Erie County 2012 Hazard Mitigation Plan

Prepared for:
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1. Introduction

1.1. Background

Across the United States, natural and man-made disasters have led to increasing levels of deaths, injuries, property damage, and interruption of business and government services. The time, money, and effort needed to recover from these disasters exhausts resources, diverting attention from important public programs and private agendas. Since 1955 there have been 42 Presidential Disaster Declarations and four Presidential Emergency Declarations in Pennsylvania, seven and one of which have included Erie County respectively. In addition to these Presidential Declarations, there have been fifteen Gubernatorial Declarations or Proclamations affecting Erie County since 1955. The emergency management community, citizens, elected officials and other stakeholders in Erie County, Pennsylvania recognize the impact of disasters on their community and support proactive efforts needed to reduce the impact of natural and human-made hazards.

Hazard mitigation describes sustained actions taken to prevent or minimize long-term risks to life and property from hazards and create successive benefits over time. Pre-disaster mitigation actions are taken in advance of a hazard event and are essential to breaking the disaster cycle of damage, reconstruction and repeated damage. With careful selection, successful mitigation actions are cost-effective means of reducing risk of loss over the long-term.

Hazard mitigation planning has the potential to produce long-term and recurring benefits by breaking the cycle of loss. A core assumption of mitigation is that current dollars invested in mitigation practices will significantly reduce the demand for future dollars by lessening the amount needed for recovery, repair, and reconstruction. These mitigation practices will also enable local residents, businesses, and industries to re-establish themselves in the wake of a disaster, getting the economy back on track sooner and with less interruption.

Accordingly, the Erie County Hazard Mitigation Steering Committee (HMSC) composed of government leaders from Erie County, in cooperation with the elected officials of the County and its municipalities have prepared this Hazard Mitigation Plan (HMP) update. The Plan is the result of work by citizens of the County to develop a pre-disaster multi-hazard mitigation plan that will not only guide the County towards greater disaster resistance, but will also respect the character and needs of the community.

1.2. Purpose

The purpose of this All-Hazard Mitigation Plan Update (HMPU) is:

- To protect life, safety, and property by reducing the potential for future damages and economic losses that result from natural hazards';
- To qualify for additional grant funding, in both the pre-disaster and the post-disaster environment;
- To qualify for additional credit under the Community Ratings System (CRS);
- To speed recovery and redevelopment following future disaster events;
- To demonstrate a firm local commitment to hazard mitigation principles; and

- To comply with both state and federal legislative requirements for local hazard mitigation plans.

1.3. Scope

The Erie County 2012 Hazard Mitigation Plan update has been prepared to meet requirements set forth by the Federal Emergency Management Agency (FEMA) and Pennsylvania Emergency Management Agency (PEMA) in order for the County to be eligible for funding and technical assistance from state and federal hazard mitigation programs. It will be updated and maintained to address both natural and human-made hazards determined to be of significant risk to the County and/or its local municipalities. Updates will take place at a minimum every five years, but they will also take place following significant disaster events.

1.4. Authority and References

Authority for this plan originates from the following federal sources:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C., Section 322, as amended;
- Code of Federal Regulations (CFR), Title 44, Parts 201 and 206;
- Disaster Mitigation Act of 2000, Public Law 106-390, as amended; and
- National Flood Insurance Act of 1968, as amended, 42 U.S.C. 4001 *et seq.*

Authority for this plan originates from the following Commonwealth of Pennsylvania sources:

- Pennsylvania Emergency Management Services Code. Title 35, Pa C.S. Section 101;
- Pennsylvania Municipalities Planning Code of 1968, Act 247 as reenacted and amended by Act 170 of 1988; and
- Pennsylvania Stormwater Management Act of October 4, 1978. P.L. 864, No. 167.

The following FEMA guides and reference documents were used to prepare this document:

- FEMA 386-1: *Getting Started*. September 2002.
- FEMA 386-2: *Understanding Your Risks: Identifying Hazards and Estimating Losses*. August 2001.
- FEMA 386-3: *Developing the Mitigation Plan*. April 2003.
- FEMA 386-4: *Bringing the Plan to Life*. August 2003.
- FEMA 386-5: *Using Benefit-Cost Review in Mitigation Planning*. May 2007.
- FEMA 386-6: *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*. May 2005.
- FEMA 386-7: *Integrating Manmade Hazards into Mitigation Planning*. September 2003.
- FEMA 386-8: *Multijurisdictional Mitigation Planning*. August 2006.
- FEMA 386-9: *Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects*. August 2008.
- FEMA *Local Multi-Hazard Mitigation Planning Guidance*. July 1, 2008.
- FEMA *National Fire Incident Reporting System 5.0: Complete Reference Guide*. January, 2008.

The following PEMA guides and reference documents were used prepare this document:

- PEMA: *Hazard Mitigation Planning Made Easy!*
- PEMA Mitigation Ideas: *Potential Mitigation Measures by Hazard Type; A Mitigation Planning Tool for Communities*. March 6, 2009.
- PEMA: *Standard Operating Guide*. October 9, 2009.

2. Community Profile

2.1. Geography and Environment

Erie County is Pennsylvania's northwestern most county and the Commonwealth's only link to the Great Lakes. It is the largest of the 67 Pennsylvania counties, with a total area of 1,558 square miles, 802 square miles of which is land. The remaining 756 square miles is covered by the waters of Lake Erie. Erie County is bordered on the north by Lake Erie, and the province of Ontario, Canada; on the northeast by Chautauqua County, New York; on the east by Warren County, PA; on the south by Crawford County, PA; and on the west by Ashtabula County, Ohio. See Figure 2.1-1 for a map of Erie County.

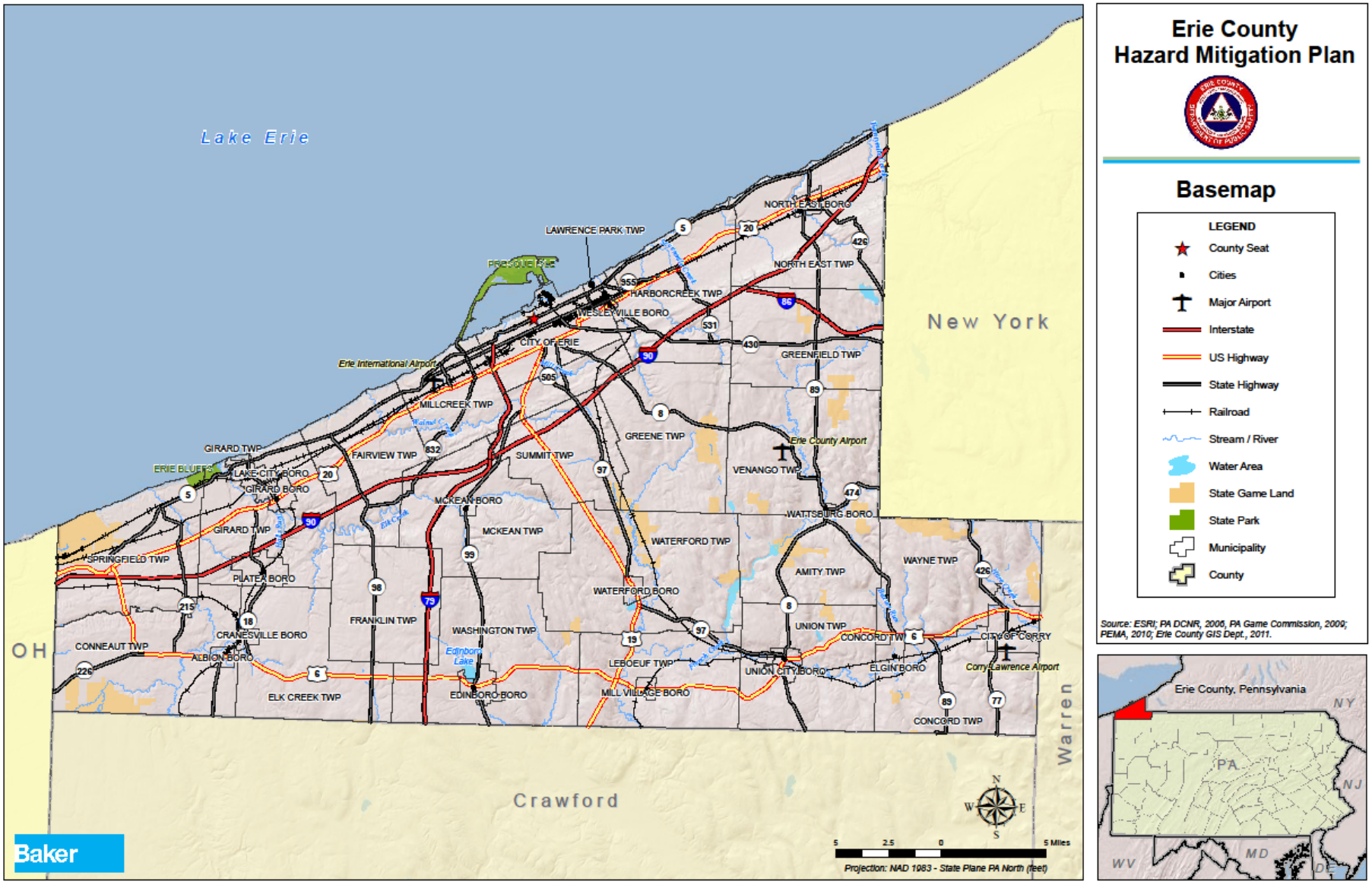
Erie County's watersheds drain into two major river basins, the Lake Erie and Ohio River basins. The majority of the county (85.7%) lies within two of these watersheds: Lake Erie / Elk Creek and French Creek. The Lake Erie / Elk Creek watershed borders 76 miles of coastline along Lake Erie and extends south through all or part of 24 different Erie County municipalities. The watershed is comprised of a series of streams, with Elk Creek being the largest; that generally flow northwest from their headwaters towards Lake Erie. The French Creek watershed drains all or part of 21 municipalities in the southern and eastern part of the County, and also contains three of the nine glacial lakes in western Pennsylvania - Lake Pleasant, Lake LeBoeuf, and Edinboro Lake. Glacial activity is also attributed for the many wetland areas in the watershed. The watersheds of Erie County are displayed in Figure 2.1-2.

Erie County's topography is bisected by portions of two Physiographic Provinces. The area adjacent to Lake Erie lies within the Eastern Lake Section of the Central Lowlands Province, and is a relatively narrow zone consisting of a series of lake-parallel, low-relief ridges. Steep-sided, narrow valleys cut through these ridges into the underlying shales and siltstones and flow into Lake Erie. Erosion of the Lake Erie shoreline has resulted in a steep bluff adjacent to the lake. The majority of the County lies within the Northwestern Glaciated Plateau Section of the Appalachian Plateaus Province, and is composed of rolling land that is notably higher in elevation than the coastal lowland. This area is typical of the glaciated portions of northwest Pennsylvania and is characterized by broad uplands separated by linear flat-floored valleys and long, linear, rounded ridges. There are also several unique scenic geological features located in Erie County including Presque Isle peninsula, the Devils Backbone, and Titus Bog. Erie County's Physiographic Provinces are shown in Figure 2.1-3.

The influence of Lake Erie is profoundly evident in the climate of Erie County. In the Central Lowlands Province along the lakeshore, the lake has a moderating effect on temperatures, and the freeze-free season is normally extended to about 200 days. Temperatures above 90°F or below 0°F are extremely rare. The lake also reduces daily temperature ranges to less than 20°F in most months. Throughout the County, cloudiness and frequent snowfalls are prevalent in winter as a result of the "lake effect" of cold air passing over the relatively warm Lake Erie, picking up moisture. Annual precipitation averages close to 40 inches, and annual snowfall averages over 80 inches per year near the lakeshore, with considerably more in the higher elevations of the County. Heavy snow squalls are produced that are capable of depositing one

to two feet of snow on the County, though as the lake surface freezes over, snowfalls of this type become less frequent.

Figure 2.1-1: Base map of Erie County (Erie County Department of Planning, 2011).



Erie County Hazard Mitigation Plan

Basemap

LEGEND

- County Seat
- Cities
- Major Airport
- Interstate
- US Highway
- State Highway
- Railroad
- Stream / River
- Water Area
- State Game Land
- State Park
- Municipality
- County

Source: ESRI; PA DCNR, 2006, PA Game Commission, 2009; PEMA, 2010; Erie County GIS Dept., 2011.

Figure 2.1-2: Watersheds of Erie County (PASDA).

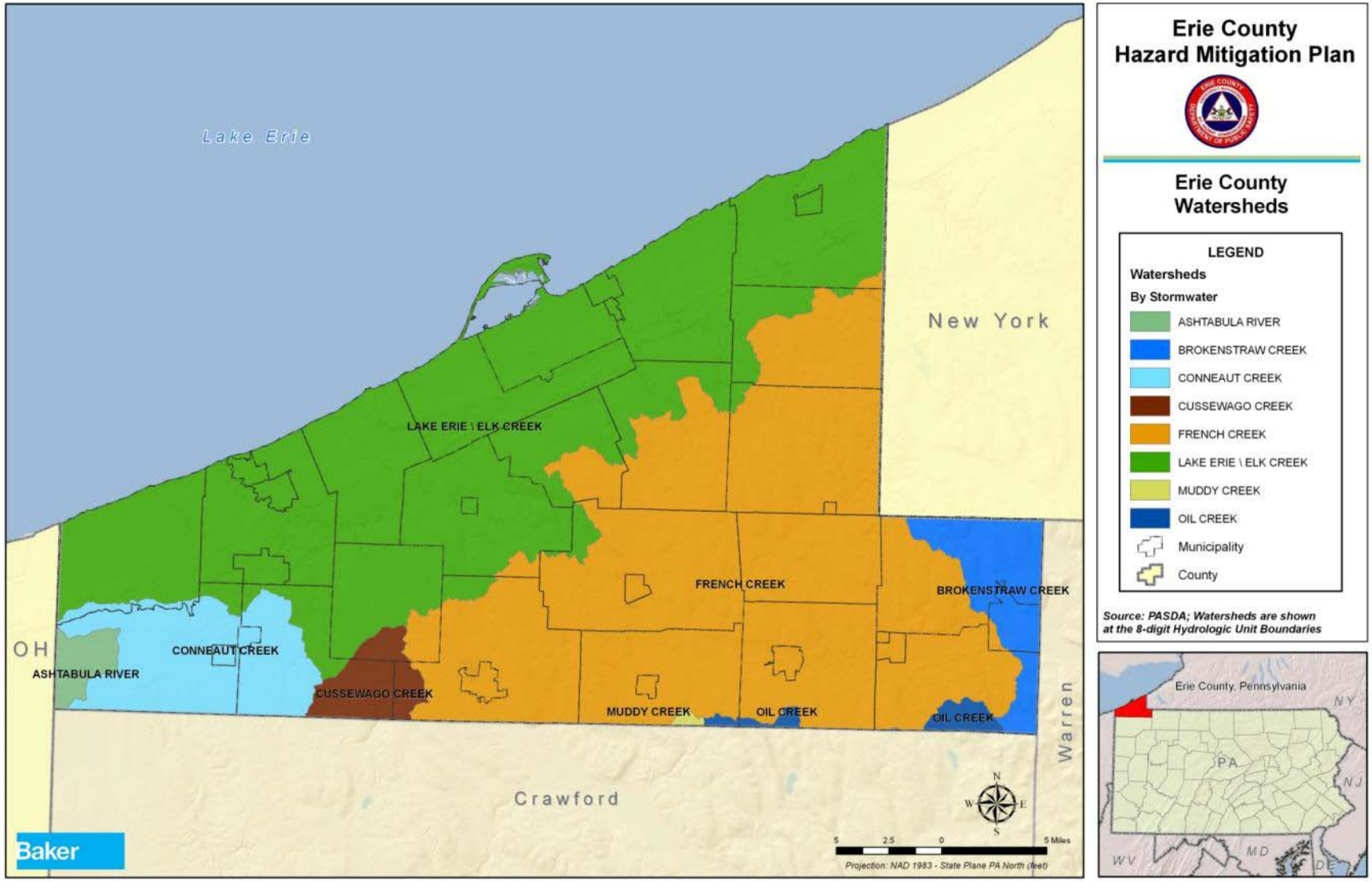
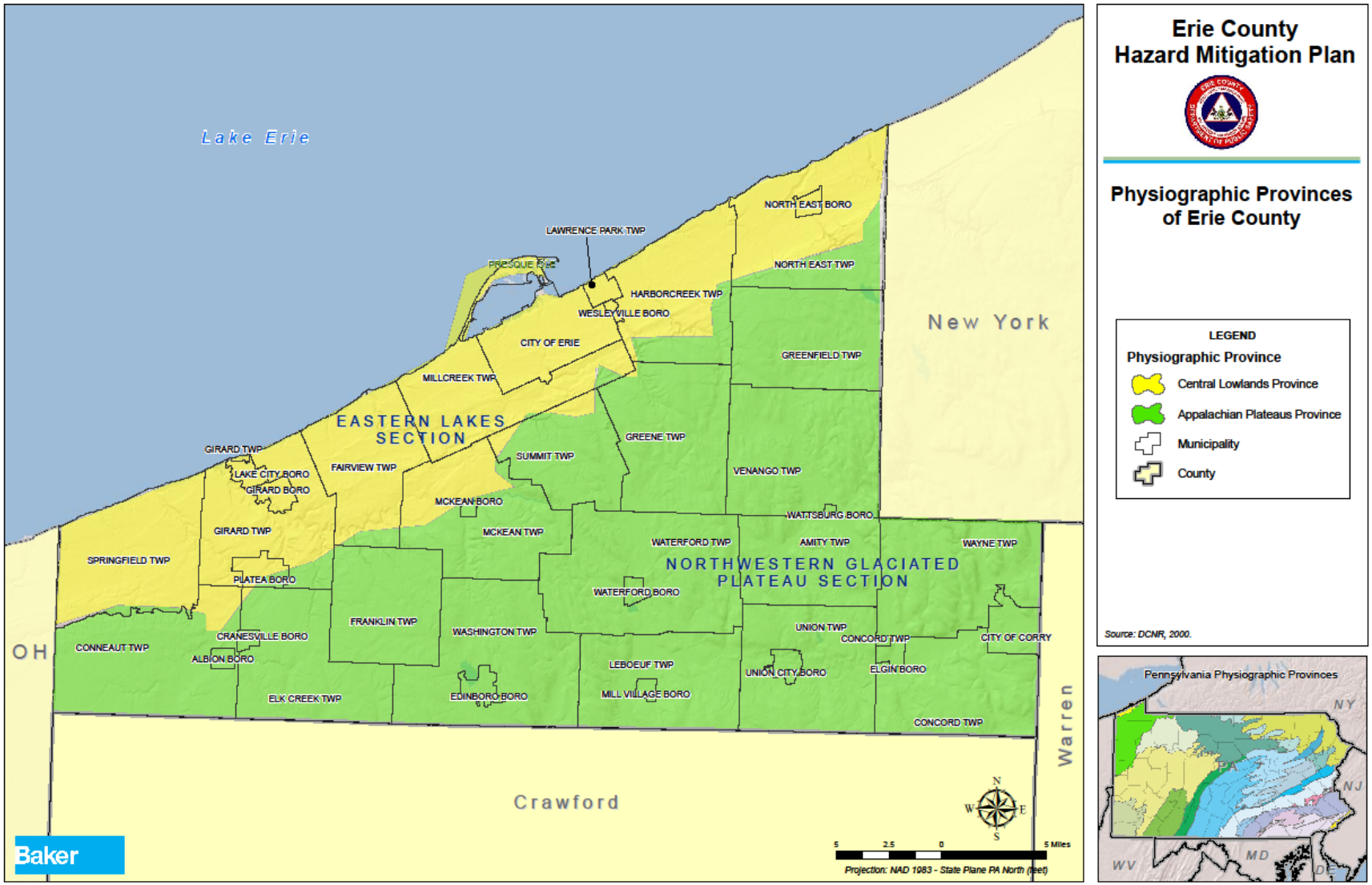


Figure 2.1-3: Physiographic Provinces of Erie County (DCNR, 2000).



2.2. Community Facts

Erie County was named after Lake Erie, the name originating from the Eriez Indians who originally inhabited the region into the mid-1600's, preceding the Iroquois and Seneca tribes' dominance of the area. Prior to America's independence, both the French and British briefly occupied the region in the mid-1700's, building forts at present-day Erie (Fort Presque Isle) and Waterford (Fort LeBoeuf) in order to control the key trade route between Lake Erie and the Ohio River. Prior to becoming part of Pennsylvania in 1792, this land was part of the "Erie Triangle" which five states (Pennsylvania, New York, Connecticut, Massachusetts, and Virginia) and the Iroquois all laid claim upon. Erie County was established on March 12, 1800.

Erie's unique geographic location is responsible for its early development, relatively rapid growth and status as the largest metropolitan area and dominant economic center in northwestern PA and the tri-state region. The only natural harbor on the south shore of Lake Erie, created by the Presque Isle peninsula, stimulated the growth of the City of Erie and Erie County from the early 1800's to today. Erie's location on the Great Lakes and its proximity to Cleveland, Pittsburgh and Buffalo afforded it strategic transportation advantages over time; first as a maritime center, then as a railroad hub, and it continues to serve as the transportation nucleus for the region. The county is served by an efficient multi-modal transportation system; including three interstate highways, mass transit facilities, an extensive railroad network, three public airports, and a commercial port.

Erie County has historically been a large manufacturing center, and it continues to have a robust manufacturing sector, with almost a fifth of its workforce employed in a diverse mix of industries. The largest employer in Erie County is GE Transportation, which produces locomotives, and has its corporate headquarters in Erie. Erie-based plastics plants manufacture or finish over 10% of the country's plastics. Education and health care industries are also very strong in Erie County, employing over a quarter of the workforce. Erie County is home to five major universities/colleges, and has six major hospitals serving the region.

Agriculture also remains an important sector of the economy of Erie County, generating over $71 million in revenues in 2007. The combination of the microclimate, topography and soils along the lake plain is ideal for growing fruits and vegetables, and especially grapes. Over 12,000 acres of vineyards are located in Erie County. It is the Commonwealth's top producer in grapes, and ranks eighteenth nationwide. The County is also a top producer of many fruits and berries, including cherries, blueberries, and strawberries. In areas of the County located further from the lake, corn, grains, and potatoes are significant crops.

The county is a significant tourism and recreation area, the largest attraction being the 3,000-acre Presque Isle State Park. Presque Isle is the most active state park in Pennsylvania, drawing over four million annual visitors, and contains seven miles of beaches and twenty-one miles of recreational and hiking trails. Along with Presque Isle, the county's 76 miles of Lake Erie shoreline provides all of the amenities associated with water, beach and fishing activities. Erie Bluffs State Park contains 540 acres along one mile of the shoreline of Lake Erie, with ninety-foot bluffs overlooking the lake. Lake Erie and its PA tributaries are world-renowned high-quality walleye, perch, bass and steelhead trout fisheries. Fishing is a popular activity in Erie

County, known as the “freshwater fishing capital of the world”. Additional recreational activities across the County include biking, hiking, hunting, boating, swimming, camping, and skiing.

2.3. Population and Demographics

Erie County contains thirty-eight municipalities, which includes two cities, fourteen boroughs and twenty-two townships. According to the 2000 Census, the population of Erie County was 280,843, which shrank by 0.10% to 280,566 according to the 2010 Census. Table 2.3-1 provides a distribution of County population per municipality obtained from the U.S. Census Bureau.

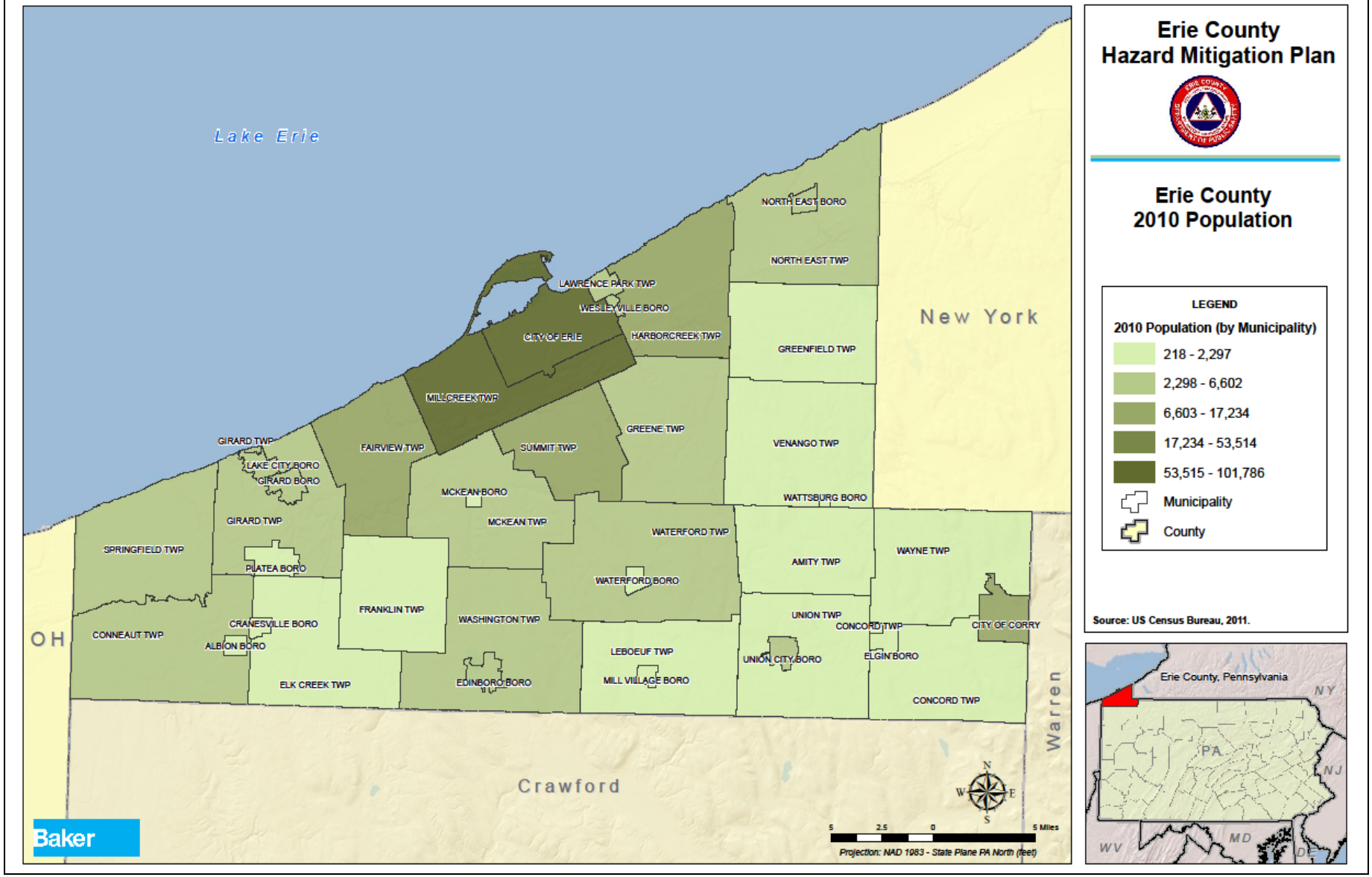
Table 2.3-1: List of municipalities in Erie County with associated populations (U.S. Census, 2011).

MUNICIPALITY	2000 POPULATION	2010 POPULATION	PERCENT CHANGE (%)
Albion Borough	1,607	1,516	-5.66%
Amity Township	1,140	1,073	-5.88%
Concord Township	1,361	1,344	-1.25%
Conneaut Township	3,908	4,290	9.77%
Corry City	6,834	6,605	-3.35%
Cranesville Borough	600	638	6.33%
Edinboro Borough	6,950	6,438	-7.37%
Elgin Borough	236	218	-7.63%
Elk Creek Township	1,800	1,798	-0.11%
Erie City	103,717	101,786	-1.86%
Fairview Township	10,140	10,102	-0.37%
Franklin Township	1,609	1,633	1.49%
Girard Borough	3,164	3,104	-1.90%
Girard Township	5,133	5,102	-0.60%
Greene Township	4,768	4,706	-1.30%
Greenfield Township	1,909	1,933	1.26%
Harborcreek Township	16,267	17,234	5.94%
Lake City Borough	2,811	3,031	7.83%
Lawrence Park Township	4,048	3,982	-1.63%
LeBoeuf Township	1,680	1,698	1.07%

Table 2.3-1: List of municipalities in Erie County with associated populations (U.S. Census, 2011).			
MUNICIPALITY	**2000 POPULATION**	**2010 POPULATION**	**PERCENT CHANGE (%)**
McKean Borough	389	388	-0.26%
McKean Township	4,619	4,409	-4.55%
Mill Village Borough	412	412	0.00%
Millcreek Township	52,129	53,515	2.66%
North East Borough	4,601	4,294	-6.67%
North East Township	6,613	6,315	-4.50%
Platea Borough	474	430	-9.28%
Springfield Township	3,378	3,425	1.39%
Summit Township	5,529	6,603	19.42%
Union City Borough	3,463	3,320	-4.13%
Union Township	1,663	1,655	-0.48%
Venango Township	2,277	2,297	0.88%
Washington Township	4,526	4,432	-2.08%
Waterford Borough	1,449	1,517	4.69%
Waterford Township	3,878	3,920	1.08%
Wattsburg Borough	378	403	6.61%
Wayne Township	1,766	1,659	-6.06%
Wesleyville Borough	3,617	3,341	-7.63%
TOTAL	**280,843**	**280,566**	**-0.10%**

The most populous municipality in the county is the City of Erie with a 2010 Census population of 101,786. Elgin Borough, with a population of 218, is the least populated. The majority of population in the county is concentrated along the urbanized-suburbanized Lake Erie / I-90 corridor, where over 80% of Erie County's residents are located. Population has a strong correlation with hazard vulnerability and loss. For example, areas with larger populations and number of structures will experience greater loss during hazard events. Figure 2.3-1 depicts 2010 Census population by municipality.

Figure 2.3-1: Erie County 2010 Population (US Census, 2011).



The age of populations can also correlate with vulnerability to hazards. Elderly populations and children may be more susceptible to hazards such as extreme temperature and pandemics. The median age of the Erie County population is 38.6 years, with 22.7 percent of the population under 18 years of age and 14.6 percent 65 years or older. (U.S. Census, 2010)

According to the 2010 Census, there are 119,138 housing units in the county, 92.7 percent of which are occupied with the remaining 7.3 percent being vacant. The median value of an owner occupied home in the county is $107,300, compared to the Pennsylvania median value of $152,300 (U.S. Census ACS, 2005-2009). The median household income in the county is $42,635, compared to the Pennsylvania median household income of $49,501. 15.7% of the county's residents live in poverty compared to the PA average of 12.5%. 90.1% of the Erie County population is White and 8.5% is Black or African-American (U.S. Census, 2010).

2.4. Land Use and Development

Land use in Erie County is diverse, including urbanized and suburban areas, small villages, and rural agricultural and undeveloped areas. The City of Erie is the county's predominant urban area. The highest densities of industrial, commercial and residential development are concentrated in the city and its surrounding suburban areas. The remainder of the county is generally low-density with a mixture of residential, agriculture and open space land uses. There are a number of small boroughs, with village style development, which are located throughout the county. The City of Corry, which is the county's second largest city, is located in the county's southeast corner.

According to the U.S.D.A. 2007 Census of Agriculture, there are approximately 1,600 farms throughout the county, consisting of slightly over 173,000 acres of farmland. As of 2010, approximately 6,490 acres of farmland have been permanently preserved by the County's agricultural conservation easement program, thus protecting them from development and helping to maintain the character of the county's rural areas. Land cover significantly affects hazard vulnerability. For example, as urbanization occurs, areas that were once covered with trees and grass are being replaced by impervious surfaces of roads, roofs, and parking lots. This urbanization reduces infiltration of rainwater thus increasing the amount of stormwater runoff and the potential for flash flooding (USGS, 2005).

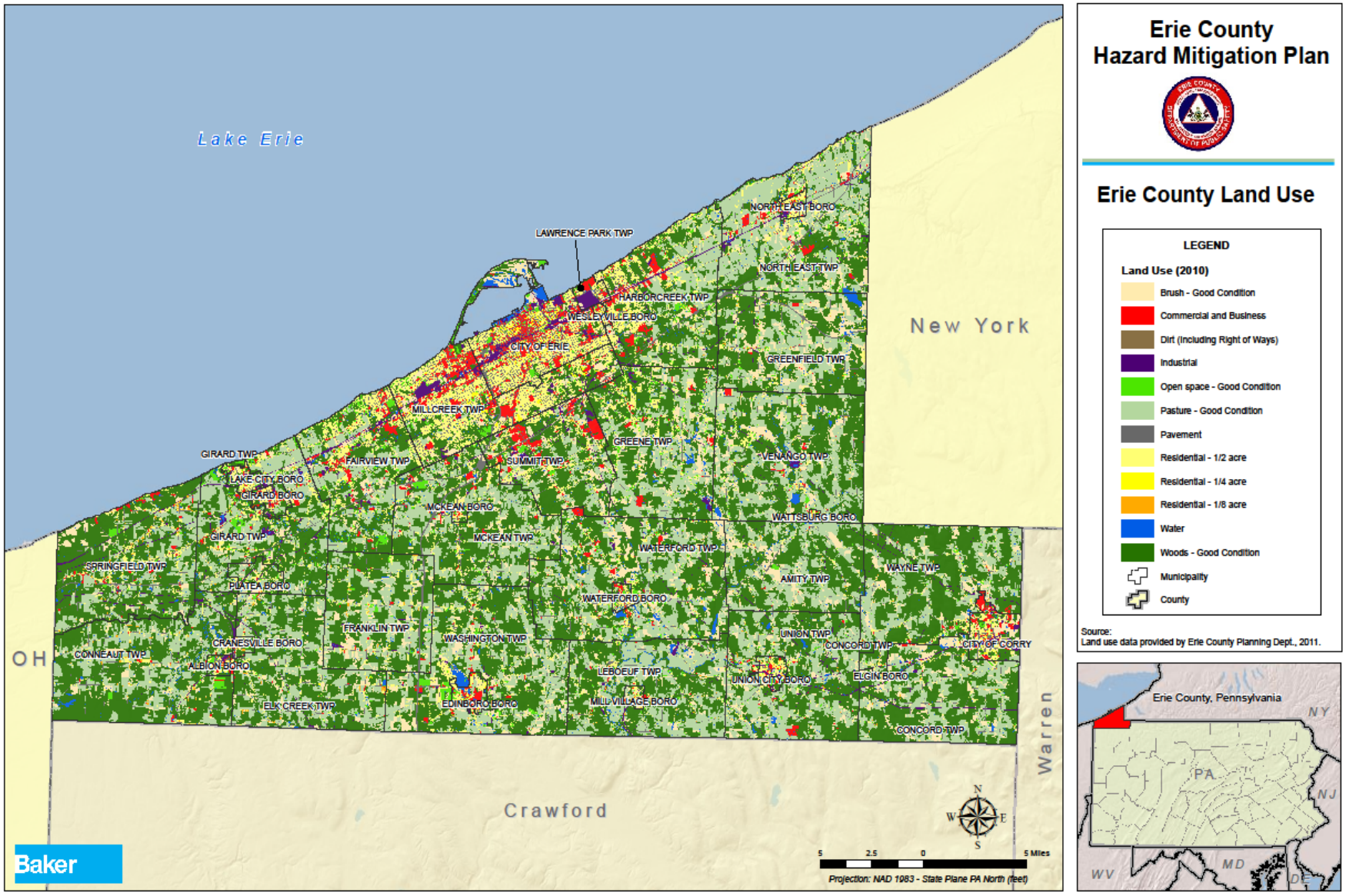
Overall, the developed area of the county has been increasing over the past 25 years. The vast majority of this growth is the result of new residential development. Much of this development has occurred, in the form of low-density suburbanization patterns, along the I-90 and I-79 corridors. Residents have been leaving older urban places, such as Erie City, and relocating to more suburban and rural areas, but often to areas that still are not too far from jobs and shopping. This accounts for the development of extensive suburbs in Fairview, Harborcreek, McKean, Millcreek and Summit Townships, as well as expansion of suburban development into townships adjacent to other urbanized areas such as Edinboro, Girard/Lake City and North East. The current land use map for Erie County is shown in Figure 2.4-1.

Land use and development is profoundly influenced by the transportation system. Roads, rail lines, airports, and ports are important for the transportation of people, goods and services, and development typically occurs around transportation hubs. Erie County is served by two major

Interstate Highway routes; I-79, a north-south link which terminates in the City of Erie, and I-90 which runs east-west through the County. There are several other important transportation routes including three US Highways and several State Routes which connect the small villages throughout the county to the Erie urbanized area and Interstate system, providing critical transportation and commuting links for county residents. The Erie Metropolitan Transit Authority provides public transit service in the form of fixed bus routes primarily in the City of Erie and the immediately surrounding communities. An extensive railroad system operates in Erie County with two Class I lines and several short lines, mostly serving industrial needs. Passenger rail service is provided by Amtrak along one of the Class I lines. One commercial airport, Erie International Airport, Tom Ridge Field, serves the county. Additional transportation of goods comes through the Port of Erie, approximately 3.5 million tons of freight is moved through the Port annually. A review of land use patterns shows development is heavily clustered along these transportation networks.

According to the 2005 State Land Use and Growth Management Report, the pace of development has been greater than population growth. This has also been the trend in Erie County. In 1980, the county's population was 279,780. By 2010, the population had increased to only 280,566. This represents a population change of less than one percent (1%), yet significant development and changes in land use have occurred during this time period. For example, according to Census records, the number of housing units increased from 108,585 units in 1990 to 119,138 units in 2010. Housing growth, and particularly building numbers and replacement values, is an important consideration during hazard mitigation planning.

Figure 2.4-1: Land Use map of Erie County (Erie County Department of Planning, 2011).



2.5. Data Sources and Limitations

In order to assess the vulnerability of different jurisdictions to the hazards, data on past occurrences of damaging hazard events was gathered. For a number of historic natural-hazard events, the National Climatic Data Center (NCDC) database was utilized. NCDC is a division of the US Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). Information on hazard events is compiled by NCDC from data gathered by the National Weather Service (NWS), another division of NOAA. NCDC then presents it on their website in various formats. The data used for this plan came the US Storm Events database, which "documents the occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce" (NOAA, 2006).

While NCDC data is comprised of natural hazards information, PEMA provided additional information focused more on human-made hazards through the Pennsylvania Emergency Incident Reporting System (PEIRS). PEIRS is the principal crisis management software that PEMA uses to to provide up-to-date information as an event unfolds through the response and recovery phases for PEMA staff and partners. PEIRS establishes standard reporting criteria, consolidates reporting requirements, and identifies PEMA as the single point of contact for an incident that requires immediate reporting. PEIRS provides reporting criteria for county emergency management coordinators, communications centers, 911 centers, commercial and industrial facilities, volunteer agencies and Commonwealth and federal agencies. This criterion is used to report emergency incidents which may affect the safety, health, or welfare of citizens of the Commonwealth, result in major property damage, preclude the operation or use of essential public facilities, and require multijurisdictional response to the emergency incident.

When applicable, PEIRS incident data spanning approximately the last 8 years (1/1/2002 - 6/1/2009) was used in the 2012 plan update. Although PEIRS data proved valuable, primarily in the human-made hazards section where few records of past occurrences exist, data limitations exist in that the reporting system is not mandatory. As a result, while PEIRS reports provide important information on the frequency of past events, because it is a voluntary reporting system, the number and frequency of events may be under-reported. PEIRS information was used in the following hazard profile sections: 4.3.4, 4.3.9, 4.3.10, 4.3.12, and 4.3.14.

Additional information used to complete the risk assessment for this plan was taken from various government agency and non-government agency sources. Those sources are cited where appropriate throughout the plan with full references listed in **Appendix A – Bibliography**. It should be noted that numerous GIS datasets were obtained from the Pennsylvania Spatial Data Access (PASDA) website (http://www.pasda.psu.edu/). PASDA is the official public access geospatial information clearinghouse for the Commonwealth of Pennsylvania. PASDA was developed by the Pennsylvania State University as a service to the citizens, governments, and businesses of the Commonwealth. PASDA is a cooperative project of the Governor's Office of Administration, Office for Information Technology, Geospatial Technologies Office and the Penn State Institutes of Energy and the Environment of the Pennsylvania State University.

The flood hazard area data used in this plan is the Preliminary countywide Digital Flood Insurance Rate Map (DFIRM), released September 30, 2009. This data provides flood frequency and elevation information used in the flood hazard risk assessment. The Erie County Department of Planning's dataset of land use and building information was used as an inventory of structures throughout the County. Other GIS datasets including *streams, lakes, roads,* and *municipal boundaries* were provided by the Erie County Department of Planning.

Mobile homes in Erie County were determined using the land use and structure information provided by the Erie County Department of Planning. The number of mobile homes in each municipality used in Sections 4.3.4 and 4.3.7 was determined by finding the amount of structures in the mobile home, mobile home with land, and mobile home parks land use designations. The number of mobile homes in Special Flooding Hazard Areas (SFHAs) was determined by selecting the addressable structures that fell within the mobile home, mobile home with land, and mobile home parks land use designations, then selecting those structures which were in SFHAs.

The population in SFHAs was determined by determining the 2000 Census block in which the centroid of that group fell within the SFHA and taking the sum of the population in those groups. This is an estimate – a census block could fall partly in a SFHA without its centroid falling in the area, or population in a census block counted could fall outside of the area. By using this process it is the intent that the over and under estimations in individual block groups will average out to an approximate estimation for the entire area.

Every attempt was made to provide consistency in reported data and in data sources. However, at the time of this plan update, the US Census Bureau is in the middle of tabulating the results of the 2010 Decennial Census; at this time, population counts are available at only the municipal, county, and state level. No population counts exist for Census Tracts or Blocks in Pennsylvania at this point. As a result, while population change data is reported in this HMP by municipality from 2000-2010, the calculated population at risk to flooding in Section 4.3.4.5 is derived from the 2000 Census Block geography. It was important to use the 2000 Block data to interpolate the population living in the SFHAs because larger geographies would grossly overestimate risk. In addition, information about housing units reported in Sections 2.4, 4.3.8, and 4.3.13 comes from the 2005-2009 American Community Survey because the Decennial Census no longer collects this information. As new data from the 2010 Census becomes available between 2011 and 2013, it will be incorporated into the HMP.

HAZUS-MH is a powerful risk assessment methodology for analyzing potential losses from floods, hurricane winds and earthquakes. In HAZUS-MH, current scientific and engineering knowledge is coupled with the latest GIS technology to produce estimates of hazard-related damage before, or after, a disaster occurs. This software was used to estimate losses for floods, both coastal and riverine as well as earthquakes in Erie County.

Throughout the risk and vulnerability assessment included in Section 4, descriptions of limited data indicate some areas in which the County and municipalities can improve their ability to identify vulnerable structures and improve loss estimates. As the County and municipal governments work to increase their overall technical capacity and implement comprehensive

planning goals, they will also attempt to improve the ability to identify areas of increased vulnerability.

This HMP evaluates the vulnerability of the County's critical facilities. For the purposes of this plan, critical facilities are those entities that are essential to the health and welfare of the community. The list of critical facilities was largely obtained from the Erie County Department of Public Safety, including locations of 911 and emergency services facilities, airports, colleges and universities, schools, fire departments, police departments and sewage treatment plants. This list was supplemented with locations of hospitals and nursing homes from the Pennsylvania Department of Health. Table 2.5-1 summarizes the critical facilities in Erie County by type and by municipality. For a complete listing of critical facilities, please see **Appendix E**.

Table 2.5-1: Summary of Critical Facilities by Type and Municipality.											
	CRITICAL FACILITY TYPE										
MUNICIPALITY	911 & EMERGENCY SERVICES	FIRE DEPARTMENT	POLICE DEPARTMENT	HOSPITAL	NURSING HOME	SCHOOL	AIRPORT	COLLEGE OR UNIVERSITY	CORRECTIONAL FACILITY	SEWAGE TREATMENT PLANT	TOTAL
Albion Borough	0	1	1	0	0	2	0	0	0	0	4
Amity Township	0	0	0	0	0	0	0	0	0	0	0
Concord Township	0	0	0	0	0	0	1	0	0	0	1
Conneaut Township	0	0	0	0	0	1	0	0	1	1	3
Corry City	0	2	1	1	1	5	0	0	0	1	11
Cranesville Borough	0	1	0	0	0	1	0	0	0	0	2
Edinboro Borough	0	1	2	0	1	0	0	1	0	1	6
Elgin Borough	0	1	0	0	0	0	0	0	0	0	1
Elk Creek Township	0	0	0	0	0	0	0	0	0	0	0
Erie City	0	6	7	6	8	31	0	2	1	1	62
Fairview Township	0	2	1	0	2	4	0	0	0	0	9
Franklin Township	0	1	0	0	0	1	0	0	0	0	2
Girard Borough	0	1	1	0	0	3	0	0	0	1	6
Girard Township	0	0	1	0	1	0	0	1	0	1	4
Greene Township	0	3	0	0	0	4	0	0	0	0	7
Greenfield Township	0	1	0	0	0	0	0	0	0	0	1
Harborcreek Township	0	4	1	0	1	6	0	1	0	0	13
Lake City Borough	0	2	1	0	0	1	0	0	0	1	5
Lawrence Park Township	0	1	2	0	1	2	0	0	0	0	6
LeBoeuf Township	0	0	0	0	0	0	0	0	0	0	0
McKean Borough	0	1	0	0	0	1	0	0	0	1	3

Table 2.5-1: Summary of Critical Facilities by Type and Municipality.											
	CRITICAL FACILITY TYPE										
MUNICIPALITY	911 & EMERGENCY SERVICES	FIRE DEPARTMENT	POLICE DEPARTMENT	HOSPITAL	NURSING HOME	SCHOOL	AIRPORT	COLLEGE OR UNIVERSITY	CORRECTIONAL FACILITY	SEWAGE TREATMENT PLANT	TOTAL
McKean Township	0	0	0	0	0	0	0	0	0	3	3
Mill Village Borough	0	1	0	0	0	1	0	0	0	0	2
Millcreek Township	0	7	1	1	6	20	1	1	0	0	37
North East Borough	0	2	1	0	0	3	0	0	0	0	6
North East Township	0	0	0	0	0	3	0	2	0	1	6
Platea Borough	0	1	0	0	0	0	0	0	0	0	1
Springfield Township	0	1	0	0	0	1	0	0	0	0	2
Summit Township	1	2	0	0	1	3	0	0	0	0	7
Union City Borough	0	1	1	0	0	3	0	0	0	0	5
Union Township	0	0	0	0	0	0	0	0	0	1	1
Venango Township	0	1	0	0	0	1	1	0	0	0	3
Washington Township	0	0	0	0	0	3	0	0	0	1	4
Waterford Borough	0	1	0	0	0	3	0	0	0	0	4
Waterford Township	0	0	0	0	0	0	0	0	0	1	1
Wattsburg Borough	0	1	0	0	0	0	0	0	0	0	1
Wayne Township	0	1	1	0	0	1	0	0	0	0	3
Wesleyville Borough	0	1	1	0	0	0	0	0	0	0	2
TOTAL	1	48	23	8	22	104	3	8	2	15	**234**

3. Planning Process

3.1. Update Process and Participation Summary

The Erie County Hazard Mitigation Planning Team, now the HMPT, was first formed in 2004 in order to complete the Erie County HMP. The Erie County Department of Planning in cooperation with the Erie County Emergency Management Agency headed this entity, composed of county representatives. The plan was completed and approved in 2006. Municipal representatives provided additional information through completing hazard vulnerability questionnaires and suggesting mitigation opportunities which were prioritized by the Erie County Planning Commission.

To begin the HMP update process, the Erie County Department of Public Safety in cooperation with the Erie County Department of Planning held a Kick-off Meeting in February 2011. PEMA secured funding support for the County to complete the HMP update with the assistance of a consultant using the standards developed in the Pennsylvania Standard Operating Guidance and the revision methodology developed by Michael Baker, Jr., Inc. Meeting invitations were mailed to the CEO and EMC (when applicable) in each municipality as well as, adjacent county representatives, and other stakeholders from state and local agencies, non-profits, and advocacy organizations. During the first meeting, a Contact Information Sheet was collected from each attendee; the HMPT mailing list was created from this contact information. Section 3.2 provides as discussion of the HMPT as well as a table of members and the organization or jurisdiction they represented.

Municipal officials and the other stakeholders continued to receive notification regarding all HMP meetings using their preferred mode of contact: regular mail, telephone, email, or some combination. Written notices were mailed to communities who had not provided an email address to ensure the municipality was informed of the meeting. A brief description of each meeting that was held can be found in Section 3.3. In addition, meeting minutes are available in **Appendix C – Meeting and Other Participation Documentation**.

In order to obtain information from municipalities and stakeholders, forms and surveys were distributed and collected throughout the planning process. Some of the forms were completed during the planning meetings while others were sent via email and were posted to the HMP website, www.ErieHMP.com, and completed and returned in between meetings. All municipalities were required to have a representative attend at least one meeting and provide pertinent information for the HMP update. At each meeting, and via emails, all municipal representatives were reminded of the participation requirement and encouraged to attend the additional HMP meetings. In addition, municipal representatives were encouraged to provide input into the planning process through the completion of forms and surveys. Table 3.1-1 lists each municipality along with their specific participation and contributions to the planning process. All thirty-eight municipalities in Erie County participated in the HMPU by attending meetings and/or providing information. Sign-in sheets for each meeting with the names and organizations of participants are available in **Appendix C** along with all completed forms and surveys.

Table 3.1-1: Summary of participation from local municipalities during the 2012 Hazard Mitigation Planning Process.

MUNICIPALITY	MEETING					WORKSHEETS/SURVEYS/FORMS			MITITGATION
	KICK-OFF MEETING February 10, 2011	RISK ASSESSMENT SUMMARY AND MITIGATION SOLUTIONS WORKSHOP March 24, 2011	PLANNING TEAM TELECON-FERENCE April 29, 2011	PUBLIC MEETING May 5, 2011	PLANNING TEAM TELECON-FERENCE June 30, 2011	HAZARD RISK EVALUATION	CAPABILITY ASSESSMENT SURVEY	GOALS AND OBJECTIVES EVALUATION	MITIGATION ACTION ITEM
Albion Borough		X				X	X	X	X
Amity Township	X			X		X	X		X
Concord Township				X			X		X
Conneaut Township					X	X			X
Corry City			X			X	X	X	X
Cranesville Borough	X	X		X		X	X	X	X
Edinboro Borough		X		X		X		X	X
Elgin Borough				X		X	X		X
Elk Creek Township	X	X		X		X	X	X	X
Erie City	X	X				X		X	X
Fairview Township	X	X				X	X	X	X
Franklin Township	X	X		X		X	X	X	X
Girard Borough	X	X		X		X	X	X	X
Girard Township	X	X		X		X	X	X	X
Greene Township		X		X		X	X	X	X

Table 3.1-1: Summary of participation from local municipalities during the 2012 Hazard Mitigation Planning Process.

MUNICIPALITY	MEETING					WORKSHEETS/SURVEYS/FORMS			MITITGATION
	KICK-OFF MEETING February 10, 2011	RISK ASSESSMENT SUMMARY AND MITIGATION SOLUTIONS WORKSHOP March 24, 2011	PLANNING TEAM TELECON-FERENCE April 29, 2011	PUBLIC MEETING May 5, 2011	PLANNING TEAM TELECON-FERENCE June 30, 2011	HAZARD RISK EVALUATION	CAPABILITY ASSESSMENT SURVEY	GOALS AND OBJECTIVES EVALUATION	MITIGATION ACTION ITEM
Greenfield Township				X		X	X		X
Harborcreek Township		X						X	X
Lake City Borough		X				X	X	X	X
Lawrence Park Township	X	X				X	X	X	X
LeBoeuf Township				X		X			X
McKean Borough						X	X		X
McKean Township	X	X		X		X	X	X	X
Mill Village Borough				X		X			X
Millcreek Township		X				X		X	X
North East Borough	X	X				X	X	X	X
North East Township		X		X		X	X		X
Platea Borough	X	X		X		X	X	X	X
Springfield Township		X		X		X	X	X	X
Summit Township		X				X	X	X	X
Union City Borough				X					X

Table 3.1-1: Summary of participation from local municipalities during the 2012 Hazard Mitigation Planning Process.

MUNICIPALITY	MEETING					WORKSHEETS/SURVEYS/FORMS			MITITGATION
	KICK-OFF MEETING February 10, 2011	RISK ASSESSMENT SUMMARY AND MITIGATION SOLUTIONS WORKSHOP March 24, 2011	PLANNING TEAM TELECON-FERENCE April 29, 2011	PUBLIC MEETING May 5, 2011	PLANNING TEAM TELECON-FERENCE June 30, 2011	HAZARD RISK EVALUATION	CAPABILITY ASSESSMENT SURVEY	GOALS AND OBJECTIVES EVALUATION	MITIGATION ACTION ITEM
Union Township	X					X			
Venango Township	X	X		X		X	X	X	X
Washington Township	X	X		X		X	X	X	X
Waterford Borough					X				
Waterford Township				X					X
Wattsburg Borough		X						X	X
Wayne Township	X	X		X		X	X		X
Wesleyville Borough		X						X	

As mentioned above, with funding support from PEMA, Michael Baker Jr., Inc., a full-service engineering firm that provides hazard mitigation planning guidance and technical support, assisted the County through the HMP update process. The 2012 Erie County HMPU was completed in July 2011. The 2012 plan follows an outline developed by PEMA in 2009 which provides a standardized format for all local HMPs in the Commonwealth of Pennsylvania. As a result, the format of the 2012 Erie County HMP contrasts with the 2006 HMP, but all information that was still current was carried over into the new plan. These changes are summarized in Table 3.1-2. Additional update summaries are provided in for each section of the plan in Sections 4.1, 5.1, 6.1, and 7.1.

Table 3.1-2: Summary of changes to the format of the 2006 and 2012 versions of the Erie County HMP.

2006 HMP SECTION	2012 HMPU SECTION
1. Introduction	**1.** Introduction
2. County Hazard Identification & Vulnerability Analysis	**4.** Risk Assessment
3. Resources and Capabilities	**5.** Capability Assessment
4. County Hazard Mitigation Opportunities/Strategies	**6.** Mitigation Strategy
5. Municipal and Public Involvement	**3.** Planning Process
6. Implementation of Plan	**7.** Plan Maintenance
A1. Erie County Hazard Mitigation Planning Team	**3.** Planning Process
A2. Erie County Planning Commission	**7.** Plan Maintenance

3.2. The Planning Team

The 2012 Erie County HMP update was led by a HMSC, which included:

1. Dale Robinson, Emergency Management Coordinator, Erie County Department of Public Safety,
2. Jake Welsh, Director, Erie County Department of Planning,
3. Brian Mesaros, Assistant Emergency Management Coordinator, Erie County Department of Public Safety,
4. John McGranor, Planner, Erie County Department of Planning, and
5. Taryn Murray, Michael Baker Jr., Inc.

In order to represent the diverse stakeholders in the County, the HMSC developed a diversified list of potential HMPT members. Invitations were extended not only to municipal and county officials but also to adjacent jurisdictions, non-profit organizations, federal, state, and county agencies with an interest or focus on hazard mitigation and emergency management. The HMSC worked throughout the process to plan and hold meetings, collect information, and conduct public outreach.

The stakeholders listed in Table 3.2-1 served on the 2012 HMPT, demonstrating their commitment to actively participate in the planning process by attending meetings, completing

assessments, surveys, and worksheets, and/or submitting comments. The HMPT consisted of county and local officials including municipal supervisors, emergency management coordinators, first responders, non-profit organizations, Conservation District Staff, and state agency representatives

Table 3.2-1: Participants in the 2012 Erie County HMP Update.

MUNICIPALITY/ORGANIZATION	PARTICIPANT(S)
Albion Borough	Steven Smith, EMC
Amity Township	Darrell Kimmy, Township Supervisor, Bob Warner, Township Supervisor Cynthia Miller, Secretary
Concord Township	Garry Blakeslee, Township Supervisor
Conneaut Township	Chelsey Gilbert, Secretary/Treasurer
Corry City	Gerry Dahl, City Administrator
Cranesville Borough	William Heald, EMC
Edinboro Borough	Butch Shafer, Superintendant of Water TJ Jemetz, Borough Manager
Elgin Borough	Jill Gibson, Secretary/Treasurer Dick Patterson, Mayor
Elk Creek Township	William Heald, EMC
Erie City	AJ Antolik, Risk Manager Andy Zimmerman, Code Enforcement Manager Jason Sayers, Assistant City Engineer Ray L. Welch, III, Assistant Chief EMC
Fairview Township	Dave Carner, Township Supervisor Pete Kraus, Township Supervisor Ralph Heidler, Township Supervisor
Franklin Township	William Heald, EMC
Girard Borough	Rob Stubenbort, Borough Manager Robert “Doc” Orr, EMC
Girard Township	William Heald, EMC
Greene Township	Clarence Hess, Township Supervisor
Greenfield Township	Renee Wagner, Secretary/Treasurer
Harborcreek Township	Brian Benovic, EMC
Lake City Borough	Lynn Becker, Borough Manager
Lawrence Park Township	Charles Lewis, EMC
LeBoeuf Township	Ted Szall, EMC
McKean Borough	Lawrence P. Davies, Secretary/Treasurer
McKean Township	Kenneth Neuburger, Township Supervisor

Table 3.2-1: Participants in the 2012 Erie County HMP Update.	
MUNICIPALITY/ORGANIZATION	**PARTICIPANT(S)**
	William Heald, EMC
Mill Village Borough	Ted Szall, EMC
Millcreek Township	Bob Mitchell, Chief Fire Inspector/EMA Coordinator Charlie Heffner, Deputy EMA Brian McGrath, Township Supervisor
North East Borough	Bob Brayman, Borough Manager
North East Township	Terry Thomson, EMC Dennis Culver, Township Supervisor
Platea Borough	William Heald, EMC
Springfield Township	Don Stichick, EMA Coordinator Blake Holliday, Chairman
Summit Township	Kip Hayford, Fire Chief
Union City Borough	Cheryl Capela, Borough Manager Dan Brumagin, Council President
Union Township	Earl Brown, Township Supervisor
Venango Township	Jack Pfadt, EMC
Washington Township	William Heald, EMC
Waterford Borough	Janet Parke, Secretary
Waterford Township	Flory Kondzielski, Township Supervisor
Wattsburg Borough	Dave Eibl, EMC
Wayne Township	Sparky Warner, Township Supervisor Jill Gibson, Secretary/Treasurer
Wesleyville Borough	Peter Nye, Borough Manager
Erie City Police Department	Randy Bowers, Deputy Chief
Erie City Fire Department	Tony Pol, Fire Chief Guy Santone, Chief Fire Inspector
Erie County Department of Planning	Jake Welsh, Director John McGranor, Planner
Erie County Department of Public Safety	Dale Robinson, EMC Brian Mesaros, Assistant EMC
Erie County Conservation District	Joseph Hudson, Watershed Specialist Earl Brown, District Manager
PA Department of Environmental Protection, Coastal Zone Management	Don Benczkowski, Environmental Planner
PA Department of Conservation and Natural Resources, Presque Isle State Park	Charlie Meade, Chief
Pennsylvania Lake Erie Watershed Association (PLEWA)	Pat Lupo, OSB, Education Director

3.3. Meetings and Documentation

The following meetings were held during the planning process. All invitations, agendas, sign-in sheets, and minutes for these meetings are included in **Appendix C: Meeting and Other Participation Documentation.**

January 7, 2010: Internal County Kick-off Meeting teleconference with HMSC discussed scope, schedule, project goals, invitees, available resources, and planning standards.

February 10, 2011: County Kick-off Meeting held at the Erie County Department of Public Safety to introduce the project and to local stakeholders, inform community representatives of the HMP update process and schedule, and make a formal request for response to the *Capability Assessment Survey* and *Evaluation of Identified Hazard and Risk Worksheet*.

March 15, 2011: Internal Mitigation Strategy Review Meeting teleconference held with the HMSC to conduct a preliminary review of plan goals and objectives and evaluate the status of 2006 plan actions/projects in advance of the entire community reviewing the Mitigation Strategy.

March 24, 2011: Risk Assessment Review and Mitigation Solutions Workshop held at the Erie County Department of Public Safety to review preliminary risk assessment results, discuss mitigation goals and objectives, and select mitigation actions and projects to be included in the HMP.

April 29, 2011: HMP Teleconference call held for any jurisdiction that had been unable to attend a regularly scheduled meeting. The HMP process and importance was introduced; identified hazards and their rankings were reviewed; capability was reviewed; and a description of the mitigation strategy was given. All jurisdictions were asked to complete the Capability Assessment Survey, Evaluation of Identified Hazards and Risk Worksheet, Mitigation Goal and Objective Comment Worksheet, and Mitigation Actions Forms. Participants were invited to participate in this call by phone with a follow-up email containing the materials.

May 5, 2011: Final Public Meeting held at the Erie County Department of Public Safety to update the public about the HMP update process and findings. The meeting was advertised in the Erie Times newspaper both with a public notice and a press release (see **Appendix C**). Attendees were informed about the timeline and their opportunity to review the entire plan on the HMP update website, www.ErieHMP.com and provide written comments.

June 30, 2011: HMP Teleconference call held for any jurisdiction that had been unable to attend a regularly scheduled meeting. The HMP process and importance was introduced; identified hazards and their rankings were reviewed; capability was reviewed; and a description of the mitigation strategy was given. Attendees were referred to the HMP website to obtain participation documents and other information. Participants were invited to participate in this call by phone or email and received a follow-up email containing the meeting materials prior to the call.

3.4. Public & Stakeholder Participation

Each stakeholder was given multiple opportunities to participate in the HMP update process through invitations to meetings, reviews of risk assessment results and mitigation actions, and an opportunity to comment on the draft HMP update. The four tools listed below were distributed with meeting invitations, at meetings, and on the HMP update website to solicit information, data, and comments from both local municipalities and other key stakeholders. Responses to these worksheets and surveys are included in **Appendix C: Meeting and Other Participation Documentation**.

1. **Evaluation of Identified Hazards and Risk Worksheet:** Capitalizes on local knowledge to evaluate the change in the frequency of occurrence, magnitude of impact, and/or geographic extent of existing hazards, and allows communities to evaluate hazards not previously profiled using the Pennsylvania Standard List of Hazards. 30 of the 38 municipalities completed this evaluation, thus helping provide strong information on which hazards are most essential to profile in the plan.
2. **Capability Assessment Survey:** Collects information on local planning, regulatory, administrative, technical, fiscal, political and resiliency capabilities that can be included in the countywide mitigation strategy. Twenty-seven of the thirty-eight municipalities completed this assessment.
3. **Mitigation Strategy Goal and Objective Comment Worksheet:** Collected comments and suggestions from municipalities on the HMPU goals and objectives that had been vetted by the HMSC at the Internal Mitigation Strategy Review Meeting.
4. **Mitigation Action Form:** Allows communities to propose mitigation actions for the HMP and include information about each action such as a lead agency/department, implementation schedule, priority, estimated costs, and potential funding source(s).

Figure 3.4-1: Notice of Public Meeting in the Erie Times.

PUBLIC NOTICE

NOTICE is hereby given that the Erie County Department of Public Safety in cooperation with the Erie County Department of Planning is in the process of updating the Erie County All-Hazard Mitigation Plan. The Plan is a blueprint for reducing property damage and saving lives from the effects of future natural and human-made disasters in Erie County. A public meeting for the plan is scheduled for 6:00 pm on Thursday, May 5, 2011 at the Erie County Department of Public Safety, 2880 Flower Road, Erie, PA 16509. Interested persons may also download and review an electronic copy of the draft Plan at: www.ErieHMP.com beginning on May 16, 2011. All comments on the draft Hazard Mitigation Plan should be submitted in writing no later than June 16, 2011 to Taryn Murray, at tmurray@mbakercorp.com or Michael Baker Jr., Inc., 1818 Market Street, Suite 3110, Philadelphia, PA 19103.

(4-1066336-NT-28)

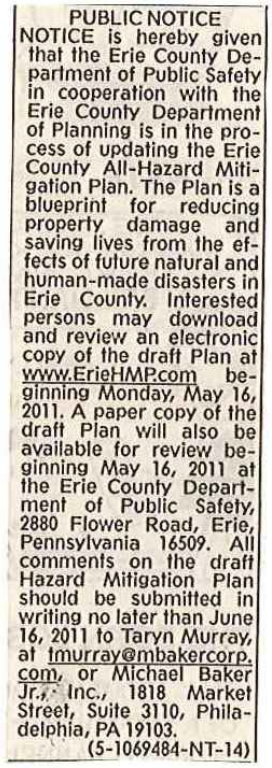
Community participation and comments were encouraged throughout the planning process, most notably through the HMP update website, www.ErieHMP.com. This site acted as a repository for the entire planning process, including presentations, agendas, minutes, and worksheets from each meeting as well as promulgating meeting dates, times, and important announcements. The public was also encouraged to provide images and stories on the effects of the identified hazards in their community on the website. Additionally, a press release was issued by County prior to the Public Meeting providing information on the HMP update and on opportunities for public and stakeholder involvement and encouraging the public to attend the public meeting and submit plan comments. This press release led to the airing of a story on the HMP Update on ABC affiliate, WJET-TV on May 5, 2011. A newspaper notice was published in

the Erie Times on April 28, 2011 to notify the citizens of Erie County of the date and time of the public meeting. A copy of this newspaper notice is shown in Figure 3.4-1.

The HMSC posted the draft Erie County HMP update on the HMP update website, www.ErieHMP.com, beginning on May 16, 2011 and accepted comments through June 16, 2011. The availability of the draft HMP was made public by placing a public notice in the Erie Times on May 14, 2011 and disseminating the information to the HMPT via email. A copy of the notice can be found in Figure 3.4-2. Comments were to be submitted in writing to Taryn Murray, Planning Consultant, or online via the HMP Update website. One comment was received and is available in Appendix C. The received comment requested that the type of schools be differentiated on the critical facilities list in Appendix E and this comment was addressed during plan finalization.

A paper copy of the 2012 Draft HMP was also be available for review and comment at the Erie County Department of Public Safety.

Figure 3.4-2: Notice of Public Comment in the Erie Times.



PUBLIC NOTICE

NOTICE is hereby given that the Erie County Department of Public Safety in cooperation with the Erie County Department of Planning is in the process of updating the Erie County All-Hazard Mitigation Plan. The Plan is a blueprint for reducing property damage and saving lives from the effects of future natural and human-made disasters in Erie County. Interested persons may download and review an electronic copy of the draft Plan at www.ErieHMP.com beginning Monday, May 16, 2011. A paper copy of the draft Plan will also be available for review beginning May 16, 2011 at the Erie County Department of Public Safety, 2880 Flower Road, Erie, Pennsylvania 16509. All comments on the draft Hazard Mitigation Plan should be submitted in writing no later than June 16, 2011 to Taryn Murray, at tmurray@mbakercorp.com, or Michael Baker Jr., Inc., 1818 Market Street, Suite 3110, Philadelphia, PA 19103.

(5-1069484-NT-14)

3.5. Multi-Jurisdictional Planning

This HMP update was developed using a multi-jurisdictional approach. With funding support form PEMA, the County had resources such as technical expertise and data which local jurisdictions lacked, but involvement from local municipalities has been critical to the collection of local knowledge relating to hazard events and mitigation activities. Local municipalities also have the legal authority to enforce compliance with land use planning and development issues. The County undertook an intensive effort to involve all jurisdictions in the planning process.

Table 3.1-1 documents jurisdictional presence at the meetings described in Section 3.3 and other involvement from each jurisdiction throughout the planning process. Each municipality was emailed or mailed invitations to all meetings. An HMP teleconference was held to give jurisdictions that previously been unable to physically attend any other meeting an opportunity to participate. Surveys and forms were emailed to jurisdictions along with letters requesting that local information be provided, and the forms (with instructions) were also posted to the HMP update website. All 38 municipalities in the County participated in the plan, thus achieving 100% participation. This is greater than the participation received during the 2006 planning process.

3.6. Existing Planning Mechanisms

There are numerous existing regulatory and planning mechanisms in place at the state, county, and municipal level of government which support hazard mitigation planning efforts. These tools include the Commonwealth of Pennsylvania Standard All-Hazard Mitigation Plan, local floodplain management ordinances, the Erie County Comprehensive Plan, Erie County

Emergency Operations Plan, Erie County Hazard Vulnerability Analysis (HVA), Erie County Stormwater Management Plan, local Emergency Operation Plans, local zoning ordinances, local subdivision and land development ordinances, local comprehensive plans, and watershed and other environmental plans. These mechanisms were discussed at community meetings and are described in Section 5.2.

Information from several of these documents has been incorporated into this plan and mitigation actions have been developed to further integrate these planning mechanisms into the hazard mitigation planning process. In particular, information on identified development constraints and potential future growth areas was incorporated from the Erie County Comprehensive Plan so that vulnerability pertaining to future development could be established. The 2006 HMP and the 2010 HVA provided extensive information on past occurrences, vulnerability, and risk in the last five years, including anecdotal information. Floodplain management ordinance information was used to aid in the establishment of local capabilities in addition to participation in the NFIP.

4. Risk Assessment

4.1. Update Process Summary

The risk assessment provides a factual basis for activities proposed by the County in their mitigation strategy. Hazards that may affect Erie County are identified and defined in terms of their location and extent, magnitude of impacts, previous events, and probability of future events. This hazard profile structure differs from that used in the 2004 HMP, where each profile included the historical information about the hazard, as well as the vulnerability and probability of each hazard. However, all information from the previous plan has been incorporated and/or updated in the 2012 HMPU unless indicated.

The 2004 Erie County HMP profiled both natural and man-made hazards in Erie County, including: severe winter storms, flooding and seiche, environmental hazards, windstorms, transportation accidents, urban fires, energy emergencies, droughts, erosion, dam failures, and landslides. In order to evaluate the hazards currently in the plan and select new hazards significant to the County, the HMPT was asked to assess the change in risk for all hazards identified in the 2004 plan and vote on which hazards not previously identified but included in the Pennsylvania Standard State List of Hazards had the potential to impact Erie County. After an analysis of the responses (found in **Appendix C**), consultation with the Pennsylvania Standard State All-Hazard Mitigation Plan, and the HMSC's assessment of hazards, two new hazards were added to the HMP: Nuclear Incident and Invasive Species. Hazard profiles were then developed in order to define the characteristics of each hazard as they apply to Erie County.

Following hazard identification and profiling, a vulnerability assessment was conducted for each hazard to identify the impact of both natural and human-made hazard events on people, buildings, infrastructure, and the community, as appropriate. Each hazard is discussed in terms of its potential impact on individual communities, including the types of structures that may be at risk. This assessment allows the County and its municipalities to focus on and prioritize local mitigation efforts on areas that are most likely to be damaged or require early response to a

hazard event. A vulnerability analysis was performed which identifies structures, critical facilities, and/or populations that may be impacted during hazard events and describes what events can do to physical, social, and economic assets. Depending upon data availability, assessment results consist of an inventory of vulnerable structures or populations.

4.2. Hazard Identification

4.2.1. Table of Presidential Disaster Declarations

Presidential Disaster and Emergency Declarations are issued when it has been determined that state and local governments need assistance in responding to a disaster event. Table 4.2-1 identifies eight Presidential Disaster and Emergency Declarations issued between 1955 through 2011 that have affected Erie County. Additional declarations beyond 2011 can be found on the FEMA website at: http://www.fema.gov/news/disasters_state.fema?id=42.

Table 4.2-1: Presidential Disaster and Emergency Declarations affecting Erie County (FEMA, 2011).

DECLARATION NUMBER	DATE	EVENT
3235	September 2005	Proclamation of Emergency - Hurricane Katrina
1497	September 2003	Hurricane Isabel/Henri
1294	September 1999	Hurricane Floyd
1093	January 1996	Flooding
3105	March 1993	Blizzard
737	May 1985	Tornado
340	June 1972	Flood (Agnes)
58	May 1956	Flood

In addition to these Federally-declared events, fifteen events warranted Gubernatorial Proclamations of Emergency. These events are listed in Table 4.2-2.

Table 4.2-2: Erie County Gubernatorial Proclamations of Emergency.

DATE	TYPE
February 2007	Proclamation of Emergency - Severe Winter Storm
February 2007	Proclamation of Emergency - Regulations
April 2007	Proclamation of Emergency - Severe Winter Storm
September 2006	Proclamation of Emergency - Tropical Depression Ernesto
September 2005	Proclamation of Emergency - Hurricane Katrina
December 1998	Drought
January 1994	Severe Winter Storms
January 1978	Heavy Snow
February 1978	Blizzard
March 1976	Heavy Rain/Ice
February 1974	Truckers Strike
July 1974	Flood
February 1972	Heavy Snow

Table 4.2-2: Erie County Gubernatorial Proclamations of Emergency.	
DATE	**TYPE**
January 1966	Heavy Snow
September 1963	Drought

Erie County has also been offered Small Business Administration Disaster Assistance for five disaster events. This disaster assistance qualifies communities for access to affordable, timely, and accessible financial assistance. Table 4.2-3 provides details for these events.

Table 4.2-3: Small Business Administration Disaster Assistance offered in Erie County.	
DATE	**TYPE**
December 2009	Fire
March 2009	Fire
June 2009	Severe Storms and Flooding
April 2007	Drought and Extreme Heat
May 2007	Drought
August 2006	Excessive Rain, Flooding and Flash Flooding
September 1996	Flooding

Since 1955, declarations have been issued for a variety of hazard events, including hurricanes, tornadoes, severe winter storms, and flooding. A unique Presidential Emergency Declaration was issued in September 2005; through Emergency Declaration 3235, President George W. Bush declared that a state of emergency existed in the Commonwealth of Pennsylvania and ordered federal aid to supplement Commonwealth and local response efforts to help people evacuated from their homes due to Hurricane Katrina. All counties within Pennsylvania, including Erie County, were indirectly affected by Hurricane Katrina as a result of evacuee assistance.

4.2.2. Summary of Hazards

The HMPT was provided the Pennsylvania Standard List of Hazards to be considered for evaluation in the 2012 HMP. Following a review of the hazards considered in the 2004 HMP and the Standard List of Hazards, the HMPT decided that the 2012 plan should identify, profile, and analyze fourteen hazards. The hazards include all hazards profiled in the 2004 plan and the addition of Nuclear Incident and Invasive Species as hazards of concern. In selecting hazards to be profiled in the plan, the HMPT determined that several hazards (mining, levees, and wildfire) were not hazards in Erie County and therefore would not be profiled. There are no active or abandoned mines in Erie County, wildfires almost never occur, and there are two minor levees: one only protects a sewage treatment plant and offers no Flood Insurance Rate Map (FIRM) protection and the other offers less than one acre of FIRM protection.

Table 4.2-4 contains a complete list of the fourteen hazards that have the potential to impact Erie County as identified through previous risk assessments, the County Hazards Vulnerability

Analysis, and input from those that participated in the 2012 HMP update. Hazard profiles are included in Section 4.3 for each of these hazards.

Table 4.2-4: Hazards identified in the 2012 Erie County Hazard Mitigation Plan and their respective definitions.	
Hazard Name	**Hazard Description**
NATURAL HAZARDS	
Coastal Erosion	Coastal erosion is a natural coastal process in which sediment outflow exceeds sediment inflow at a particular location. These sediments are typically transported from one location to another by wind, waves, currents, tides, wind-driven water, waterborne ice, runoff of surface waters, or groundwater seepage. Depending on the location and processes in place, coastal erosion can take place very slowly, whereby the shoreline shifts only inches to a foot per year; or more rapidly, whereby changes can exceed ten feet per year. Intense storms and human interference can result in avulsive events where large portions of a beach or dune are washed away by strong currents and large waves. With the exception of portions of Erie County, coastal erosion is not a hazard for communities in Pennsylvania. (FEMA, 1997).
Drought	Drought is a natural climatic condition which occurs in virtually all climates, the consequence of a natural reduction in the amount of precipitation experienced over a long period of time, usually a season or more in length. High temperatures, prolonged winds, and low relative humidity can exacerbate the severity of drought. This hazard is of particular concern in Pennsylvania due to the presence of farms as well as water-dependent industries and recreation areas across the Commonwealth. A prolonged drought could severely impact these sectors of the local economy, as well as residents who depend on wells for drinking water and other personal uses. (National Drought Mitigation Center, 2006).
Earthquake	An earthquake is the motion or trembling of the ground produced by sudden displacement of rock usually within the upper 10-20 miles of the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of underground caverns. Earthquakes can affect hundreds of thousands of square miles, cause damage to property measured in the tens of billions of dollars, result in loss of life and injury to hundreds of thousands of persons, and disrupt the social and economic functioning of the affected area. Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking which is dependent upon amplitude and duration of the earthquake. (FEMA, 1997).

Table 4.2-4: Hazards identified in the 2012 Erie County Hazard Mitigation Plan and their respective definitions.	
Hazard Name	**Hazard Description**
Flood, Flash Flood, Ice Jam	Flooding is the temporary condition of partial or complete inundation on normally dry land and it is the most frequent and costly of all hazards in Pennsylvania. Flooding events are generally the result of excessive precipitation. General flooding is typically experienced when precipitation occurs over a given river basin for an extended period of time. Flash flooding is usually a result of heavy localized precipitation falling in a short time period over a given location, often along mountain streams and in urban areas where much of the ground is covered by impervious surfaces. The severity of a flood event is dependent upon a combination of stream and river basin topography and physiography, hydrology, precipitation and weather patterns, present soil moisture conditions, the degree of vegetative clearing as well as the presence of impervious surfaces in and around flood-prone areas (NOAA, 2009). Winter flooding can include ice jams which occur when warm temperatures and heavy rain cause snow to melt rapidly. Snow melt combined with heavy rains can cause frozen rivers to swell, which breaks the ice layer on top of a river. The ice layer often breaks into large chunks, which float downstream, piling up in narrow passages and near other obstructions such as bridges and dams. Seiches can also cause flooding. Seiches are oscillations of the surface of landlocked bodies of water (such as a lake) that last for a few minutes up to several hours as a result of seismic or atmospheric disturbances. These disturbances create fluctuations in water levels in a short time period and cause flooding on land. All forms of flooding can damage infrastructure (USACE, 2007).
Invasive Species	An invasive species is a species that is not indigenous to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. These species can be any type of organism: plant, fish, invertebrate, mammal, bird, disease, or pathogen. Infestations may not necessarily impact human health, but can create a nuisance or agricultural hardships by destroying crops, defoliating populations of native plant and tree species, or interfering with ecological systems (Governor's Invasive Species Council of Pennsylvania, 2009).
Landslide	A landslide is the downward and outward movement of slope-forming soil, rock and vegetation reacting to the force of gravity. Landslides may be triggered by both natural and human-caused changes in the environment, including heavy rain, rapid snow melt, steepening of slopes due to construction or erosion, earthquakes and changes in groundwater levels. Mudflows, mudslides, rockfalls, rockslides and rock topples are all forms of a landslide. Areas that are generally prone to landslide hazards include previous landslide areas, the bases of steep slopes, the bases of drainage channels, developed hillsides and areas recently burned by forest and brush fires.

Table 4.2-4: Hazards identified in the 2012 Erie County Hazard Mitigation Plan and their respective definitions.	
Hazard Name	**Hazard Description**
Tornado, Windstorm	A wind storm can occur during severe thunderstorms, winter storms, coastal storms, or tornadoes. Straight-line winds such as a downburst have the potential to cause wind gusts that exceed 100 miles per hour. Based on 40 years of tornado history and over 100 years of hurricane history, FEMA identifies western and central Pennsylvania as being more susceptible to higher winds than eastern Pennsylvania. (FEMA, 1997). A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity (but sometimes result from hurricanes or tropical storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of high wind velocities and wind-blown debris. According to the National Weather Service, tornado wind speeds can range between 30 to more than 300 miles per hour. They are more likely to occur during the spring and early summer months of March through June and are most likely to form in the late afternoon and early evening. Most tornadoes are a few dozen yards wide and touch down briefly, but even small, short-lived tornadoes can inflict tremendous damage. Destruction ranges from minor to catastrophic depending on the intensity, size, and duration of the storm. Structures made of light materials such as mobile homes are most susceptible to damage. Waterspouts are weak tornadoes that form over warm water and are relatively uncommon in Pennsylvania. Each year, an average of over 800 tornadoes is reported nationwide, resulting in an average of 80 deaths and 1,500 injuries (NOAA, 2002). Based on NOAA Storm Prediction Center Statistics, the number of recorded F3, F4, & F5 tornadoes between 1950-1998 ranges from <1 to 15 per 3,700 square mile area across Pennsylvania (FEMA, 2009). A water spout is a tornado over a body of water (American Meteorological Society, 2009).
Winter Storm	Winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. A winter storm can range from a moderate snowfall or ice event over a period of a few hours to blizzard conditions with wind-driven snow that lasts for several days. Many winter storms are accompanied by low temperatures and heavy and/or blowing snow, which can severely impair visibility and disrupt transportation. The Commonwealth of Pennsylvania has a long history of severe winter weather. (NOAA, 2009).
HUMAN-MADE HAZARDS	

Table 4.2-4: Hazards identified in the 2012 Erie County Hazard Mitigation Plan and their respective definitions.	
Hazard Name	**Hazard Description**
Dam Failure	A dam is a barrier across flowing water that obstructs, directs, or slows down water flow. Dams provide benefits such as flood protection, power generation, drinking water, irrigation, and recreation. Failure of these structures results in an uncontrolled release of impounded water. Failures are relatively rare, but immense damage and loss of life is possible in downstream communities when such events occur. Aging infrastructure, hydrologic, hydraulic and geologic characteristics, population growth, and design and maintenance practices should be considered when assessing dam failure hazards. The failure of the South Fork Dam, located in Johnstown, PA, was the deadliest dam failure ever experienced in the United States. It took place in 1889 and resulted in the Johnstown Flood which claimed 2,209 lives (FEMA, 1997). Today there are approximately 3,200 dams and reservoirs throughout Pennsylvania (Pennsylvania Department of Environmental Protection, 2009).
Environmental Hazards	Environmental hazards are hazards that pose threats to the natural environment the built environment, and public safety through the diffusion of harmful substances, materials, or products. Environmental hazards include the following: • **Hazardous material releases** – at fixed facilities or as such materials are in transit and including toxic chemicals, infectious substances, biohazardous waste, and any materials that are explosive, corrosive, flammable, or radioactive (PL 1990-165, § 207(e)). • **Air or Water Pollution** – the release of harmful chemical and waste materials into water bodies or the atmosphere, for example (National Institute of Health Sciences, July 2009; EPA, *Natural Disaster PSAs*, 2009).
Nuclear Incidents	Nuclear incidents generally refer to events involving the release of significant levels of radioactivity or exposure of workers or the general public to radiation (FEMA, 1997). Nuclear accidents/incidents can be placed into three categories: 1) Criticality accidents which involve loss of control of nuclear assemblies or power reactors, 2) Loss-of-coolant accidents which result whenever a reactor coolant system experiences a break or opening large enough so that the coolant inventory in the system cannot be maintained by the normally operating make-up system, and 3) Loss-of-containment accidents which involve the release of radioactivity. The primary concern following such an incident or accident is the extent of radiation, inhalation, and ingestion of radioactive isotopes which can cause acute health effects (e.g. death, burns, severe impairment), chronic health effects (e.g. cancer), and psychological effects. (FEMA, 1997).
Transportation Accident	Transportation accidents can result from any form of air, rail, water, or road travel. It is unlikely that small accidents would significantly impact the larger community. However, certain accidents could have secondary regional impacts such as a hazardous materials release or disruption in critical supply/access routes, especially if vital transportation corridors or junctions are present. (US DOT, 2009). Traffic congestion in certain circumstances can also be hazardous. Traffic congestion is a condition that occurs when traffic demand approaches or exceeds the available capacity of the road network. This hazard should be carefully evaluated during emergency planning since it is a key factor in timely disaster or hazard response, especially in areas with high population density. (Federal Highway Administration, 2009).

Table 4.2-4: Hazards identified in the 2012 Erie County Hazard Mitigation Plan and their respective definitions.	
Hazard Name	**Hazard Description**
Urban Fire and Explosion	An urban fire involves a structure or property within an urban or developed area. For hazard mitigation purposes, major urban fires involving large buildings and/or multiple properties are of primary concern. The effects of a major urban fire include minor to significant property damage, loss of life, and residential or business displacement. Explosions are extremely rapid releases of energy that usually generate high temperatures and often lead to fires. The risk of severe explosions can be reduced through careful management of flammable and explosive hazardous materials. (FEMA, 1997).
Utility Interruption	Utility interruption hazards are hazards that impair the functioning of important utilities in the energy, telecommunications, public works, and information network sectors. Utility interruption hazards include the following: • **Geomagnetic Storms**; including temporary disturbances of the Earth's magnetic field resulting in disruptions of communication, navigation, and satellite systems (National Research Council et al., 1986). • **Fuel or Resource Shortage**; resulting from supply chain breaks or secondary to other hazard events. • **Electromagnetic Pulse**; originating from an explosion or fluctuating magnetic field and causing damaging current surges in electrical and electronic systems (Institute for Telecommunications Sciences, 1996). • **Information Technology Failure**; due to software bugs, viruses, or improper use (Rainer Jr., et al, 1991). • **Ancillary Support Equipment**; electrical generating, transmission, system-control, and distribution-system equipment for the energy industry (Hirst & Kirby, 1996). • **Public Works Failure**; damage to or failure of highways, flood control systems, deepwater ports and harbors, public buildings, bridges, dams, for example (United States Senate Committee on Environment and Public Works, 2009). • **Telecommunications System Failure**; Damage to data transfer, communications, and processing equipment, for example (FEMA, 1997) • **Transmission Facility or Linear Utility Accident**; liquefied natural gas leakages, explosions, facility problems, for example (United States Department of Energy, 2005) • **Major Energy, Power, Utility Failure**; interruptions of generation and distribution, power outages, for example (United States Department of Energy, 2000).

4.3. Hazard Profiles and Vulnerability Analysis

NATURAL HAZARDS

4.3.1. Coastal Erosion

4.3.1.1. Location and Extent

There are 76.6 miles of coastline along the northern border of Erie County. It includes the highest bluffs anywhere on the Lake Erie shore and Presque Isle, the only significant coastal depositional feature on the south shore of the lake. Presque Isle is a compound re-curved spit

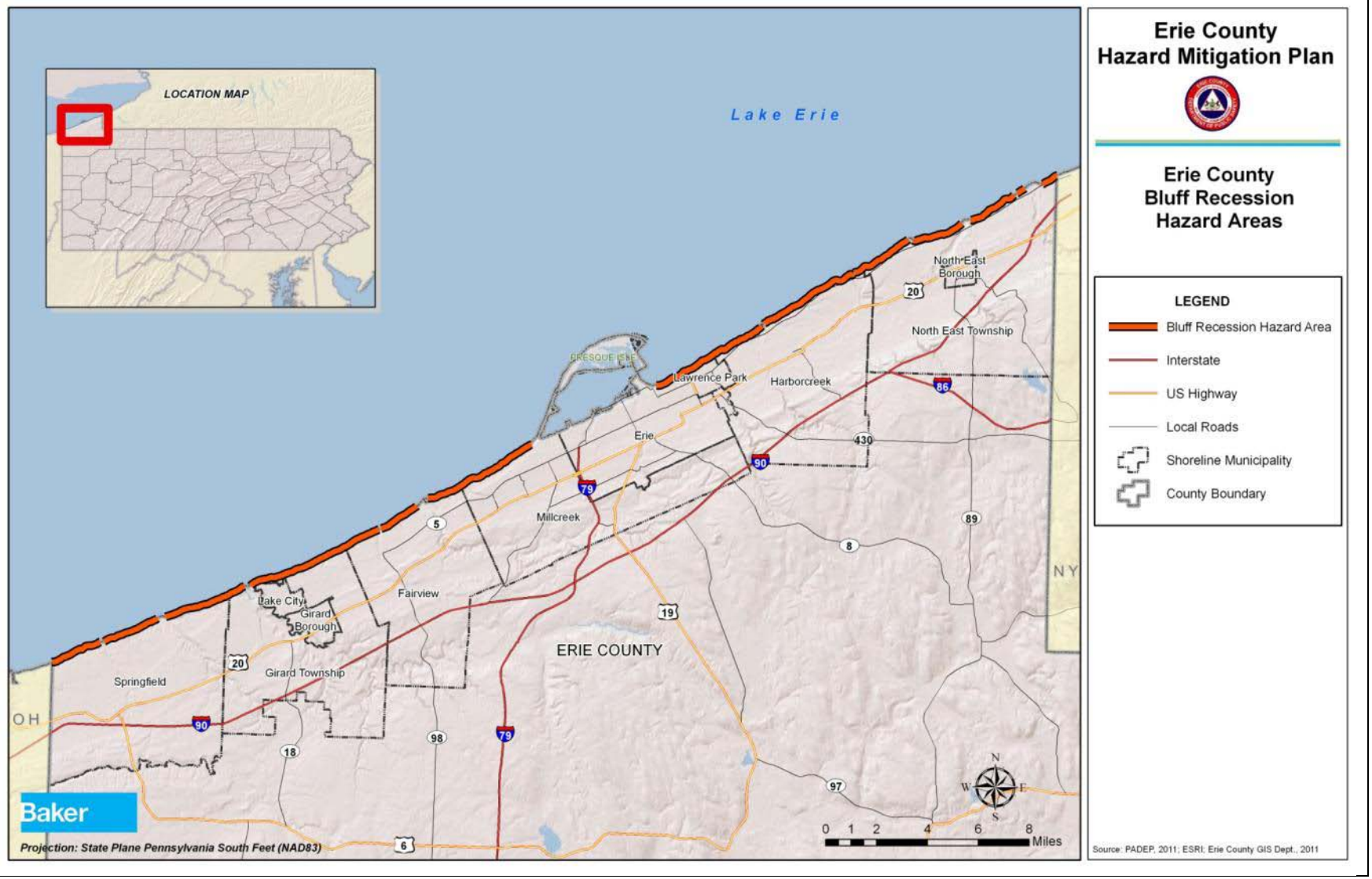
made up of beach, dune, and inter-dune-pond features which protects Erie Harbor. Most of the Pennsylvania lake shore consists of narrow beaches in front of bluffs, five to one hundred-eighty feet high (PADEP, 2002). The glaciers that carved out the Great Lakes basin resulted in the deposition of sediments that make up the bluffs. These unconsolidated glacial sediments include sand, gravel and clay, all of which are very vulnerable to erosion when exposed to the forces of direct wave contact, groundwater flows, surface water runoff, ice, wind and rain. In some areas along the Lake Erie coast, the bluffs have a bottom layer of exposed bedrock or shale which is often weathered and undercut over the long-term by wave action.

Shoreline erosion and *bluff recession* are the most significant Lake Erie coastal hazards. However, these hazards occur as a result of different geomorphologic processes. Bluff recession is the landward retreat of the bluff face caused by erosive forces along the shoreline. Shoreline erosion occurs when the amount of beach sand replenished by littoral drift processes is exceeded by erosional forces. Both shoreline erosion and bluff recession are affected by lake levels, groundwater discharges, ground elevations, and human activity.

Figure 4.3.1-1 identifies Bluff Recession Hazard Areas (BRHAs) identified by the Pennsylvania Department of Environmental Protection Coastal Zone Management Program. BRHAs are defined in Section 3 of the Bluff Recession and Setback Act as “an area or zone where the rate of progressive bluff recession creates a substantial threat to the safety or stability of nearby or future structures or utility facilities.” These bluffs are present along the majority of Erie County’s border with Lake Erie and present a hazard. Original designations of BRHAs, codified at 25 Pa. Code § 85.26, are based on a 1975 study titled *Shoreline Erosion and Flooding – Erie County* (PADEP, 2004). Current designations were established in 2009 based on a 2004 study titled, *Study to Tentatively Designate Bluff Recession Hazard Areas*. All BHRAs were first established in 1980 except for the BRHA within the City of Erie, which was established during the 2009 update (PADEP, 2011).

The BRHAs determine where along the shoreline development will be subject to Minimum Bluff Setback Distances. Sections of shoreline which are not identified as a BRHA (e.g. beach and dune areas, headlands, armored shorelines, etc…) may not be subject to bluff recession, but remain vulnerable to shoreline erosion.

Figure 4.3.1-1: Bluff Recession Hazard Areas along the Lake Erie Shoreline (PADEP, 2011)

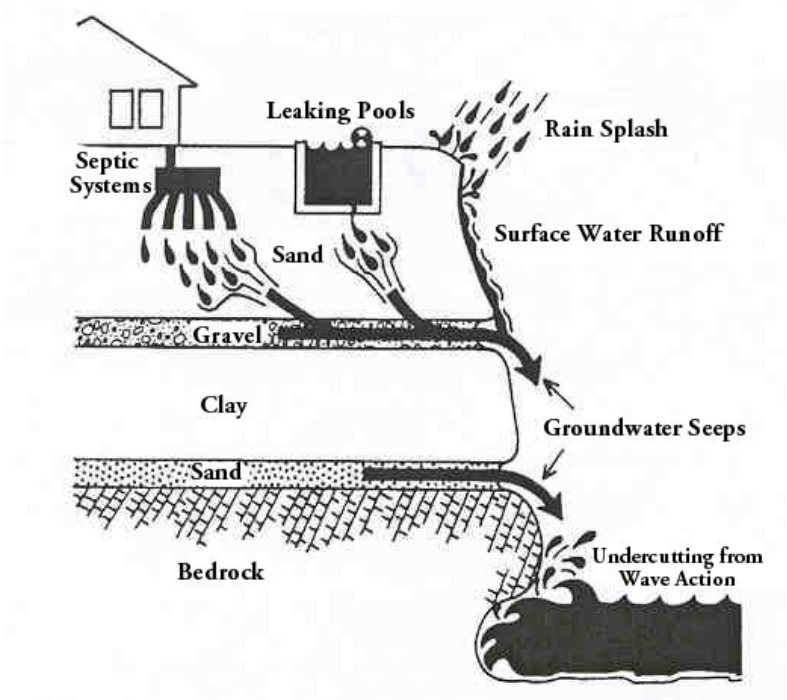


4.3.1.2. Range of Magnitude

Bluff recession and shoreline erosion events can take place gradually over decades or abruptly during a single storm event. The magnitude of bluff recession and shoreline erosion events depends greatly on fluctuating lake levels and the amount of beach material along the shoreline, but other factors that affect rate of change include surrounding land use, storm impacts, vegetative cover, soil type, depth of unconsolidated soils, hydrology, bedrock geology, slope gradient, offshore bathymetry and human activity. Figure 4.3.1-2 illustrates both the natural and human-induced processes which influence bluff recession rates of change.

Bluff instability often occurs as a result of erosion of foreshore beach materials and the undercutting of bluffs by wave attack. However, slumping and mass-wasting of the bluff face can also occur without the presence of direct wave attack. Erosion of the bluffs may be accelerated by groundwater seepage, surface water runoff, and human activity or changes in land use that would alter the hydrology or vegetation on a site.

Figure 4.3.1-2: Diagram showing many of the natural and human-induced processes which influence result in coastal erosion along the Lake Erie shoreline.



In beach and dune areas such as Presque Isle, wind-driven waves, especially during periods of high lake levels, can inundate natural protective beaches and allow water and damaging waves to reach the back beach areas. During prolonged periods of inundation, large quantities of beach material can be moved offshore. It is during these periods that the greatest threat of property damage and site instability occurs.

Much of Lake Erie and its beaches and bluffs are frozen during winter, inhibiting the formation of storm waves and reducing erosion. However, during ice formation in early winter and during the spring thaw, ice processes can accelerate erosion and recession. The spring rains, snowmelt, and low evaporation rates cause Lake Erie's average water level in June to be more than 30 centimeters above the typical January level. Several years of above-normal precipitation, as in the mid-1980s, can cause Lake Erie's water level to rise significantly above its long-term average, increasing the likelihood of erosion.

Lake Erie is the shallowest of the Great Lakes, reaching a maximum depth of 210 feet in the eastern basin. The lake topography coupled with changing water levels can have extreme effects on the shoreline. Because the lake is shallow, the effects of storm driven waves are amplified. The axis of the lake runs from southwest to northeast, corresponding to the direction of prevailing winds. Strong winds can push water toward one end of Lake Erie (setup) and may create a difference in elevation of over 15 feet. When the wind stops, the water will rebound creating a seiche effect which causes the water to move back and forth across the lake. Strong winds or northeasters can also be a problem, driving storm waves opposite of their normal path. Elevated water levels associated with these seiche events can result in significant erosion events.

The impacts of bluff recession and shoreline erosion may be minimal in areas where buildings and infrastructure have been constructed at an adequate setback distance or erosion mitigation measures have been employed. However, development within and south of designated hazard areas can result in damage or complete destruction of property and public infrastructure as well as threats public health and safety. A worst-case scenario for coastal erosion would be if coastal erosion from a strong storm occurred, causing a slumping or mass-wasting of a bluff and numerous homes on the bluff to collapse. This could result in not only property damage, but loss of life or injuries if the homes are occupied at the time of the slope collapse. Figure 4.3.1-3 shows an example of a building imminently threatened by significant bluff recession, dating back to the 1970s. Figure 4.3.1-4 shows an example of a collapsed retaining structure.

Figure 4.3.1-3: Photograph of large avulsive event along the Lake Erie, PA shoreline (Hapke *et al*., 2009).

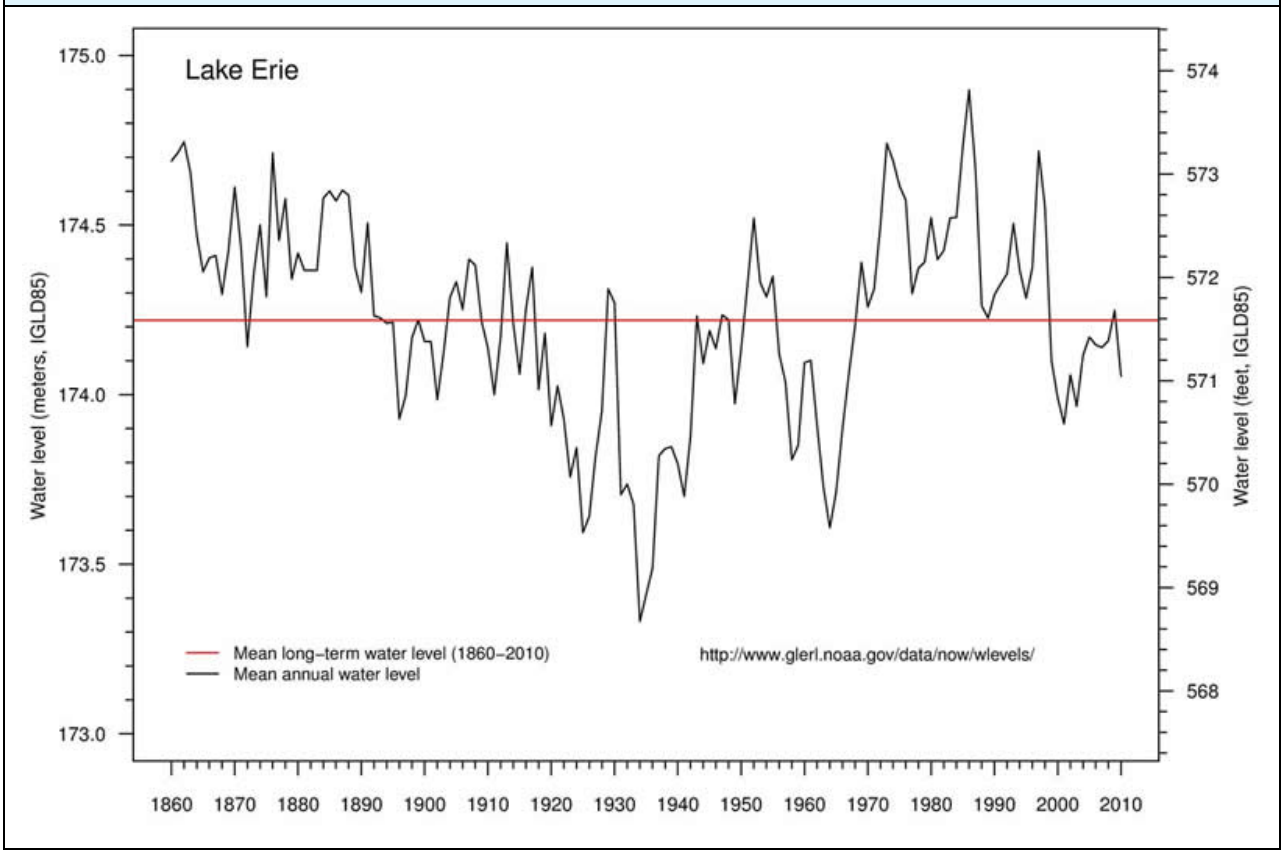
Figure 4.3.1-4: Photograph of collapsed retaining wall structure along the Lake Erie, PA shoreline (PADEP, 2011).

4.3.1.3. Past Occurrence

As previously mentioned, shoreline erosion and bluff recession events are often dependent on water levels on Lake Erie. Changes in precipitation (i.e. rain and snow) are a main cause of lake level fluctuation; however, other factors affecting lake levels include evaporation, wind (i.e. seiche events), crustal (i.e. glacial) rebound, dredging, diversions, flood control, and power generation. However, human effects on lake levels are slight. For instance, construction of the Welland Canal, which bypasses Niagara Falls, dropped the level of Lake Erie by approximately four inches. Most fluctuation is due to changes in input from the upper Great Lakes watershed, which contributes almost 90% of the total input into Lake Erie. Additional water inputs come from sources including tributaries, groundwater, and precipitation.

Figure 4.3.1-5 shows average annual lake levels for the period 1860 – 2010. Note that Figure 4.3.1-5 depicts average levels; annual cycles and short-term changes are not represented. In a typical year, the lowest levels occur in February, the highest in June. Average lake levels have varied on the order of five feet over the period 1860 – 2009. The droughts of the 1930s and 1960s are clearly reflected in lake levels.

Figure 4.3.1-5: Lake Erie water levels between 1860 and 2010 (NOAA GLERL, 2011).



Lake Erie water levels reached record highs in the mid-1980s and near-record levels from 1996 through 1998, affecting shoreline residents and public utilities. These record high lake-levels caused significant erosion events on the Lake Erie shoreline in 1985, 1986, and 1987 (Malone,

2010). Table 4.3.1-1 shows the results of a damage assessment performed for the 1987 event by the Pennsylvania Coastal Resources Management Program (PA DEP, 1987).

Table 4.3.1-1: Summary of the impact of damages caused by high water levels on the Pennsylvania Coastal Zone in Erie County, 1985-1987 (PA DEP, 1987).

Item	Number Affected (Total)	No. Affected by Flooding	No. Affected by Shoreline Erosion	No. of People Affected
PUBLIC FACILITIES				
Water Plants	1	1	0	0
Sewage Plants	0	0	0	0
Marinas, Decks	12	12	0	300
Parks/Beaches	12	12	11	0
Roadways	6	6	0	0
Hospitals	0	0	0	0
Schools	0	0	0	0
Sewer Facilities Systems	3	3	0	0
Airports	0	0	0	0
Sanitary Landfills	0	0	0	0
PRIVATE FACILITIES				
Commercial	7	3	5	15
Industrial	0	0	0	0
Residential	180	136	144	474
Power Plants	0	0	0	0
OTHER				
Seasonal Residences	31	14	20	65
Boathouses	5	0	5	37
Bathhouse/Comfort Stations	3	3	0	0 (other facilities available)

Various studies, notably those developed by the U.S. Army Corps of Engineers (Buffalo District) and the Pennsylvania Coastal Resources Management Program, have assessed shoreline damage statistics and the costs of protection. Shore structure inventories have also been prepared in recent years, some of which are ongoing. These documents provide useful information for measuring losses and recording efforts made to mitigate damage. However, studies more recent than the 1987 damage assessment are not currently available.

The long-term average historical recession rate based on 130 fixed control point monuments for the Pennsylvania Lake Erie Coastal Zone is 1.0 ft/yr. Figure 4.3.1-6 displays historical long-term bluff recession rates along the Pennsylvania Lake Erie shoreline as of 2007. Field surveys are being performed through 2011 to update the control point monument data; therefore, updated recession rates should be available for the next Erie County Hazard Mitigation Plan update.

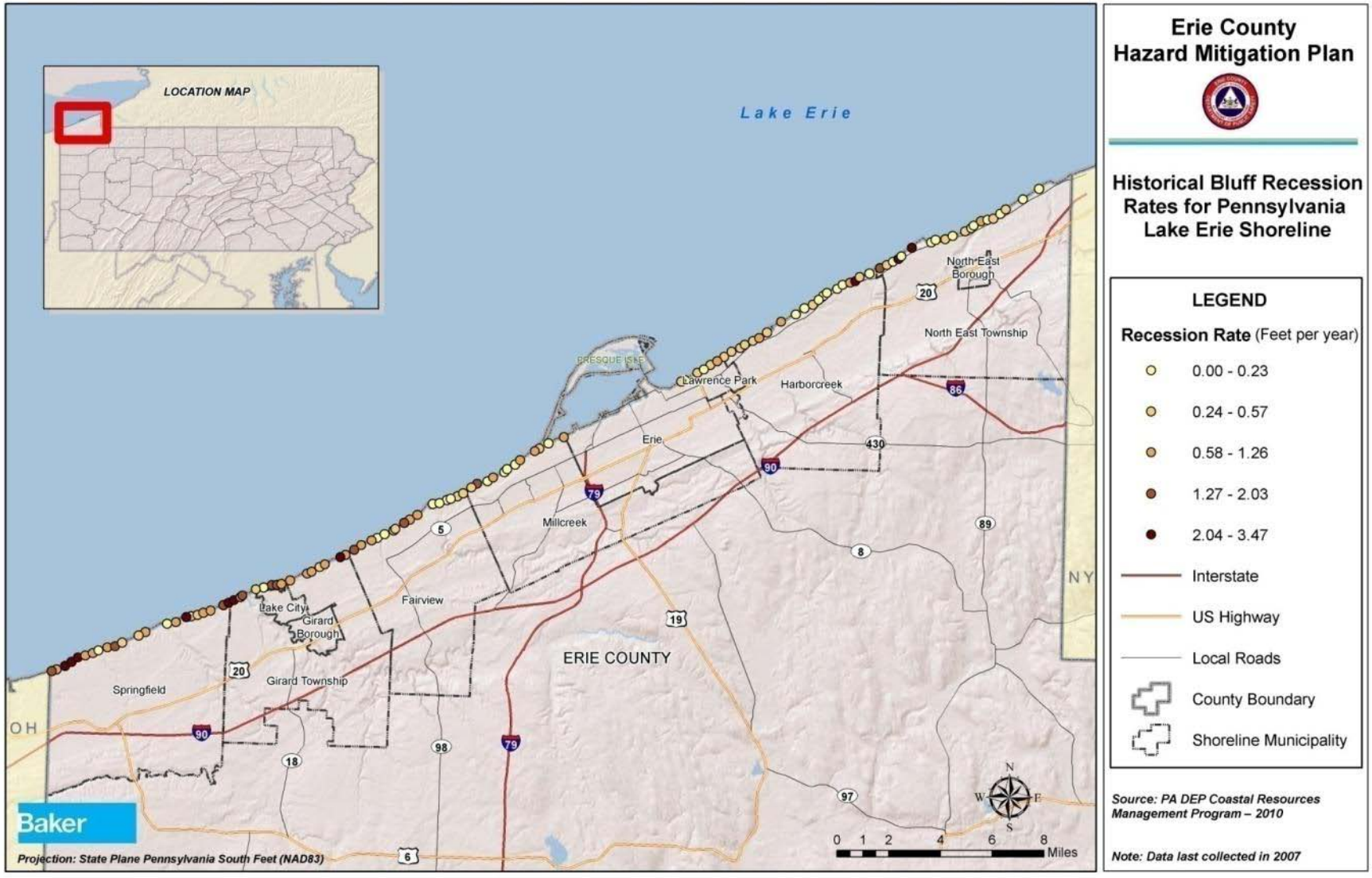
A study performed by the U.S. Geological Survey in cooperation with the Pennsylvania Coastal Resources Management Program divided the Pennsylvania Lake Erie shoreline into two areas

along which recession rates were calculated (*Hapke et al*., 2009). Using data from 1938-2006, the study area extending southwest of Presque Isle had an average rate of recession of 0.98 +/- 0.33 ft/yr. Using data from 1938-1998, the study area extending northeast of Presque Isle had an average rate of recession of 0.66 +/- 0.33 ft/yr. A maximum rate of 3.28 +/- 0.33 ft/yr was measured in each study area, both occurring in predominantly agricultural areas.

Due to excessive precipitation in the spring of 2011, several lakefront properties experienced significant bluff recession. One of the properties affected by this event receded approximately 100 ft. (ECDPS, 2011).

Historical recession data is valuable for long-term planning purposes. However, historical rates are spatially variable and temporally episodic. During the past two decades of monitoring, losses of up to twenty feet in a single year have been observed (Hapke *et al*., 2009). In addition, low retreat rates have been measured at certain control points, while rates in immediately adjacent areas are much higher. Therefore, the limitations of historical rates must be recognized and data must be used appropriately for purposes of evaluating risk.

Figure 4.3.1-6: Historical erosion rates along the Pennsylvania Lake Erie Shoreline.



4.3.1.4. Future Occurrence

The geological processes along the Lake Erie shoreline are continuous, but rates of change vary as a result of the natural and human-caused influences previously described. Future shoreline erosion and bluff recession can be considered *highly likely*; as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1), however, rates of change will vary over time, primarily as a function of changing lake levels.

Historical rates described in Section 4.3.1.3 serve as best estimates of future changes. In Section 4.3.1.5, these rates are applied to structures located in close proximity to the shoreline to identify properties at risk throughout Erie County over the next 100 years.

4.3.1.5. Vulnerability Assessment

The Bluff Recession and Setback Act was passed in 1980 and requires that new residential, commercial and industrial structures will be constructed landward of Minimum Bluff Setback Distances (MBSD). Such setbacks protect the health and safety of residents, as well as property investments. The statutory authority of the Act only applies to Lake Erie. There are nine municipalities along Pennsylvania's Lake Erie coast that have designated BRHAs and enacted ordinances. Table 4.3.1-2 provides a summary of the life span used to calculate MBSDs based on structure type, where:

Bluff Recession Rate (ft/yr) x Appropriate Life Span of Structure (yrs) = MBSD (ft)

Table 4.3.1-2: Summary of life spans used to calculate Minimum Bluff Setback Distances for development in Lake Erie Bluff Recession Hazard Areas.

Type of Structure	Appropriate Life Span (years)
Residential	50
Commercial	75
Industrial	100

Note: MBSDs are determined by and currently set in 25 Pa. Code § 85.26(c). Some municipalities have enacted setback requirements which are greater than the MBSDs published in Chapter 85. For example, Girard Township (200 ft.), Lake City Borough (150 ft.), and Fairview Township (100 ft.) (ECDPS, 2011).

For purposes of this risk assessment, an investigation of properties located within a 100-year bluff recession hazard area was performed. Based on nearby historical recession rates, properties located within BRHAs that are considered at risk from bluff recession over the next 100 years were identified. A planning horizon of 100 years was used since it is the longest of the three life spans used to calculate Minimum Bluff Setback Distances under the Bluff Recession and Setback Act. Using building footprints provided by the Erie County Planning Department, the distance of each structure was measured from the approximate bluff edge. The current approximate setback distance was then divided by a representative historical erosion rate (see Figure 4.3.1-6) to determine which buildings are located along areas of the Lake Erie shoreline expected to erode over the 100 years. A summary of these buildings is provided in Table 4.3.1-3 by municipality, along with total building value information. Building

location and building value information is based on 2011 tax assessment data provided by Erie County.

The following assumptions should be considered when interpreting assessment results:

- Long-term bluff recession rates were used to determine setback life. Natural (e.g. changing lake level) or human influences (e.g. construction of shore protection structures) which will alter future recession rates are not considered.
- Control point monuments are typically located every 1,650 ft. along the Lake Erie shoreline. The recession rate from the nearest control point monument was applied to each structure; however this monument may not always be most representative of erosion risk for a given structure.
- Only buildings located adjacent to the BRHAs were included in this assessment. Additional buildings which may be at risk (e.g. buildings located between breaks in BRHA or in non-bluff areas) were not included. While the number of excluded buildings potentially at risk is considered to be relatively small compared to overall assessment results, it is worth noting since results likely serve as conservative estimates of properties at risk over the next 100 years.
- Setback measurements used in the assessment are determined based on the distance of a given building footprint to the approximate bluff edge. The property a building is located on as well as surrounding infrastructure are likely at risk prior to damage to the building itself.
- By regulation, MBSDs are measured from the bluff crest, which due to its dynamic nature, is determined on a case by case basis through field surveys. For purposes of this assessment, a delineation of the bluff edge was created based on the most recent aerial imagery available from the ESRI World Imagery dataset. While this delineation is reasonably accurate, it was not verified with topographic data or field survey data and should therefore be considered approximate.
- New or future development is not accounted for; this assessment is based on present development only.

Table 4.3.1-3: Buildings identified in 100-yr Erosion Hazard Area by community with associated building and land value data.

Municipality	No. of Buildings in 100-yr Erosion Hazard Area (Percent of Total Buildings Throughout County in 100-yr Erosion Hazard Area)	Total Building Value	Total Land Value	Total Land & Building Value
Erie City	25 (9.4%)	$316,540	$3,340,650	$3,657,190
Fairview Township	11 (4.2%)	$4,039,100	$2,647,700	$6,686,800
Girard Township	14 (5.3%)	$1,165,600	$6,349,200	$7,514,800
Harborcreek Township	51 (19.2%)	$4,249,070	$8,166,500	$12,415,570
Lake City Borough	0 (0.0%)	$0	$0	$0
Lawrence Park Township	3 (1.1%)	$281,000	$333,200	$614,200

Table 4.3.1-3: Buildings identified in 100-yr Erosion Hazard Area by community with associated building and land value data.

Municipality	No. of Buildings in 100-yr Erosion Hazard Area (Percent of Total Buildings Throughout County in 100-yr Erosion Hazard Area)	Total Building Value	Total Land Value	Total Land & Building Value
Millcreek Township	111 (41.9%)	$8,842,640	$10,030,000	$18,872,640
North East Township	33 (12.5%)	$2,446,500	$3,240,300	$5,686,800
Springfield Township	17 (6.4%)	$5,619,500	$4,635,300	$10,254,800
TOTAL	**265**	**$26,959,950**	**$38,742,850**	**$65,702,800**

Based on results from this assessment, 265 structures along the Lake Erie shoreline are considered at risk of significant damage or complete destruction from coastal erosion over the next 100 years. These buildings are spread across eight municipalities with over 40% of them located in Millcreek Township. Based on 2011 tax assessment data provided by Erie County, these 265 buildings have a total value of $26,959,950. In addition, the total value of land associated with these properties and potentially at risk from coastal erosion losses equals $38,742,850.

It is imperative that residents living near the shoreline are well-educated on shoreline erosion and bluff recession hazards. Appropriate mitigation measures also need to be put into place to help lessen the impact of shoreline erosion, bluff recession, and flooding on coastal structures, residents, land, and wildlife.

In addition, because Lake Erie bluffs are reshaped daily by the natural forces of gravity, water, and wind, through proper land-use management practices, bluff recession can be slowed, but not prevented. Since the majority of bluff recession-related problems start at the base of the bluff as a result of wave damage, the following measures can be used to stabilize the shoreline. Note that recent events have shown these measures to be relatively ineffective in protecting bluff areas from groundwater-induced recession:

- Revetments: concrete blocks placed on banks to absorb the energy of incoming waves. These structures protect only the land immediately behind them, not adjacent areas.
- Groins: concrete structures that extend perpendicular from the shore. Groins interrupt the natural wave movement of beach sediment by trapping and retaining sand on the up drift side of the groin.

Once the shoreline is secured, the following bluff face re-contouring and stabilization practices can be undertaken:

- Biotechnical slope protection: combines the use of biodegradable wood cribbing and appropriate vegetation. The structure provides support for the bluff at a groundwater seepage area, while the vegetation absorbs the groundwater, eventually stabilizing the bluff face.

- Dewatering**:** intercepts groundwater before it reaches the bluff face. Wells and groundwater trenches collect groundwater and re-channel it through pipes over the bluff face to the base of the bluff.
- Vegetation: naturally and inexpensively protects the bluffs. Root systems absorb groundwater and hold the soil together. Leaves intercept the impact of raindrops and transfer water absorbed by the root systems into the atmosphere through evapo-transpiration.

The PADEP Coastal Zone Management Program provides funding as well as technical assistance for projects located within the 76.6 miles of coastline and landward to the Lake Erie watershed boundary. Grant funds can be used for many types of projects including education, construction, research, planning, acquisition, and design. The program's main goal is to balance coastal land use with conservation and protection of water-related resources.

4.3.2. Drought

4.3.2.1. Location and Extent

Drought conditions may affect both rural and urban areas with extensive socio-economic consequences. There are commonly of two types of droughts, agricultural and hydrological. *Agricultural* drought inflicts harm on crops and livestock. *Hydrological* drought is characterized by a depletion of groundwater supplies, reductions in stream flow and lowered lake and reservoir levels. A growing population, with individual and communal demands upon water supplies, coupled with industrial and agricultural uses, will combine to affect water use during both normal and drought conditions. However, areas with extensive agricultural land use are most vulnerable to drought.

Droughts are regional events and the spatial extent for areas of impact can range from areas of Pennsylvania to the entire mid-Atlantic region. When these drought events occur in Erie County, impacts are felt across the entire County as well as areas outside County boundaries. While Figure 4.3.2-1 shows that all of Erie County has an equal occurrence of severe or extreme drought, the agricultural industry is often hardest hit.

Clean groundwater resources in Erie County are available from unconsolidated deposits and from fractured bedrock aquifers. The aquifers that have the highest well yields and specific capacities are glacial-outwash and glacial-beach deposits. However, these deposits are limited in area extent, being restricted to the major stream (buried) valleys and near Lake Erie shoreline. Erie County is most often affected by hydrological droughts (ECEMA, 2010). A hydrological drought occurs when surface and subsurface water levels drop, such as in streams, rivers, lakes, and reservoirs.

Some preliminary discussion of the impact of drought and potential solutions can also be found in the Comprehensive planning document titled the State Water Plan. This document was published over twenty years ago and is therefore dated. The State has been authorized by the legislature to rewrite this plan and it is expected to inventory existing and potential drought

mitigation strategies and options that may avoid or lessen the consequences of prolonged hydrologic drought.

4.3.2.2. Range of Magnitude

Hydrologic drought events result in a reduction of stream flows, reduction of lake/reservoir storage, and a lowering of groundwater levels. These events have adverse impacts on public water supplies for human consumption, rural water supplies for livestock consumption and agricultural operations, water quality, natural soil water or irrigation water for agriculture, soil moisture, conditions conducive to wildfire events, and water for navigation and recreation.

The Commonwealth uses five parameters to assess drought conditions:

1) Stream flows (compared to benchmark records)
2) Precipitation (measured as the departure from normal, 30 year average precipitation)
3) Reservoir storage levels in a variety of locations (especially three New York City reservoirs in upper Delaware River Basin)
4) Groundwater elevations in a number of counties (comparing to past month, past year and historic record)
5) The Palmer Drought Severity Index – a soil moisture algorithm calibrated for relatively homogeneous regions which measures dryness based on recent precipitation and temperature (see Table 4.3.2-1).

Table 4.3.2-1: Palmer Drought Severity Index (PSDI) classifications (NDMC, 2009).

SEVERITY CATEGORY	PSDI VALUE
Extremely wet	4.0 or more
Very wet	3.0 to 3.99
Moderately wet	2.0 to 2.99
Slightly wet	1.0 to 1.99
Incipient wet spell	0.5 to 0.99
Near normal	0.49 to -0.49
Incipient dry spell	-0.5 to -0.99
Mild drought	-1.0 to -1.99
Moderate drought	-2.0 to -2.99
Severe drought	-3.0 to -3.99
Extreme drought	-4.0 or less

Phases of drought preparedness in Pennsylvania in order of increasing severity are:

- Drought Watch: A period to alert government agencies, public water suppliers, water users and the public regarding the potential for future drought-related problems. The focus is on increased monitoring, awareness and preparation for response if conditions worsen. A request for voluntary water conservation is made. The objective of voluntary water conservation measures during a drought watch is to reduce water uses by 5 percent in the affected areas. Due to varying conditions, individual water suppliers or municipalities may be asking for more stringent conservation actions.

- Drought Warning: This phase involves a coordinated response to imminent drought conditions and potential water supply shortages through concerted voluntary conservation measures to avoid or reduce shortages, relieve stressed sources, develop new sources, and if possible forestall the need to impose mandatory water use restrictions. The objective of voluntary water conservation measures during a drought warning is to reduce overall water uses by 10-15 percent in the affected areas. Due to varying conditions, individual water suppliers or municipalities may be asking for more stringent conservation actions.
- Drought Emergency: This stage is a phase of concerted management operations to marshal all available resources to respond to actual emergency conditions, to avoid depletion of water sources, to assure at least minimum water supplies to protect public health and safety, to support essential and high priority water uses and to avoid unnecessary economic dislocations. It is possible during this phase to impose mandatory restrictions on non-essential water uses that are provided in the Pennsylvania Code (Chapter 119), if deemed necessary and if ordered by the Governor of Pennsylvania. The objective of water use restrictions (mandatory or voluntary) and other conservation measures during this phase is to reduce consumptive water use in the affected area by fifteen percent, and to reduce total use to the extent necessary to preserve public water system supplies, to avoid or mitigate local or area shortages, and to assure equitable sharing of limited supplies.
- Local Water Rationing: Although not a drought phase, local municipalities may, with the approval of the PA Emergency Management Council, implement local water rationing to share a rapidly dwindling or severely depleted water supply in designated water supply service areas. These individual water rationing plans, authorized through provisions of the Pennsylvania Code (Chapter 120), will require specific limits on individual water consumption to achieve significant reductions in use. Under both mandatory restrictions imposed by the Commonwealth and local water rationing, procedures are provided for granting of variances to consider individual hardships and economic dislocations.

Environmental impacts of drought include:

- Hydrologic effects – lower water levels in reservoirs, lakes, and ponds; reduced streamflow; loss of wetlands; estuarine impacts; groundwater depletion and land subsidence; effects on water quality such as increases in salt concentration and water temperature
- Damage to animal species – lack of feed and drinking water; disease; loss of biodiversity; migration or concentration; and reduction and degradation of fish and wildlife habitat
- Damage to plant communities – loss of biodiversity; loss of trees from urban landscapes and wooded conservation areas
- Increased number and severity of fires
- Reduced soil quality
- Air quality effects – dust and pollutants
- Loss of quality in landscape

4.3.2.3. Past Occurrence

Erie County is unique in Pennsylvania in that it fronts Lake Erie and connects the Commonwealth with the Great Lakes System. The County normally has an abundant amount of rainfall each year because of its location. Whenever a weather pattern crosses the area, moisture is gathered on the Lake and then released as it starts to travel over the land area. Seventy percent of the population resides on thirty percent of land with municipal water systems. Thirty percent of the population resides on seventy percent of land with wells that would be most impacted from a drought. Drought mainly affects rural areas that rely on private domestic wells as the municipal water supply comes from Lake Erie.

There have been nineteen droughts in Erie County over the last thirty years. Three of these have been Drought Emergencies. The most recent Drought Emergency occurred in July through September of 1999. The Governor declared a State of Drought Emergency because of the agricultural disaster effects of the drought. Table 4.2-2 shows that since 1955, there has been one Gubernatorial Proclamation in response to drought conditions within Erie County.

A worst drought event in Erie County occurred in the fall of 1995. A drought began in September and ran through October of that year because of a lack of rain. Late season crops suffered, estimates of crop losses averaged from 20 to 50 percent with the total dollar loss amount unknown. A number of residential water wells went or remained dry and local and state officials restricted water use and open burning in some areas around the County.

Other droughts of note in the last 30 years include a drought emergency in the summer of 1991 when a number of communities experienced moderate water deficiencies and many homeowners in rural areas had dry wells until fall rains replenished the water table. The drought in September 1999 affected the area to the south of the City of Erie and caused unknown monetary losses due to reduced crop yields. Erie County was most recently under a drought watch in the summer of 2010, because of statewide drought conditions leading to steadily-declining ground and surface water levels.

The history of declared drought status for Erie County from 1980 to 2009 is shown in Table 4.3.2-2. Descriptions for drought status categories (i.e. *watch*, *warning*, and *emergency*) are included in Section 4.3.2.2. The Department of Environmental Protection is the agency responsible for collecting drought information. Data for all counties in the Commonwealth is available for the years 1980 through 2009.

Table 4.3.2-2: Erie County Declared Drought Status from 1980 to 2009 (PADEP, 2010).

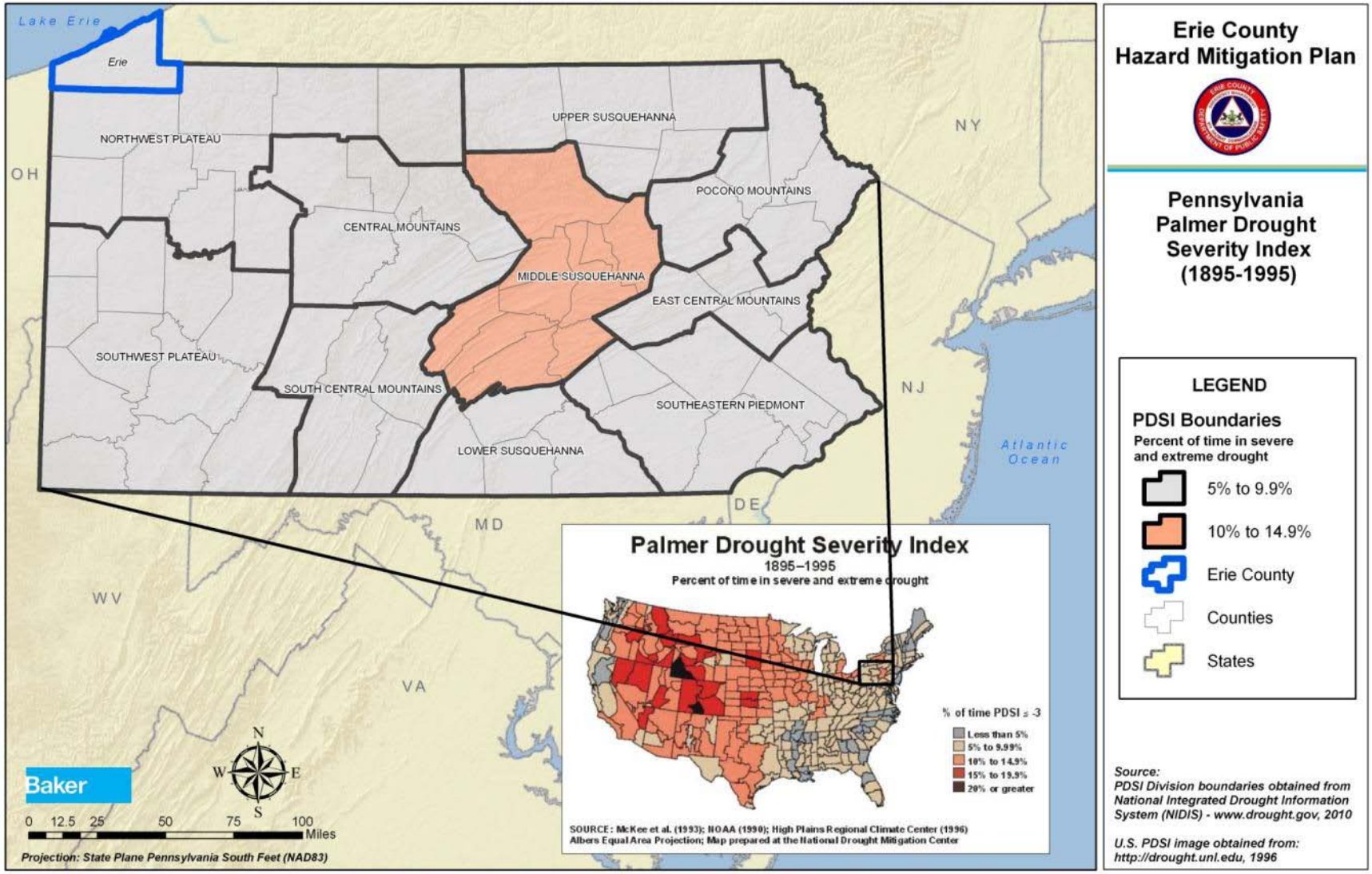
DATE	DROUGHT STATUS	DATE	DROUGHT STATUS
Jul 7, 1988 - Aug 24, 1988	Watch	Mar 15, 1999 - Jul 20, 1999	Watch
Aug 24, 1988 - Dec 12, 1988	Warning	Jul 20, 1999 - Sep 30,1999	Emergency
Jun 28, 1991 - Jul 24, 1991	Watch	Sep 30, 1999 - Feb 25, 2000	Warning
Jul 24, 1991 - Aug 16, 1991	Warning	Feb 25, 2000 - May 5, 2000	Watch
Aug 16, 1991 - Apr 20, 1992	Emergency	Aug 24, 2001 - May 13, 2002	Watch
Apr 20, 1992 - Jun 23, 1992	Warning	Sep 5, 2002 - Jun 18, 2003	Watch

Table 4.3.2-2: Erie County Declared Drought Status from 1980 to 2009 (PADEP, 2010).			
DATE	**DROUGHT STATUS**	**DATE**	**DROUGHT STATUS**
Jun 23, 1992 - Sep 11, 1992	Watch	Apr 11, 2006 - Jun 30, 2006	Watch
Sep 1, 1995 - Dec 18, 1995	Watch	Aug 8, 2007 - Jan 26, 2009	Watch
Dec 3, 1998 - Jan 15, 1999	Warning	Sep 16, 2010 - Dec 17, 2010	Watch
Jan 15, 1999 - Mar 15, 1999	Emergency		

4.3.2.4. Future Occurrence

It is difficult to forecast the severity and frequency of future drought events in Erie County. Based on national data from 1895 to 1995, Erie County is in severe or extreme drought approximately 5-10 percent of the time (see Figure 4.3.2-1). This is equivalent to a Palmer Drought Severity Index value less than or equal to *-3*. Therefore, future occurrence can be considered *possible* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1).

Figure 4.3.2-1: Percent of time areas of the United States have PSDI values <= -3 (NIDIS, 2010).



4.3.2.5. Vulnerability Assessment

Droughts can cause hardship on many different sectors of the Erie County economy. The most significant losses resulting from drought events are typically found in the agriculture sector. Therefore, drought events can severely impair the local economy with prolonged drought negatively impacting the livelihood of residents within agricultural communities particularly. Erie County is ranked 24th in the Commonwealth of Pennsylvania in terms of the market value of the agricultural products sold, a large part of the over $71 million of agricultural products sold could be affected by a drought (USDA, 2007).

In addition to farmers and agriculture-dependent businesses, other industries could be affected by a drought. Businesses relying on recreational activities or tourism could also be negatively affected in a drought. Tourists may be reluctant to visit, use of parks may be discouraged because of fire hazards, and water-based recreation may also decrease (ECEMA, 2010).

Erie County residents that use private domestic wells are more vulnerable to droughts because their wells can dry up. There are over 8,100 of these domestic wells in Erie County. Table 4.3.2-3 shows the number of domestic wells per municipality as collected by the Pennsylvania Groundwater Information System (PaGWIS) compared to the total population of each municipality. It is important to note, however, that the well data collected by PaGWIS relies on voluntary submissions of well record data by well drillers; therefore, it is not a complete database of all domestic wells in the County.

Table 4.3.2-3: Number of domestic wells per municipality in Erie County (PaGWIS, 2010).

MUNICIPALITY	DOMESTIC WELLS	TOTAL POPULATION	MUNICIPALITY	DOMESTIC WELLS	TOTAL POPULATION
Albion Borough	47	1,516	LeBoeuf Township	214	1,698
Amity Township	76	1,073	McKean Borough	244	388
Concord Township	82	1,344	McKean Township	453	4,409
Conneaut Township	270	4,290	Mill Village Borough	19	412
Corry City	22	6,605	Millcreek Township	800	53,515
Cranesville Borough	11	638	North East Borough	204	4,294
Edinboro Borough	69	6,438	North East Township	175	6,315
Elgin Borough	14	218	Platea Borough	52	430
Elk Creek Township	243	1,798	Springfield Township	119	3,425
Erie City	144	101,786	Summit Township	552	6,603
Fairview Township	639	10,102	Union City Borough	25	3,320
Franklin Township	313	1,633	Union Township	142	1,655
Girard Borough	9	3,104	Venango Township	240	2,297

Table 4.3.2-3: Number of domestic wells per municipality in Erie County (PaGWIS, 2010).					
MUNICIPALITY	DOMESTIC WELLS	TOTAL POPULATION	MUNICIPALITY	DOMESTIC WELLS	TOTAL POPULATION
Girard Township	459	5,102	Washington Township	635	4,432
Greene Township	624	4,706	Waterford Borough	243	1,517
Greenfield Township	173	1,933	Waterford Township	225	3,920
Harborcreek Township	244	17,234	Wattsburg Borough	34	403
Lake City Borough	8	3,031	Wayne Township	305	1,659
Lawrence Park Township	2	3,982	Wesleyville Borough	0	3,341

The majority of residents of Erie County rely on Lake Erie for their water supply, instead of on the domestic wells. The vulnerability of these residents is less than those who rely on wells in the case of a drought (ECEMA, 2010).

4.3.3. Earthquake

4.3.3.1. Location and Extent

Earthquakes are geological events that involve movement or shaking of the crust of the earth. Earthquakes are measured in terms of their magnitude and intensity (Instrumental – Catastrophic). Earthquakes can cause devastating destruction to the manmade environment.

Earthquake events in Erie County are and that region of Pennsylvania are mild. When events occur, they impact very small areas less than 100 kilometers in diameter. Erie County has been affected by minor seismic activity over this 16 year period. Earthquakes that have occurred, took place in the central and western portion of the County.

4.3.3.2. Range of Magnitude

Earthquake magnitude is often measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake. Table 4.3.3-1 summarizes Richter Scale magnitudes as they relate to the spatial extent of impacted areas. Based on historical events, earthquakes in the Pennsylvania region do not exceed magnitudes greater than 6.0.

Table 4.3.3-1: Richter scale magnitudes and associated earthquake size effects.	
RICHTER MAGNITUDES	EARTHQUAKE EFFECTS
Less than 3.5	Generally not felt, but recorded.
3.5-5.4	Often felt, but rarely causes damage.
Under 6.0	At most, slight damage to well-designed buildings; can cause major damage to poorly constructed buildings over small regions.
6.1-6.9	Can be destructive in areas where people live up to about 100 kilometers across.
7.0-7.9	Major earthquake; can cause serious damage over large areas.
8.0 or greater	Great earthquake; can cause serious damage in areas several hundred kilometers across.

The impact an earthquake event has on an area is typically measured in terms of earthquake intensity. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale based on direct and indirect measurements of seismic effects. A detailed description of the Modified Mercalli Intensity Scale is shown in Table 4.3.3-2. The earthquakes that occur in Pennsylvania originate deep with the Earth's crust; not on an active fault. Therefore, little or no damage is expected. No injury or severe damage from earthquake events has been reported in Erie County.

Table 4.3.2-2: Modified Mercalli Intensity Scale with associated impacts.

SCALE	INTENSITY	DESCRIPTION OF EFFECTS	CORRESPONDING RICHTER SCALE MAGNITUDE
I	Instrumental	Detected only on seismographs	<4.2
II	Feeble	Some people feel it	
III	Slight	Felt by people resting; like a truck rumbling by	
IV	Moderate	Felt by people walking	
V	Slightly Strong	Sleepers awake; church bells ring	<4.8
VI	Strong	Trees sway; suspended objects swing; objects fall off shelves	<5.4
VII	Very Strong	Mild alarm, walls crack, plaster falls	<6.1
VIII	Destructive	Moving cars uncontrollable, masonry fractures, poorly constructed buildings damaged	<6.9
IX	Ruinous	Some houses collapse, ground cracks, pipes break open	
X	Disastrous	Ground cracks profusely, many buildings destroyed, liquefaction and landslides widespread	<7.3
XI	Very Disastrous	Most buildings and bridges collapse, roads, railways, pipes and cables destroyed, general triggering of other hazards	<8.1
XII	Catastrophic	Total destruction, trees fall, ground rises and falls in waves	>8.1

Though the impacts of earthquakes can be numerous, widespread, and devastating, Erie County is unlikely to experience an earthquake that causes more than moderate damage. The largest earthquake ever recorded in Pennsylvania was the Pymatuning Earthquake which occurred in 1998 and had a magnitude of 5.2. A similar earthquake in Erie County could cause damage to buildings, infrastructure, and historic properties. The worst earthquake incident to date was experienced in Erie County during an earthquake of intensity V in 1938. Buildings swayed, people left theaters, and dishes were thrown from cupboards in the City of Erie. The earthquake was felt with lesser intensity at Edinboro, Girard, Mill Village, North East, and Waterford (ECEMA, 2010).

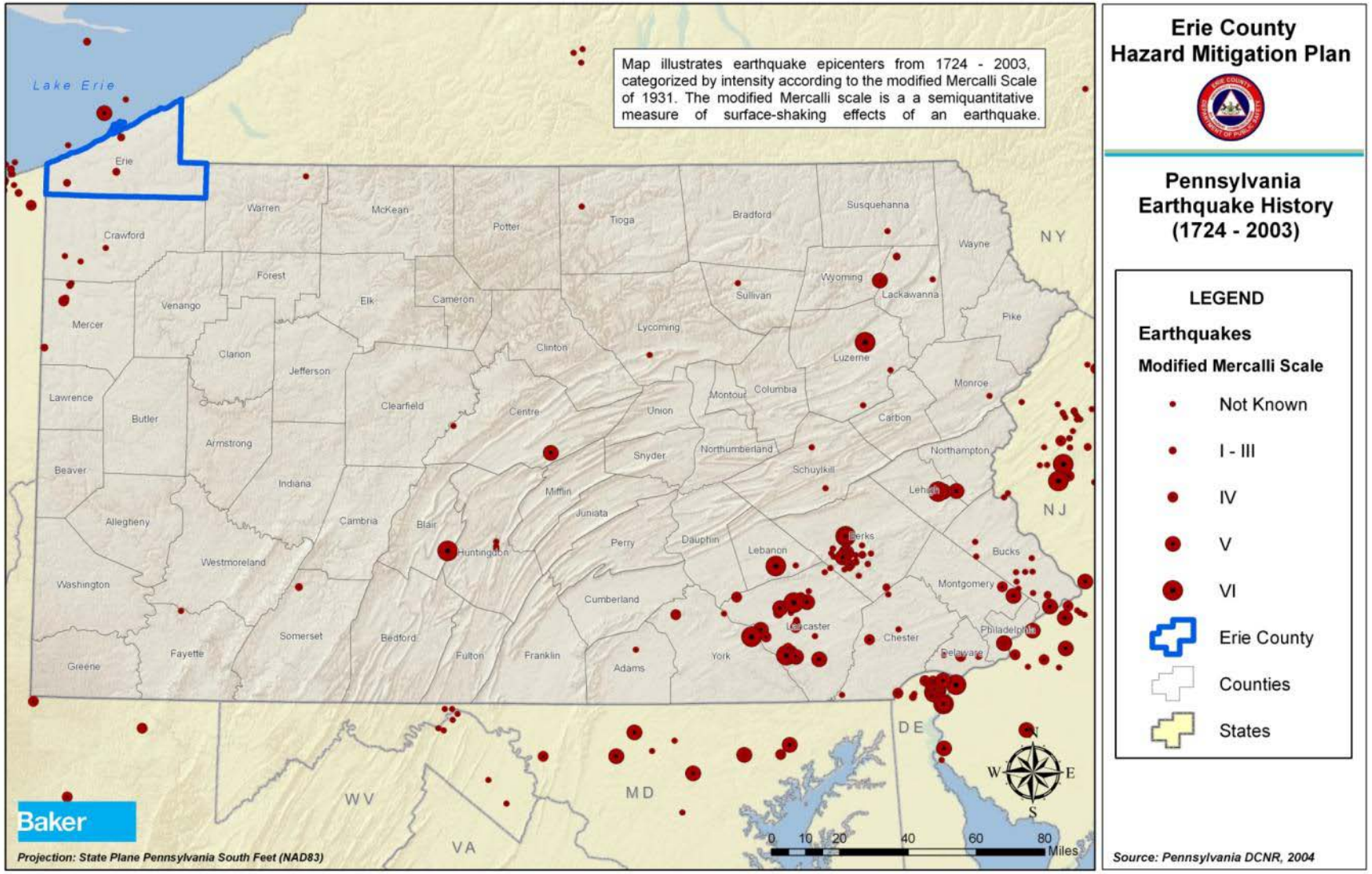
4.3.3.3. Past Occurrence

Earthquakes are relatively infrequent and uncommon in Erie County, but Table 4.3.3-3 shows that there have been effects of earthquakes which have occurred both within and outside of the County that have been recorded as having an effect in the County.

Table 4.3.3-3: Earthquake occurrences in Erie County (ECEMA, 2010).		
DATE	**OCCURRENCE**	**EFFECTS OR DAMAGE**
1/23 - 2/27 1812	3 Earthquakes, New Madrid, MO	Tremors Felt
10/23/1857	Buffalo, NY	Tremors Felt
07/06/1873	Canada	Tremors Felt
08/10/1884	New York, NY	Tremors Felt
8/12/1929	Attica, NY	Tremors Felt and Windows Shaken
10/29/1934	Erie	Slight Damage, Strong Local Shock
12/20/1934	Lake Ossipee, NH	Slight Damage in Erie
11/1/1935	Ontario, Canada	Tremors Felt
3/8/1943	Buffalo, NY	Tremors Felt
1/1/1966	Western NY State	Intensity III in Erie County
10/7/1983	Blue Mt. Lake, NY	Tremors Felt
1/1/1986	Lake Erie, near Perry Ohio	Tremors Felt, Slight Damage
1/31/1986	Southern Lake County	Tremors Felt
12/17/1990	Between Erie and Ashtabula, OH	Tremors Felt
1991	Ashtabula, OH	None Reported
9/25/1998	Mercer County	Preliminary 5.2, Slight Damage-Mill Village
1/25/2001	Ashtabula, OH	Tremors Felt

There have been three earthquakes with epicenters in Erie County, as shown in Figure 4.3.3-1. However, as shown in Table 4.3.3-3, there have been many earthquakes in the surrounding region which have been felt in Erie County. Tremors were recorded in Erie County from the magnitude 7 earthquakes along the New Madrid fault in 1811 and 1812, which is near St. Louis, Missouri to Memphis, Tennessee (ECEMA, 2010).

Figure 4.3.3-1: Map showing the location of significant earthquake epicenters in Pennsylvania (DCNR, 2004).



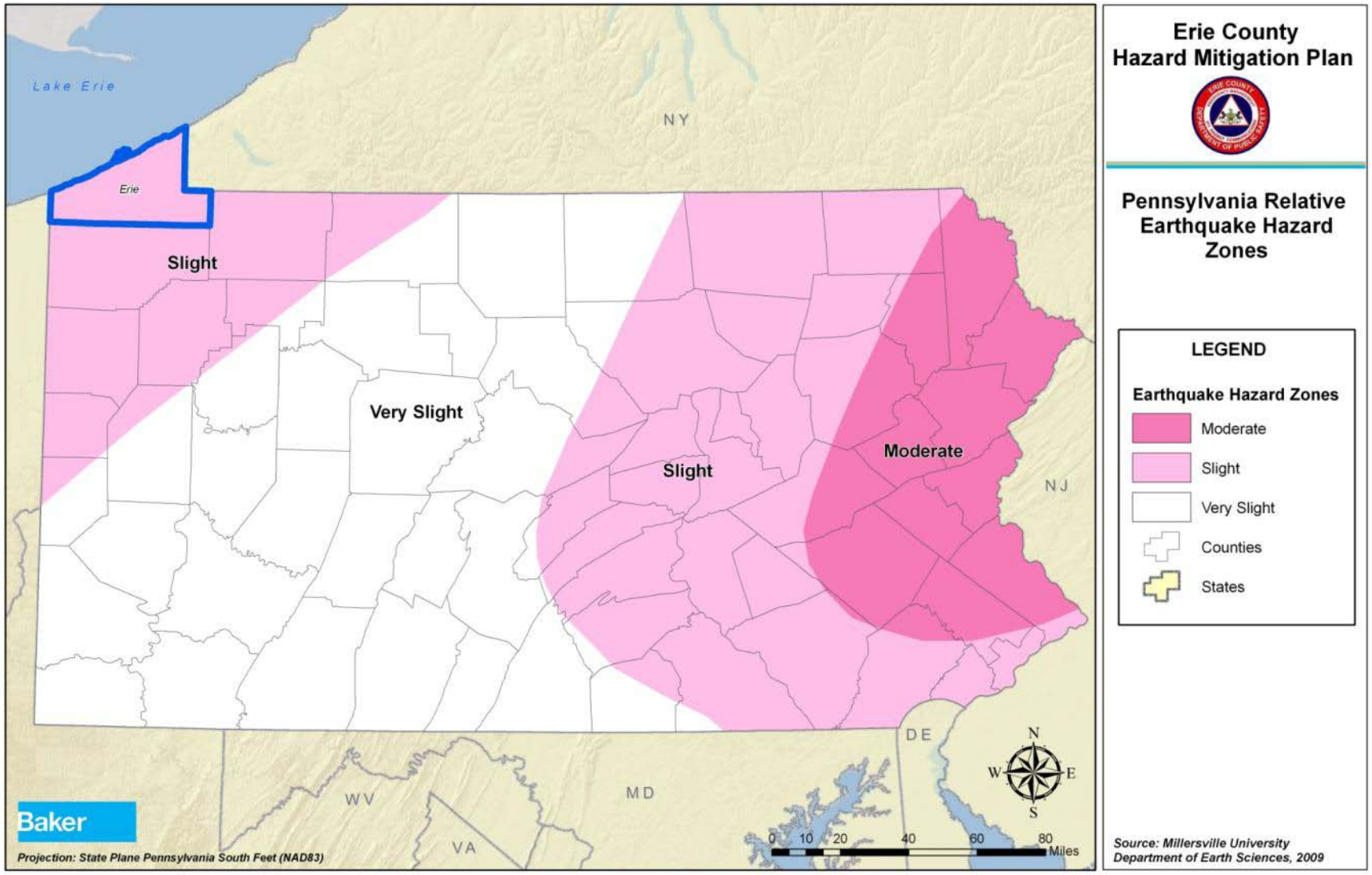
4.3.3.4. Future Occurrence

Although the possibility does exist, the occurrence of an earthquake in Erie County is rare and uncommon. The earthquakes that the county has experienced occurred deep within the earth's crust not on an active fault. Earthquakes not on active faults tend to cause little or no damage. The Ramapo Fault is the best known fault zone in the region, and consists of a system of faults over 185 miles between the Appalachian Mountains and the Piedmont area. This system primarily produces tiny earthquakes, with the occasional tremor. This fault poses a threat of future activity, which Erie County would feel the effect of (ECEMA, 2010).

One way to express an earthquake's severity is to compare its acceleration to the normal acceleration due to gravity. Peak ground acceleration (PGA) measures the strength of ground movements in this manner. PGA represents the rate in change of motion of the earth's surface during an earthquake as a percent of the established rate of acceleration due to gravity.

Figure 4.3.3-2 shows the relative earthquake hazard zones in Pennsylvania identified by the Department of Earth Sciences at Millersville University. According to this map, earthquake hazards are "slight" for Erie County, meaning the ten percent probability of exceeding over a 50-year period equals 5-10 PGA. Therefore, the future occurrence of an earthquake in Erie County can be considered *possible* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1). In general, ground acceleration must exceed 15 PGA for significant damage to occur, although soil conditions at local sites are extremely important in controlling how much damage will occur as a consequence of a given amount of ground acceleration.

Figure 4.3.2-2: Map of Pennsylvania earthquake hazard zones (Millersville University Department of Earth Sciences, 2009).



4.3.3.5. Vulnerability Assessment

Pennsylvania's vulnerability to earthquakes decreases from west to east, primarily affecting the southeastern parts of the state. The effects of an earthquake could potentially be anything from detected only on seismographs to ground water wells collapsing to total destruction; trees falling, ground rises and falls in waves.

The effects and secondary effects of a large earthquake in Erie County could be extensive and include building or bridge collapse, hazardous material spills, subsidence, dam failures, groundwater contamination, pipeline breaks, infrastructure disruptions, and epidemics. Depending on the magnitude of the earthquake, the level of damage would vary. Minor earthquakes also have the potential to cause power outages, as well as hazardous material spills, dam failures, and landslides.

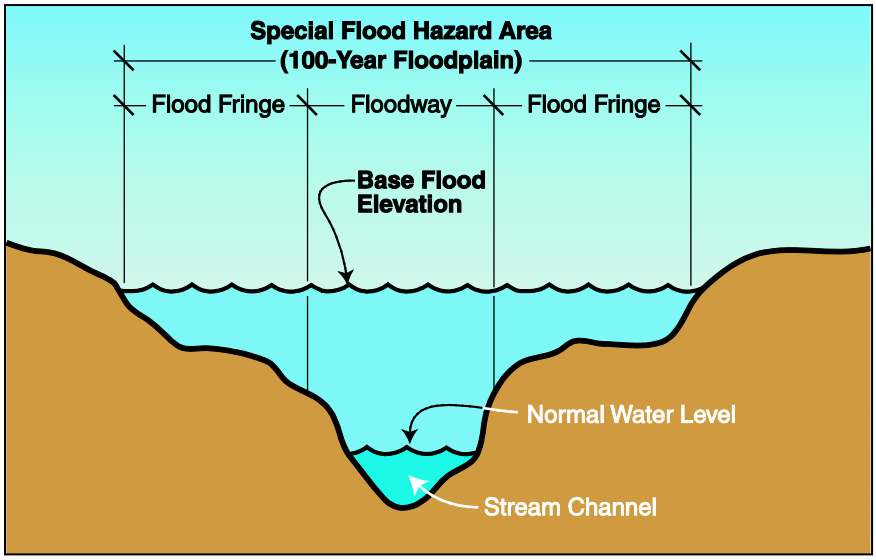
4.3.4. Flood, Flash Flood, Ice Jam

4.3.4.1. Location and Extent

Most communities in Erie County are located along the stream and creek valleys throughout the County. Flooding can occur in all municipalities in Erie County, all of which are flood prone as seen in Figure 4.3.4-3. Excess water from snowmelt or rainfall accumulates and overflows onto stream banks and adjacent floodplains. Floodplains are lowlands adjacent to rivers, streams and creeks that are subject to recurring floods. The size of the floodplain is described by the recurrence interval of a given flood. Flood recurrence intervals are explained in more detail in Section 4.3.4.4. However, in assessing the potential spatial extent of flooding it is important to know that a floodplain associated with a flood that has a 10 percent chance of occurring in a given year is smaller than the floodplain associated with a flood that has a 0.2% annual chance of occurring. Community development of the floodplain has resulted in frequent flooding in these areas.

The National Flood Insurance Program (NFIP), for which Flood Insurance Rate Maps are published, identifies the 1% annual chance flood. This 1% annual chance flood event is used to delineate the *Special Flood Hazard Area* (SFHA) and identify *Base Flood Elevations*. Figure 4.3.4-1 illustrates these terms. The SFHA serves as the primary regulatory boundary used by FEMA, the Commonwealth of Pennsylvania and Erie County local governments.

Figure 4.3.4-1: Diagram identifying Special Flood Hazard Area, 1% annual chance (100-Year) floodplain, floodway and flood fringe.



Preliminary Countywide Digital Flood Insurance Rate Maps (DFIRMs) were released for Erie County on September 30, 2009 and each community is expected to have Effective DFIRMs by June 2013. All communities within the County will now be shown on a single set of countywide FIRMs. Previous FIRMs and Flood Boundary and Floodway Maps (FBFM) were digitized to produce a DFIRM that is compatible with GIS. Prior to the publication of this digital data, flood hazard information from FEMA was available through paper FIRMs and Q3 data. Once the final FIRMs for the entire county become effective in 2013, they can be obtained from the FEMA Map Service Center (http://www.msc.fema.gov). These maps can be used to identify the expected spatial extent and elevation of flooding from a 1% and 0.2% annual chance event. All of the municipalities in the County were determined to have special flood hazard areas (SFHA).

The 2010 Erie County Hazard Vulnerability Analysis (ECHVA) identified Raccoon Creek, Crooked Creek, Trout Run, Bear Creek, Mill Creek, 4 Mile Creek, 6 Mile Creek, 7 Mile Creek, 8 Mile Creek, Scott Run, 12 Mile Creek, 16 Mile Creek, 20 Mile Creek, French Creek, Elk Creek, Walnut Creek, Turkey Creek, and the Conneaut Creek as the most prone to flooding in the County (ECEMA, 2010). The 2009 Erie County Preliminary Flood Insurance Study lists several streams that were studied by detailed methods which were selected with priority given to all known flood hazards and areas of projected development or proposed construction. These streams include but are not limited to: Baker Creek, Bear Run, Beaver Run, Conneauttee Creek, Crane Creek, East Branch Conneauttee Creek, Hare Creek, Lamson Run, Le Boeuf Creek, McDannel Run, Mill Creek Tributary No. 1, Russell Run, Shenango Creek, South Branch Conneauttee Creek, South Branch French Creek, Temple Creek, Townley Run. The tributaries of French Creek are also of primary concern to Erie County. Many of these creeks are prone to flash flooding including French Creek and Walnut Creek.

Figure 4.3.4-3 shows the location of watercourses and flood zones in Erie County. The location of approximate and detailed (including Base Flood Elevations) SFHAs (1% annual-chance-zones) are shown. Approximate and detailed SFHAs are differentiated on the map by color because these two types of study methods result in different requirements for flood plain management. For example, those areas studies by detailed methods which result in base flood elevations are labeled Zone AE on DFIRMs. Municipalities in Erie County in which Zone AE occurs must adopt more stringent floodplain management requirements in order to participate in the NFIP.

In addition to flooding from precipitation and ice jams near the waterways in Erie County, the areas near the lakeshore face an additional threat from seiche, or a freshwater tidal wave (ECEMA, 2004). Seiche is a standing wave that oscillates in a lake as a result of seismic or atmospheric disturbances. These disturbances create fluctuations in water levels in a short time period. Seiche events in Erie County are most often caused by atmospheric disturbances and not seismic activity or tidal forces (ECEMA, 2010).

Wind or storm surge can cause short-term fluctuations that occur in lake basins, including Lake Erie and the rest of the Great Lakes. A storm surge or wind set-up consists of high sustained winds from one direction that push the water level up at one end of the lake and drop the water level considerably at the opposite end (see Figure 4.3.4-2). Additionally, a storm surge can cause a seiche when there is a dramatic change in atmospheric pressure or a sudden drop in the wind speed.

Figure 4.3.4-2: Diagram of seiche effects in a lake basin (The Weather Doctor, 2004).

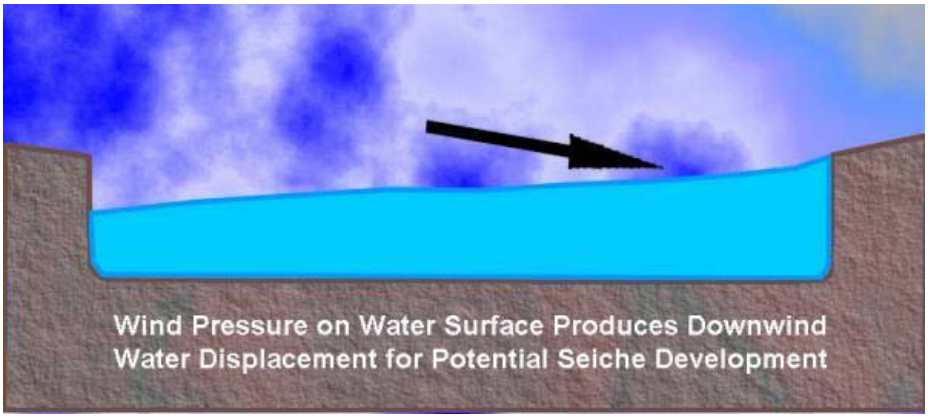
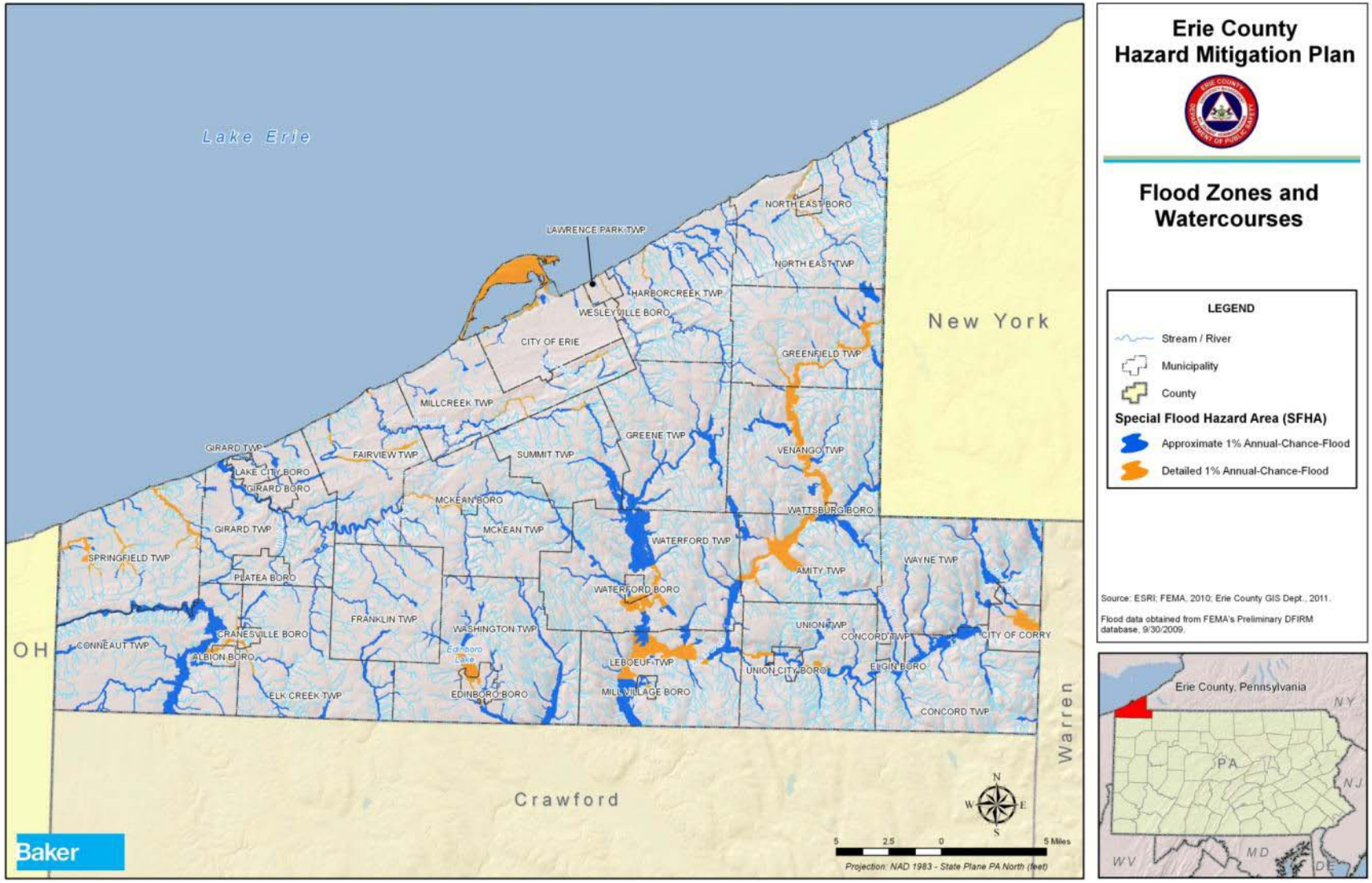


Figure 4.3.4-3: Map showing the location of watercourses and flood zones throughout Erie County (FEMA, 2009).



4.3.4.2. Range of Magnitude

Floods are considered hazards when people and property are affected. Most injuries and deaths from flooding happen when people are swept away by flood currents and most property damage results from inundation by sediment-filled water. A large amount of rainfall over a short time span can result in flash flood conditions. Small amounts of rain can result in floods in locations where the soil is frozen or saturated from a previous wet period or if the rain is concentrated in an area of impermeable surfaces such as large parking lots, paved roadways, or other impervious developed areas. Flooding can occur in individual municipalities within Erie County or it can even have a countywide affect, involving multiple sites and streams.

Several factors determine the severity of floods, including rainfall intensity and duration, topography, ground cover and rate of snowmelt. Water runoff is greater in areas with steep slopes and little to no vegetative ground cover. Also, urbanization typically results in the replacement of vegetative ground cover with asphalt and concrete, increasing the volume of surface runoff and stormwater, particularly in areas with poorly planned stormwater drainage systems.

In the winter and early spring (February to April), major flooding has occurred as a result of heavy rainfall on dense snowpack throughout contributing watersheds. Spring thaws often cause flooding which can result in road closures sometimes for long periods of time, restricting or delaying emergency services. Summer floods have occurred from intense rainfall on previously saturated soils. Summer thunderstorms deposit large quantities of rainfall over a short period of time that can result in flash flood events, when the velocity of floodwaters has the potential to amplify the impacts of a flood event.

Winter floods also have resulted from runoff of intense rainfall on frozen ground, and, on rare occasions, local flooding has been exacerbated by ice jams in rivers. Ice jam floods occur on rivers that are totally or partially frozen. A rise in stream stage will break up a totally frozen river and create ice flows that can pile up on channel obstructions such as shallow riffles, log jams, or bridge piers. The jammed ice creates a dam across the channel over which the water and ice mixture continues to flow, allowing for more jamming to occur. Historically, Erie County has experienced seasonal spring flooding caused by ice jams at waterways entering Lake Erie. French Creek, located in the southern portion of the county, experiences spring flooding due to ice jams as well.

The worst flooding event in Erie County occurred in the City of Erie in 1915 following a 650-year storm event. More than 5.5 inches of rain fell in just under 14 hours. Mill Creek, which runs through Erie, was jammed by logs and other significant debris after a thunderstorm which caused significant flooding across parts of the City primarily between Holland and State Streets from 7th Street to 26th Street. This flooding caused at least 5 million dollars of damage including damage to 10 bridges and 35 deaths (FIA 1978).

Although floods can cause damage to property and loss of life, floods are naturally occurring events that benefit riparian systems which have not been disrupted by human actions. Such benefits include groundwater recharge and the introduction of nutrient rich sediment improving soil fertility. However, the destruction of riparian buffers, changes to land use and land cover

throughout a watershed, and the introduction of chemical or biological contaminants which often accompany human presence cause environmental harm when floods occur. Hazardous material facilities are potential sources of contamination during flood events. Other negative environmental impacts of flooding include: water-borne diseases, heavy siltation, damage or loss of crops, and drowning of both humans and animals.

The magnitude of a seiche event is dependent on a number of factors. Wind speed and barometric pressure are the largest variables to the size of an event in a lake basin. However, the size and shape of the basin and water body also contributes to the magnitude of a seiche – larger and shallower lakes tend to increase the magnitude of a seiche. Lake Erie produces the most and largest seiches of the five Great Lakes because it is the shallowest (ECEMA, 2010). Severe and deadly seiche events are rare on the Great Lakes. Minor seiches could cause damage to property right on the lakefront of Lake Erie, including cottages and boats. Large seiches would have to be between 80 feet to 100 feet to cause significant damage to property or risk of life in Erie.

4.3.4.3. Past Occurrence

Erie County has a long history of flooding events. Flash flooding is the most common type of flooding that occurs in the County. Five of the eight Presidential Disaster and Emergency Declarations affecting Erie County have been in response to hazard events related to flooding (see Section 4.2.1: Table of Presidential Disaster Declarations). Table 4.3.4-1 lists flood event information from 1993 to 2010 obtained from the NCDC and PIERS databases. Estimated property damage was not available for most flooding events.

Table 4.3.4-1: Flood and flash flood events impacting Erie County from 1993-2010 (NCDC, 2011; PIERS, 2010). "Countywide" indicates several locations in the County were affected.

DATE	LOCATION & DESCRIPTION
1/29/94	Countywide. Ice Jam/Flash Flood – An ice jam on Twenty Mile Creek resulted in flooding along roads and land between Routes 5 and 20.
6/11/94	Countywide. Flood – Between one and two inches of rain fell within 25 minutes causing flooding on roads and highways.
6/13/94	Multiple locations. Flash Flood/Flood – Heavy rain caused flooding of streets and sidewalks in Wesleyville. Elk and North Creeks flooded in East Springfield causing five to six feet of flooding and stranding four people at the Tomes Campground.
8/13/94	Countywide. Flash Flood – Several thunderstorms produced between 2 to 4 inches of rain resulting in flooded streets and streams. An estimated $35,000 of damage was done to a water treatment plant.
6/25/95	Corry and Union City. Flash Flood – Heavy rains produced flooding of streets and low lying areas.
6/26/95	Waterford and McKean. Flash Flood – Heavy rains produced flooding of streets and poor drainage areas.
7/25/95	Albion. Flash Flood – Heavy rains, about two inches in an hour, produced flooding of streets and poor drainage areas.
1/18/96	Countywide. Flash Flood – Heavy rains and snowmelt produced flooding of low lying areas, small streams, and poor drainage areas. Some roads were closed in Union City, Girard, and Albion.
2/21/96	Waterford. Flash Flood.
4/23/96	Western Erie County. Flash Flood – Heavy rains produced flooding which caused power

Table 4.3.4-1: Flood and flash flood events impacting Erie County from 1993-2010 (NCDC, 2011; PIERS, 2010). "Countywide" indicates several locations in the County were affected.	
DATE	**LOCATION & DESCRIPTION**
	outages and closed roads.
5/9/96	Countywide. Flash Flood – Heavy rains during thunderstorm caused flooding of streets and low lying areas.
6/7/96	Union City. Flash Flood – Heavy rains produced flooding of roads and low lying areas.
6/11/96	Countywide. Flash Flood – Heavy rain caused flooding in streets and low lying areas. Roads were closed in the City of Erie.
6/18/96	North East and Erie. Flash Flood – Heavy rain caused flooding of streets, basements, and low lying areas. Streets were closed in the City of Erie.
6/18/96	Countywide. Flash Flood – Heavy rain caused flooding of streets, basements, and low lying areas; resulted in 1 to 2 feet of water on roads in Millcreek Township.
6/19/96	Countywide. Flash Flood – Heavy rain caused flooding of streets, basements, and low lying areas. A street in the City of Corry was cut in half by a cave in resulting from the floods.
7/19/96	Countywide. Flash Flood – Heavy rain caused flooding of streets and low lying areas.
7/30/96	Hammett. Flash Flood – Heavy rain caused flooding of streets, streams, and low lying areas.
8/8/96	Edinboro. Flash Flood – Heavy rain caused flooding of roads and low lying areas.
9/17/96	Northern Erie County. Flash Flood – Seven inches of rain fell during heavy thunderstorms flooding streets, streams, basements, and low lying areas. About $5 million of damage was done to businesses, houses, and roads in the City of Erie and Mill Creek Township; people had to be rescued from rooftops.
9/28/96	Countywide. Flash Flood – Heavy rain caused flooding of creeks, streets, basements, and low lying areas.
5/19/97	City of Erie. Flash Flood – Heavy rain caused flooding of streams, streets, and low lying areas.
1/7/98	Countywide. Flood – Heavy rain on saturated soil from snowmelt caused flooding of streams, low lying areas, roads, and basements. Flood waters over six feet closed an underpass in Fairview Township.
1/9/98	Countywide. Flood – Heavy thunderstorm rain on saturated soil caused flooding of roads, low lying areas, and basements.
6/16/98	Shore of Lake Erie. Flood – Heavy rain caused flooding of underpasses and streets.
9/29/99	City of Erie. Flash Flood – Three inches of rain fell causing flooding of roads and low lying areas. Two passengers had to be rescued from cars under railroad viaduct.
8/2/00	Countywide. Flash Flood – Three to five inches of rain fell in one evening causing streams and creeks to flood. Roads were closed, some of which were covered by up to 5 feet of flood waters. Foundations of houses were washed out in Mill Creek and Lawrence Park Townships.
8/3/01	Countywide. Flash Flood – Over four inches of rain fell during thunderstorms in eastern and southern parts of count. Roads and streams flooded across the area.
8/31/01	City of Erie. Flash Flood – One to two inches of rain fell in less than 90 minutes causing streets and low lying areas to flood. Cars were stranded in areas of city and passengers had to be rescued.
9/15/02	Countywide. Flash Flood – Over three inches of rain fell in less than two hours flooding and washing out roads across the county.
6/12/03	Southern Erie County. Flash Flood – Two inches of rain fell in 45 minutes, total of 5 inches during the string of storms. Roads and streams were flooded, and two culverts were damaged.
7/21/03	Mill Village. Flash Flood – Heavy rains fell on already saturated soils causing French Creek to flood much of Mill Village, including one to two feet of water on many of the streets.
7/22/03	Countywide. Flash Flood – Thunderstorms caused one to two inches of rain in short time period producing flooding in lowland and urban areas. A neighborhood in Mill Village was evacuated; hundreds of homes were damaged and several roads were washed out in the

Table 4.3.4-1: Flood and flash flood events impacting Erie County from 1993-2010 (NCDC, 2011; PIERS, 2010). "Countywide" indicates several locations in the County were affected.	
DATE	**LOCATION & DESCRIPTION**
	southern part of the county.
7/31/03	Countywide. Flash Flood – Heavy rains during thunderstorms caused urban and lowland flooding. A road was washed out in Mill Creek and a landslide at a nearby construction site damaged houses.
8/5/03	Countywide. Flood – Heavy rains during thunderstorms caused flooding in small streams and creeks. Roads were closed in Corry, Lake City, and Greenfield Township.
3/17/04	Wattsburg. Flood.
5/10/04	Central Erie County. Flash Flood – A cluster of thunderstorms produced three to four inches of rain in a short time period causing levels of streams and creeks to rise rapidly and flood nearby roads and neighborhoods.
5/22/04	Countywide. Flash Flood – Multiple days of rain preceded heavy rainfall causing flooding across Erie County resulting in $2.7 million in damage to homes, businesses, and vehicles. Damage and flooding was most extensive in Mill Village where two bridges were washed out and people had to be rescued from their homes.
7/12/04	Southern Erie County. Flash Flood – Runoff from heavy rain flooded several streams and creeks producing flood waters of up to four feet on roads near Corry.
7/17/04	Southern Erie County. Flash Flood – Heavy rains caused flooding in streams and creeks near Corry, causing many roads to close and some roads to wash out.
7/18/04	Southeast Erie County. Flash Flood – Runoff from heavy rains flooded roads near Corry with up to two feet of standing flood water.
9/8/04	Countywide. Flood – Two to four inches of rain fell as the remnants of Tropical Storm Francis moved through the area causing lowland and urban flooding.
9/9/04	Countywide. Flash Flood – Rains from Tropical Storm Francis persisted producing up to six inches of rainfall in some areas. Water overflowed a dam on Edinboro Lake resulting in evacuations of residents across the area. Additional evacuations took place across the county. Two bridges and multiple roads and routes were washed out. A landslide wiped out 500 feet of PA Route 5 in Fairview Township. Overall $5.6 million of damage was done.
9/17/04	Erie and Crawford Counties. Flood – The remnants of Hurricane Ivan produced heavy rains causing flooding across streams, creeks, roads, and lowland areas.
1/1/05	Erie and Crawford Counties. Flood – Heavy rain and snowmelt caused widespread flooding causing flooding in low lying areas and across a few roads.
7/16/05	Southern Erie County. Flash Flood – Heavy rains produced over two inches of rainfall in an hour, flood waters reached over two feet high in some areas.
7/22/05	Wesleyville. Flash Flood – Heavy rains produced urban flooding. Roads were closed with reports of three to four feet of flood water flowing over roads.
11/29/05	Northern Erie County. Flood – Heavy rain produced flooding of roads and basements in northern portions of the County.
10/28/06	Northern Erie County. Flood – High waves along Lake Erie shore caused flooding in this area.
12/1/06	Millcreek Township. Flood – Severe weather caused flooding which resulted in a flooded trailer park in Millcreek Township.
3/2/07	Countywide. Flood.
3/15/07	Countywide. Flood – Flooding on roadways closed roads throughout the County.
8/7/07	Countywide. Flash Flood – Heavy rains during thunderstorms produced areas of flooding across the area including some houses and roads.
9/8/07	City of Erie. Flash Flood – Heavy rainfall flooded a creek and a nearby underpass.
2/6/08	Countywide. Flood – Severe weather caused flooding which resulted in many roads being closed.

Table 4.3.4-1: Flood and flash flood events impacting Erie County from 1993-2010 (NCDC, 2011; PIERS, 2010). "Countywide" indicates several locations in the County were affected.	
DATE	**LOCATION & DESCRIPTION**
6/30/08	Mill Village. Flood – Flooding caused deterioration and closure of roadway in Mill Village.
7/8/08	City of Erie. Flood – Heavy rain flooded streets throughout the City of Erie.
7/22/08	Northeast Erie County. Flash Flood – Heavy rain produced 2 to 3.5 inches of rain in less than 1.5 hours flooding streams and roads in the area.
7/26/08	Corry. Flood.
12/11/08	Venango Township. Flood – Heavy rain and flooding caused road closures in Venango Township.
12/26/08	Waterford Township. Flood – Flooded closed roadways in Waterford Township.
2/11/09	Union City Borough and Fairview Township. Ice Jam – Ice jams reported on French Creek and Walnut Creek.
3/10/09	Girard and Washington Townships. Flood – Heavy rain caused minor flooding closing two roads and flooding basements.
6/30/09	Countywide. Flood – Steady rain produced flooding causing roadways to be impassable and close. Flooding was especially severe near Mill Creek as the creek flooded and storm drains were unable to process the large amount of water. Flooding across the County caused over $8 million in damage.
8/10/09	Waterford. Flash Flood – Thunderstorms produced 3.5 inches of rain in less than 2 hours. Flood waters rising out of the streams flooded mobile homes in area and moved the homes off their foundation. PA Route 19 was closed as large logs were deposited by flood waters.

In addition to the aforementioned past flood events, the National Flood Insurance Program identifies properties that frequently experience flooding. *Repetitive loss properties* are structures insured under the NFIP which have had at least two paid flood losses of more than $1,000 over any ten year period since 1978. A property is considered a *severe repetitive loss property* either when there are at least four losses each exceeding $5,000 or when there are two or more losses where the building payments exceed the property value. As of March 4, 2010, there were forty-two repetitive loss properties in Erie County (PEMA, 2010). These repetitive loss properties are located in Erie City, Fairview Township, Girard Township, Harborcreek Township, Lake City Township, McKean Township, McKean Borough, Millcreek Townhip, and North East Township. Table 4.3.4-3 shows the number of repetitive loss properties by municipality. There is one severe repetitive loss property in Erie County. One single family residence in McKean Township is a severe repetitive loss property.

Table 4.3.4-2: Summary of the number and type of Repetitive Loss properties by municipality (PEMA, 2010).					
MUNICIPALITY	**TYPE**				**SUM OF REPETITIVE LOSS PROPERTIES**
	NON-RESIDENTIAL	**2-4 FAMILY**	**SINGLE FAMILY**	**CONDOS**	
Albion Borough	0	0	0	0	**0**
Amity Township	0	0	0	0	**0**
Concord Township	0	0	0	0	**0**
Conneaut Township	0	0	0	0	**0**

Table 4.3.4-2: Summary of the number and type of Repetitive Loss properties by municipality (PEMA, 2010).

MUNICIPALITY	TYPE				SUM OF REPETITIVE LOSS PROPERTIES
	NON-RESIDENTIAL	2-4 FAMILY	SINGLE FAMILY	CONDOS	
Corry City	0	0	0	0	**0**
Cranesville Borough	0	0	0	0	**0**
Edinboro Borough	0	0	0	0	**0**
Elgin Borough	0	0	0	0	**0**
Elk Creek Township	0	0	0	0	**0**
Erie City	1	1	2	0	**4**
Fairview Township	0	0	1	0	**1**
Franklin Township	0	0	0	0	**0**
Girard Township	0	0	2	0	**2**
Girard Borough	0	0	0	0	**0**
Greene Township	0	0	0	0	**0**
Greenfield Township	0	0	0	0	**0**
Harborcreek	0	0	0	1	**1**
Lake City Borough	0	0	2	0	**2**
Lawrence Park	0	0	0	0	**0**
LeBoeuf Township	0	0	0	0	**0**
McKean Township	0	0	1	0	**1**
McKean Borough	1	0	0	0	**1**
Mill Village Borough	0	0	0	0	**0**
Millcreek Township	2	0	13	0	**15**
North East Township	3	0	11	1	**15**
North East Borough	0	0	0	0	**0**
Platea Borough	0	0	0	0	**0**
Springfield Township	0	0	0	0	**0**
Summit Township	0	0	0	0	**0**
Union Township	0	0	0	0	**0**
Union City Borough	0	0	0	0	**0**
Venango Township	0	0	0	0	**0**
Washington Township	0	0	0	0	**0**
Waterford Township	0	0	0	0	**0**
Waterford Borough	0	0	0	0	**0**
Wattsburg Borough	0	0	0	0	**0**
Wayne Township	0	0	0	0	**0**
Wesleyville Borough	0	0	0	0	**0**
TOTAL	**7**	**1**	**32**	**2**	**42**

Floods are the most common and costly natural catastrophe in the United States. In terms of economic disruption, property damage, and loss of life, floods are “nature’s number-one disaster.” For that reason, flood insurance is almost never available under industry-standard

homeowner's and renter's policies. The best way for citizens to protect their property against flood losses is to purchase flood insurance through the NFIP.

Congress established the NFIP in 1968 to help control the growing cost of federal disaster relief. The NFIP is administered by the Federal Emergency Management Agency (FEMA), part of the U.S. Department of Homeland Security. The NFIP offers federally-backed flood insurance in communities that adopt and enforce effective floodplain management ordinances to reduce future flood losses.

Since 1983, the chief means of providing flood insurance coverage has been a cooperative venture of FEMA and the private insurance industry known as the Write Your Own (WYO) Program. This partnership allows qualified property and casualty insurance companies to "write" (that is, issue) and service the NFIP's Standard Flood Insurance Policy (SFIP) under their own names.

Today, nearly 90 WYO insurance companies issue and service the SFIP under their own names. More than 4.4 million federal flood insurance policies are in force. These policies represent $650 billion in flood insurance coverage for homeowners, renters, and business owners throughout the United States and its territories.

The NFIP provides flood insurance to individuals in communities that are members of the program. Membership in the program is contingent on the community adopting and enforcing floodplain management and development regulations.

The NFIP is based on the voluntary participation of communities of all sizes. In the context of this program, a "community" is a political entity – whether an incorporated city, town, township, borough, or village, or an unincorporated area of a county or parish – that has legal authority to adopt and enforce floodplain management ordinances for the area under its jurisdiction.

National Flood Insurance is available only in communities that apply for participation in the NFIP and agree to implement prescribed flood mitigation measures. Newly participating communities are admitted to the NFIP's Emergency Program. Most of these communities quickly earn "promotion" to the Regular Program.

The Emergency Program is the initial phase of a community's participation in the NFIP. In return for the local government's agreeing to adopt basic floodplain management standards, the NFIP allows local property owners to buy modest amounts of flood insurance coverage.

In return for agreeing to adopt more comprehensive floodplain management measures, an Emergency Program community can be "promoted" to the Regular Program. Local policyholders immediately become eligible to buy greater amounts of flood insurance coverage. All participating municipalities in Erie County are in the Regular Program.

The minimum floodplain management requirements include:

- Review and permit all development in the SFHA;

- Elevate new and substantially improved residential structures above the Base Flood Elevation;
- Elevate or dry floodproof new and substantially improved non-residential structures;
- Limit development in floodways;
- Locate or construct all public utilities and facilities so as to minimize or eliminate flood damage; and
- Anchor foundation or structure to resist floatation, collapse, or lateral movement.

In addition, Regular Program communities are eligible to participate in the NFIP's Community Rating System (CRS). Under the CRS, policyholders can receive premium discounts of 5 to 45 percent as their cities and towns adopt more comprehensive flood mitigation measures. Currently, no municipalities in Erie County participate in CRS.

Table 4.3.4-3 lists the Erie County municipalities participating in the NFIP along with the date of the initial FIRM and the current effective map date. Note that all municipalities in the County participate in the program except Platea Borough which had no SFHA under the original FIRM maps and therefore has never been mapped.

Table 4.3.4-3: Erie County Municipal Participation in the National Flood Insurance Program.

COMMUNITY	PARTICIPATION STATUS	CID	INITIAL FIRM IDENTIFIED	CURRENT EFFECTIVE MAP DATE
ALBION BOROUGH	PARTICIPATING	422409	06/19/89	06/19/89
AMITY TOWNSHIP	PARTICIPATING	421360	11/04/88	11/04/88
CONCORD TOWNSHIP	PARTICIPATING	422410	11/05/82	11/05/82
CONNEAUT TOWNSHIP	PARTICIPATING	421361	11/15/89	11/15/89
CORRY CITY	PARTICIPATING	420447	02/15/78	02/15/78
CRANESVILLE BOROUGH	PARTICIPATING	421356	06/19/89	06/19/89
EDINBORO BOROUGH	PARTICIPATING	420448	06/15/81	06/15/81
ELGIN BOROUGH	PARTICIPATING	422411	09/28/79	09/28/79
ELK CREEK TOWNSHIP	PARTICIPATING	422412	06/19/89	06/19/89
ERIE CITY	PARTICIPATING	420449	03/01/79	03/01/79
FAIRVIEW TOWNSHIP	PARTICIPATING	420450	09/29/78	09/29/78
FRANKLIN TOWNSHIP	PARTICIPATING	421362	10/01/86	10/01/86
GIRARD BOROUGH	PARTICIPATING	422413	06/30/76	06/30/76
GIRARD TOWNSHIP	PARTICIPATING	421363	06/30/76	06/30/76
GREENE TOWNSHIP	PARTICIPATING	421364	12/01/86	12/01/86
GREENFIELD TOWNSHIP	PARTICIPATING	421365	08/02/90	08/02/90
HARBORCREEK TOWNSHIP	PARTICIPATING	421144	09/17/80	09/17/80
LAKE CITY BOROUGH	PARTICIPATING	422414	06/30/76	06/30/76
LAWRENCE PARK TOWNSHIP	PARTICIPATING	420451	09/29/78	09/29/78
LE BOEUF TOWNSHIP	PARTICIPATING	422415	05/15/84	05/15/84
MCKEAN BOROUGH	PARTICIPATING	422416	09/30/77	09/30/77

Table 4.3.4-3: Erie County Municipal Participation in the National Flood Insurance Program.				
COMMUNITY	**PARTICIPATION STATUS**	**CID**	**INITIAL FIRM IDENTIFIED**	**CURRENT EFFECTIVE MAP DATE**
MCKEAN TOWNSHIP	PARTICIPATING	422623	07/16/80	07/16/80
MILL VILLAGE BOROUGH	PARTICIPATING	422417	05/19/81	05/19/81
MILLCREEK TOWNSHIP	PARTICIPATING	420452	04/16/79	04/16/79
NORTH EAST BOROUGH	PARTICIPATING	421359	01/04/81	02/04/81
NORTH EAST,TOWNSHIP	PARTICIPATING	421368	05/19/81	05/19/81
PLATEA BOROUGH	NOT PARTICIPATING	422699	NA	NA
SPRINGFIELD TOWNSHIP	PARTICIPATING	421369	12/01/82	12/01/82
SUMMIT TOWNSHIP	PARTICIPATING	422418	09/16/81	09/16/81
UNION CITY BOROUGH	PARTICIPATING	420453	09/28/79	09/28/79
UNION TOWNSHIP	PARTICIPATING	421370	09/16/81	09/16/81
VENANGO TOWNSHIP	PARTICIPATING	421371	09/30/81	09/30/81
WASHINGTON TOWNSHIP	PARTICIPATING	421372	05/19/81	05/19/81
WATERFORD BOROUGH	PARTICIPATING	420454	12/15/81	12/15/81
WATERFORD TOWNSHIP	PARTICIPATING	422419	02/17/82	09/30/83
WATTSBURG BOROUGH	PARTICIPATING	420455	05/19/81	05/19/81
WAYNE TOWNSHIP	PARTICIPATING	421373	12/14/79	12/14/79
WESLEYVILLE BOROUGH	PARTICIPATING	420456	07/16/81	07/16/81

There have been very few seiche events reported in Erie County. The first event was reported in 1935 with no damages, and a second event was reported in 1984 which caused damage to a segment of beach and cottages on Presque Isle Beach. The most recent seiche in Erie County occurred on November 12th and 13th in 2003 (ECEMA, 2010). This seiche was caused by sustained high moving winds from the west. Erie and Buffalo, New York experienced a 7 foot surge and waves over these two days (see Figure 4.3.4-4), while the water level at the Fermi Nuclear Plant on the west end of the lake dropped by 7 feet. The waves during this storm were 10 to 15 feet above the increase of the water level of 7 feet due to the surge (NOAA, 2006). There were no injuries or damage to the shoreline during this event.

Figure 4.3.4-4: Picture of seiche and waves on Presque Isle Beach (NOAA, 2006).

4.3.4.4. Future Occurrence

In Erie County, flooding occurs commonly and can occur during any season of the year. Therefore, the future occurrence of floods in Erie County can be considered *highly likely* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1). Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. The NFIP uses historical records to determine the probability of occurrence for different extents of flooding. The probability of occurrence is expressed in percentages as the chance of a flood of a specific extent occurring in any given year.

The NFIP recognizes the 1%-annual-chance flood, also known as the *base flood*, as the standard for identifying properties subject to federal flood insurance purchase requirements. A 1%-annual-chance flood is a flood which has a 1% chance of occurring over a given year. The DFIRMs, once effective, will be able to be used to identify areas subject to the 1- and 0.2%-annual-chance flooding. Areas subject to 2% and 10% annual chance events are not shown on maps; however, water surface elevations associated with these events are included in the flood source profiles contained in the Flood Insurance Study Report.

Table 4.3.2-5 shows a range of flood recurrence intervals and associated probabilities of occurrence.

Table 4.3.4-4: Recurrence intervals and associated probabilities of occurrence (FEMA, 2001).	
RECURRENCE INTERVAL	**CHANCE OF OCCURRENCE IN ANY GIVEN YEAR (%)**
10 year	10
50 year	2
100 year	1
500 year	0.2

There is no way of predicting when a seiche event may happen and what the magnitude of the event will be, since it is dependent on barometric pressure and wind speed. This event will continue to not be the major source of flooding for Erie County.

4.3.4.5. Vulnerability Assessment

Erie County is vulnerable to flooding that causes loss of lives, property damage, and road closures. The vulnerability to seiches exists only along the lakeshore of Erie County, and the magnitude of the seiche would have to be incredibly high in order to cause serious damage. However, flooding due to precipitation events, snowmelt, and ice jams can cause more serious damage more frequently than seiches. Flood water damages that occur to agricultural, urban, and other properties such as roads, bridges and utilities are projected to increase in Erie County due to development. Development and associated impervious surfaces will lead to additional storm water runoff and will result in increased flooding. Most, if not all of the municipalities have stormwater management plans that will control the development on flood prone lands.

For purposes of assessing vulnerability, the County focused on community assets that are located in the 1%-annual-chance floodplain. While greater and smaller floods are possible, information about the extent and depths for this floodplain is available for all municipalities countywide, thus providing a consistent basis for analysis. Flood vulnerability maps for each applicable local municipality, showing the 1%-annual-chance flood hazard area and addressable structures, critical facilities and transportation routes within it, are included in **Appendix D**. These maps were created using FEMA Countywide Preliminary digital data.

Table 4.3.4-5 displays the number of addressable structures, mobile home parcels and structures, and populations intersecting the SFHA along with the total number of addressable structures, structures in mobile home parcels, and population in each municipality. The number of vulnerable addressable structures was calculated by overlaying the addressable structures with the SFHA. Similarly, the estimated population in the SFHA was calculated by overlaying the centroids of Census blocks with the SFHA; while clearly an estimate, using the block centroid helps to minimize overestimation of floodprone populations. In order to estimate the number of mobile home structures in the SFHA, addressable structures that fall within parcels with the land use “mobile home” were selected; then the structures were intersected with the SFHA.

Union City Borough and Wattsburg Borough each have over 100 structures located in the SFHA. However, proportionally, Wattsburg Borough has by far the highest percentage of structures in the SFHA; 55.8% of all structures in the municipality are located in the SFHA. The next highest proportion of addressable structures in the SFHA is Union City Borough with 7.8 percent. Mill Village, Union City, Elgin, and Wattsburg Boroughs and Waterford Township have the highest proportion of their populations living in the SFHA with over 20 percent of the population. Platea Borough, Franklin Township, and Greenfield Township have a comparatively lower vulnerability with no addressable structures within the SFHA. These are not necessarily the jurisdictions with the lowest proportion of population in the SFHA; of the communities with structures in the SFHA, Lawrence Park Township, Wesleyville Borough, Lake City Borough, and McKean Borough each have no population living in the SFHA.

Table 4.3.4-5: Structure and population vulnerability to floods in Erie County.									
Municipality	**Total Addressable Structures**	**Total Addressable Structures in SFHA**	**% of Total Addressable Structures in SFHA**	**# of Mobile Home Parcels**	**# of Addressable Structures in Mobile Home Parcels**	**# of Mobile Home Structures in SFHA**	**Total Population (2000)**	**Estimated 2000 Population in SFHA**	**% Population in SFHA**
Albion Borough	670	1	0.1%	39	35	0	1607	19	1.2%
Amity Township	420	7	1.7%	38	35	0	1140	89	7.8%
Concord Township	563	7	1.2%	47	51	0	1361	49	3.6%
Conneaut Township	932	9	1.0%	94	105	0	3908	123	3.1%
Corry City	2913	23	0.8%	20	142	0	6834	358	5.2%
Cranesville Borough	255	2	0.8%	22	47	0	600	64	10.7%
Edinboro Borough	1496	47	3.1%	5	5	0	6950	147	2.1%
Elgin Borough	103	2	1.9%	4	5	0	236	59	25.0%
Elk Creek Township	788	3	0.4%	56	54	0	1800	6	0.3%
Erie City	37720	72	0.2%	23	22	0	103717	238	0.2%
Fairview Township	4171	7	0.2%	15	85	1	10140	79	0.8%
Franklin Township	663	0	0.0%	37	36	0	1609	4	0.2%
Girard Borough	1284	8	0.6%	40	37	0	3164	29	0.9%
Girard Township	2226	21	0.9%	86	668	1	5133	50	1.0%
Greene Township	2007	4	0.2%	33	172	0	4768	292	6.1%
Greenfield Township	687	0	0.0%	59	44	0	1909	89	4.7%
Harborcreek Township	5905	40	0.7%	68	197	4	16267	240	1.5%
Lake City Borough	1112	1	0.1%	15	71	0	2811	0	0.0%
Lawrence Park Township	1673	1	0.1%	5	75	0	4048	0	0.0%
LeBoeuf Township	729	33	4.5%	70	65	4	1680	164	9.8%
McKean Borough	176	1	0.6%	4	4	0	389	0	0.0%
McKean Township	2006	4	0.2%	42	341	0	4619	39	0.8%
Mill Village Borough	183	4	2.2%	18	23	2	412	84	20.4%
Millcreek Township	22619	26	0.1%	230	1348	1	52129	676	1.3%
North East Borough	1685	77	4.6%	4	3	1	4601	230	5.0%

Table 4.3.4-5: Structure and population vulnerability to floods in Erie County.									
Municipality	**Total Addressable Structures**	**Total Addressable Structures in SFHA**	**% of Total Addressable Structures in SFHA**	**# of Mobile Home Parcels**	**# of Addressable Structures in Mobile Home Parcels**	**# of Mobile Home Structures in SFHA**	**Total Population (2000)**	**Estimated 2000 Population in SFHA**	**% Population in SFHA**
North East Township	3070	78	2.5%	67	530	17	6613	157	2.4%
Platea Borough	207	0	0.0%	24	26	0	474	0	0.0%
Springfield Township	1655	12	0.7%	181	388	0	3378	39	1.2%
Summit Township	3019	7	0.2%	82	787	0	5529	59	1.1%
Union City Borough	1294	101	7.8%	44	82	1	1663	357	21.5%
Union Township	742	2	0.3%	43	45	0	3463	33	1.0%
Venango Township	827	9	1.1%	38	78	0	2277	392	17.2%
Washington Township	1966	27	1.4%	52	266	3	4526	270	6.0%
Waterford Borough	392	15	3.8%	11	21	1	3878	57	1.5%
Waterford Township	1638	48	2.9%	110	378	5	1449	379	26.2%
Wattsburg Borough	199	111	55.8%	12	16	10	378	199	52.6%
Wayne Township	735	7	1.0%	46	101	2	1766	98	5.5%
Wesleyville Borough	1495	1	0.1%	25	297	1	3617	0	0.0%
TOTAL	**110225**	**818**	**0.7%**	**1809**	**6685**	**54**	**280843**	**5168**	**1.8%**

Table 4.3.3-6 displays the number of critical facilities that are located in the SFHA by jurisdiction. There are 5 critical facilities that are located in the SFHA, representing just 2.1 percent of the County's total critical facilities. Conneaut, Girard, Millcreek, North East Townships, and Wattsburg Borough have 1 critical facility each located within the SFHA.

Table 4.3.4-6: Critical facilities vulnerable to flood by municipality.

MUNICIPALITY	TOTAL CRITICAL FACILITIES	TOTAL CRITICAL FACILITIES IN SFHA
Albion Borough	4	0
Amity Township	0	0
Concord Township	1	0
Conneaut Township	3	0
Corry City	11	1
Cranesville Borough	2	0
Edinboro Borough	6	0
Elgin Borough	1	0
Elk Creek Township	0	0
Erie City	62	0
Fairview Township	9	0
Franklin Township	2	0
Girard Borough	6	0
Girard Township	4	1
Greene Township	7	0
Greenfield Township	1	0
Harborcreek Township	13	0
Lake City Borough	5	0
Lawrence Park Township	6	0
LeBoeuf Township	0	0
McKean Borough	3	0
McKean Township	3	0
Mill Village Borough	2	0
Millcreek Township	37	1
North East Borough	6	0
North East Township	6	1
Platea Borough	1	0
Springfield Township	2	0
Summit Township	7	0
Union City Borough	5	0
Union Township	1	0
Venango Township	3	0
Washington Township	4	0
Waterford Borough	4	0

Table 4.3.4-6: Critical facilities vulnerable to flood by municipality.		
MUNICIPALITY	**TOTAL CRITICAL FACILITIES**	**TOTAL CRITICAL FACILITIES IN SFHA**
Waterford Township	1	0
Wattsburg Borough	1	1
Wayne Township	3	0
Wesleyville Borough	2	0
TOTAL	**234**	**5**

Additional information on flood vulnerability and losses in Erie County, including the 1%-annual-chance flood event results from HAZUS, FEMA's loss estimation software, the number of parcels vulnerable to flood hazards and the assessed value of vulnerable parcels, is provided in Section 4.4.3: Potential Loss Estimates.

4.3.5. Invasive Species

4.3.5.1. Location and Extent

An invasive species is a species that is not indigenous to a given ecosystem and that, when introduced to a non-native environment, is likely to cause economic or environmental harm, or pose a hazard to human health. The Commonwealth of Pennsylvania, and Erie County, play host to a number of invasive pathogens, insects, plants, invertebrates, fish, and higher mammals. These species have largely been introduced by the actions of humans. Common pathways for invasive species threats include unintentional release of species, the movement of goods and equipment that may unknowingly harbor species, smuggling, ship ballast, hull fouling, and escape from cultivation (PISC, 2010). Invasive species threats are generally divided into two main subsets:

- ***Aquatic Invasive Species*** are nonnative viruses, invertebrates, fish, and aquatic plants that threaten the diversity or abundance of native species, the ecological stability of the infested waters, human health and safety, or commercial, agriculture, aquaculture, or recreational activities dependent on such waters.
- ***Terrestrial Invasive Species*** are nonnative arthropods, vascular plants, higher vertebrates, or pathogens that complete their lifecycle on land instead of in an aquatic environment and whose introduction does or is likely to cause economic or environmental harm or harm to human health.

The Governor's Invasive Species Council of Pennsylvania (PISC), the lead organization for invasive species threats, has identified a number of invasive species in these categories which have been detected in Erie County (see Table 4.3.5-1).

Table 4.3.5-1: Invasive Species of Concern to Erie County (PISC, 2011).		
AQUATIC INVASIVE SPECIES		
Fish		
Rudd	Tubenose Goby	Bighead Carp
Grass Carp	Sea Lamprey	Round Goby
Diseases		
Viral Hemorrhagic Septicemia		
Invertebrates		
Zebra Mussels	Quagga Mussels	Fishook Waterflea
Asian Clam		
Birds		
Canada Goose		
Submerged Aquatic Plants		
Wild Taro	Carolina Fanwort	Eurasian Watermilfoil
Brittle Naiad	Curly Leaf Pondweed	Brazilian Waterweed
TERRESTRIAL INVASIVE SPECIES		
Terrestrial Plants		
Narrow-leaved Cattail	Common Reed	Japanese Hop
Giant Hogweed	Purple Loosestrife	Japanese Knotweed
Giant Knotweed		
Insects and Invertebrates		
Pine Shoot Beetle	Beech Bark Scale	
Plant Pathogens		
Sudden Oak Death		
Vascular Plants		
Multiflora Rose	Johnson Grass	Canada Thistle
Asiatic Bittersweet	Tree-of-Heaven	

The location and extent of these invasive threats depends on the preferred habitat of the species as well as the species' ease of movement and establishment. Other species have limited extent due to the diligence of state agencies; the emerald ash borer's extent has been limited to six counties (Allegheny, Beaver, Butler, Lawrence, Mercer, and Mifflin) because of an aggressive quarantine and testing program.

4.3.5.2. Range of Magnitude

There is a wide range of environmental impacts caused by invasive species. The aggressive nature of many invasive species can cause significant reductions in biodiversity by crowding out native species. This can affect the health of individual host organisms as well as the overall well-being of the affected ecosystem. Beyond causing human, animal, and plant harm, there are secondary impacts of invasive species that go beyond harm to host species and ecosystems, particular in the case of invasive species that attack forests. Forests prevent soil degradation and erosion, protect watersheds, stabilize slopes, and absorb carbon dioxide emissions. The

key role of forests in the hydrologic system means that if forest land is wiped out, the effects of erosion and flooding will be amplified. There is also an impact on agricultural harvests.

The scale of an invasive species threat is generally amplified when the ecosystem or host species is already stressed, such as in times of drought. The already weakened state of the native ecosystem causes it to more easily succumb to an infestation.

The magnitude of invasive species threats ranges from nuisance to widespread killer. Some invasive species like the Brown Marmorated Stink Bugs, which has not migrated to Erie County but is in eastern Pennsylvania, are not considered an agricultural pest and do not harm humans. Other invasive species can cause significant changes in the composition of Pennsylvania ecosystems. For example, Sudden Oak Death can kill oak trees as well as other plants in the area. Other invasive species can harm humans, including the Giant Hogweed which can cause serious burns and sensitivity to light (PISC, 2010). Some other invasive species can cause loss of recreational value to the land, harming an area's economy. An example of one these species is the Japanese Knotweed which can create a wall of vegetation that has cut people off from waterways in Erie County and Pennsylvania.

The worst event pertaining to invasive species in Erie County involves the zebra mussels in Lake Erie. The zebra mussel is a one to two inch mussel which originates from the freshwater areas in Eastern Europe and western Asia. They were first transported to the major rivers and Great Lakes in ballast water large transport ships coming from these areas. Zebra mussels have now spread to the large navigable rivers in the United States as well as 230 lakes in the Great Lakes region (USGS, 2011). Zebra mussels have a large impact on the natural systems in the areas they invade as well as on the economy in the area. The zebra mussels anchor themselves to native mussels, limiting the ability of the native species to function properly. Zebra mussels also eat algae; each mussel can filter the algae out of up to a liter of water a day, depriving the natural species in an area of this food source.

Zebra mussels can multiply at an astounding rate. The female can lay up to one million eggs in a single season, and the larvae are invisible to the naked eye; the eggs and larvae can be transported in any amount of fresh water so they spread easily to new freshwater areas. Additionally, the mussels can survive outside of water for days if the weather is humid. The zebra mussels can take over the habitat of the natural species in a body of freshwater (USGS, 2011). In Lake Erie the zebra mussels have edged out the native species in the western basin, and they continue to spread across the Lake.

The largest economic impact comes when zebra mussels are drawn into pipes of power and other industrial plants. Once inside of the pipes, the zebra mussels grow so that they clog the pipes of these plants. The mussels are very hard to remove so companies along lake fronts are spending capital to clean the mussels out of their pipes, prevent them from entering in the first place, and monitor for growth of mussels before they clog the pipes (USGS, 2011). These costs have been passed on to consumers, increasing the scope of the economic impact beyond Erie County.

4.3.5.3. Past Occurrence

Invasive species have been entering the Commonwealth since the arrival of early European settlers, but not all occurrences have required government action. The first invasive species outbreak requiring state attention occurred in 1862 when legislation was enacted to provide for the destruction of and to prevent the spread of Canada Thistle, Johnson Grass, and Marijuana. Since then, there have been 26 acts and quarantines enacted to prevent the spread of invasive species. However, some of these species have still migrated into Erie County, which are marked in Table 4.3.5-2. As illustrated in Table 4.3.5-2, the volume of acts and quarantines has increased since 2000 (PISC, 2009).

Table 4.3.5-2: Previous Occurrences of Invasive Species Events Requiring State Action or Quarantine (PISC, 2009).

YEAR	SPECIES	YEAR	SPECIES
1911	Chestnut Blight Disease	1999	Plum Pox Virus
1917	Tuberculosis	2003	Black Carp, Bighead Carp*, Silver Carp
1919	European Wart Disease of the Potato	2005	Eurasian Watermilfoil*
1923	Japanese Beetle	2006	Chronic Wasting Disease
1925	European Corn Borer	2006	Scrapie
1927	Canada Thistle*, Wild Garlic, Orange Hockweed, King-Devil, Sow Thistle, Field Bindweed	2006	Vesicular Stomatitis
1933	White Pine Blister	2007	Emerald Ash Borer
1933	Gypsy Moth	2007	Feral Pig
1935	Mosquitoes*	2008	Viral Hemorrhagic Septicemia*
1953	Black Stem Rust	2009	Avian Influenza
1983-4	Avian Influenza	2009	Tuberculosis
1992	Pine Shoot Beetle*	2009	Emerald Ash Borer (quarantine expansion)
1996	Reptile and Amphibian Species	2009	West Nile encephalitis, Chronic Wasting Disease, Spring Viremia of Carp, Viral Hemorrhagic Septicemia*, Lymphocitic Choriomeningitis Virus, Equine Rhinopneumonitis

**Denotes a invasive species that is still present in Erie County*

4.3.5.4. Future Occurrence

Future occurrence for invasive species threats can be considered possible as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1). According to the PISC, the probability of future occurrence for invasive species threats is on the rise because of the growing volume of transported goods, increasing technology, efficiency and speed of transportation and expanding international trade agreements. Erie County faces additional risk from the ships coming into the ports and exposing the waterways to additional invasive species that have attached to their hull. Expanded global trade has created opportunities for many organisms to be transported to and establish themselves in new countries and regions. Furthermore, climate change is contributing to the introduction of new invasive species. As

maximum and minimum seasonal temperatures change, pests are able to establish themselves in previously inhospitable climates. This also gives introduced species an earlier start and increases the magnitude of their growth, and may shift the dominance of ecosystems in the favor of nonnative species.

In order to combat the increase in future occurrences, the PISC, which is a collaboration of state agencies, public organizations, and federal agencies, released the Invasive Species Management Plan in April 2010. This plan outlines the Commonwealth's goals for the management of the spread of nonnative invasive species as well as creates a framework for responding to threats through research, action, and public outreach and communication. More information on the Management Plan can be found online at www.invasivespeciescouncil.com. There has not been county-level invasive species management at this time in Erie County.

4.3.5.5. Vulnerability Assessment

Erie County's exact vulnerability will depend on the invasive species in question. In general, though, the University of Arizona and the National Invasive Species Information Center have identified the following characteristics of areas that are more likely to be invaded:

- Lack of natural predators or diseases that kept the species under control in its native environment;
- Present vacant ecological niches that can be exploited by nonnative species;
- Generally lacking in species diversity;
- Lack of a multi-tiered canopy (in the case of invasive plants);
- More likely to have been disturbed by fire, construction, or agriculture prior to invasion (University of Arizona, 2006).

Much of Erie County is vulnerable to invasive forest and agricultural pests. Thirty-seven percent of the County's land cover is forested, and economic industries dependent on the forest, including tourism, are vulnerable to invasion. Communities that are dependent on agricultural production may also find themselves more vulnerable to invasive species threats. Twenty-seven percent of Erie's land cover is agricultural; $71 million is annually earned from selling the agricultural products from the County, these communities are also economically vulnerable to invasive species.

4.3.6. Landslide

4.3.6.1. Location and Extent

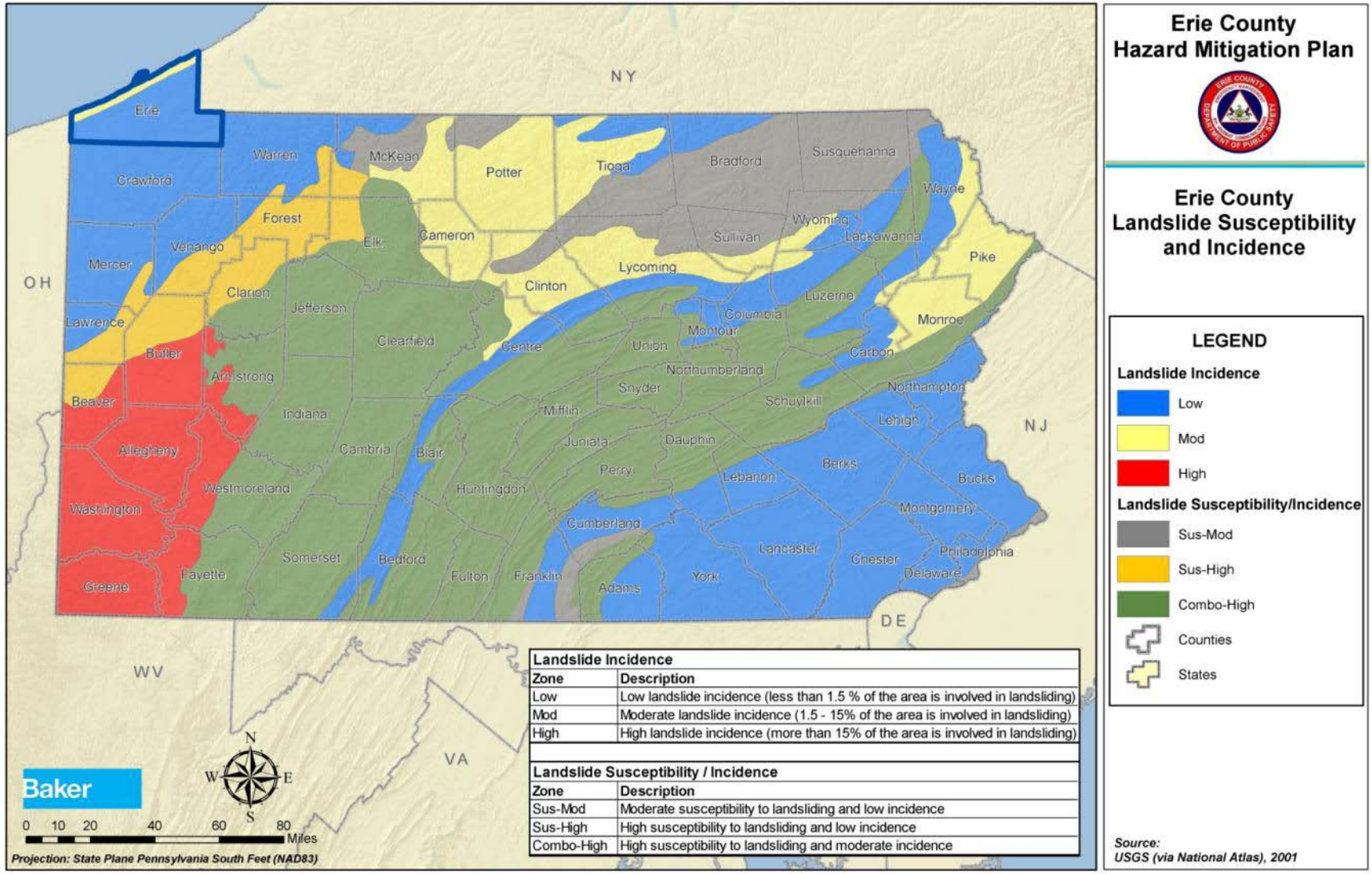
According to the United States Geological Survey, landslides are major geologic hazards that occur in all 50 states, cause $1-2 billion in damages and result in an average of more than 25 fatalities each year (USGS, 2011a). Landslides can include rockfalls, rockslides, block glide, debris slide, earth flow, mud flow, and other slope failures. Slide materials may be composed of natural rock, soil, artificial fill or combinations of these materials. They usually occur in areas with moderate to steep slopes and high precipitation. Landslides can often occur with other natural hazards such as earthquakes and floods. Many slope failures are associated with precipitation events – periods of sustained above-average precipitation, specific rainstorms, or snowmelt events. Areas experiencing erosion, decline in vegetation cover, and earthquakes are

also susceptible to landslides. Human activities that contribute to slope failure include altering the natural slope gradient, increasing soil water content, and removing vegetation cover.

Although landslides may occur anywhere in Pennsylvania, only 15 to 18 percent of the Commonwealth's land area is naturally prone to landslides. The southwestern region of Pennsylvania by far has the highest concentration of landslides. Outside the southwest, high susceptibility areas are smaller and have more varied geology and topography.

The USGS identifies Erie County as falling into two distinct zones of landslide susceptibility seen in Figure 4.3.6-1. Erie County generally has a low probability of landslide occurrence; however, there are areas along the lake bluffs and stream banks where the potential of landslides is moderate. These areas are susceptible to types of landslides characteristic of the flat-lying sedimentary rocks, primarily thin soil cover with few areas of unconsolidated thick glacial soils, and steep slopes found along the lake bluffs in Erie County (Delano and Wilshusen, 2001). The most common landslide types in areas with these characteristics are debris slides and soil slumps. Wave action in Lake Erie can remove materials at the base of the bluffs causing periodic slumps, slides, or flows.

Figure 4.3.6-1: Map of general landslide hazard areas in Pennsylvania (USGS, 2001).



4.3.6.2. Range of Magnitude

Landslides cause damage to transportation routes, utilities, and buildings and create travel delays and other side effects. Fortunately, deaths and injuries due to landslides are rare in Pennsylvania. Almost all of the known deaths due to landslides have occurred when rockfalls or other slides along highways have involved vehicles. Storm-induced debris flows are the only other type of landslide likely to cause death and injury. As residential and recreational development increases on and near steep mountain slopes, the hazard from these rapid events will also increase. Most Pennsylvania landslides are moderate to slow moving and damage property rather than people.

The Pennsylvania Department of Transportation and large municipalities incur substantial costs due to landslide damage and to extra construction costs for new roads in known landslide-prone areas. A 1991 estimate showed an average of $10 million per year is spent on landslide repair contracts across the Commonwealth and a similar amount is spent on mitigation costs for grading projects (DCNR, 2010).

Buildings, utilities, and transportation routes near the lake bluffs in Erie County are susceptible to damage from a landslide. However, there is not a large risk of human injury or casualty resulting from a landslide in these areas (ECEMA, 2010). Damage from a landslide could have very little impact on the County, causing minor nuisances from utility interruptions and travel delays. However a worst case scenario of a landslide in Erie County would be if a landslide along the lake bluff were to cause serious damage to a hazardous material facility in the area. This would increase the risk to the population in the area from the effects of the landslide as well as the effects of possible releases of hazardous materials if the facilities were damaged.

4.3.6.3. Past Occurrence

There is no formal national, state, or local reporting system for landslides, and there are no records of landslide occurrence reported by the Erie County Emergency Management Agency (ECEMA, 2010). However, a 2001 USGS Report notes that there are periodic soil slumps and debris flows along the bluffs near Lake Erie (Delano and Wilshusen, 2001).

4.3.6.4. Future Occurrence

Based on historical events, landslides are not a serious risk for the majority of Erie County, but are more likely to occur in the bluff areas along Lake Erie. Debris flows or soil slumps could occur in these areas as a result of high precipitation or degrading at the base of the bluffs from waves off of Lake Erie. Future occurrence of landslides in the County can be considered *unlikely* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1). The potential of damage to lives or property from this type of natural hazard is low. Mismanaged intense development, removal of vegetation, or increased infrastructure construction in these areas could increase the frequency of occurrence of landslides as well as the impact on the population.

4.3.6.5. Vulnerability Assessment

The majority of Erie County is in a zone of low landslide occurrence except for along the lake bluffs and stream banks near the bluffs. These areas are in a moderate landslide occurrence, but have the possibility of inflicting minor damage to life and residential property. However,

landslides in these areas can cause increased damage to transportation routes, utilities, and industrial structures. As population and development increase in Erie County, the number of individuals and properties susceptible to the effects of landslides will also rise.

Measures exist to lessen the damages of landslides in Erie County, including local ordinances that place limitations on construction or development, monitor construction practices, prepare studies of slide prone areas, and list erosion protection measures and drainage considerations (ECEMA, 2010). Additional measures to provide further protection in the future would include construction of debris dams, retaining walls, and drainage systems in landslide-prone areas.

4.3.7. Tornado, Windstorm

4.3.7.1. Location and Extent

Tornadoes and windstorms can occur throughout Erie County, though events are usually localized. Tornadoes have touched down in many of Erie County's municipalities, particularly several municipalities along the County's southern border. Tornadoes can occur at any time during the day or night, but they most frequently occur during late afternoon into early evening – the warmest hours of the day – and are most likely to occur during the spring and early summer months of March through June. Severe thunderstorms may result in conditions favorable to the formation of numerous or long-lived tornadoes.

Tornado movement is characterized in two ways: direction and speed of spinning winds, and forward movement of the tornado, also known as the storm track. The forward motion of the tornado path can be a few hundred yards or several hundred miles in length. The width of tornadoes can vary greatly, but generally range in size from less than 100 feet to over a mile in width. Some tornadoes never touch the ground and are short-lived, while others may touch the ground several times.

Straight-line winds and windstorms are experienced on a more region-wide scale. While such winds usually accompany tornadoes, straight-lined winds are caused by the movement of air from areas of higher pressure to areas of lower pressure. Stronger winds are the result of greater differences in pressure. Windstorms are generally defined with sustained wind speeds of 40 mph or greater lasting for one hour or longer, or winds of 58 mph or greater for any duration.

4.3.7.2. Range of Magnitude

Each year, tornadoes account for $1.1 billion in damages and cause over 80 deaths nationally (NCAR, 2001). While the extent of tornado damage is usually localized, the vortex of extreme wind associated with a tornado can result in some of the most destructive forces on Earth. Rotational wind speeds can range from 100 mph to more than 250 mph. In addition, the speed of forward motion can range from 0 to 50 mph. Therefore, some estimates place the maximum velocity (combination of ground speed, wind speed, and upper winds) of tornadoes at about 300 mph. The damage caused by a tornado is a result of the high wind velocity and wind-blown debris, also accompanied by lightning or large hail. The most violent tornadoes have rotating winds of 250 miles per hour or more and are capable of causing extreme destruction and turning normally harmless objects into deadly missiles.

Damages and deaths can be especially significant when tornadoes move through populated, developed areas. The destruction caused by tornadoes ranges from light to inconceivable depending on the intensity, size and duration of the storm. Typically, tornadoes cause the greatest damages to structures of light construction such as mobile homes. The Enhanced Fujita Scale, also known as the "EF-Scale," measures tornado strength and associated damages. The EF-Scale is an update to the earlier Fujita Scale, also known as the "F-Scale," that was published in 1971. It classifies United States tornadoes into six intensity categories, as shown in Table 4.3.7-1, based upon the estimated maximum winds occurring within the wind vortex. Since its implementation by the National Weather Service in 2007, the EF-Scale has become the definitive metric for estimating wind speeds within tornadoes based upon damage to buildings and structures. F-Scale categories with corresponding EF-Scale wind speeds are provided in Table 4.3.7-1 since the magnitude of previous tornado occurrences is based on the F-Scale.

Table 4.3.7-1: Enhanced Fujita Scale (EF-Scale) categories with associated wind speeds and description of damages.

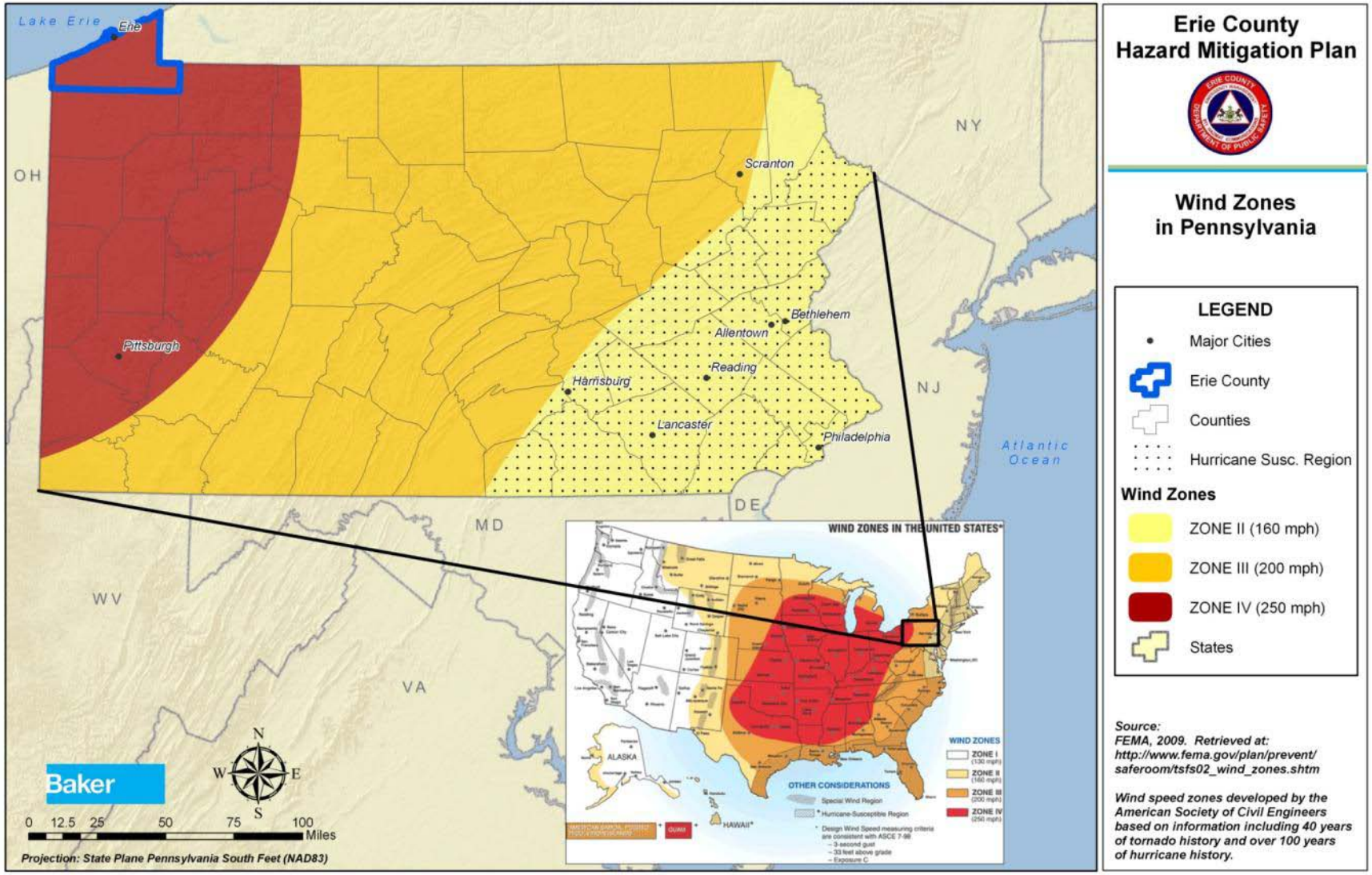
EF-SCALE NUMBER	WIND SPEED (mph)	F-SCALE NUMBER	TYPE OF DAMAGE POSSIBLE
EF0	65–85	F0-F1	**Minor damage**: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.
EF1	86-110	F1	**Moderate damage**: Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111–135	F1-F2	**Considerable damage**: Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136–165	F2-F3	**Severe damage**: Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166–200	F3	**Devastating damage**: Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	>200	F3-F6	**Extreme damage**: Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (300 ft); steel reinforced concrete structure badly damaged; high-rise buildings have significant structural deformation.

Figure 4.3.7-1 shows wind speed zones developed by the American Society of Civil Engineers based on information including 40 years of tornado history. These wind zones identify wind speeds that could occur across the United States to be used as the basis for design and evaluation of the structural integrity of shelters and critical facilities. Erie County falls within Zone IV, meaning design wind speeds for shelters and critical facilities should be able to withstand a 3-second gust of up to 250 mph, regardless of whether the gust is the result of a tornado or windstorm event. Therefore, these structures should be able to withstand the wind speeds experienced in an EF5 tornado event.

The worst tornado occurrence to date happened in Erie County on May 31, 1985 as part of the string of severe storms and tornadoes that wreaked havoc across eastern Ohio and western Pennsylvania discussed in further detail in Section 4.3.7.3. Two F4 tornados caused an estimated $10 million in property damage across the southern part of the County. Additionally, these two tornadoes resulted in a total of 12 deaths and 133 injuries in Erie County (ECEMA, 2010). The first F4 tornado touched down in Albion Township and destroyed 309 buildings. The second F4 tornado touched down between Wattsburg and Corry and remained on the ground for 45 minutes. One of the ten Presidential Declaration of Disasters in Erie County was issued after this storm as a result of the loss of life and amount of property damage.

Since tornado and windstorm events are typically localized, environmental impacts are rarely widespread. However, where these events occur, severe damage to plant species is likely. This includes loss of trees and an increased threat of wildfire in areas where dead trees are not removed. Hazardous material facilities should meet design requirements for the wind zones identified in Figure 4.3.7-1 in order to prevent release of hazardous materials into the environment.

Figure 4.3.7-1: Wind Zones in Pennsylvania and Erie County (FEMA, 2009).



4.3.7.3. Past Occurrence

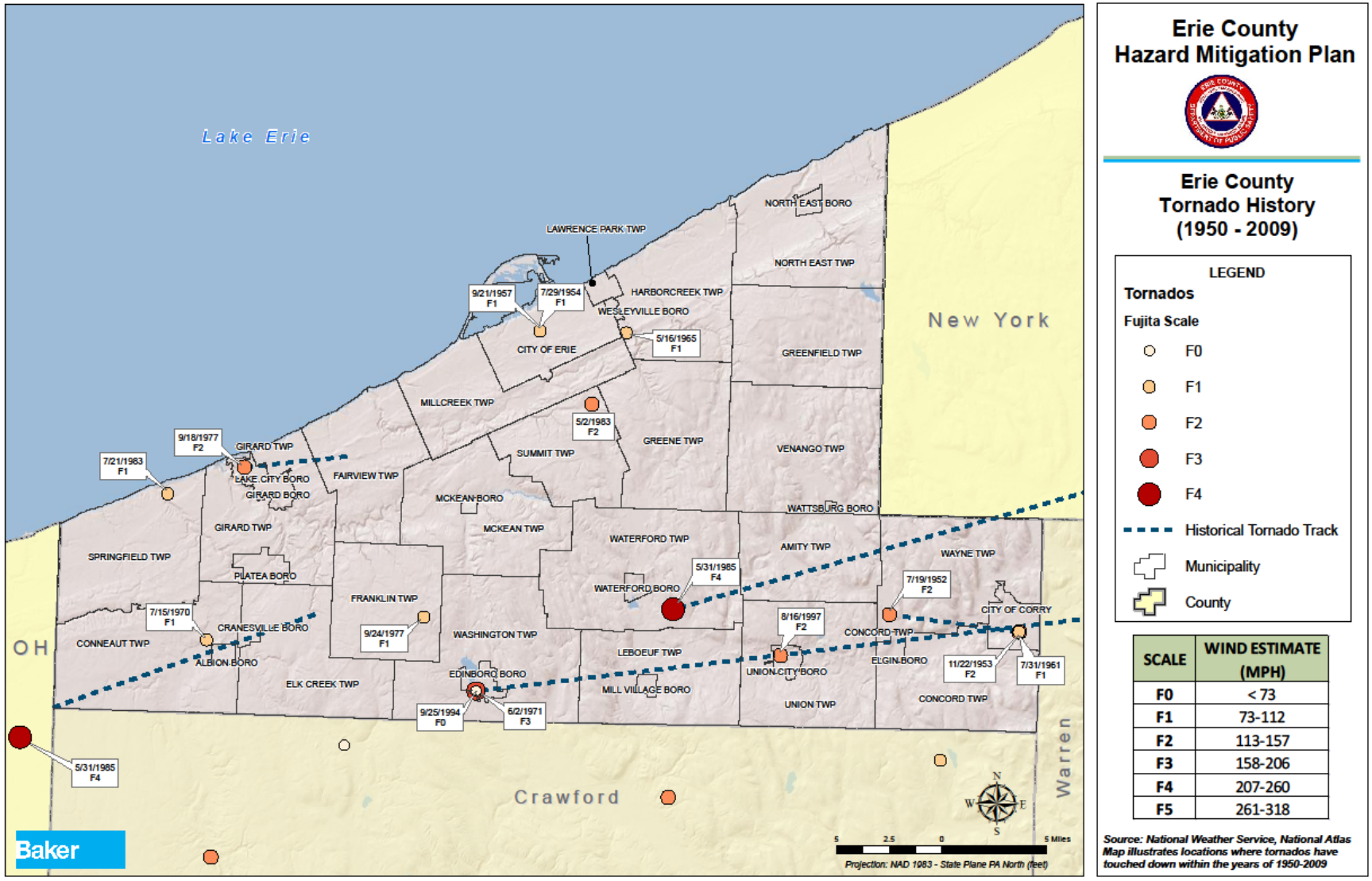
Tornadoes have occurred in all seasons and all regions of Pennsylvania, but the northern, western, and southeastern portions of the Commonwealth have been struck more frequently. The deadliest tornado in the Commonwealth occurred during a string of severe thunderstorm and tornado events in 1985. On May 31, 1985 a very rare outbreak of 21 tornadoes tracked across northeast Ohio and northwest Pennsylvania, killing a total of 76 people. One of these tornadoes was rated an F6 while six were rated F4s on the old Fujita Scale. Two of the F4 tornados touched down three times in Erie County during this string of storms.

A list of tornado events that have occurred in Erie County between 1950 and 2010 is shown in Table 4.3.7-2 with an associated Fujita Tornado Scale magnitude. There have been a total of eighteen tornado events during this time period in Erie County. Outside of the injuries and fatalities reported during the May 31, 1985 storms, there have been limited injuries and zero fatalities as a result of tornadoes in Erie County. Five of the remaining tornado events caused a total of fifteen injuries. A map showing the approximate location of previous events from 1950-2004 is included in Figure 4.3.7-2.

Table 4.3.7-2: Previous tornado events between 1950 and 2010 in Erie County (NCDC, 2011).

LOCATION	DATE	ESTIMATED LENGTH	ESTIMATED WIDTH	MAGNITUDE	ESTIMATED PROPERTY DAMAGE ($)
Erie County	7/19/1952	5.6 miles	27 yards	F2	$2,500
Erie County	11/22/1953	2.0 miles	67 yards	F2	$25,000
Erie County	7/29/1954	-	-	F1	$300
Erie County	9/21/1957	0.3 miles	200 yards	F1	$25,000
Erie County	7/31/1961	0.3 miles	7 yards	F1	$25,000
Erie County	5/16/1965	-	-	F1	$25,000
Erie County	7/15/1970	0.5 miles	167 yards	F1	$25,000
Erie County	6/2/1971	29.3 miles	33 yards	F3	$25,000
Erie County	9/18/1977	4.5 miles	33 yards	F2	$2,500,000
Erie County	9/24/1977	-	-	F1	$250,000
Erie County	5/2/1983	1 mile	33 yards	F2	$250,000
Erie County	7/21/1983	0.2 miles	10 yards	F1	$250,000
Erie County	5/31/1985	12 miles	400 yards	F4	$25,000,000
Erie County	5/31/1985	16 miles	300 yards	F4	N/A
Erie County	5/31/1985	2 miles	300 yards	F4	N/A
Union City	8/16/1997	2 miles	100 yards	F2	$500,000
Springfield Station	6/6/2010	6 miles	50 yards	F0	$200,000
Waldameer Park	6/27/2010	-	-	F0	$120,000

Figure 4.3.7-2: Previous tornado events in Erie County (National Atlas, 2008).



Erie County Hazard Mitigation Plan

Erie County Tornado History (1950 - 2009)

LEGEND

Tornados

Fujita Scale

- F0
- F1
- F2
- F3
- F4
- Historical Tornado Track
- Municipality
- County

SCALE	WIND ESTIMATE (MPH)
F0	< 73
F1	73-112
F2	113-157
F3	158-206
F4	207-260
F5	261-318

Source: National Weather Service, National Atlas
Map illustrates locations where tornados have touched down within the years of 1950-2009

Windstorm events in Erie County may be the result of thunderstorms, winter storms, or nor'easters.

There have been 130 events of wind speeds greater than 50 knots in Erie County between 1950 and 2010. There were twelve injuries caused by one storm in

Thunderstorm produced winds caused one death in the worst wind storm event in Erie County. Winds of 52 knots, or almost 60 miles per hour, tore through a campground along Lake Erie near North Springfield in Springfield Township. The winds knocked over one camper in the campground, and killed a man who was standing next to the camper. A list of all events greater than 50 knots that have occurred since 1950 in Erie County is shown in Table 4.3.7-3.

Table 4.3.7-3: Previous windstorm events greater than 50 knots in Erie County between 1950 and 2010. (NCDC, 2010). *N/A = Not available*.

LOCATION	DATE	ESTIMATED WIND SPEED	DEATHS	INJURIES	ESTIMATED PROPERTY DAMAGE ($)
Erie County	6/23/1956	61 kts.	0	0	N/A
Erie County	11/1/1959	70 kts.	0	0	N/A
Erie County	4/19/1963	50 kts.	0	0	N/A
Erie County	6/19/1964	62 kts.	0	0	N/A
Erie County	4/11/1965	70 kts.	0	0	N/A
Erie County	7/9/1965	50 kts.	0	0	N/A
Erie County	9/15/1965	70 kts.	0	0	N/A
Erie County	9/15/1965	73 kts.	0	0	N/A
Erie County	2/15/1967	60 kts.	0	0	N/A
Erie County	6/29/1968	50 kts.	0	0	N/A
Erie County	6/27/1969	50 kts.	0	0	N/A
Erie County	7/4/1969	58 kts.	0	0	N/A
Erie County	6/15/1972	55 kts.	0	0	N/A
Erie County	11/26/1979	51 kts.	0	0	N/A
Erie County	6/15/1982	65 kts.	0	0	N/A
Erie County	6/15/1982	54 kts.	0	0	N/A
Erie County	7/20/1983	58 kts.	0	0	N/A
Erie County	9/6/1983	69 kts.	0	0	N/A
Erie County	10/13/1983	54 kts.	0	0	N/A
Erie County	10/13/1983	66 kts.	0	0	N/A
Erie County	6/5/1984	52 kts.	0	0	N/A
Erie County	9/30/1986	53 kts.	0	0	N/A
Erie County	8/2/1987	52 kts.	0	0	N/A
Erie County	5/9/1988	50 kts.	0	0	N/A
Erie County	8/28/1990	52 kts.	0	0	N/A
Erie County	8/28/1990	52 kts.	0	0	N/A
Erie County	7/13/1992	52 kts.	0	0	N/A
Erie County	7/18/1992	52 kts.	0	0	N/A
Erie and Crawford Counties	1/18/1996	52 kts.	0	0	11,000
Erie and Crawford Counties	1/27/1996	50 kts.	0	0	6,000
Erie and Crawford Counties	2/11/1996	63 kts.	0	0	7,000
Erie and Crawford Counties	3/25/1996	50 kts.	0	0	N/A

Table 4.3.7-3: Previous windstorm events greater than 50 knots in Erie County between 1950 and 2010. (NCDC, 2010). *N/A = Not available*.

LOCATION	DATE	ESTIMATED WIND SPEED	DEATHS	INJURIES	ESTIMATED PROPERTY DAMAGE ($)
Erie County	4/12/1996	61 kts.	0	12	800,000
Edinboro	5/9/1996	55 kts.	0	0	N/A
Corry	6/11/1996	50 kts.	0	0	2,000
Western Erie County	8/15/1996	50 kts.	0	0	5,000
Erie and Crawford Counties	10/30/1996	50 kts.	0	0	2,000
McKean	12/1/1996	50 kts.	0	0	N/A
Edinboro	2/22/1997	60 kts.	0	0	5,000
Erie	2/22/1997	50 kts.	0	0	2,000
Erie	5/6/1997	55 kts.	0	0	20,000
Northern Erie County	2/4/1998	50 kts.	0	0	N/A
Erie County	8/24/1998	52 kts.	0	0	30,000
Erie International Airport	7/3/1999	53 kts.	0	0	N/A
Erie International Airport	7/31/1999	53 kts.	0	0	N/A
Corry	6/2/2000	59 kts.	0	0	N/A
Waterford	6/24/2000	64 kts.	0	0	25,000
Erie	8/26/2001	57 kts.	0	0	50,000
Erie and Crawford Counties	3/9/2002	52 kts.	0	0	550,000
Erie International Airport	4/28/2002	55 kts.	0	0	250,000
Erie County	2/12/2003	53 kts.	0	0	85,000
Girard	8/5/2003	50 kts.	0	0	5,000
North East	8/16/2003	50 kts.	0	0	50,000
Erie	8/16/2003	50 kts.	0	0	10,000
Girard	8/16/2003	50 kts.	0	0	2,000
Lake City	8/26/2003	50 kts.	0	0	25,000
Waterford	8/29/2003	50 kts.	0	0	2,000
Erie	9/27/2003	50 kts.	0	0	3,000
Mill Village	10/14/2003	50 kts.	0	0	2,000
Elgin	10/14/2003	50 kts.	0	0	1,000
Erie and Crawford Counties	11/12/2003	63 kts.	0	0	800,000
Erie and Crawford Counties	3/5/2004	50 kts.	0	0	225,000
Corry	5/8/2004	50 kts.	0	0	6,000
Union City	5/8/2004	50 kts.	0	0	4,000
Erie	5/8/2004	50 kts.	0	0	1,000
Corry	5/10/2004	50 kts.	0	0	2,000
Elgin	5/20/2004	50 kts.	0	0	75,000
North East	5/21/2004	50 kts.	0	0	10,000
Erie County	6/14/2004	50 kts.	0	0	50,000
Erie County	12/1/2004	52 kts.	0	0	55,000
Erie and Crawford Counties	12/7/2004	50 kts.	0	0	55,000
Erie County	7/24/2005	50 kts.	0	0	50,000
Erie County	7/26/2005	53 kts.	0	0	250,000
Erie International Airport	9/29/2005	50 kts.	0	0	N/A
North East	9/29/2005	50 kts.	0	0	N/A
Union City	9/29/2005	50 kts.	0	0	N/A

Table 4.3.7-3: Previous windstorm events greater than 50 knots in Erie County between 1950 and 2010. (NCDC, 2010). *N/A = Not available*.

LOCATION	DATE	ESTIMATED WIND SPEED	DEATHS	INJURIES	ESTIMATED PROPERTY DAMAGE ($)
Erie and Crawford Counties	11/6/2005	55 kts.	0	0	80,000
Erie and Crawford Counties	2/17/2006	52 kts.	0	0	160,000
Erie County	3/13/2006	50 kts.	0	0	13,000
Albion	7/27/2006	50 kts.	0	0	1,000
Northern Erie County	10/28/2006	60 kts.	0	0	200,000
Erie County	12/1/2006	50 kts.	0	0	15,000
North East	6/8/2007	74 kts.	0	0	N/A
Lake City	6/8/2007	50 kts.	0	0	3,000
Erie	6/8/2007	50 kts.	0	0	75,000
Erie	6/19/2007	50 kts.	0	0	20,000
Mill Village	6/27/2007	50 kts.	0	0	3,000
Corry	8/7/2007	50 kts.	0	0	3,000
Erie County	12/23/2007	50 kts.	0	0	5,000
Southern Erie County	1/9/2008	55 kts.	0	0	10,000
Northern Erie County	1/9/2008	73 kts.	0	0	15,000
Erie	1/9/2008	57 kts.	0	0	N/A
North East	1/9/2008	56 kts.	0	0	15,000
Erie County	1/30/2008	55 kts.	0	0	30,000
Erie	6/10/2008	52 kts.	0	0	2,000
Corry	6/13/2008	50 kts.	0	0	3,000
Wattsburg	6/26/2008	61 kts.	0	0	3,000
Swanville	7/8/2008	65 kts.	0	0	N/A
Erie	7/8/2008	60 kts.	0	0	N/A
Erie	7/8/2008	50 kts.	0	0	2,000
Union City	7/23/2008	50 kts.	0	0	10,000
Erie and Crawford Counties	9/14/2008	52 kts.	0	0	1,500,000
Erie	12/28/2008	52 kts.	0	0	N/A
Erie	12/28/2008	50 kts.	0	0	6,000
Erie and Crawford Counties	2/12/2009	61 kts.	0	0	250,000
Waterford	8/10/2009	50 kts.	0	0	120,000
Erie	8/20/2009	50 kts.	0	0	25,000
Erie County	12/9/2009	54 kts.	0	0	750,000
Erie	5/7/2010	50 kts.	0	0	35,000
Girard	5/7/2010	50 kts.	0	0	1,000
Edinboro	5/7/2010	50 kts.	0	0	15,000
Northern Erie County	5/8/2010	56 kts.	0	0	200,000
Southern Erie County	5/8/2010	50 kts.	0	0	75,000
Edinboro	5/31/2010	50 kts.	0	0	10,000
North Springfield	6/6/2010	52 kts.	1	0	150,000
Erie	6/6/2010	50 kts.	0	0	10,000
Corry	6/6/2010	50 kts.	0	0	5,000
Drakes Mills	6/23/2010	50 kts.	0	0	10,000
Eaglehurst	6/27/2010	50 kts.	0	0	2,000
Swanville	6/27/2010	50 kts.	0	0	5,000

Table 4.3.7-3: Previous windstorm events greater than 50 knots in Erie County between 1950 and 2010. (NCDC, 2010). *N/A = Not available*.

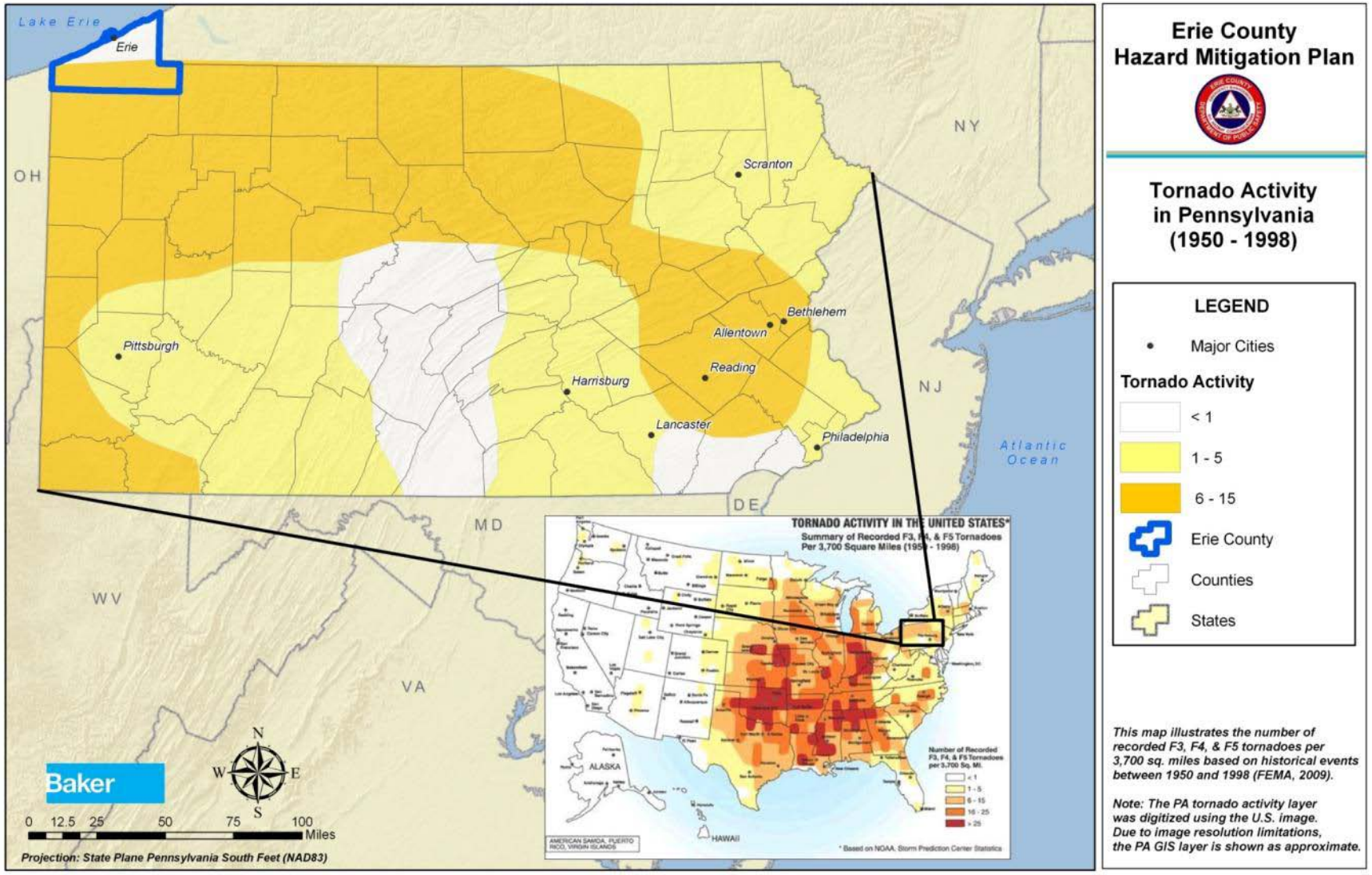
LOCATION	DATE	ESTIMATED WIND SPEED	DEATHS	INJURIES	ESTIMATED PROPERTY DAMAGE ($)
Waldameer Park	6/27/2010	50 kts.	0	0	35,000
North East	6/27/2010	50 kts.	0	0	1,000
Middleboro	6/28/2010	50 kts.	0	0	100,000
Erie	7/23/2010	50 kts.	0	0	1,000
Erie	7/23/2010	50 kts.	0	0	15,000
Erie	7/24/2010	50 kts.	0	0	3,000
Edinboro	7/28/2010	50 kts.	0	0	15,000
Wattsburg	9/7/2010	50 kts.	0	0	30,000
Erie	9/7/2010	50 kts.	0	0	1,000
Northern Erie County	11/17/2010	53 kts.	0	0	N/A
TOTAL			**1**	**12**	**7,571,000**

4.3.7.4. Future Occurrence

According to the National Weather Service, the Commonwealth of Pennsylvania has an annual average of ten tornadoes with two related deaths. While the chance of being hit by a tornado is small, the damage that results when the tornado arrives is devastating. An F4 tornado, with a 0.019 percent annual probability of occurring, can carry wind velocities of 200 mph, resulting in a force of more than 100 pounds per square foot of surface area. This is a “wind load” that exceeds the design limits of most buildings.

Future occurrence of a tornado in Erie County can be considered *possible* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1). Based on tornado activity information for Pennsylvania between 1950 and 1998, the southern half of Erie County lies within an area that has experienced between six and fifteen Category F3, F4, or F5 tornadoes per 3,700 square miles (see Figure 4.3.7-3). However, the northern half of Erie County has experienced one Category F3, F4, or F5 tornado or less per 3,700 square miles during this time period. This equals a 12.5 to 33.3 percent chance or *possible* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1) that Erie County will be affected by a Category F3, F4, or F5 tornado each year.

Figure 4.3.7-3: Tornado activity in Erie County (FEMA, 2009).



4.3.7.5. Vulnerability Assessment

Based on historical tornado events, windstorm events are likely to occur across Erie County, and tornado events are more likely in the southern portion of the County. While the frequency of windstorms and minor tornadoes is expected to remain relatively constant, vulnerability increases in more densely developed areas. Since high wind events may affect the entire County, it is important to identify specific critical facilities and assets that are most vulnerable to the hazard. For most assets, this would require site-specific analysis. However, due to their lightweight and often unanchored design, manufactured homes are most often extremely vulnerable to high winds.

Table 4.3.7-4 lists the number of each of these structures in each municipality, estimated by examining the numbers of addressable structures that fall within parcels with "mobile home", "mobile home with land", or "mobile home park" land use classifications in each municipality. While clearly an estimate, this enables Erie County to take a preliminary look at which jurisdictions are more vulnerable to mobile home damage.

Countywide there are over 6,600 addressable structures in mobile home parcels. All municipalities have at least one addressable structure within the mobile home classified parcels; however, Edinboro Borough, Elgin Borough, McKean Borough, and North East Borough all have five structures or less. It is expected that these municipalities will not be as vulnerable to wind impacts. At the other end of the spectrum Millcreek Township has over 1,300 addressable structures in mobile home parcels. Additionally, Girard Township, North East Township, and Summit Township all have over 500 addressable structures within their mobile home parcels. These townships may be more vulnerable to tornado and windstorm events.

Table 4.3.7-4: Number of mobile home parcels and addressable structures in mobile home parcels (Erie County Department of Planning, 2011).

Municipality	# of Mobile Home Parcels	# of Addressable Structures in Mobile Home Parcels
Albion Borough	39	35
Amity Township	38	35
Concord Township	47	51
Conneaut Township	94	105
Corry City	20	142
Cranesville Borough	22	47
Edinboro Borough	5	5
Elgin Borough	4	5
Elk Creek Township	56	54
Erie City	23	22
Fairview Township	15	85
Franklin Township	37	36
Girard Borough	40	37
Girard Township	86	668
Greene Township	33	172
Greenfield Township	59	44

Table 4.3.7-4: Number of mobile home parcels and addressable structures in mobile home parcels (Erie County Department of Planning, 2011).		
Municipality	**# of Mobile Home Parcels**	**# of Addressable Structures in Mobile Home Parcels**
Harborcreek Township	68	197
Lake City Borough	15	71
Lawrence Park Township	5	75
LeBoeuf Township	70	65
McKean Borough	4	4
McKean Township	42	341
Mill Village Borough	18	23
Millcreek Township	230	1,348
North East Borough	4	3
North East Township	67	530
Platea Borough	24	26
Springfield Township	181	388
Summit Township	82	787
Union City Borough	44	82
Union Township	43	45
Venango Township	38	78
Washington Township	52	266
Waterford Borough	11	21
Waterford Township	110	378
Wattsburg Borough	12	16
Wayne Township	46	101
Wesleyville Borough	25	297
TOTAL	**1809**	***6,685**
*According to the Erie County Assessment Office the total number of Addressable Structures in Mobile Home Parcels 6913 which differs slightly from the County GIS information used to generate this table.		

4.3.8. Winter Storm

4.3.8.1. Location and Extent

Every county in the Commonwealth, including Erie, is subject to severe winter storms. However, the Northern Tier, Western Counties, and the mountainous regions of Pennsylvania tend to experience these storms with more frequency and with greater severity. Erie County also lies in the Lake Erie Snow Belt region with the potential of greater annual snowfall than the majority of counties in Pennsylvania. As of 2007, the City of Erie is 13th on *USA Today's* list of the snowiest places in the United States, averaging 88 inches of snow per year (ECEMA, 2010). An average daily snowfall of about 12 inches is not uncommon in parts of the County, with a maximum of approximately 21 inches.

Within Erie County there are variations in the average amount of snowfall that is received throughout different parts of the County because of terrain differences and proximity to Lake Erie. Generally, the average annual snowfall in the County increases from the lakefront on the

northwest side of the County with an annual average of between 90 to 100 inches of annual snowfall, to the central and southeast parts of the County which receive over 100 inches of annual snowfall (see Figure 4.3.8-2).

4.3.8.2. Range of Magnitude

Winter storms consist of cold temperatures, heavy snow or ice and sometimes strong winds. They begin as low-pressure systems that move through Pennsylvania either following the jet stream or developing as extra-tropical cyclonic weather systems over the Atlantic Ocean called Nor'easters. Due to their regular occurrence, these storms are considered hazards only when they result in damage to specific structures or cause disruption to traffic, communications, electric power, or other utilities.

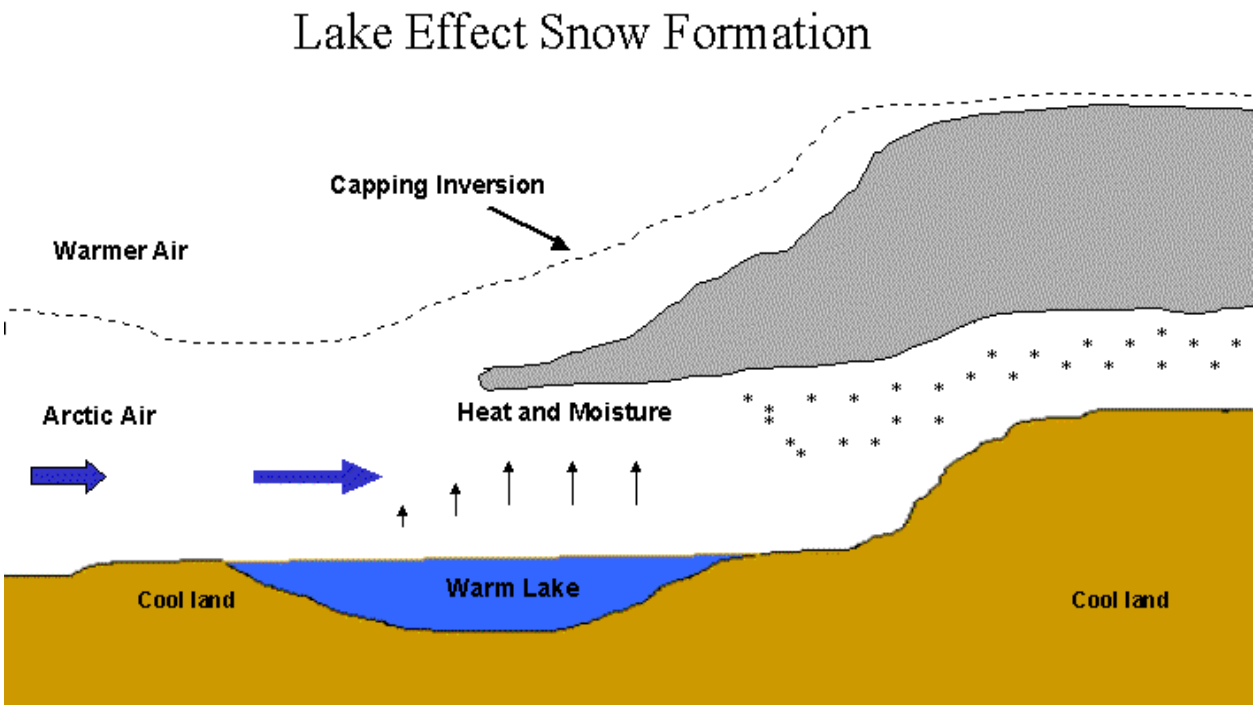
A winter storm can adversely affect roadways, utilities, business activities, and can cause frostbite or loss of life. These storms may include one or more of the following weather events:

- **Heavy Snowstorm:** Accumulations of four inches or more in a six-hour period, or six inches or more in a twelve-hour period.
- **Sleet Storm:** Significant accumulations of solid pellets which form from the freezing of raindrops or partially melted snowflakes causing slippery surfaces posing hazards to pedestrians and motorists.
- **Ice Storm:** Significant accumulations of rain or drizzle freezing on objects (trees, power lines, roadways, etc.) as it strikes them, causing slippery surfaces and damage from the sheer weight of ice accumulation.
- **Blizzard:** Wind velocity of 35 miles per hour or more, temperatures below freezing, considerable blowing snow with visibility frequently below one-quarter mile prevailing over an extended period of time.
- **Severe Blizzard:** Wind velocity of 45 miles per hour, temperatures of 10 degrees Fahrenheit or lower, a high density of blowing snow with visibility frequently measured in feet prevailing over an extended period time.

In addition to the aforementioned weather events, Erie County is susceptible to lake effect snow. Lake effect snow occurs when a very cold air mass moves over a large, relatively warmer body of water (i.e., Lake Erie). As illustrated below in Figure 4.3.8-1, heat and moisture from the warm lake rise into the arctic air, where it then cools and condenses into snow clouds over the lake. As the clouds move from the smooth surface of the lake to the shore, the clouds slow down and pile up at the downwind shore, causing additional lift, propelling the storm over land. As the clouds move downwind and lift, they develop into snow showers and squalls, sometimes accompanied by thunder and lightning. Because the Arctic air usually associated with lake effect snows blow from the west or northwest, the snow itself is expected on the east or southeast sides of the lakes – exactly where Erie County lies in relation to Lake Erie. The volume of snowfall associated with a lake effect snow event is dependent on the direction of the winds, the duration of winds, and the magnitude of the temperature differential between the water and the

air; the greater the differential, the more snow is expected. Lake effect snows are enhanced when the moistened air mass is forced over the hilly terrain of northwestern Pennsylvania (Gelber, 2002).

Figure 4.3.8-1: Lake Effect Snow Formation (NOAA ERH).



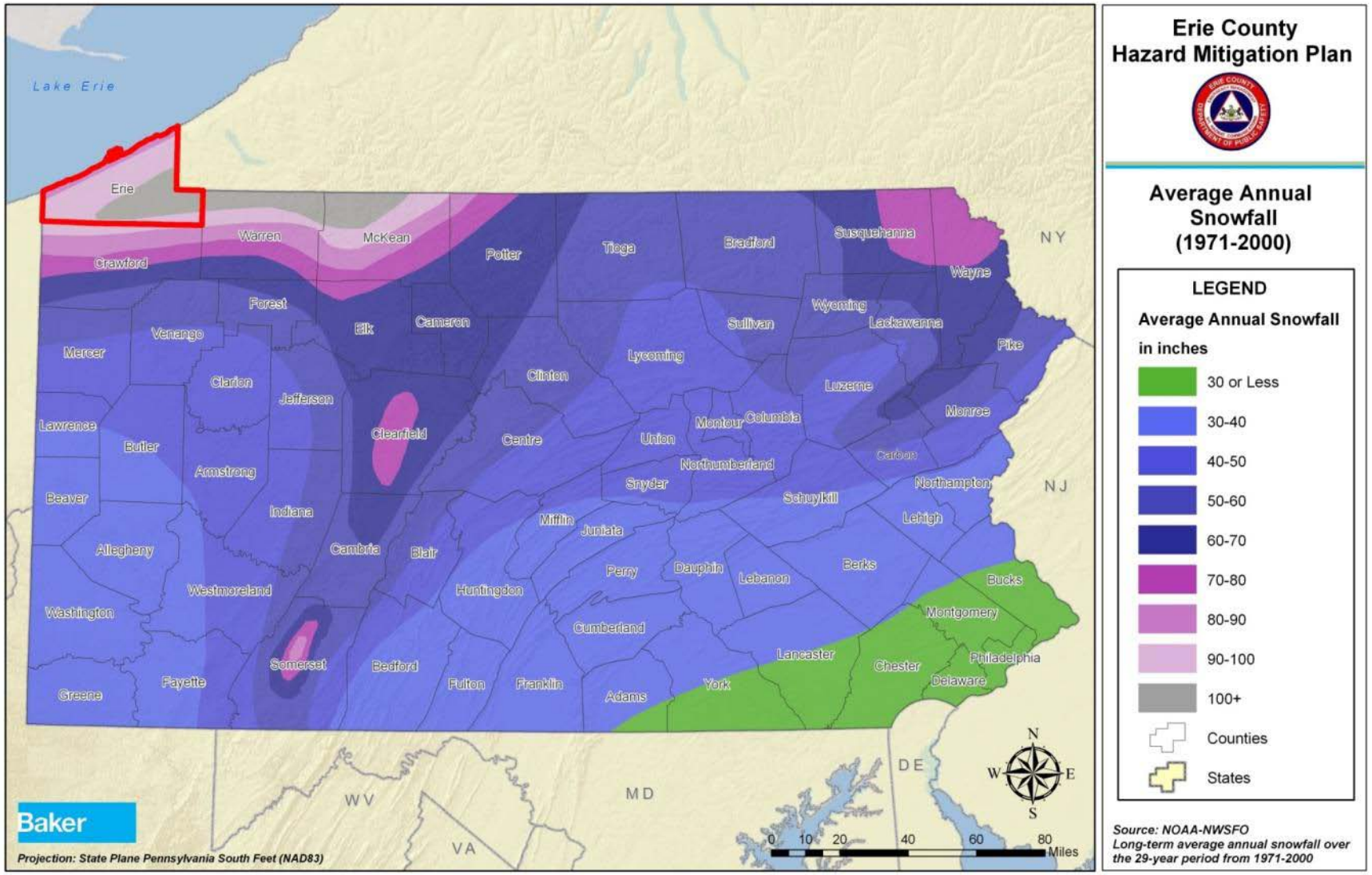
Any of the above events can result in the closing of major or secondary roads, particularly in rural locations, stranded motorists, transportation accidents, loss of utility services, and depletion of oil heating supplies. Environmental impacts often include damage to shrubbery and trees due to heavy snow loading, ice build-up and/or high winds which can break limbs or even bring down large trees. Gradual melting of snow and ice provides excellent groundwater recharge. However, high temperatures following a heavy snowfall can cause rapid surface water runoff and severe flooding.

Figure 4.3.8-2 shows mean annual snowfall in Erie County to be between 90 and over 100 inches. Two of the eight Presidential Disaster and Emergency Declarations affecting Erie County have been in response to hazard events related to winter storms (see Table 4.2-1). Other reported winter storm events, including those associated with Disaster Declarations, are listed in Table 4.3.8-1.

Most recently, between 2000 and 2010 Erie County has experienced 27 winter storms in addition 46 heavy snow occurrences causing a combined total of approximately $26 million in

damages. During this time period the County also experienced 27 lake-effect snow conditions (ECEMA, 2010). The worst winter storm event in Erie occurred on February 27, 2002. Multiple bands of heavy snow moved across the County producing snow accumulations during the afternoon of 6 inches near Lake Erie and over 10 inches further inland. The heavy snow resulted in whiteout conditions, leading to an accident on Interstate 90 south of the City of Erie involving over 100 vehicles. Multiple injuries and one death resulted from this massive traffic accident (NCDC, 2011).

Figure 4.3.8-2: Mean Annual Snowfall for Pennsylvania and Erie County (NOAA –NWSFO).



4.3.8.3. Past Occurrence

Erie County and the Commonwealth of Pennsylvania have a long history of severe winter weather. There have been 150 winter storm events that have affected Erie County since 1993, according to the NCDC. The NCDC data on past occurrence for winter storm events since 1993 is the only comprehensive list of data available for the county aside from information from past disaster declarations.

One of the storms that had a wider impact than the February 2002 storm occurred across the Commonwealth in the winter of 1993-1994. That winter, Pennsylvania was hit by a series of protracted winter storms. The severity and nature of these storms combined with accompanying record-breaking frigid temperatures posed a major threat to the lives, safety and well-being of Commonwealth residents and caused major disruptions to the activities of schools, businesses, hospitals and nursing homes.

One of these devastating winter storms occurred in early January 1994 with record snowfall depths in many areas of the Commonwealth, strong winds, and sleet/freezing rains. Numerous storm-related power outages were reported and as many as 600,000 residents were without electricity, in some cases for several days at a time. A ravaging ice storm followed which closed major arterial roads and downed trees and power lines. Utility crews from a five-state area were called to assist in power restoration repairs. Officials from PPL Corporation stated that this was the worst winter storm in the history of the company; related damage-repair costs exceeded $5,000,000.

Serious power supply shortages continued through mid-January because of record cold temperatures at many places, causing sporadic power generation outages across the Commonwealth. The entire Pennsylvania-New Jersey-Maryland grid and its partners in the District of Columbia, New York and Virginia experienced 15-30 minute rolling blackouts, threatening the lives of people and the safety of the facilities in which they resided. In Erie County these rolling blackouts caused problems especially for service-related businesses and industries (ECEMA, 2010). Power and fuel shortages affecting Pennsylvania and the East Coast power grid system required the Governor to recommend power conservation measures be taken by all commercial, residential and industrial power consumers.

The record cold conditions resulted in numerous water-main breaks and interruptions of service to thousands of municipal and city water customers throughout the Commonwealth. Additionally, the extreme cold in conjunction with accumulations of frozen precipitation resulted in acute shortages of road salt. As a result, trucks were dispatched to haul salt from New York to expedite deliveries to Pennsylvania Department of Transportation storage sites.

In addition to the events described above, other winter storm events are listed in Table 4.3.8-1. The majority of the event types listed in the table below are *Heavy Snow* which is defined by the National Weather Service Forecast as snowfall of 6 inches or more in 12 hours or less, or 8 inches or more in 24 hours or less.

Table 4.3.8-1: Previous winter storm events impacting Erie County since 1994 (NCDC, 2011). Events with the location "Multiple Counties" include Erie County.

LOCATION	DATE	TYPE
Southern Erie County	1/25/1993	Heavy Snow
Multiple Counties	2/16/1993	Heavy Snow
Northern Erie County	2/18/1993	Heavy Snow
Erie and McKean Counties	2/21/1993	Heavy Snow
Erie and McKean Counties	2/23/1993	Heavy Snow
Multiple Counties	3/4/1993	Heavy Snow
Erie and Warren Counties	3/10/1993	Heavy Snow
Multiple Counties	10/31/1993	Heavy Snow
Erie, Crawford, Warren Counties	12/21/1993	Heavy Snow
Erie, Crawford, Warren Counties	12/25/1993	Heavy Snow
Erie County	12/29/1993	Heavy Snow
Multiple Counties	1/4/1994	Heavy Snow
Southern Erie County	1/15/1994	Heavy Snow
Multiple Counties	1/17/1994	Heavy Snow
Multiple Counties	3/2/1994	Heavy Snow/Blizzard
Erie, Cameron, Crawford, McKean, Warren Counties	3/10/1994	Heavy Snow
Erie, Crawford, Forest, Mercer, Venango Counties	11/23/1994	Heavy Snow
Erie County	1/2/1995	Heavy Snow
Multiple Counties	1/4/1995	Heavy Snow
Multiple Counties	1/7/1995	Ice Storm
Erie, Crawford, Warren Counties	2/5/1995	Heavy Snow
Multiple Counties	2/15/1995	Ice Storm
Erie and Crawford Counties	11/4/1995	Heavy Snow
Erie County	11/8/1995	Heavy Snow
Erie and Crawford Counties	11/15/1995	Heavy Snow
Erie and Crawford Counties	11/21/1995	Heavy Snow
Erie County	12/9/1995	Heavy Snow
Erie and Crawford Counties	12/13/1995	Ice Storm
Erie and Crawford Counties	12/19/1995	Heavy Snow
Erie and Crawford Counties	12/20/1995	Heavy Snow
Erie and Crawford Counties	12/25/1995	Heavy Snow
Erie and Crawford Counties	1/2/1996	Heavy Snow
Erie and Crawford Counties	1/9/1996	Heavy Snow
Erie and Crawford Counties	3/2/1996	Heavy Snow
Northern Erie County	11/2/1996	Heavy Snow

Table 4.3.8-1: Previous winter storm events impacting Erie County since 1994 (NCDC, 2011). Events with the location "Multiple Counties" include Erie County.

LOCATION	DATE	TYPE
Erie and Crawford Counties	11/9/1996	Heavy Snow
Erie County	12/8/1996	Heavy Snow
Northern Erie County	12/20/1996	Heavy Snow
Erie and Crawford Counties	12/24/1996	Heavy Snow
Erie and Crawford Counties	1/6/1997	Heavy Snow
Erie and Crawford Counties	1/16/1997	Heavy Snow
Erie and Crawford Counties	1/26/1997	Heavy Snow
Erie County	2/16/1997	Heavy Snow
Erie and Crawford Counties	3/6/1997	Heavy Snow
Erie and Crawford Counties	10/22/1997	Heavy Snow
Northern Erie County	11/12/1997	Heavy Snow
Erie and Crawford Counties	11/14/1997	Heavy Snow
Erie and Crawford Counties	11/15/1997	Heavy Snow
Southern Erie County	11/23/1997	Heavy Snow
Erie and Crawford Counties	12/5/1997	Heavy Snow
Southern Erie County	12/10/1997	Heavy Snow
Erie and Crawford Counties	12/30/1997	Heavy Snow
Erie County	1/13/1998	Ice, Freezing Rain, Snow
Erie and Crawford Counties	3/10/1998	Heavy Snow
Erie and Crawford Counties	3/14/1998	Heavy Snow
Northern Erie County	3/21/1998	Heavy Snow
Erie and Crawford Counties	12/16/1998	Heavy Snow
Erie and Crawford Counties	12/21/1998	Heavy Snow
Erie and Crawford Counties	12/30/1998	Heavy Snow
Erie and Crawford Counties	1/2/1999	Heavy Snow
Erie and Crawford Counties	1/8/1999	Winter Storm
Erie and Crawford Counties	1/10/1999	Heavy Snow
Erie and Crawford Counties	1/13/1999	Winter Storm
Erie and Crawford Counties	1/14/1999	Heavy Snow
Erie and Crawford Counties	1/16/1999	Heavy Snow
Erie and Crawford Counties	2/12/1999	Heavy Snow
Southern Erie County	3/1/1999	Heavy Snow
Erie and Crawford Counties	3/3/1999	Heavy Snow
Erie and Crawford Counties	3/5/1999	Heavy Snow
Southern Erie County	11/3/1999	Heavy Snow
Erie and Crawford Counties	12/23/1999	Heavy Snow

Table 4.3.8-1: Previous winter storm events impacting Erie County since 1994 (NCDC, 2011). Events with the location "Multiple Counties" include Erie County.

LOCATION	DATE	TYPE
Erie and Crawford Counties	12/27/1999	Heavy Snow
Southern Erie County	1/20/2000	Heavy Snow
Erie and Crawford Counties	1/21/2000	Heavy Snow
Northern Erie County	2/11/2000	Winter Storm
Northern Erie County	2/13/2000	Winter Storm
Erie and Crawford Counties	3/11/2000	Winter Storm
Northern Erie County	11/15/2000	Heavy Snow
Southern Erie County	11/17/2000	Heavy Snow
Erie and Crawford Counties	11/20/2000	Heavy Snow
Erie and Crawford Counties	11/21/2000	Heavy Snow
Erie and Crawford Counties	12/5/2000	Heavy Snow
Erie and Crawford Counties	12/6/2000	Heavy Snow
Erie and Crawford Counties	12/13/2000	Winter Storm
Southern Erie County	12/19/2000	Heavy Snow
Northern Erie County	12/22/2000	Heavy Snow
Erie and Crawford Counties	12/24/2000	Heavy Snow
Erie and Crawford Counties	12/27/2000	Heavy Snow
Southern Erie County	12/31/2000	Heavy Snow
Erie and Crawford Counties	2/2/2001	Heavy Snow
Erie and Crawford Counties	3/5/2001	Heavy Snow
Erie and Crawford Counties	3/26/2001	Heavy Snow
Erie and Crawford Counties	12/20/2001	Heavy Snow
Erie and Crawford Counties	12/28/2001	Heavy Snow
Northern Erie County	12/31/2001	Heavy Snow
Southern Erie County	1/18/2002	Heavy Snow
Erie and Crawford Counties	2/4/2002	Heavy Snow
Erie and Crawford Counties	2/27/2002	Heavy Snow
Erie and Crawford Counties	3/3/2002	Heavy Snow
Erie and Crawford Counties	3/10/2002	Heavy Snow
Erie and Crawford Counties	3/22/2002	Heavy Snow
Erie and Crawford Counties	3/24/2002	Winter Storm
Erie and Crawford Counties	11/22/2002	Heavy Snow
Erie and Crawford Counties	11/27/2002	Heavy Snow
Erie and Crawford Counties	11/30/2002	Heavy Snow
Erie and Crawford Counties	12/1/2002	Heavy Snow
Erie and Crawford Counties	12/24/2002	Heavy Snow

Table 4.3.8-1: Previous winter storm events impacting Erie County since 1994 (NCDC, 2011). Events with the location "Multiple Counties" include Erie County.

LOCATION	DATE	TYPE
Erie and Crawford Counties	1/10/2003	Heavy Snow
Northern Erie County	1/112003	Heavy Snow
Southern Erie County	1/15/2003	Heavy Snow
Northern Erie County	1/26/2003	Heavy Snow
Erie and Crawford Counties	2/24/2003	Heavy Snow
Erie and Crawford Counties	12/17/2003	Heavy Snow
Erie and Crawford Counties	1/6/2004	Winter Storm
Erie and Crawford Counties	1/14/2004	Heavy Snow
Erie and Crawford Counties	1/19/2004	Heavy Snow
Erie and Crawford Counties	1/27/2004	Winter Storm
Erie and Crawford Counties	3/12/2004	Heavy Snow
Erie and Crawford Counties	3/16/2004	Heavy Snow
Erie and Crawford Counties	4/4/2004	Heavy Snow
Erie and Crawford Counties	12/13/2004	Heavy Snow
Erie and Crawford Counties	12/22/2004	Winter Storm
Erie and Crawford Counties	1/5/2005	Winter Storm
Erie and Crawford Counties	1/22/2005	Winter Storm
Erie and Crawford Counties	3/1/2005	Winter Storm
Erie and Crawford Counties	4/2/2005	Winter Storm
Erie and Crawford Counties	11/17/2005	Heavy Snow
Erie and Crawford Counties	11/24/2005	Winter Storm
Erie and Crawford Counties	12/1/2005	Heavy Snow
Erie and Crawford Counties	12/6/2005	Heavy Snow
Southern Erie County	12/19/2006	Heavy Snow
Erie and Crawford Counties	1/24/2006	Heavy Snow
Erie and Crawford Counties	2/5/2006	Winter Storm
Southern Erie County	2/13/2007	Winter Storm
Northern Erie County	2/13/2007	Winter Storm
Erie County	3/16/2007	Heavy Snow
Erie and Crawford Counties	12/15/2007	Winter Storm
Erie and Crawford Counties	1/1/2008	Winter Storm
Erie County	2/12/2008	Winter Storm
Erie and Crawford Counties	2/26/2008	Winter Storm
Erie and Crawford Counties	3/4/2008	Winter Storm
Erie County	3/7/2005	Winter Storm
Erie County	12/19/2008	Winter Storm

Table 4.3.8-1: Previous winter storm events impacting Erie County since 1994 (NCDC, 2011). Events with the location "Multiple Counties" include Erie County.		
LOCATION	**DATE**	**TYPE**
Erie and Crawford Counties	1/27/2009	Winter Storm
Erie County	2/9/2010	Winter Storm
Erie and Crawford Counties	2/25/2010	Winter Storm

4.3.8.4. Future Occurrence

Winter storms are a regular, annual occurrence in Erie County; future occurrence of these events in Erie County can be considered *highly likely* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1). Table 4.3.8-2 shows the probability of receiving measureable snowfall by month in Erie County. These probabilities are based on data collected over a minimum of 20 years. There is slight variation in the probabilities of snowfall, especially in April, May, and October, in different locations in Erie County.

Table 4.3.8-2: Probability of Measurable Snowfall in Erie County by Snow Station Location (NCDC, 2011).				
MONTH	**PROBABILITY (%)**			
	Corry	**Erie WSO ARPT**	**North East 2 SE**	**Union City Filtration Plant**
January	98.7	100	100	100
February	100	100	100	100
March	98.7	100	100	100
April	88.0	81.2	66.7	86.3
May	8.2	2.6	3.6	1.8
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	34.7	24.3	25.0	32.7
November	97.3	96.1	87.5	94.1
December	100	100	100	100

4.3.8.5. Vulnerability Assessment

Based on the information available, all communities in Erie County are essentially equally vulnerable to the direct impacts of winter storms. However, some municipalities are affected more by travelers who are not able to drive on the interstates and major roads in the County during heavy snow conditions. These roads are hard or impossible to travel until the storm is over and plowing can be the most successful in clearing the roads. New York State officials have closed I-90 during severe winter storms, because of the high winds and heavy snow. As a result of the road closure, travelers are forced in seeking shelter in the northeastern section of the Erie County, especially in North East Township and North East Borough.

Major sources of vulnerability in Erie County include the ability to provide heat to residents and travelers in the case of power outages and the ability of emergency responders to travel to areas where residents and travelers are in distress. Heavy snow and ice can result in power outages across the County, which would result in many households to go without a heating source as well. While approximately 102 shelters have been identified in Erie County by the American Red Cross, relatively few have generating capabilities to provide heat (ECEMA, 2010). Sheltering large numbers of people in warming centers would be difficult in Erie County, and loss of power could pose an immediate threat to human life in below freezing temperatures.

Heavy snow or ice storms can also paralyze all forms of transportation in Erie County for days at a time. In addition to putting a strain on municipalities who have to shelter travelers during these circumstances, this can also hinder emergency management and public safety officials in performing their jobs of transporting people to shelters or transporting resources to individuals. Residents who live in more rural areas of Erie County, or who are in need of special assistance are the most vulnerable to these effects.

Vulnerability to the effects of winter storms on buildings is partly dependent on the age of the building type, construction material used and condition of the structure. Table 4.3.8-3 below shows that a majority of housing units in Erie County have been built since 1940 (US Census ACS, 2005-2009). However, there are still a large amount – 34,206 structures or 28.93% of the total in Erie County – of housing units which were built over 60 years ago. This does not account for non-residential building occupancies; this information is not collected by the County or federal governments. Additional information on construction type and building codes enforced at time of construction would allow a more thorough assessment of the vulnerability of structures to winter storm impacts such as severe wind and heavy snow loading. Based on the available information some of the smaller municipalities have the largest portion of their housing stock which was built before 1940, including: Cranesville Borough, McKean Borough, and Wattsburg Borough. However, two larger boroughs also have a majority of their houses built before 1940: North East Borough and Union City Borough. Additionally, a large number of Erie City's houses are over 60 years old – 20,352 units or 44.2% of the total housing units in the city.

Table 4.3.8-3: Age of Housing Units in Erie County (US Census, ACS, 2005-2009).

Municipality	Number of Housing Units Built Prior to 1940	Percent of Total Housing Units
Albion Borough	281	39.75%
Amity Township	100	27.93%
Concord Township	165	28.95%
Conneaut Township	179	23.68%
Corry City	1,264	46.15%
Cranesville Borough	120	52.86%
Edinboro Borough	284	9.58%
Elgin Borough	38	43.18%
Elk Creek Township	210	29.49%
Erie City	20,352	44.30%

Table 4.3.8-3: Age of Housing Units in Erie County (US Census, ACS, 2005-2009).		
Municipality	**Number of Housing Units Built Prior to 1940**	**Percent of Total Housing Units**
Fairview Township	551	14.47%
Franklin Township	149	22.85%
Girard Borough	301	21.97%
Girard Township	352	16.93%
Greene Township	168	8.95%
Greenfield Township	135	18.34%
Harborcreek Township	837	13.40%
Lake City Borough	520	43.23%
Lawrence Park Township	644	46.36%
LeBoeuf Township	203	31.38%
McKean Borough	89	53.29%
McKean Township	264	14.36%
Millcreek Township	1,760	7.67%
Mill Village Borough	69	40.35%
North East Borough	890	50.54%
North East Township	705	25.22%
Platea Borough	66	34.92%
Springfield Township	364	25.51%
Summit Township	311	12.43%
Union Township	213	29.54%
Union City Borough	901	57.83%
Venango Township	236	27.10%
Washington Township	241	14.18%
Waterford Borough	215	36.44%
Waterford Township	236	14.45%
Wattsburg Borough	87	58.39%
Wayne Township	159	23.80%
Wesleyville Borough	547	37.59%
TOTAL	**34,206**	**28.93%**

Because of the frequency of winter storms, strategies have been developed to respond to these events. Snow removal and utility repair equipment is present to respond to typical events. The use of auxiliary heat and electricity supplies such as wood burning stoves, kerosene heaters and gasoline power generators reduces the vulnerability of humans to extreme cold temperatures commonly associated with winter storms. People residing in structures lacking adequate equipment to protect against cold temperatures or significant snow and ice are more vulnerable to winter storm events. Even for communities that are prepared to respond to winter storms, severe events involving snow accumulations that exceed six or more inches in a twelve hour period can cause a large number of traffic accidents, strand motorists due to snow drifts,

interrupt power supply and communications, and cause the failure of inadequately designed and/or maintained roof systems.

HUMAN-MADE HAZARDS

4.3.9. Dam Failure

Due to sensitivity issues, the Dam Failure profile can be found in **Appendix G**.

4.3.10. Environmental Hazards

4.3.10.1. Location and Extent

A. HAZARDOUS MATERIALS RELEASE

Environmental hazards in Erie County are primarily caused by hazardous material releases. Hazardous materials fall into several categories, such as flammable and combustible materials, compressed gases, explosive and blasting agents, radioactive materials, oxidizing materials, poisons, and corrosive liquids. Hazardous materials incidents are generally unintentional, and associated with transportation accidents or accidents at fixed facilities. However, hazardous materials can be released as a criminal or terrorist act. These releases can result in injury and death and may contaminate air, water and soils.

Facilities that use, manufacture, or store hazardous materials in Pennsylvania must comply with both Title III of the federal Superfund Amendments and Reauthorization Act (SARA), also known as the Emergency Planning and Community Right-to-Know Act (EPCRA), and the Commonwealth's reporting requirements under the Hazardous Materials Emergency Planning and Response Act (1990-165), as amended. The community right-to-know reporting requirements keep communities abreast of the presence and release of chemicals at individual facilities. EPCRA was designed to ensure that state and local communities are prepared to respond to potential chemical accidents through Local Emergency Planning Committees (LEPCs). LEPCs are charged with developing emergency response plans for SARA Title III facilities; these plans cover the location and extent of hazardous materials, establish evacuation plans, response procedures, methods to reduce the magnitude of a materials release, and establish methods and schedules for training and exercises. There are 247 SARA Title III facilities in Erie County, 88 of which hold extremely hazardous substances (ECEMA, 2010).

Because SARA Title III facilities are covered under their own unique planning process and are continually evaluated through the LEPC, this Hazard Mitigation Plan will focus on the Environmental Protection Agency (EPA)-identified hazardous materials sites. This dataset, publicly available at http://www.epa.gov/enviro/geo_data.html, includes a number of materials facilities including:

- Superfund National Priorities List (NPL) sites,
- RCRAInfo (EPA and state treatment, storage, disposal) facilities,
- Toxic Release Inventory System (TRI) sites,
- Integrated Compliance Information System (ICIS) and Permit Compliance System (PCS) - National Pollutant Discharge Elimination System (NPDES) Majors,
- RCRAInfo - Large Quantity Generators (LQG),
- Air Facility System (AFS) - Major discharges of air pollutants,

- RCRAInfo - Corrective Actions,
- Risk Management Plan,
- Section Seven Tracking System Sites (Pesticides), and
- ACRES - Brownfields Properties.

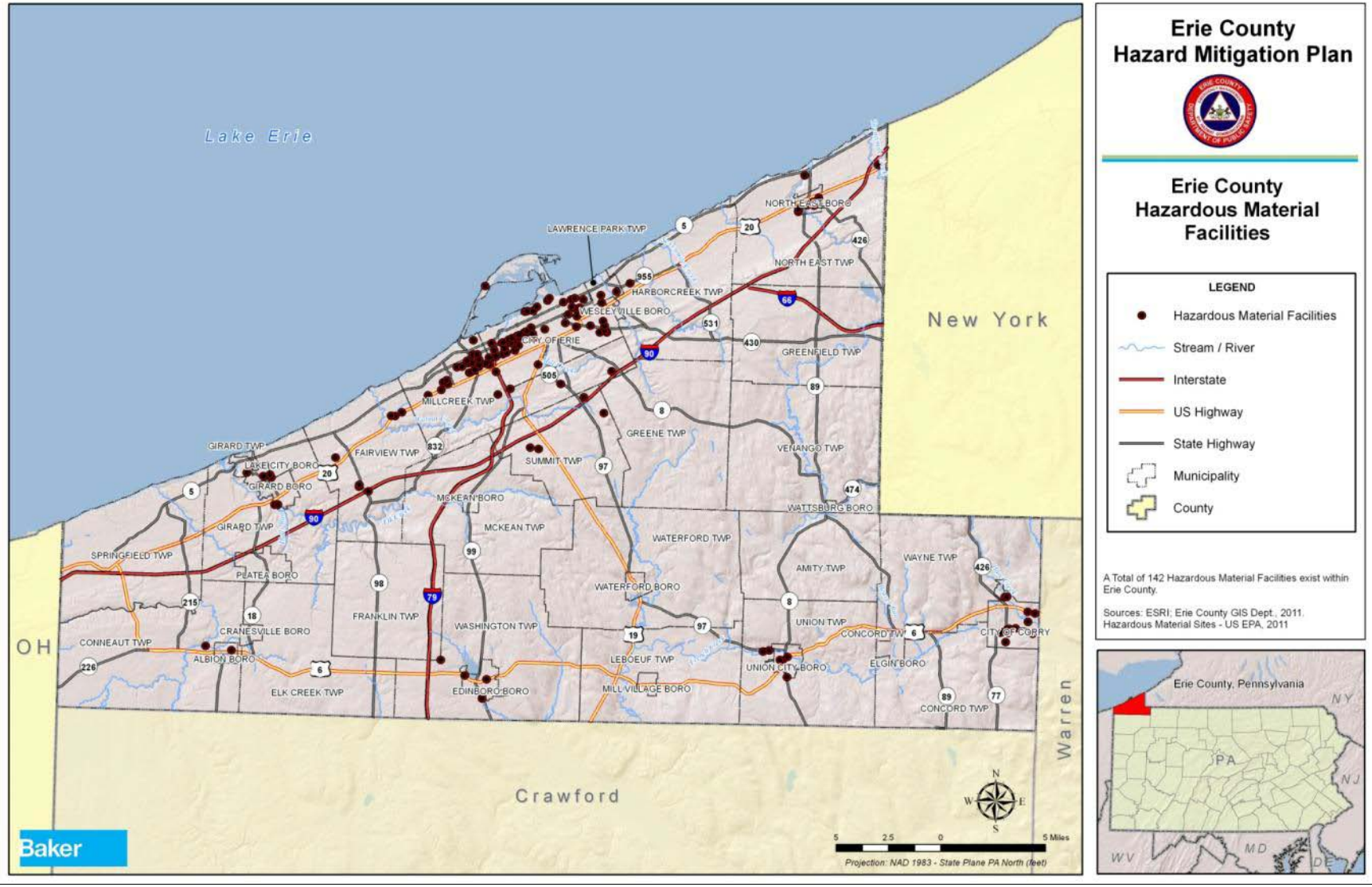
Using this dataset will help to provide a more complete picture of the risk of hazardous materials releases in the County. There are 142 EPA-identified hazardous materials sites throughout Erie County. The City of Erie has the most hazardous materials facilities in the County with 60; Millcreek Township has the next highest amount of facilities with 26. Other jurisdictions hosting TRI sites include Conneaut, Fairview, Girard, Harborcreek, Lawrence Park, North East, Summit, Union, and Washington Townships; Albion, Edinboro, Girard, Lake City, North East, and Union City Boroughs; and the City of Corry. The number of facilities in each municipality is listed in Table 4.3.10-2.

There are also several pipe lines, pump stations and terminals for transport and distribution of petroleum products, including numerous gas utility lines throughout the county. Each of these lines and facilities pose certain level of risk depending on the types of materials and their proximity to the population centers in the county.

Transportation of hazardous materials on highways involves tanker trucks or trailers. Unsurprisingly, large trucks are responsible for the greatest number of hazard material release incidents. Hazardous material releases from rail transport are also of concern due to collisions and derailments that result in large spills.

Erie County is second only to Philadelphia County for the amount of hazardous materials being transported in the Commonwealth of Pennsylvania (ECEMA, 2010). Erie County has an extensive highway and railway network that pose a high risk for hazardous material incidents. These networks transport hazardous material daily, on interstates 79 and 90, as well as US and Pennsylvania Routes 5, 6, 8, 19, and 20. These major roads pass through very populous areas. Similarly, the rail lines pass through cities and boroughs where large numbers of people could be vulnerable should a serious accident occur in these places. Both high and low level nuclear material and waste is transported through Erie County on I-79 and I-90. These major transportation routes are shown in Figure 4.3.10-1 while Figure 4.3.12-3 shows truck traffic volume throughout the County.

Figure 4.3.10-1: Erie County hazardous material facilities and major roadways (EPA, 2011).



B. OIL AND GAS WELL INCIDENTS

There are both active and inactive oil and gas wells located across Erie County. The majority of the existing wells – almost 3,000 – are active, over 600 are inactive, while less than 200 are abandoned. Figure 4.3.10-2 shows the location of all active and abandoned oil and gas wells in Erie County. According to the Department of Environmental Protection, all but two municipalities – Elgin Borough and McKean Borough – in Erie County has an active, inactive, or abandoned well within its boundaries, as seen in Table 4.3.10-1.

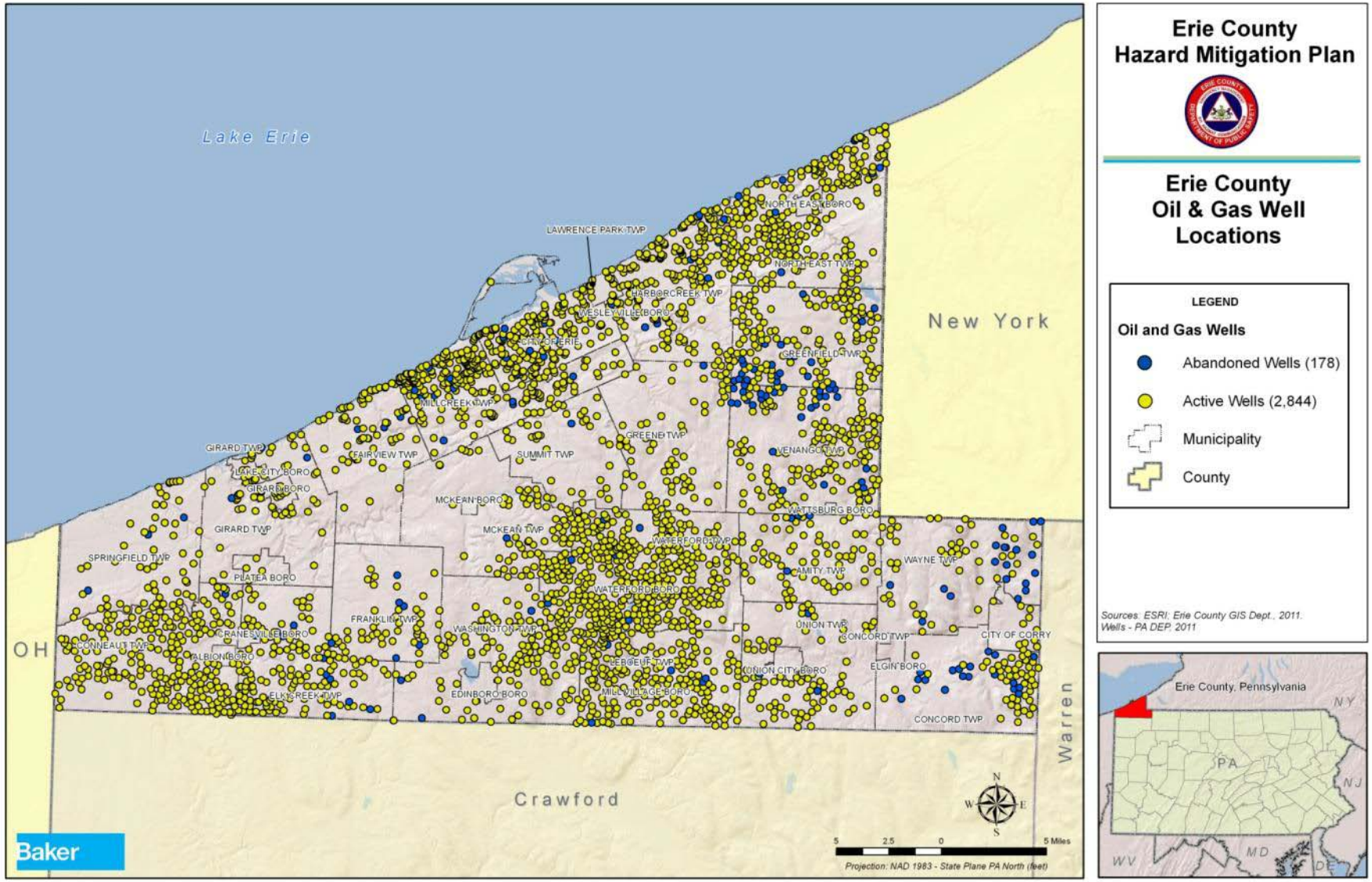
There are both active and inactive oil and gas wells located across Erie County. The majority of the existing wells – almost 3,000 – are active, over 600 are inactive, while less than 200 are abandoned. Figure 4.3.10-2 shows the location of all active and abandoned oil and gas wells in Erie County. According to the Department of Environmental Protection, all but two municipalities – Elgin Borough and McKean Borough – in Erie County has an active, inactive, or abandoned well within its boundaries, as seen in Table 4.3.10-1. Of the wells found in Figure 4.3.10-2, 23 are owned by National Fuel Gas Supply Corporation, all but one of which are inactive at this time. Additionally, according to the Pennsylvania State Hazard Mitigation Plan, Erie County hosts 151 miles of gas pipeline, including empty gas, hydrogen gas, natural gas, nitrogen, and other gas (PA PUC, 2010). The National Pipeline Mapping System indicates that most of these pipelines are owned by National Fuel Gas Supply Corporation, though Tennessee Gas pipeline Company operates a 12-mile segment that runs through the eastern side of the County from Crawford County to Chautauqua County, New York (US Pipeline and Hazardous Materials Safety Administration, 2010).

Table 4.3.10-1: Oil and gas wells in Erie County (DEP, 2011).

MUNICIPALITY	ABANDONED WELLS	ACTIVE WELLS	INACTIVE WELLS	PROPOSED WELLS	TOTAL WELLS
Albion Borough	-	4	-	-	**4**
Amity Township	4	65	16	33	**118**
Concord Township	18	47	9	40	**114**
Conneaut Township	1	223	63	18	**305**
Corry City	-	10	-	1	**11**
Cranesville Borough	1	-	1	2	**4**
Edinboro Borough	-	-	3	1	**4**
Elk Creek Township	9	136	27	7	**179**
Erie City	9	168	70	9	**256**
Fairview Township	5	64	10	2	**81**
Franklin Township	7	49	6	12	**74**

Table 4.3.10-1: Oil and gas wells in Erie County (DEP, 2011).					
MUNICIPALITY	**ABANDONED WELLS**	**ACTIVE WELLS**	**INACTIVE WELLS**	**PROPOSED WELLS**	**TOTAL WELLS**
Girard Borough	-	19	-	1	**20**
Girard Township	3	39	-	5	**47**
Greene Township	1	72	9	52	**134**
Greenfield Township	21	120	25	37	**203**
Harborcreek Township	9	212	13	9	**243**
Lake City Borough	-	13	1	-	**14**
Lawrence Park Township	-	12	4	-	**16**
LeBoeuf Township	6	190	54	39	**289**
McKean Township	1	65	24	20	**110**
Mill Village Borough	-	6	1	1	**8**
Millcreek Township	12	221	43	24	**300**
North East Borough	-	4	4	-	**8**
North East Township	8	212	20	5	**245**
Platea Borough	-	5	1	-	**6**
Springfield Township	3	58	43	8	**112**
Summit Township	1	39	15	8	**63**
Union City Borough	-	1	-	1	**2**
Union Township	3	81	7	45	**136**
Venango Township	27	140	32	54	**253**
Washington Township	3	125	59	32	**219**
Waterford Borough	-	13	-	2	**15**
Waterford Township	6	375	31	29	**441**
Wattsburg Borough	-	1	-	-	**1**
Wayne Township	19	48	21	3	**91**
Wesleyville Borough	1	7	1	-	**9**
TOTAL	**178**	**2844**	**613**	**500**	**4135**

Figure 4.3.10-2: Oil and Gas wells in Erie County (PA DEP, 2011).



4.3.10.2. Range of Magnitude

A. HAZARDOUS MATERIALS RELEASE

Hazardous material releases can contaminate air, water and soils, possibly resulting in death and/or injuries. Dispersion can take place rapidly when transported by water and wind. While often accidental, releases can occur as a result of human carelessness, intentional acts, or natural hazards. When caused by natural hazards, these incidents are known as secondary events. Hazardous materials can include toxic chemicals, radioactive materials, infectious substances and hazardous wastes. Such releases can affect nearby populations and contaminate critical or sensitive environmental areas.

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

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

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

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

The worst hazardous material release incident occurred in 2002. A chlorine leak caused the evacuation of the guests of a hotel in Summit Township. Twenty-two persons were injured during this event.

B. OIL AND GAS WELL INCIDENTS

Oil and gas well drilling can have a variety of effects on the environment. Abandoned oil and gas wells which are not properly plugged can contaminate groundwater and consequently drinking water wells. Surface waters and soil are sometimes polluted by brine, a salty wastewater product of oil and gas well drilling, and from oil spills occurring at the drilling site or from a pipeline breach. This can spoil public drinking water supplies and be particularly detrimental to vegetation and aquatic animals.

Natural gas well fires occur when natural gas is ignited at the well site. Often, these fires erupt during drilling when a spark from machinery or equipment ignites the gas. The initial explosion and resulting flames have the potential to seriously injure or kill individuals in the immediate area. These fires are often difficult to extinguish due to the intensity of the flame and the abundant fuel source. A worst case scenario for oil and gas well incidents would be if there was an explosion at a gas well, causing groundwater contamination and injuries to workers.

4.3.10.3. Past Occurrence

The number and quantity of hazardous materials being produced, stored and transported continue to increase each year in Pennsylvania. Cumulatively, EPA TRI records indicate that there have been a total of 86,796,098 pounds of chemicals released from fixed sites in Erie County between 1987 and 2008 (EPA, 2008). Also, the number of oil and gas wells could increase if the proposed well sites seen in Table 4.3.10-1 are put into operation.

According to Erie County, between 1980 and 1993 there were 87 occurrences involving hazardous materials, oil, or gas both in transit and at a fixed site location, with no fatalities but 28 injuries resulting from these incidents. More recent data of incidents was compiled from 2002 to 2010 using data from the Pennsylvania Emergency Incident Reporting System (PIERS) and the Erie County Emergency Management Agency. Since the PIERS data is from a voluntary reporting system this is not a complete data set. This system collected data through June 2009. Additionally, the 2010 Hazard Vulnerability Analysis only provided information for incidents in Erie County from January to October 2010, so there is a gap in reporting from June 2009 and January 2010, as well as after October 2010. These release incidents are described in Table 4.3.10-2.

Table 4.3.10-2: Previous hazardous materials incidents in Erie County between 2002 and 2010 (ECEMA, 2010; PIERS, 2002-2009).

DATE	LOCATION	MATERIAL INVOLVED	TYPE OF INCIDENT/DETAILS
2/15/2002	Millcreek Township	Unknown	Chemical Release
4/26/2002	Millcreek Township	Unknown	Chemical Release
10/8/2002	City of Erie	Hydrofloric Acid	Chemical Release - 488 pounds released into atmosphere
12/31/2002	Summit Township	Chlorine	Chemical Release - Leak caused evacuation of hotel, 22 injured

Table 4.3.10-2: Previous hazardous materials incidents in Erie County between 2002 and 2010 (ECEMA, 2010; PIERS, 2002-2009).

DATE	LOCATION	MATERIAL INVOLVED	TYPE OF INCIDENT/DETAILS
3/12/2003	City of Erie	Ethylene Oxide	Chemical Release - Released inside a tank room at the Veteran Administration Health Center
7/23/2003	McKean Township	Naptha	Chemical Spill - Leaked during transit due to equipment failure in tanker truck
3/30/2004	Washington Township	Diesel Fuel	Oil Spill - 100 gallons entered Lake Edinboro through a storm drain
4/8/2004	Springfield Township	Printer's Paint	Chemical Spill - Leak from a tractor trailer at truck stop
6/4/2004	Harborcreek Township	Unknown	Chemical Spill - 5,000 pounds of an acidic powdery material dumped at business
6/21/2004	Summit Township	Sodium Chloride and Sodium Hydrochlorite	Chemical Spill - 3,824 gallons spilled from tanked which exploded onto the ground on I-90
8/10/2004	City of Erie	Perchloroethylene	Chemical Spill - 16 gallons spilled at dry cleaning business
8/11/2004	Summit Township	Chemical waste	Chemical Spill - Spill from truck onto the ground at truck stop
9/25/2004	City of Erie	Ammonia	Chemical Release - Unknown quantity released from faulty pipe, 2 injuries were reported
10/7/2004	City of Erie	Unknown	Chemical Release
10/25/2004	Franklin Township	Propane	Propane Release - Propane tanker truck released material after traffic accident, Routes 6 and 98 were closed and residents in half mile radius were evacuated
11/3/2004	Harborcreek Township	Waste Material containing PCB	Chemical Release - Tanker truck caught fire at truck stop, truck stop was evacuated
12/4/2004	City of Erie	Anhydrous Ammonia	Chemical Release - Released from malfunctioning equipment at plant
9/7/2005	Conneaut Township	Natural Gas	Natural Gas Release - Release occurred after gas well head was sheared off by a vehicle, residences nearby were evacuated
11/7/2005	North East Borough	Anhydrous Ammonia	Chemical Release - 100 pounds released as a result of a malfunctioning relief valve
11/9/2005	City of Erie	Battery Acid	Chemical Spill - 16 gallons spilled from batteries that fell off of locomotive of CSX Railroad
6/1/2006	Harborcreek Township	Natural Gas	Natural Gas Release - Released when a tractor ran over a wellhead, nearby residences were evacuated
6/8/2006	City of Erie	Oil	Oil Spill - An undetermined quantity washed onto ground

Table 4.3.10-2: Previous hazardous materials incidents in Erie County between 2002 and 2010 (ECEMA, 2010; PIERS, 2002-2009).

DATE	LOCATION	MATERIAL INVOLVED	TYPE OF INCIDENT/DETAILS
9/12/2006	Millcreek Township	Acid	Chemical Release - Chemical reaction occurred in an acid tank, employees of corporation evacuated
12/6/2006	City of Erie	Nitric Acid	Chemical Release - An unknown chemical mixed with nitric acid and caused a release
4/24/2007	Harborcreek Township	Natural Gas	Natural Gas Release - Occurred at a private well
9/20/2007	Millcreek Township	Nitric Acid	Chemical Release - An undetermined quantity was released from malfunctioning equipment
9/20/2007	Harborcreek Township	Chromic Acid	Chemical Release - Off gassing occurred at a truck stop
11/20/2007	Millcreek Township	Natural Gas	Natural Gas Release - Gas well leaked, nearby residences were evacuated
1/22/2008	Wattsburg	Propane	Propane Release - Propane tanker truck overturned during a vehicle accident
2/5/2008	City of Erie	Propane	Propane Release - Cylinder containing propane ruptured in a basement
5/9/2008	City of Corry	Natural Gas	Well Fire - Gas well fire
6/9/2008	City of Erie	Oil	Oil Spill
8/31/2008	Wesleyville	Petroleum	Chemical Spill - Petroleum was spilled from a tanker truck
10/6/2008	Harborcreek Township	Carbon Dioxide	Chemical Release - Release from malfunctioning equipment on a tank car on CSX train
2/19/2009	City of Erie	Petroleum	Oil Spill
5/21/2009	Washington Township	Propane	Propane Release - Released after a valve was ruptured at a construction site, a dormitory was evacuated
1/8/2010	City of Erie	Gasoline	Chemical Spill
1/20/2010	Girard Township	Flammable Liquid	Chemical Spill - Spill after tanker truck was involved in a vehicle accident
3/3/2010	Harborcreek Township	Fuel	Chemical Spill
3/30/2010	Millcreek Township	Diesel Fuel	Chemical Spill
4/8/2010	North East Borough	Chemical spill	Chemical Spill
4/12/2010	Springfield Township	Fuel	Chemical Spill
4/30/2010	City of Erie	Hazardous Material	Hazardous Materials Incident
6/24/2010	Harborcreek Township	Flammable Liquid	Chemical Spill - A leaking tanker released material
6/29/2010	Springfield Township	Chemical spill	Chemical Spill

Table 4.3.10-2: Previous hazardous materials incidents in Erie County between 2002 and 2010 (ECEMA, 2010; PIERS, 2002-2009).

DATE	LOCATION	MATERIAL INVOLVED	TYPE OF INCIDENT/DETAILS
7/28/2010	Edinboro Borough	Hazardous Material	Chemical Spill - Into lake
8/2/2010	Millcreek Township	Fuel	Chemical Spill
8/7/2010	Wesleyville	Fuel	Chemical Spill
8/7/2010	City of Erie	Fuel	Chemical Spill
10/7/2010	Summit Township	Fuel	Chemical Spill
10/11/2010	City of Erie	Natural Gas	Natural Gas Release - BASF HazMat Incident

4.3.10.4. Future Occurrence

While many incidents involving hazardous materials, oil, and gas releases have occurred in Erie County in the past, it is difficult to predict the time and magnitude of an incident into the future. However, future occurrence of these releases can be considered *highly likely* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1). Any occurrence is largely dependent upon the accidental or intentional actions of a person or group.

A. HAZARDOUS MATERIALS RELEASE

The Erie County Emergency Management Agency has noted an increase of transportation accidents involving hazardous materials in the Hazard Vulnerability Analysis, which is expected to increase. In addition, population growth can expose more people to these hazards (ECEMA, 2010).

B. OIL AND GAS WELL INCIDENTS

It is difficult to predict which oil and gas wells will lead to environmental hazard situations. There are 500 proposed well sites which have not yet materialized, which may increase the likelihood of oil and gas well incidents. However, stringent monitoring through the Pennsylvania Department of Environmental Protection will reduce the likelihood of potential impacts to the community and the environment.

4.3.10.5. Vulnerability Assessment

A. HAZARDOUS MATERIALS RELEASE

Jurisdictions that are home to one or more of the TRI facilities should be considered vulnerable to hazardous materials releases from fixed facilities. Table 4.3.10-2 illustrates the number of TRI sites by municipality in Erie County. The City of Erie has over twice as many facilities as Millcreek Township, which has the second highest amount of facilities in the County. The City of Corry is the only other municipality which has over ten EPA-identified TRI facilities. Amity, Concord, Elk Creek, Franklin, Greene, Greenfield, LeBoeuf, McKean, Springfield, Venango, Waterford, and Wayne Townships and Cranesville, Elgin, McKean, Mill Village, Platea,

Waterford, Wattsburg, and Wesleyville Boroughs face a lower relative vulnerability to fixed hazardous materials incidents because they have no TRI facilities.

Populations in and around the communities that are home to TRI sites are more vulnerable to facility releases, particularly those within 1.5 miles of the facility. Table 4.3.10-3 also shows the number of addressable structures and critical facilities within 1.5 miles of hazardous materials sites. Unsurprisingly, as the jurisdiction with by far the most TRI facilities, Erie City has the highest number of addressable structures within 1.5 miles with 37,720 and the highest number of critical facilities vulnerable to fixed hazardous materials incidents with 60. Millcreek Township has 21,009 addressable structures and 36 facilities within a 1.5 mile buffer of the TRI facilities. Corry City, Edinboro Borough, Fairview Township, Girard Borough, Girard Township, Harborcreek Township, Lake City Borough, Lawrence Park Township, North East Borough, North East Township, Summit Township, Union City Borough, and Wesleyville Borough all have over 1,000 addressable structures within 1.5 miles of a fixed hazardous material site.

It is important to note that even if a jurisdiction houses no hazardous materials sites, it may be vulnerable to a release event occurring in an adjacent municipality. Concord Township, Cranesville Borough, Elk Creek Township, Green Township, LeBoef Township, McKean Township, and Platea Borough have addressable structures within a 1.5 mile buffer of a TRI facility, even though these municipalities do not have any facilities within their borders.

Table 4.3.10-3: TRI facilities per municipality (EPA, 2008).

MUNICIPALITY	NUMBER OF TRI FACILITIES	TOTAL ADDRESSABLE STRUCTURES WITHIN 1.5 MILE BUFFER OF HAZARDOUS MATERIAL SITES	TOTAL CRITICAL FACILITIES WITHIN 1.5 MILE BUFFER OF HAZARDOUS MATERIAL SITES
Albion Borough	1	670	4
Amity Township	0	0	0
Concord Township	0	124	1
Conneaut Township	1	318	3
Corry City	13	2,913	11
Cranesville Borough	0	237	2
Edinboro Borough	2	1,496	6
Elgin Borough	0	0	0
Elk Creek Township	0	130	0
Erie City	60	37,720	60
Fairview Township	7	3,329	9
Franklin Township	0	42	0
Girard Borough	2	1,284	6
Girard Township	1	1,704	3
Greene Township	0	333	0

Table 4.3.10-3: TRI facilities per municipality (EPA, 2008).			
MUNICIPALITY	**NUMBER OF TRI FACILITIES**	**TOTAL ADDRESSABLE STRUCTURES WITHIN 1.5 MILE BUFFER OF HAZARDOUS MATERIAL SITES**	**TOTAL CRITICAL FACILITIES WITHIN 1.5 MILE BUFFER OF HAZARDOUS MATERIAL SITES**
Greenfield Township	0	0	0
Harborcreek Township	1	3,252	5
Lake City Borough	5	1,112	5
Lawrence Park Township	2	1,673	6
LeBoeuf Township	0	18	0
McKean Borough	0	0	0
McKean Township	0	27	0
Mill Village Borough	0	0	0
Millcreek Township	26	21,009	36
North East Borough	7	1,685	6
North East Township	2	1,948	6
Platea Borough	0	4	0
Springfield Township	0	0	0
Summit Township	4	2,497	6
Union City Borough	4	1,294	5
Union Township	2	364	1
Venango Township	0	0	0
Washington Township	2	957	2
Waterford Borough	0	0	0
Waterford Township	0	0	0
Wattsburg Borough	0	0	0
Wayne Township	0	178	0
Wesleyville Borough	0	1,495	2
TOTAL	**142**	**87,813**	**185**

Shipping on Lake Erie waterways poses another threat to the shoreline and populace of Erie County, specifically to the City of Erie. The Port of Erie is located in Presque Isle Bay which has significant shipping activity during the shipping season. Many of the barges and ships which stop in Erie are carrying hazardous materials throughout the Great Lakes Region and could cause a major impact if an accident occurred.

In 2007 the Pennsylvania Emergency Management Agency rated Erie County among fourteen counties as having high risk from hazardous material release (PEMA, 2007). Transportation carriers must have response plans in place to address accidents, otherwise the local emergency

response team will step in to secure and restore the area. Quick response minimizes the volume and concentration of hazardous materials that disperse through air, water and soil. Populations living within ¼ mile of major highways and railways should also be considered more vulnerable in the event of a transportation incident involving hazardous materials. For more information on the numbers of addressable structures located within ¼ mile of major highways and railways, please see Section 4.3.11.5.

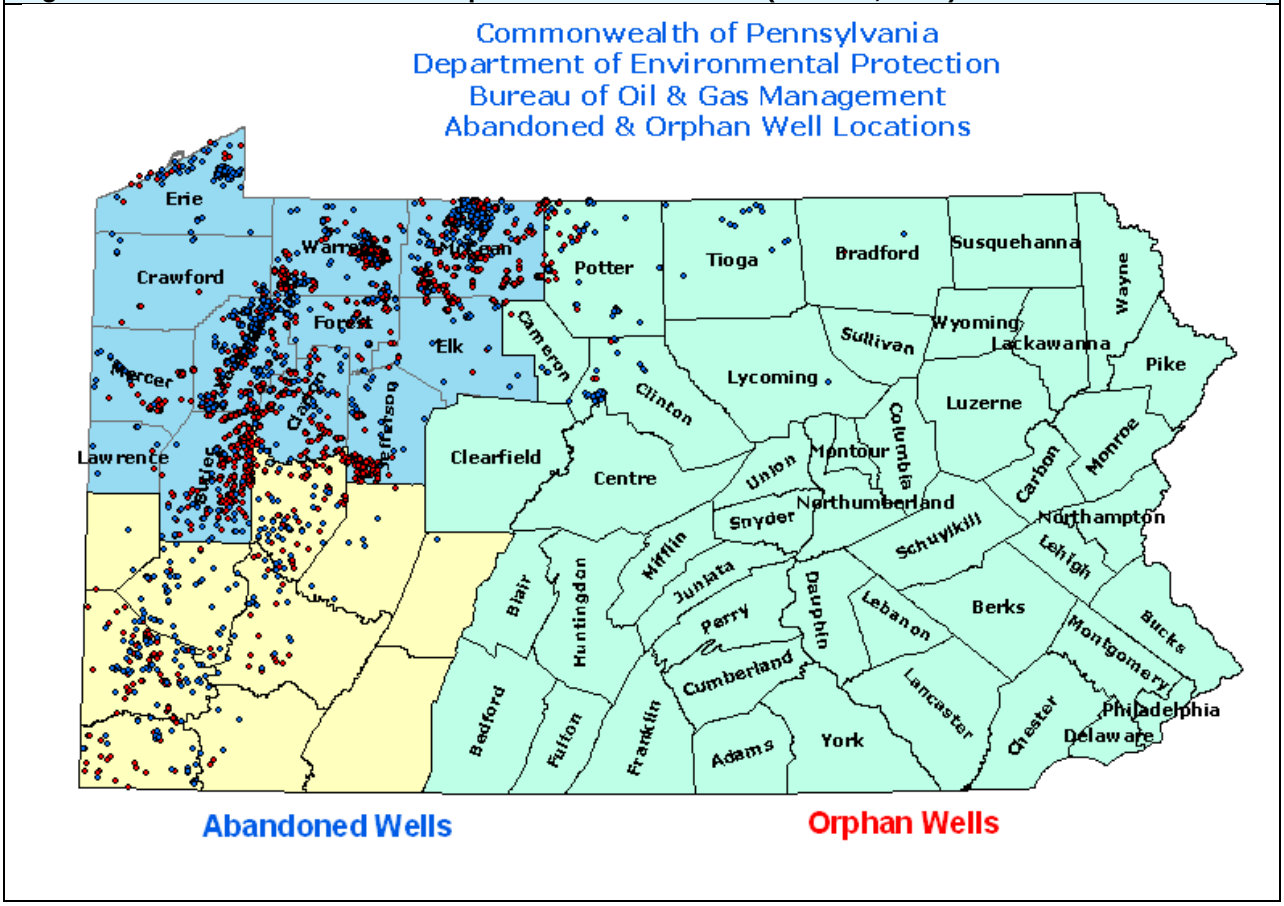
B. OIL AND GAS WELL INCIDENTS

All municipalities in Erie County are vulnerable on some level, directly or indirectly, to environmental hazards resulting from oil and gas well activity. Surface waters closest to well sites are most vulnerable to damage and oil and gas industry workers are most likely to be affected by gas well fires.

Private water supplies such as domestic drinking water wells in the vicinity of oil and gas wells are at risk of contamination from brine and other pollutants including methane which can pose a fire hazard. Ideally vulnerability of private drinking well owners would be established by comparing distance of drinking water well to known oil and gas well locations but this data is not available at this time. Private drinking water is largely unregulated and information on these wells is voluntarily submitted to the Pennsylvania Topographic and Geologic Survey by water well drillers via the PaGWIS, discussed in Section 4.3.2.5.

In order to reduce the vulnerability of communities to oil and gas well incidents, especially the environmental and health concerns posed by abandoned mines, the PA DEP instituted the Abandoned and Orphaned Well program. This program plugs abandoned and orphaned wells with no responsible owner and that were never subject to a bonding requirement, but the program's focus is on plugging wells that have the potential to cause health, safety, or environmental concerns. As is shown in Figure 4.3.10.3, there are a number of abandoned and orphan wells located in Erie County, but the DEP does not indicate which, if any, of Erie County's abandoned wells have been prioritized by causing health, safety, or environmental problems.

Figure 4.3.10-3: Abandoned and Orphaned Well Locations (PA DEP, 2011).



4.3.11. Nuclear Incident

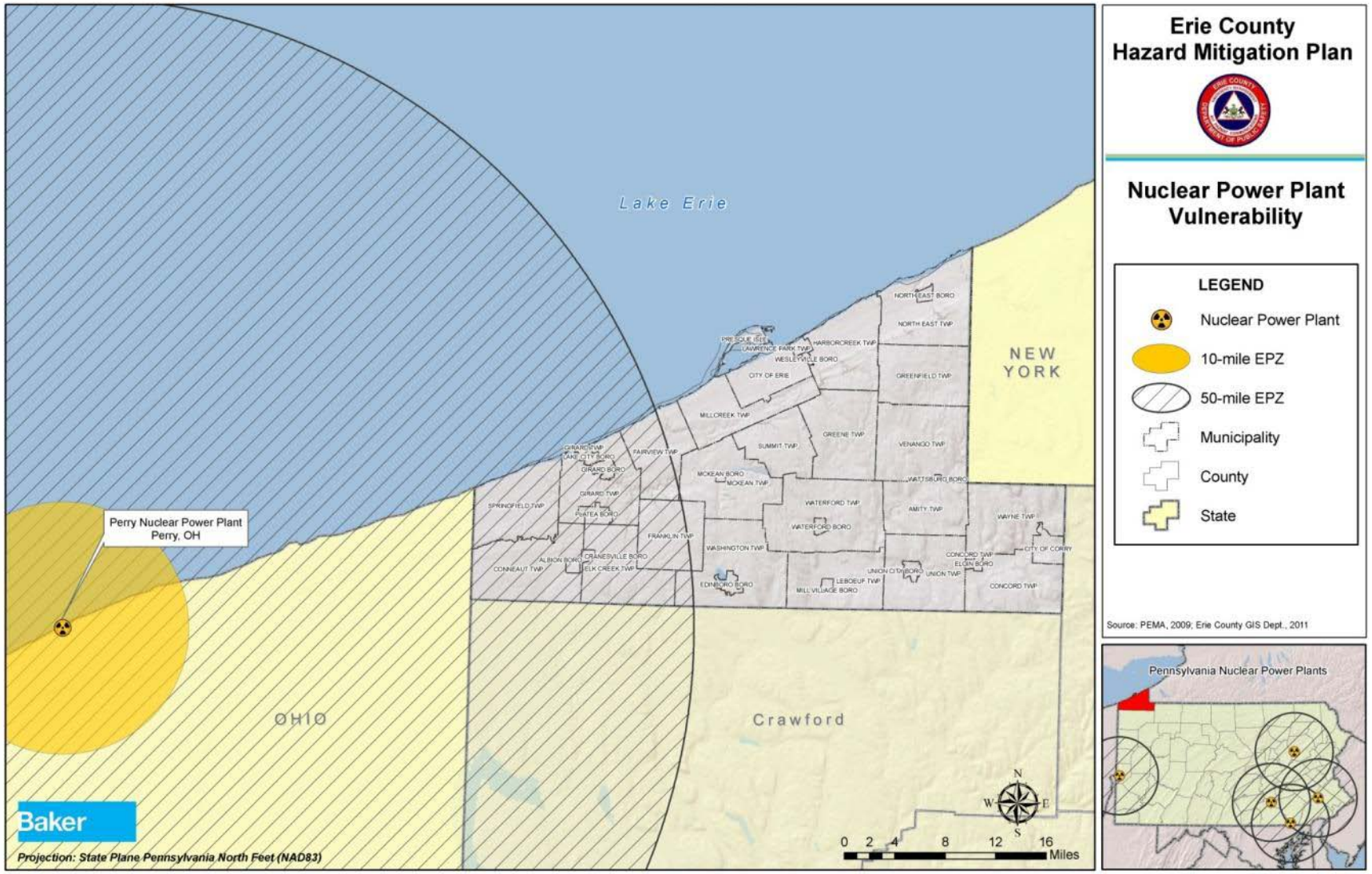
4.3.11.1. Location and Extent

Nuclear Incidents generally refer to events involving the release of significant levels of radioactivity or exposure of workers or the general public to radiation. The Nuclear Regulatory Commission encourages the use of Probabilistic Risk Assessments to quantitatively estimate the potential risk to public health and safety considering the design, operations and maintenance practices at nuclear power plants. Probabilistic Risk Assessments typically focus on accidents that can severely damage the core and that may challenge containment. FEMA, PEMA and county governments have formulated Radiological Emergency Response Plans to prepare for radiological emergencies at the five nuclear power generating facilities in the Commonwealth of Pennsylvania. These plans include a *Plume Exposure Pathway Emergency Planning Zone (EPZ)* with a radius of ten miles from each nuclear power facility and an *Ingestion Exposure Pathway EPZ* with a radius of fifty miles from each facility.

Erie County is not located within the ten-mile Plume Exposure Pathway EPZ. However, the western portion of the County is within the fifty-mile Ingestion Exposure Pathway EPZ of the Perry Nuclear Power Plant in Perry, Ohio (see Figure 4.3.11-1). The municipalities within the Plume Exposure Pathway EPZ include Springfield Township, Conneaut Township, Albion Borough, Girard Township, Lake City Borough, Girard Borogh, Platea Borough, Cranesville

Borough, Elk Creek Township, Franklin Township, and Fairview Township. There are no other nuclear facilities within a hazardous range of Erie County, and the majority of County is not within the EPZ from the Perry Nuclear Power Plant. However, there could be increased exposure in other parts of Erie County to the Ingestion Exposure Pathway EPZ from the Perry Nuclear Facility or another nuclear facility to the southwest of the County due to distribution of the plume along prevailing winds in that direction. Additionally, in the event of a nuclear emergency, evacuees from distant EPZs may seek shelter in Erie County.

Figure 4.3.11-1: EPZ coverage in Erie County (PEMA, 2009).



4.3.11.2. Range of Magnitude

The Plume Exposure Pathway refers to whole-body external exposure to gamma radiation from a radioactive plume and from deposited materials and inhalation exposure from the passing radioactive plume. The duration of primary exposures could range in length from hours to days, but the Plume Exposure Pathway is not a significant concern for Erie County. The County instead focuses on the impact of the nearby Ingestion Exposure Pathway EPZ. This EPZ refers to exposure primarily from ingestion of water or foods such as milk and fresh vegetables that have been contaminated with radiation. This kind of exposure can stem from any of the three categories of nuclear accident.

Nuclear accidents are classified into three categories:

- Criticality accidents: Involves loss of control of nuclear assemblies or power reactors.
- Loss-of-coolant accidents: Occurs whenever a reactor coolant system experiences a break or opening large enough so that the coolant inventory in the system cannot be maintained by the normally operating make-up system.
- Loss-of-containment accidents: Involves the release of radioactivity from materials such as tritium, fission products, plutonium, and natural, depleted, or enriched uranium. Points of release have been containment vessels at fixed facilities or damaged packages during transportation accidents.

Nuclear facilities must notify the appropriate authorities in the event of an accident. The Nuclear Regulatory Commission uses four classification levels for nuclear incidents (NRC, 2008):

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

After a nuclear incident, the primary concern is the effect on the health of the population near the incident. The duration of primary exposure could range in length from hours to months depending on the proximity to the point of radioactive release. External radiation and inhalation and ingestion of radioactive isotopes can cause acute health effects (e.g. death, severe health impairment), chronic health effects (e.g. cancers) and psychological effects.

Potential environmental impacts specific to the 50-mile Ingestion Exposure Pathway EPZ, include the long-term effects of radioactive contamination in the environment and in agricultural products. If a nuclear incident occurred at the Perry Nuclear Plant, Erie County could expect low amounts of radioactive contamination. This is not a significant concern in terms of external exposure and immediate health risks, but even a small amount of radiation will require protection of the food chain, particularly milk supplies. Small amounts of radiation ingested over time could lead to future health issues. As a result, in the case of a nuclear incident, foodstuffs, crops, milk, livestock feed and forage, and farm water supplies will need to be protected from and tested for contamination. Additionally, spills and releases of radiologically active materials from accidents can result in the contamination of soil and public water supplies. If this contamination was spread through water supplies into Erie County this would increase the affect of the nuclear incident in the county.

The worst-case scenario for Erie County would be if a General Emergency occurred at Perry Nuclear Power Plant. If a sufficient amount of radiation leaked into the ground or water supply during the incident this could create longer-term damage for the residents and agricultural producers in Erie County.

4.3.11.3. Past Occurrence

There has been one nuclear incident above the *Alert* classification in the United States. In March 1979, a *Site Area Emergency* event occurred at Three Mile Island - Unit 2. This event is the most serious commercial nuclear accident in United States history. During this incident, equipment malfunctions, design-related problems, and worker errors led to a partial meltdown of the Three Mile Island Unit 2 reactor core at Three Mile Island. The resulting contamination and state of the reactor core led to the development of a ten-year cleanup and scientific effort. Despite the severity of the damage, no injuries due to radiation exposure occurred. There were however, significant health effects reported due to the psychological stress on the individuals living in the area.

4.3.11.4. Future Occurrence

Pennsylvania is home to the only nuclear power plant General Emergency in the nation. Since the Three Mile Island incident, nuclear power has become significantly safer and is one of the most heavily regulated industries in the nation. Despite the knowledge gained since then, there is still the potential for a similar accident to occur again at one of the five nuclear generating facilities in the Commonwealth, or at the out-of-state facilities which are close to Pennsylvania. The Nuclear Energy Agency of the Organization for Economic Co-Operation and Development notes that studies estimate the chance of protective barriers in a modern nuclear facility at less than one in 100,000 per year (Nuclear Energy Agency, 2005).

Across the United States, a number of *Unusual Event* and *Alert* classification level events occur each year at the 100+ nuclear facilities that warrant notification of local emergency managers. Of these, *Alert* emergencies occur less frequently. For example, in 1997, there were forty notifications of *Unusual Events* and three *Alert* events nationwide. Based on historical events, *Site Area Emergency* and *General Emergency* incidents are very rare. The future occurrence of a nuclear incident that affects Erie County can be considered *unlikely* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1).

4.3.11.5. Vulnerability Assessment

Erie County's primary vulnerability to nuclear incidents comes in the form of food, soil, and water contamination. Erie County earns over $71 million in agricultural production annually; radiation contamination spreading through the Ingestion Exposure Pathway EPZ would pose a risk to the food produced in the western portion of the County as well as the economy in the agriculture sector (USDA, 2007). There are almost 91,000 acres of agricultural land, or over $135 million in agricultural land value, within the Ingestion Exposure Pathway EPZ in Erie County (see Table 4.3.11-1). The time of year could also impact the vulnerability and losses estimated for a nuclear incident; an incident that occurs during the prime growing and harvesting season will have a larger impact on the County. For example, the incident at Three Mile Island occurred in the off-season; as a result, the Pennsylvania Department of Agriculture estimated that agricultural losses for the entire Commonwealth were not more than $1 million.

Table 4.3.11-1 shows the number of addressable structures and critical facilities in the Ingestion Exposure Pathway from the Perry Nuclear Power Plant, in addition to the amount and value of agricultural land in this area.

Table 4.3.11-1: Structures, critical facilities, and agricultural land within the Ingestion Exposure Pathway EPZ (Erie County Department of Planning, 2011).

MUNICIPALITY	ADDRESSABLE STRUCTURES IN 50 MILE EPZ	TOTAL CRITICAL FACILITIES IN 50 MILE EPZ	TOTAL AGRICULTURAL PARCEL ACRES AFFECTED	TOTAL AGRICULTURAL LAND VALUE IN 50 MILE EPZ
Albion Borough	670	4	125.67	$102,800
Conneaut Township	932	3	21,311.45	$19,890,400
Cranesville Borough	255	2	259.65	$235,300
Elk Creek Township	788	0	19,724.59	$25,772,510
Fairview Township	2275	8	6,207.76	$17,887,417
Franklin Township	491	2	12,262.44	$18,704,300
Girard Borough	1284	6	241.37	$286,800
Girard Township	2226	3	13,372.43	$26,401,500
Lake City Borough	1112	5	136.90	$381,300
McKean Township	6	0	142.76	$152,800
Platea Borough	207	1	1,483.40	$1,439,200
Springfield Township	1655	2	13,644.81	$20,760,650
Washington Township	83	0	2,036.29	$3,851,800
TOTAL	**11984**	**36**	**90,949.50**	**$135,866,777**

Water contamination is also a concern in nuclear incidents. There are over 8,100 private wells reported in Erie County (see Section 4.3.2.5 for wells by municipality), which could be vulnerable to contamination from radiation if there was a nuclear incident and it was carried to the water supply in the County. Additionally, ten municipalities provide public water service including: Albion Borough, Edinboro Borough, the City of Erie, Fairview Township, Millcreek Township, North East Borough, North East Township, Summit Township, Union City Borough,

and Washington Township (U.S. Census GID, 2007). These water supplies are also vulnerable if contamination spread to Erie County from a nuclear incident. Albion Borough and Fairview Township in the Ingestion Exposure Pathway EPZ, so they face a higher risk of this contamination.

4.3.12. Transportation Accident

4.3.12.1. Location and Extent

For the purposes of this plan, transportation accidents are defined as incidents involving highway, air, rail, and ship travel. Erie County is served by 23 U.S. and State Routes: 6, 6N, 19, 20; 8, 18, 77, 89, 97, 98, 99, 215, 226, 290, 299, 426, 430, 474, 505, 531 and 832. Additionally, Interstates 90, 86, and 79 pass through Erie County. Within the County, there are a total of 2,569 miles of developed roads. This includes 805 miles of state and federal highways and 1,764 miles of secondary and municipal roads (ECEMA, 2010).

Railroad services in Erie County include both passenger and freight services. These services are run by the six companies: Amtrak, CSX and Norfolk Southern. Erie County is also served by fifteen private and three public airports and a port for Great Lakes shipping. Figure 4.3.12-1 illustrates these major transportation routes in the County. Figures 4.3.12-2 and 4.3.12-3 show the traffic volume and truck traffic volume on key roadways respectively.

Figure 4.3.12-1: Erie County transportation systems.

Figure 4.3.12-2: Erie County traffic volume on key roadways (PennDOT, 2010).

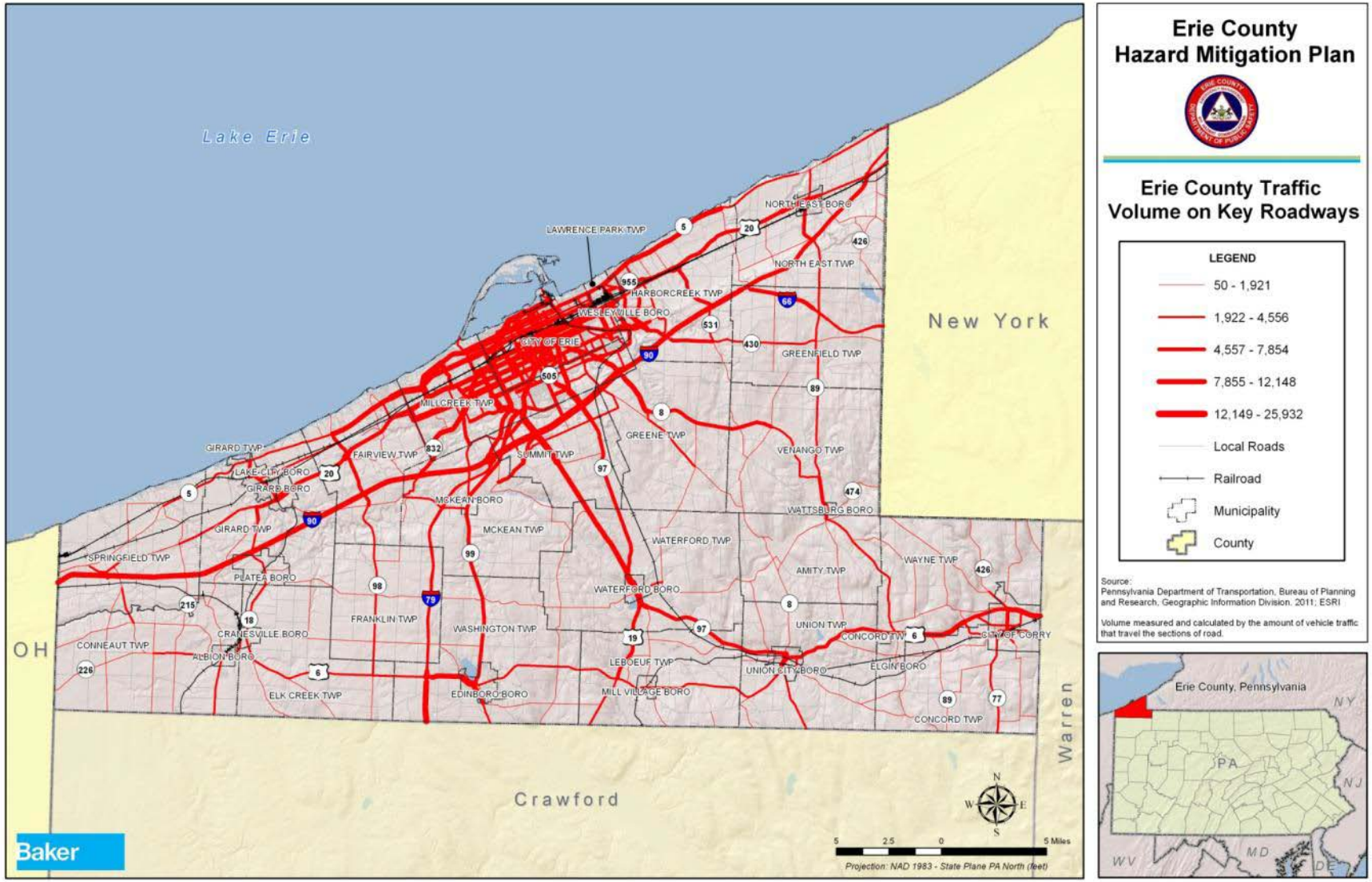
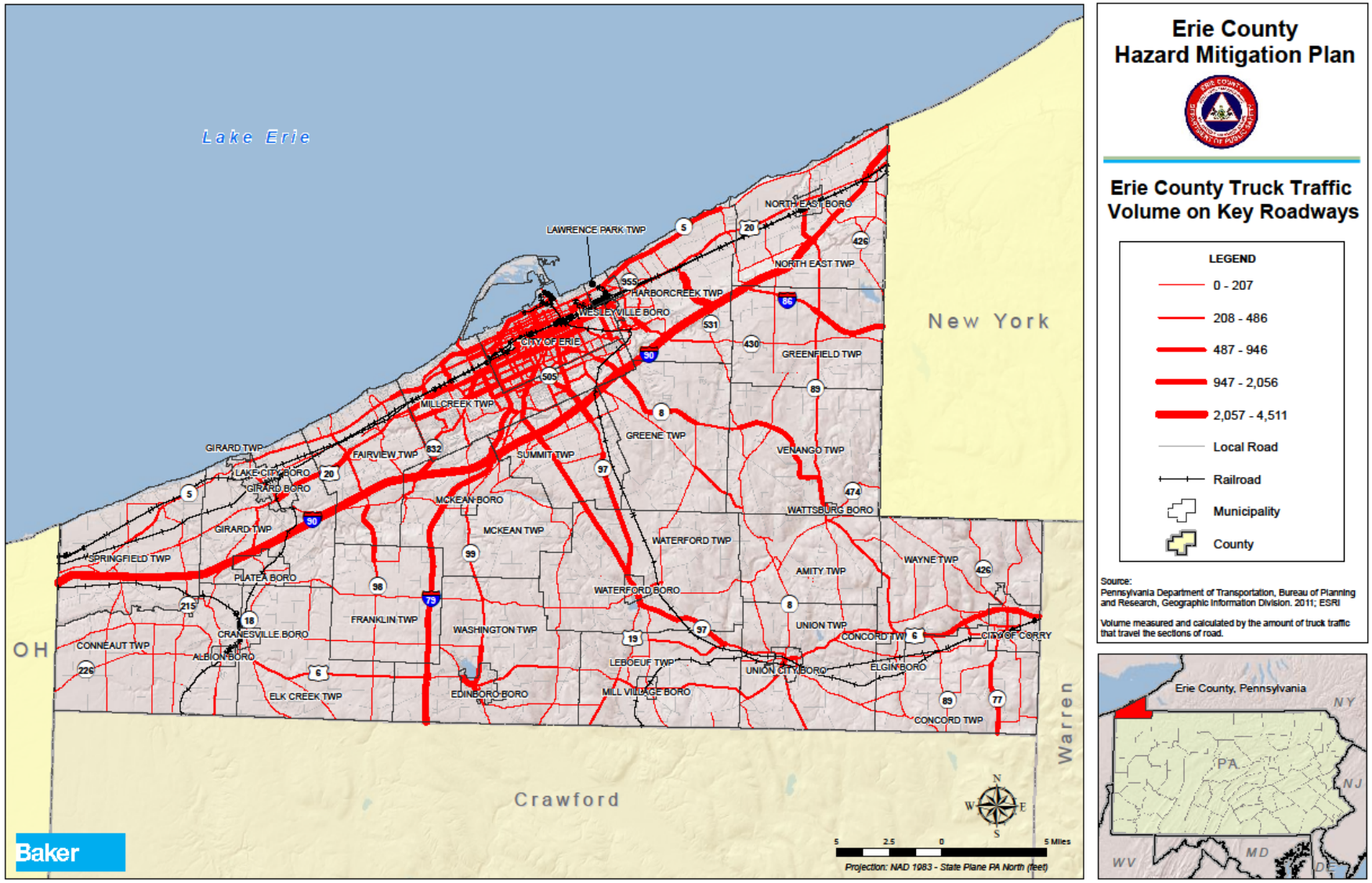


Figure 4.3.12-3: Erie County truck traffic volume on key roadways (PennDOT, 2010).



Erie County Hazard Mitigation Plan

Erie County Truck Traffic Volume on Key Roadways

LEGEND

- 0 - 207
- 208 - 486
- 487 - 946
- 947 - 2,056
- 2,057 - 4,511
- Local Road
- Railroad
- Municipality
- County

Source:
Pennsylvania Department of Transportation, Bureau of Planning and Research, Geographic Information Division. 2011; ESRI

Volume measured and calculated by the amount of truck traffic that travel the sections of road.

4.3.12.2. Range of Magnitude

At a minimum, transportation accidents can result in damage to the vehicles and minor injuries to passengers and drivers. At worst, significant transportation accidents can result in death or serious injury or extensive property loss or damage coupled with business interruptions and hours of congestion. Road and railway accidents in particular have the potential to result in hazardous materials releases if the vehicle involved in an accident is hauling hazardous materials. The expected impacts of transportation accidents are amplified by the fact that there is often little warning of accidents.

A train derailment involving hazardous materials happened in 1985. While there was significant damage done to the train and many of its cars, the cars that were carrying the hazardous materials were not damaged and did not release the materials (ECEMA, 2010).

One of the worst transportation accidents in Erie County occurred in 1986 when a 727 US Airliner ran off a snow-covered runway at Erie International Airport. The plane landed off of airport property onto Asbury Road (ECEMA, 2010). While the aircraft had the capability of carrying over 100 passengers, there were only 25 on board. Additionally, no cars or structures were struck by the plan when it left the airport's property. There were no fatalities and only one injury requiring hospital treatment. The plane caught fire and there was an explosion on board, destroying the plane and causing minor property damage to airport property.

4.3.12.3. Past Occurrence

The most common transportation accidents in Erie County are highway accidents involving motor vehicles. The County's most serious transportation concerns involve Interstates 90, 86, and 79. These routes have the highest annual average traffic counts, the most truck traffic, and have illustrated the most potential for disaster in the past. Additionally, there is a temporal aspect to highway transportation accidents; in the spring and early summer, when construction and narrowed lanes are commonplace, the incidence of large-scale transportation accidents increases.

Over the five-year period from 2005-2009, highway accidents have decreased by almost 200 accidents. Table 4.3.12-1 summarizes the overall vehicular crash data from 2005-2009 for Erie County. The data was gathered through the PennDOT Crash Statistics Reports.

Table 4.3.12-1: Total number of crashes, traffic deaths, and pedestrian deaths for Erie County from 2005-2009 (PennDOT, 2010).

YEAR	TOTAL CRASHES	TOTAL TRAFFIC DEATHS	TOTAL PEDESTRIAN DEATHS
2005	2,766	23	4
2006	2,554	36	3
2007	2,731	27	2
2008	2,817	39	0
2009	2,572	30	1

In comparison to highway accidents, the past occurrences of rail, ship, and air accidents is quite small. PEIRS data was used to identify the number of rail, ship, and aircraft accidents in Erie County from 2002-2009. The incidents involving rail, ship, and air transportation are listed in Table 4.3.12-2. Because PEIRS is a voluntary reporting system this may not be a comprehensive list.

During this time period there were seven accidents involving aircrafts. Three of these resulted in injuries or fatalities. There were six accidents in this time period involving rail transportation, four of these involved a train striking a pedestrian and two were between a train and a car. There were two incidents during this time period involving ships, one of which resulted in fatalities.

Table 4.3.12-2: Rail and Air Transportation Accidents in Erie County from 2002- 2009 (PEIRS, 2010).

DATE	MUNICIPALITY	MODE	DETAILS
3/4/2002	Harborcreek Township	Aircraft	
3/26/2002	Erie City	Aircraft	
11/7/2002	Harborcreek Township	Aircraft	An ultra light aircraft crashed at the Moreheadville Airport. No injuries were reported.
7/16/2003	Waterford Township	Aircraft	An ultra light aircraft crashed in the yard of a residence. One injury reported.
2/26/2004	Wayne Township	Aircraft	A single-engine Piper plane crashed killing the pilot.
8/25/2004	Erie City	Railroad	A Norfolk Southern Railway train struck and killed a trespasser.
8/13/2005	Millcreek Township	Aircraft	A PA 28 aircraft ran out of fuel while attempting to land at Erie International Airport. Three fatalities and two injuries were reported.
2/8/2007	Erie City	Ship	A pleasure vessel became partially submerged in the East Canal Basin with no people on board.
9/28/2007	Millcreek Township	Aircraft	A twin engine airplane made an emergency landing at Tom Ridge Field without incident.
9/4/2008	Springfield Township	Ship	A small boat took on water, there were two fatalities and one person reported missing.
9/7/2008	North East Borough	Railroad	An accident with a vehicle, with one injury reported.
9/27/2008	Millcreek Township	Railroad	A Norfolk Southern train struck and killed a pedestrian.
1/16/2009	Union City	Railroad	A vehicle crashed into a Western New York train with one injury resulting.
3/14/2009	Erie City	Railroad	A Norfolk Southern train struck and killed a pedestrian.
5/16/2009	Erie City	Railroad	A pedestrian was struck and injured by a train.

4.3.12.4. Future Occurrence

The County's population has increased in some municipalities over the last decade, meaning it is likely that traffic volumes have also risen in these areas. The trucking industry is expected to continue maintaining and possibly increasing the number of tractor-trailers on the County's road system. Roadway transportation accidents may increase slightly over the next five years without proper mitigation strategies in place.

The low number of rail and air traffic accidents in the County indicates that the bulk of future transportation accidents will be roadway accidents. However, the increased traffic through the port at the City of Erie can also result in increased accidents (ECEMA, 2004). There has been increase of both passenger and cargo ferries, so while there has been no reported occurrence of incidents at the port, there could be in the future. Therefore, future occurrence can be considered *highly likely* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1).

4.3.12.5. Vulnerability Assessment

A transportation-related incident can occur on any stretch of road or railway in Erie County. However, severe accidents are more likely on the County's highways, such as Interstates 90, 86 and 79, as well as US 20, US 6, PA 8, PA 505, and PA 77, which experience heavier traffic volumes including heavy freight vehicles. The combination of high traffic volume, severe winter weather in the County and large numbers of hazardous materials haulers increase the chances of traffic accidents occurring. The population most likely affected by a traffic accident, especially one involving truckers transporting hazardous materials, are those that live within a ¼ mile radius of the accident.

Like highway incidents, rail incidents can impact populations living near rail lines. These include populations in all but eleven municipalities in Erie County. Additionally, the County is also susceptible to airplane accidents from air traffic through the Corry-Lawrence Airport, Erie County Airport and Erie International Airport. Table 4.3.12-3 shows the number of addressable structures and critical facilities near each of the airports which are most likely to be vulnerable to airplane accidents.

Table 4.3.12-3: Addressable structures and critical facilities vulnerable to airport accidents by airport (ECDES, 2011).

AIRPORT	ADDRESSABLE STRUCTURES WITHIN 5 MILE RADIUS OF AIRPORT	CRITICAL FACILITIES WITHIN 5 MILE RADIUS OF AIRPORT
Corry-Lawrence Airport	3,874	14
Erie County Airport	2,128	9
Erie International Airport	36,696	52
TOTAL	**42,698**	**75**

Table 4.3.12-4 illustrates the vulnerability of addressable structures and critical facilities for each kind of transportation accident except for ship accidents. For this analysis, vulnerability for

highway accidents was defined as jurisdictions falling within a ¼ mile of Interstate and US highways, the high-speed roads likely to yield deadly crashes. Vulnerability for air traffic accidents is defined as jurisdictions falling within five miles of the airports. Similar to highway accidents, jurisdictions that are vulnerable to rail accidents are those located within ¼ mile of rail lines. Using these definitions, all jurisdictions are vulnerable to at least one type of transportation accident.

The specific vulnerability of jurisdictions depends on the mode of transportation in question. All jurisdictions in Erie County have addressable structures located within ¼ mile of major highways, but Elgin Borough has 16 structures compared to the City of Erie which has over 24,000 structures. Many jurisdictions also have critical facilities within ¼ mile of major highways; of the jurisdictions with vulnerable critical facilities, City of Erie, Harborcreek Township and Millcreek Township have the highest with 53, 11 and 25 respectively.

All but eleven jurisdictions have addressable structures that are susceptible to effects from railroad accidents. North East Borough, Lawrence Park Township, Union City Borough, Corry City, Millcreek Township, and Erie City each have a large portion of addressable structures near rail lines, over 900 structures each. Erie City has by far the most structures, over 8,000, near rail lines. Erie City also has the most critical facilities within a ¼ mile radius of rail lines, they have 11 while Corry City has 8, Harborcreek Township has 5, and 11 other municipalities have less than three.

Vulnerability to air accidents is more concentrated because there are two airports in Erie County. However, nine municipalities around these airports have addressable structures within a five mile radius of one of the airports. Elgin Borough has only three addressable structures in this radius, while the City of Erie has over 14,000 and Millcreek Township has over 18,000 structures near the airport. Additionally, eleven of these municipalities have critical facilities within five miles of the airport. Concord, Greenfield and McKean Townships have the fewest with 1 structure each, while Erie City and Millcreek Township have the most with 15 and 32 respectively.

The City of Erie is undertaking further development of the Bayfront, which will most likely result in increased passenger and cargo ferries entering into the Port of Erie (ECEMA, 2010). The escalated waterway traffic, as well as the increased transportation of hazardous materials through this route, can increase the vulnerability population near the lakefront to effects of an accident near the port.

Table 4.3.12-4: Addressable structures and critical facilities vulnerable to railroad, highway, and airport accidents.							
MUNICIPALITY	TOTAL ADDRESSABLE STRUCTURES	ADDRESSABLE STRUCTURES WITHIN 1/4 MILE OF RAILROAD	CRITICAL FACILITIES WITHIN 1/4 MILE OF RAILROAD	ADDRESSABLE STRUCTURES WITHIN 1/4 MILE OF *MAJOR HIGHWAYS	CRITICAL FACILITIES WITHIN 1/4 MILE OF *MAJOR HIGHWAYS	ADDRESSABLE STRUCTURES WITHIN 5 MILE RADIUS OF AIRPORT	CRITICAL FACILITIES WITHIN 5 MILE RADIUS OF AIRPORT
Albion Borough	670	470	2	586	3	0	0
Amity Township	420	0	0	76	0	152	0
Concord Township	563	101	0	167	0	475	1
Conneaut Township	932	106	0	348	3	0	0
Corry City	2913	1383	8	2026	8	2913	11
Cranesville Borough	255	134	1	129	2	0	0
Edinboro Borough	1496	0	0	1053	5	0	0
Elgin Borough	103	67	0	16	1	3	0
Elk Creek Township	788	16	0	305	0	0	0
Erie City	37720	8388	13	24413	48	14555	15
Fairview Township	4171	474	0	2114	10	2683	5
Franklin Township	663	0	0	132	1	0	0
Girard Borough	1284	764	5	968	5	0	0
Girard Township	2226	283	0	794	2	0	0
Greene Township	2007	11	0	401	4	651	4
Greenfield Township	687	0	0	268	1	250	1
Harborcreek Township	5905	792	5	3304	11	6	0
Lake City Borough	1112	654	3	842	4	0	0
Lawrence Park Township	1673	936	2	1238	5	0	0
LeBoeuf Township	729	72	0	269	0	0	0
McKean Borough	176	0	0	146	3	0	0
McKean Township	2006	0	0	895	2	718	1
Mill Village Borough	183	133	1	131	2	0	0
Millcreek Township	22619	1668	2	10689	25	18413	31

Table 4.3.12-4: Addressable structures and critical facilities vulnerable to railroad, highway, and airport accidents.							
MUNICIPALITY	**TOTAL ADDRESSABLE STRUCTURES**	**ADDRESSABLE STRUCTURES WITHIN 1/4 MILE OF RAILROAD**	**CRITICAL FACILITIES WITHIN 1/4 MILE OF RAILROAD**	**ADDRESSABLE STRUCTURES WITHIN 1/4 MILE OF *MAJOR HIGHWAYS**	**CRITICAL FACILITIES WITHIN 1/4 MILE OF *MAJOR HIGHWAYS**	**ADDRESSABLE STRUCTURES WITHIN 5 MILE RADIUS OF AIRPORT**	**CRITICAL FACILITIES WITHIN 5 MILE RADIUS OF AIRPORT**
North East Borough	1685	903	2	1569	6	0	0
North East Township	3070	259	0	1662	3	0	0
Platea Borough	207	99	1	98	1	0	0
Springfield Township	1655	307	0	1009	2	0	0
Summit Township	3019	186	1	1214	1	327	0
Union City Borough	1294	994	3	990	3	0	0
Union Township	742	127	1	283	1	0	0
Venango Township	827	0	0	338	1	827	3
Washington Township	1966	0	0	560	2	0	0
Waterford Borough	392	65	0	221	4	0	0
Waterford Township	1638	0	0	522	1	43	0
Wattsburg Borough	199	0	0	199	1	199	1
Wayne Township	735	0	0	338	1	483	2
Wesleyville Borough	1495	426	2	1286	2	0	0
TOTAL	**110225**	**19818**	**51**	**61599**	**174**	**42698**	**75**
*Major Highways include Interstates, US Highways and State Highways.							

4.3.13. Urban Fire and Explosion

4.3.13.1. Location and Extent

There are over 1.6 million reported fires in the United States every year, resulting in over 3,600 deaths and over 18,700 injuries annually. Nationally, the combined average annual losses from floods, hurricanes, tornadoes, earthquakes, other natural disasters, and terrorist attacks is a fraction of the casualties from fires. Pennsylvania as a state experienced 13 major urban/suburban fires in the past 80 years, 10 of which occurred in the past 10 years (ECEMA, 2010).

Urban fire and explosion hazards incorporate vehicle and building/structure fires as well as overpressure rupture, overheat, or other explosions that do not ignite. Statewide, this hazard occurs in the denser, more urbanized areas and occurs most often in residential structures (US Fire Administration, 2009). Urban fires can more easily spread from building to building in these denser areas.

Urban fires and explosions often begin as a result of other hazards, particularly severe storms, drought, transportation accidents, hazardous materials releases, criminal activity such as arson, and terrorism.

4.3.13.2. Range of Magnitude

Severe urban fires result in extensive damage to residential, commercial, and/or public property. Damages ranges from minor smoke and/or water damage to the destruction of buildings. People are often displaced for several months to years depending on the magnitude of the fire or explosion event. Urban fires and explosions can also cause injuries and death, to the people in the structure or the firefighters who respond to the fire. Although most instances of fire do not reach disaster proportions, the sum of the impact of all small fires is often much greater than the impact of the few major fire and explosion hazards that occur.

There are additional economic consequences related to this hazard. Urban fires and explosions may result in lost wages due to temporarily or permanently closed businesses, destruction and damage involving business and personal assets, loss of tax base, recovery costs, and lost investments on destroyed property. The secondary effects of urban fire and explosion events relate to the ability of public, private, and non-profit entities to provide post-incident relief. Human services agencies (community support programs, health and medical services, public assistance programs and social services) can be affected by urban fire and explosion events as well. Effects may consist of physical damage to facilities and equipment, disruption of emergency communications, loss of health and medical facilities and supplies, and an overwhelming load of victims who are suffering from the effects of the urban fire, including loss of their home or place of business.

Figure 4.3.13-1: Fire at Granada Apartments in Millcreek Township on March 28, 2009 (CNN iReport, 2009).

Fires or explosions in apartment buildings can affect multiple residents and families if the fire is not controlled. One of the worst large urban fire incidents occurred in Millcreek Township in 2009 when a three-story apartment building caught fire and quickly spread to all the units in the building, also causing one small explosion (CNN iReport, 2009). The fire at Granada Apartments on March 28, 2009 did not cause any casualties or injuries, but all 25 units in the building were destroyed and the residents of the units were all displaced. Twelve fire companies and 23 fire trucks responded to the fire.

4.3.13.3. Past Occurrence

Erie County experiences a number of urban fire and explosion events each year, most of which are small and affect a limited number of structures. There were over 1,700 reported fires that fire departments across the County responded to between 2007 and 2009 (ECEMA, 2010). Additionally, fire departments responded to 33 explosions and to almost 1,700 calls of hazardous conditions that could create fires during this time period (see Table 4.3.13-1).

Table 4.3.13-1: Firefighter response to urban fire events (ECEMA, 2010)

URBAN FIRE EVENT TYPE	2007	2008	2009	TOTAL
Fire	553	580	604	1,737
Overpressure Rupture, Explosion, Overheat	10	12	11	33
Hazardous Condition	491	655	542	1,688
Fire events –yearly totals	*1,054*	*1,247*	*1,157*	*3,458*

4.3.13.4. Future Occurrence

Future occurrence of urban fire events in Erie County can be considered *highly likely* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1). The threat of events increases annually as existing housing stock and commercial structures grow older, communities become more densely populated, and more homeowners depend on wood burners and portable heaters (ECEMA, 2010).

The greatest urban fire and explosion threats in Erie County are industrial fires. While residential fires are more common, industrial fires have a potentially higher risk because of the possibility of there being flammable chemicals and a sustained fuel source at industrial sites.

4.3.13.5. Vulnerability Assessment

Areas where large buildings are located or development is closely spaced should be considered more vulnerable to urban fire and explosion events. Areas with the highest housing and population density in Erie County were determined using the amount of land area identified in the 2000 Decennial Census, the total population identified in the 2010 Decennial Census, and the total amount of housing units identified in the 2005-2009 American Community Survey. These densities are listed by municipality in Table 4.3.13-2.

Areas with the highest population density, over 1,000 people per square mile, in Erie County include the Corry and Erie Cities; Albion, Edinboro, Girard, Lake City, Millcreek Township, North East, Union City, Waterford, Wattsburg, and Wesleyville Boroughs; and Lawrence Park Township. Areas with the highest housing density, over 55 housing units per square mile, in Erie County include Albion Borough, Edinboro Borough, Erie City, Girard Borough, Lake City Borough, Lawrence Park Township, Millcreek Township, North East Borough, Union City Borough, and Wesleyville Borough.

Table 4.3.13-2: Population and housing densities in Erie County municipalities (U.S. Census, 2000; U.S. Census, 2011; U.S. Census ACS, 2005-2009).

MUNICIPALITY	SQUARE MILES OF LAND	TOTAL POPULATION	POPULATION DENSITY	TOTAL HOUSING UNITS	HOUSING UNIT DENSITY
Albion Borough	1.06	1,516	1,430.19	707	666.98
Amity Township	28.27	1,073	37.96	358	12.66
Concord Township	33.02	1,344	40.70	570	17.26
Conneaut Township	43.31	4,290	99.05	756	17.46
Corry City	6.1	6,605	1,082.79	2,739	449.02
Cranesville Borough	0.92	638	693.48	227	246.74
Edinboro Borough	2.32	6,438	2,775.00	2,963	1,277.16
Elgin Borough	1.56	218	139.74	88	56.41
Elk Creek Township	34.73	1,798	51.77	712	20.50

Table 4.3.13-2: Population and housing densities in Erie County municipalities (U.S. Census, 2000; U.S. Census, 2011; U.S. Census ACS, 2005-2009).

MUNICIPALITY	SQUARE MILES OF LAND	TOTAL POPULATION	POPULATION DENSITY	TOTAL HOUSING UNITS	HOUSING UNIT DENSITY
Erie City	21.96	101,786	4,635.06	45,942	2,092.08
Fairview Township	29.16	10,102	346.43	3,807	130.56
Franklin Township	28.79	1,633	56.72	652	22.65
Girard Borough	2.35	3,104	1,320.85	1,370	582.98
Girard Township	31.77	5,102	160.59	2,079	65.44
Greene Township	37.53	4,706	125.39	1,877	50.01
Greenfield Township	33.82	1,933	57.16	736	21.76
Harborcreek Township	34.25	17,234	503.18	6,246	182.36
Lake City Borough	1.8	3,031	1,683.89	1,203	668.33
Lawrence Park Township	1.86	3,982	2,140.86	1,389	746.77
LeBoeuf Township	33.71	1,698	50.37	647	19.19
McKean Borough	0.58	388	668.97	167	287.93
McKean Township	36.61	4,409	120.43	1,838	50.20
Mill Village Borough	0.91	412	452.75	171	187.91
Millcreek Township	29.48	53,515	1815.30	22,958	778.77
North East Borough	1.31	4,294	3,277.86	1,761	1,344.27
North East Township	42.36	6,315	149.08	2,795	65.98
Platea Borough	3.29	430	130.70	189	57.45
Springfield Township	37.69	3,425	90.87	1,427	37.86
Summit Township	23.88	6,603	276.51	2,503	104.82
Union City Borough	36.5	1,655	45.34	721	19.75
Union Township	1.87	3,320	1,775.40	1,558	833.16
Venango Township	43.58	2,297	52.71	871	19.99
Washington Township	45.19	4,432	98.07	1,700	37.62
Waterford Borough	1.22	1,517	1,243.44	590	483.61
Waterford Township	50.02	3,920	78.37	1,633	32.65

Table 4.3.13-2: Population and housing densities in Erie County municipalities (U.S. Census, 2000; U.S. Census, 2011; U.S. Census ACS, 2005-2009).					
MUNICIPALITY	**SQUARE MILES OF LAND**	**TOTAL POPULATION**	**POPULATION DENSITY**	**TOTAL HOUSING UNITS**	**HOUSING UNIT DENSITY**
Wattsburg Borough	0.33	403	1,221.21	149	451.52
Wayne Township	38.29	1,659	43.33	668	17.45
Wesleyville Borough	0.53	3,341	6,303.77	1,455	2,745.28

In order to adequately assess vulnerability to urban fires and explosions, detailed information on the design specifications, specifically fire codes, used for the construction of individual buildings is required. As of December 31, 2006, all communities in Pennsylvania are required to comply with the Uniform Construction Codes. This includes requirements to comply with both the International Fire Code and the International Wildland Urban Interface Code. The adoption and enforcement of these codes will hopefully decrease the overall vulnerability of structures in Erie County. However, these regulations will only affect new construction, as well as additions and renovations to existing structures. Older buildings that do not meet the criteria established in these modern fire codes will continue to remain vulnerable to urban fire and explosion events.

4.3.14. Utility Interruption

4.3.14.1. Location and Extent

Utility interruptions in Erie County include disruptions in fuel, water, electric and telecommunications capabilities in the County. A fuel shortage occurs when the supply of energy resources does not meet the demand. The inability to produce or transfer sufficient quantities of the energy resource at an acceptable cost to businesses, industry, and the public can create a national or regional fuel shortage. Fuel shortages can also be caused more locally by imbalances of supply due to weather or misdistribution.

Utility interruptions are often a secondary impact of another hazard. Severe thunderstorms, windstorms, tornados, and winter storms can also lead to more regional utility interruptions, while localized outages can be caused by traffic accidents or wind damage. Heat waves may also result in rolling blackouts where power may not be available for an extended period of time. Utility interruptions have the potential to take place throughout Erie County.

4.3.14.2. Range of Magnitude

Most severe utility interruptions and power failures are regional events. A loss of utilities can have numerous impacts including, but not limited to, food spoilage, loss of water supply (either because of a damaged pipeline or well pump failure), loss of heating or air conditioning, basement flooding (sump pump failure), lack of indoor lighting, and lack of telephone and internet service. At a minimum, utility interruptions can cause short term disruption in the orderly functioning of business, government, and private citizen functioning and activities like traffic signals, elevators, and retail sales.

Likewise, most fuel shortages are regional or national events. A fuel shortage can have numerous impacts including increases in the cost of fuel putting an economic burden on families and businesses, long lines at gas stations due to fuel rationing, disruptions in freight traffic, incidents of violence, truck driver strikes, and a shortage of heating fuels.

These issues range from a minor nuisance to a full hazard event, but the degree of damage or harm depends on the population affected and the severity of the outage. For example, loss of heating and cooling capability is more dangerous in the winter and summer months, when heat sensitive populations like the elderly count on utilities and fuel to maintain a safe temperature. A worst case scenario for utility interruption in Erie County would be a fuel shortage or power outage in the winter months, especially during a severe winter weather event, which may leave many homes without a source of heat.

4.3.14.3. Past Occurrence

Erie County, like most of Pennsylvania, experienced long lines at gasoline pumps and shortages of fuel in 1973 as a result of the OPEC oil embargo. Government actions were taken to assure that fuels and power were available for emergency and priority users. Between 1976 and 1977, prices for fuel rapidly increased and a similar fuel shortage was experienced in the County as the fuel shortage of 1972-73, which presented hardships for low income consumers in particular.

Windstorms and winter storms have caused localized power outages throughout Erie County on numerous occasions. Extreme cold has hampered distribution of natural gas, while transportation accidents have also caused minor power outages. Minor utility interruptions occur annually in Erie County, caused by these and other circumstances. There is no complete list of utility interruption events available for the County. Events reported to the Pennsylvania Emergency Incident Reporting System are listed in Table 4.3.14-1. PEIRS is comprised of events which are voluntarily reported to the system, so this is not a comprehensive list. According to the PEIRS information, there were 54 reported phone and power outages as well as water main breaks between 2002 and 2009 in Erie County.

Table 4.3.14-1: Utility interruption events in Erie County reported to PEIRS, 2002-2009 (PEMA, 2011).

UTILITY INTERRUPTION TYPE	2002	2003	2004	2005	2006	2007	2008	2009*	TOTAL
Phone Outage	0	0	1	1	0	1	3	2	8
Power Outage	7	7	2	2	2	13	4	3	40
Water Main Break	0	1	0	0	1	0	2	2	6
Utility Interruption events – yearly totals	*7*	*8*	*3*	*3*	*3*	*14*	*9*	*7*	*54*

**Events totaled through June 2009*

4.3.14.4. Future Occurrence

Minor, short-term utility interruptions may occur several times a year for any given area in Erie County, while major, long-term events may take place once every few years. Utility

interruptions are difficult to predict, but they are likely to have a relatively short duration of 24 hours or less. Since utility interruptions are sometimes by-products of severe weather events, citizens should prepare for them during severe storms.

A major fuel crisis could develop in the future depending on international relationship and tensions. However, significant changes seem to have reduced both the likelihood of another major oil embargo and/or drastic price increases. Alternative sources of energy, conservation and significant increases in efficiency through technological advances have reduced the growth in demand for oil thus reducing the probability of another 1973 type of crisis will occur.

The future occurrence of utility interruptions and fuel shortages can be considered *unlikely* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1).

4.3.14.5. Vulnerability Assessment

Although the risk for future occurrence of utility interruptions is low across Erie County, there is higher frequency of incidents of contributing factors, namely traffic accidents and severe weather. Therefore, the County is vulnerable to these interruptions, though they are usually short lived.

Hospitals and emergency medical facilities, including retirement homes and senior centers, are particularly vulnerable to fuel shortages and utility interruptions as elderly populations are particularly vulnerable to temperature extremes. Back-up power generators are often used at these facilities, but the population will become particularly vulnerable if the fuel shortage or power outage lasts longer than the back-up power supply. Elderly residents who live outside of these facilities are vulnerable to these interruptions or fuel shortages as well, and they often do not have access to back-up power supplies. Sick or disabled residents are also vulnerable to these interruptions or shortages (ECEMA, 2010).

Additionally, escalating fuel prices can make lower income household more vulnerable to utility shut offs and more frequent depletion of fuel supplies. Erie County has developed programs to provide emergency fuel assistance to these households if these situations arise (ECEMA, 2010). Businesses and industries are also vulnerable to fuel shortages and utility interruptions, as these events can have a large impact on the amount of time they can be operational.

4.4. Hazard Vulnerability Summary

4.4.1. Methodology

Ranking hazards helps communities set goals and priorities for mitigation based on their vulnerabilities. A Risk Factor (RF) is a tool used to measure the degree of risk for identified hazards in a particular planning area. The RF can also be used to assist local community officials in ranking and prioritizing those hazards that pose the most significant threat to their area based on a variety of factors deemed important by the planning team and other stakeholders involved in the hazard mitigation planning process. The RF system relies mainly on historical data, local knowledge, general consensus opinions from the planning team and information collected through development of the hazard profiles included in Section 4.3. The RF approach produces numerical values that allow identified hazards to be ranked against one another; the higher the RF value, the greater the hazard risk.

RF values were obtained by assigning varying degrees of risk to five categories for each of the eleven hazards profiled in the 2012 HMP. Those categories include: *probability*, *impact*, *spatial extent*, *warning time* and *duration*. Each degree of risk was assigned a value ranging from 1 to 4. The weighting factor is shown in Table 4.4-1. To calculate the RF value for a given hazard, the assigned risk value for each category was multiplied by the weighting factor. The sum of all five categories equals the final RF value, as demonstrated in the example equation:

Risk Factor Value = [(Probability x .30) + (Impact x .30) +
(Spatial Extent x .20) + (Warning Time x .10) + (Duration x .10)]

Table 4.4-1 summarizes each of the five categories used for calculating a RF for each hazard. According to the weighting scheme applied, the highest possible RF value is 4.0.

Table 4.4-1: Summary of Risk Factor approach used to rank hazard risk.

Risk Assessment Category	Degree of Risk			Weight Value
	Level	Criteria	Index	
PROBABILITY *What is the likelihood of a hazard event occurring in a given year?*	**UNLIKELY**	LESS THAN 1% ANNUAL PROBABILITY	**1**	**30%**
	POSSIBLE	BETWEEN 1% & 49.9% ANNUAL PROBABILITY	**2**	
	LIKELY	BETWEEN 50% & 90% ANNUAL PROBABILITY	**3**	
	HIGHLY LIKELY	GREATER THAN 90% ANNUAL PROBABILTY	**4**	
IMPACT *In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?*	**MINOR**	VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF CRITICAL FACILITIES.	**1**	**30%**
	LIMITED	MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE DAY.	**2**	
	CRITICAL	MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE WEEK.	**3**	
	CATASTROPHIC	HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR 30 DAYS OR MORE.	**4**	
SPATIAL EXTENT *How large of an area could be impacted by a hazard event? Are impacts localized or regional?*	**NEGLIGIBLE**	LESS THAN 1% OF AREA AFFECTED	**1**	**20%**
	SMALL	BETWEEN 1 & 10.9% OF AREA AFFECTED	**2**	
	MODERATE	BETWEEN 11 & 25% OF AREA AFFECTED	**3**	
	LARGE	GREATER THAN 25% OF AREA AFFECTED	**4**	
WARNING TIME *Is there usually some lead time associated with the hazard event? Have warning measures been implemented?*	**MORE THAN 24 HRS**	SELF-DEFINED	**1**	**10%**
	12 TO 24 HRS	SELF-DEFINED	**2**	
	6 TO 12 HRS	SELF-DEFINED	**3**	
	LESS THAN 6 HRS	SELF-DEFINED	**4**	
DURATION *How long does the hazard event usually last?*	**LESS THAN 6 HRS**	SELF-DEFINED	**1**	**10%**
	LESS THAN 24 HRS	SELF-DEFINED	**2**	
	LESS THAN 1 WEEK	SELF-DEFINED	**3**	
	MORE THAN 1 WEEK	SELF-DEFINED	**4**	

(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)

(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)

4.4.2. Ranking Results

Using the methodology described in Section 4.4.1, Table 4.4-2 lists the Risk Factor calculated for each of the fourteen potential hazards identified in the 2012 Hazard Mitigation Plan Update. Hazards identified as *high* risk have risk factors greater than 2.5. Risk Factors ranging from 2.0 to 2.4 were deemed *moderate* risk hazards. Hazards with Risk Factors 1.9 and less are considered *low* risk.

Table 4.4-2: Ranking of hazard types based on Risk Factor methodology.

HAZARD RISK	HAZARD NATURAL (N) or MAN-MADE (M)	RISK ASSESSMENT CATEGORY					RISK FACTOR
		PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
HIGH	Winter Storm (N)	4	3	4	2	4	**3.5**
	Flood, Flash Flood, Ice Jam (N)	4	3	3	3	2	**3.2**
	Environmental Hazards (M)	4	2	1	4	2	**2.6**
MODERATE	Tornado, Wind Storm (N)	2	3	1	4	1	**2.2**
	Transportation Accidents (M)	4	1	1	4	1	**2.2**
	Urban Fire and Explosion (M)	4	1	1	4	1	**2.2**
	Utility Interruption (M)	1	2	4	1	4	**2.2**
	Nuclear Incident (M)	1	2	3	2	4	**2.1**
	Drought (N)	2	1	3	1	4	**2.0**
	Earthquake (N)	2	1	3	4	1	**2.0**
LOW	Coastal Erosion (N)	4	1	1	1	1	**1.9**
	Dam Failure (M)	1	2	2	4	2	**1.9**
	Invasive Species (N)	2	1	1	1	4	**1.6**
	Landslide(N)	1	1	1	4	1	**1.3**

Based on these results, there are three *high* risk hazards, seven *moderate* risk hazards and four *low* risk hazards in Erie County. Mitigation actions were developed for all high, moderate, and low risk hazards (see Section 6.4). The threat posed to life and property for moderate and high risk hazards is considered significant enough to warrant the need for establishing hazard-specific mitigation actions. Mitigation actions related to future public outreach and emergency service activities are identified to address low risk hazard events.

A risk assessment result for the entire County does not mean that each municipality is at the same amount of risk to each hazard. Table 4.4-3 shows the different municipalities in Erie County and whether their risk is greater than (>), less than (<), or equal to (=) the risk factor assigned to the County as a whole.

Table 4.4-3: Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk

JURISDICTION	IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR													
	Winter Storm (N)	Flood, Flash Flood, Ice Jam (N)	Environmental Hazards (M)	Tornado, Wind Storm (N)	Transportation Accidents (M)	Urban Fire and Explosion (M)	Utility Interruption (M)	Nuclear Incident (M)	Drought (N)	Earthquake (N)	Coastal Erosion (N)	Dam Failure (M)	Invasive Species (N)	Landslide (N)
	3.5	*3.2*	*2.6*	*2.2*	*2.2*	*2.2*	*2.2*	*2.1*	*2.0*	*2.0*	*1.9*	*1.9*	*1.6*	*1.3*
Albion Borough	>	>	<	=	<	<	<	>	>	<	<	<	<	<
Amity Township	=	=	=	=	=	=	=	=	=	=	<	=	>	=
Concord Township	=	=	=	=	=	=	=	=	=	=	<	=	=	=
Conneaut Township	=	=	=	=	=	=	=	>	=	=	<	>	>	=
City of Corry	=	=	>	=	>	>	=	=	=	=	<	=	=	=
Cranesville Borough	>	>	=	=	>	=	>	>	=	=	<	<	=	=
Edinboro Borough	>	=	>	=	=	>	=	=	=	=	<	>	=	=
Elgin Borough	=	=	<	=	=	=	=	=	=	<	<	=	=	=
Elk Creek Township	>	>	=	=	>	=	>	>	>	=	<	<	=	=
City of Erie	>	>	>	>	>	>	>	=	=	>	>	<	>	>
Fairview Township	=	>	=	=	=	>	>	>	=	=	>	=	=	>
Franklin Township	>	>	=	=	>	=	>	>	>	=	<	<	=	=
Girard Borough	=	=	>	=	=	>	>	>	=	=	<	<	=	=
Girard Township	=	>	>	=	>	=	>	>	>	=	>	<	>	>
Greene Township	=	=	=	=	=	=	=	=	=	=	<	=	>	=
Greenfield Township	=	=	=	=	=	=	=	=	=	=	<	>	>	=
Harborcreek Township	>	=	=	=	>	>	>	=	=	>	>	=	=	>
Lake City Borough	=	=	>	=	=	>	=	>	=	=	=	=	=	=
Lawrence Park Township	=	>	>	=	=	>	=	=	=	=	>	<	=	>
LeBoeuf Township	=	=	=	=	=	=	=	=	>	=	<	>	>	=

Table 4.4-3: Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk

JURISDICTION	IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR													
	Winter Storm (N)	Flood, Flash Flood, Ice Jam (N)	Environmental Hazards (M)	Tornado, Wind Storm (N)	Transportation Accidents (M)	Urban Fire and Explosion (M)	Utility Interruption (M)	Nuclear Incident (M)	Drought (N)	Earthquake (N)	Coastal Erosion (N)	Dam Failure (M)	Invasive Species (N)	Landslide (N)
	3.5	*3.2*	*2.6*	*2.2*	*2.2*	*2.2*	*2.2*	*2.1*	*2.0*	*2.0*	*1.9*	*1.9*	*1.6*	*1.3*
McKean Borough	=	=	=	=	=	=	=	=	=	=	<	=	=	=
McKean Township	=	=	>	=	>	=	=	=	=	<	<	=	=	=
Mill Village Borough	=	=	=	=	=	=	=	=	=	<	<	=	=	=
Millcreek Township	=	>	>	=	>	>	>	=	=	>	>	>	=	=
North East Borough	=	=	>	=	=	>	=	=	>	=	<	=	>	=
North East Township	=	=	>	=	=	=	=	=	=	=	>	=	>	=
Platea Borough	=	=	=	=	>	=	=	>	=	>	<	<	=	=
Springfield Township	=	=	>	=	>	=	=	>	=	=	>	=	>	>
Summit Township	=	=	>	=	>	=	=	=	=	=	<	=	=	=
Union City Borough	=	=	>	=	=	>	=	=	=	=	<	=	=	=
Union Township	=	=	=	=	=	=	=	=	=	=	<	>	=	=
Venango Township	>	>	>	=	>	=	=	=	=	=	<	<	=	=
Washington Township	>	=	=	=	>	=	>	>	>	=	<	>	=	=
Waterford Borough	=	=	=	=	=	>	=	=	=	=	<	=	=	=
Waterford Township	=	=	=	=	=	=	=	=	=	=	<	=	>	=
Wattsburg Borough	>	>	=	=	=	=	=	=	=	<	<	=	=	=
Wayne Township	=	=	=	=	=	=	=	=	=	=	<	=	>	=
Wesleyville Borough	=	=	>	=	=	>	=	=	<	=	<	<	=	=

4.4.3. Potential Loss Estimates

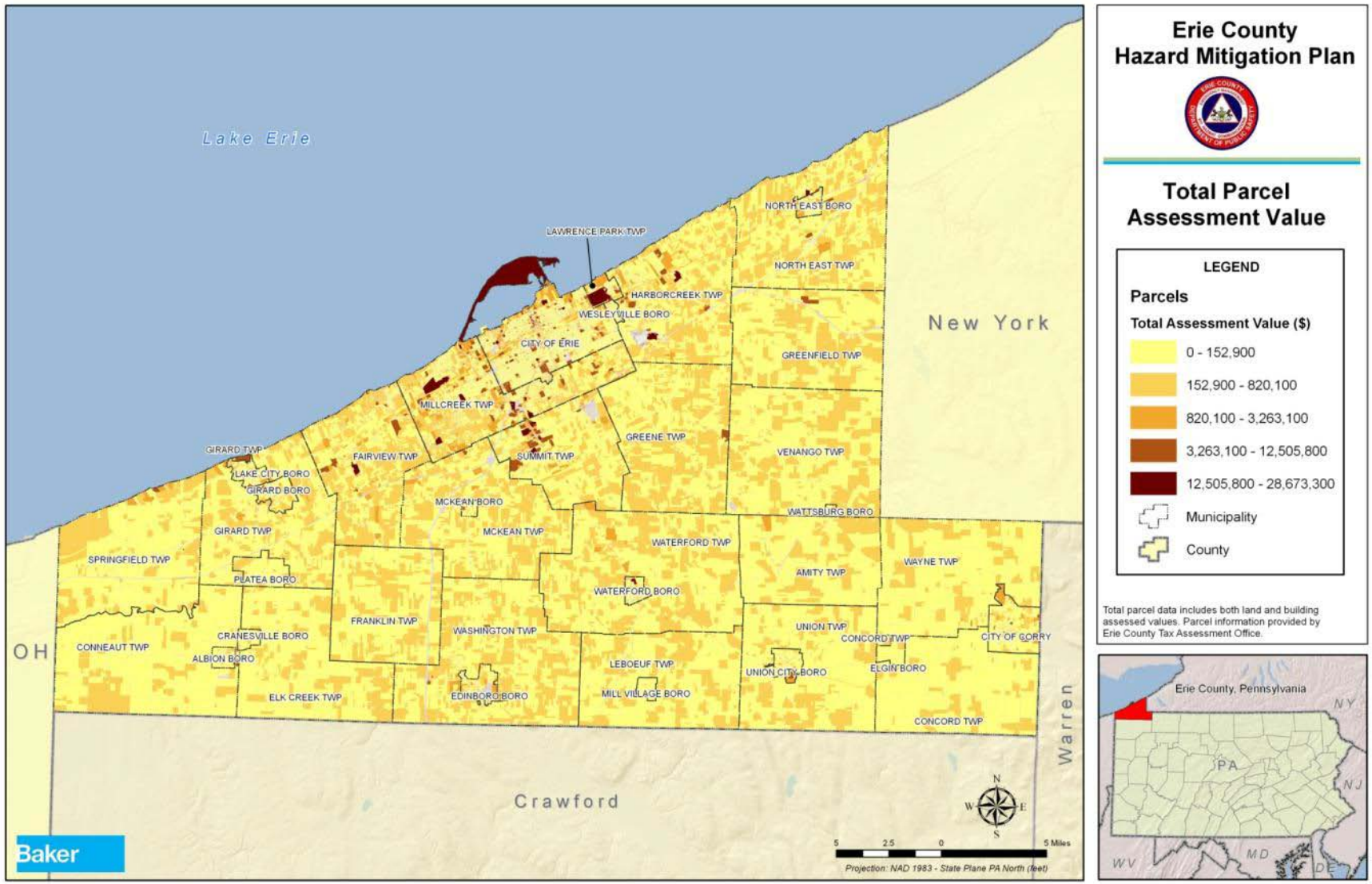
Based on various kinds of available data, potential loss estimates were established for earthquake, flood, flash flood, and ice jam, tornado and windstorms, drought, nuclear incident, and winter storms. Estimates provided in this section are based on HAZUS-MH, version MR4, geospatial analysis, and previous events. Estimates are considered *potential* in that they generally represent losses that could occur in a countywide hazard scenario. In events that are localized, losses may be lower, while regional events could yield higher losses.

Potential loss estimates have four basic components, including:

- Replacement Value: Current cost of returning an asset to its pre-damaged condition, using present-day cost of labor and materials.
- Content Loss: Value of building's contents, typically measured as a percentage of the building replacement value.
- Functional Loss: The value of a building's use or function that would be lost if it were damaged or closed.
- Displacement Cost: The dollar amount required for relocation of the function (business or service) to another structure following a hazard event.

The parcel data used in this plan includes building values provided in the county tax assessment database. These values are representative of replacement value alone; content loss, functional loss, and displacement cost are not included. Figure 4.4-1 illustrates the range of parcel values in Erie County. The 113,833 parcels in Erie County have a cumulative assessed value of over $13.7 billion. The average assessed value of these parcels is $120,066. The City of Erie and Millcreek Township hold the largest amount of assets in the County with $3.7 billion and $3.3 billion respectively. At the other end of the spectrum, Elgin Borough has the potential to experience the least loss of all municipalities with less than $8.2 million in building assessed value.

Figure 4.4-1: Erie County parcel assessed values.



The full suite of potential losses was calculated for both riverine and coastal flood events as well as a historical earthquake event using HAZUS-MH MR4, a standardized loss estimation software package available from FEMA. These studies provided estimates of total economic loss, building damage, content damage, and other economic impacts that can be used in local response and mitigation planning activity.

A. RIVERINE FLOODING

Using HAZUS-MH, total building-related losses for the 1% annual-chance flood event were estimated to be $272 million. Approximately 48.4% of these building-related losses were incurred by commercial properties, 28.4% of building-related losses were incurred by residential occupancies, and 17.4% of total building-related losses were incurred by industrial occupancies. Figure 4.4-2 shows the spatial distribution of total economic losses at the Census block level for the riverine flood scenario. These total economic losses incorporate both building-related losses and business interruption losses. The highest economic losses are expected in the City of Erie, Lawrence Park Township, and Millcreek Township. Total economic loss, including replacement value, content loss, functional loss, and displacement cost was estimated at $274.4 million for the entire County. The full HAZUS results report can be found in **Appendix F**. The County feels that the loss estimates calculated with HAZUS-MH MR4 for riverine flooding and shown on Inset 1 in Figure 4.4-2 are significantly higher than actual losses from the 1% annual chance flood. Tubes were installed on Mill Creek more than 70 years ago, and the SFHA modeled in HAZUS for Mill Creek does not take this into account. The HAZUS model for Mill Creek also differs from the existing and preliminary DFIRM information. As stated in the HAZUS-MH Flood Event Report, the estimates of social and economic impacts contained in the report are produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There **are uncertainties** inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic impacts.

B. COASTAL FLOODING

Additional total economic losses were estimated for the 1% annual-chance flood event occurring due to flooding along the shore of Lake Erie. Total economic losses, including building-related losses, business interruptions, replacement value, content loss, functional loss, and displacement cost for this event was estimated at $24.8 million. Nearly all of the total economic loss for this scenario is building-related; building-related losses amount to $24.6 million of this total. Residential occupancies incurred 64.6% of these total building-related losses, commercial properties incurred 15.6% of these losses, and industrial properties incurred 2.9% of these total building-related losses. Figure 4.4-3 maps the total economic loss by Census block; economic loss is limited to those areas immediately adjacent to Lake Erie, and the highest losses are expected in the City of Erie and Lawrence Park Township. The full HAZUS results report can be found in **Appendix F**. The County feels that the loss estimates calculated with HAZUS-MH MR4 for coastal flooding are significantly higher than actual losses from the 1% annual chance flood. The report does not seem to take into account existing bluffs that would protect much of the surrounding area and reduce or prevent the magnitude of flooding depicted in Figure 4.4-3.

As stated in the HAZUS-MH Flood Event Report, the estimates of social and economic impacts contained in the report are produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There **are uncertainties** inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic impacts.

Figure 4.4-2: Erie County potential economic loss from 1% annual-chance-flood calculated with HAZUS-MH MR4.

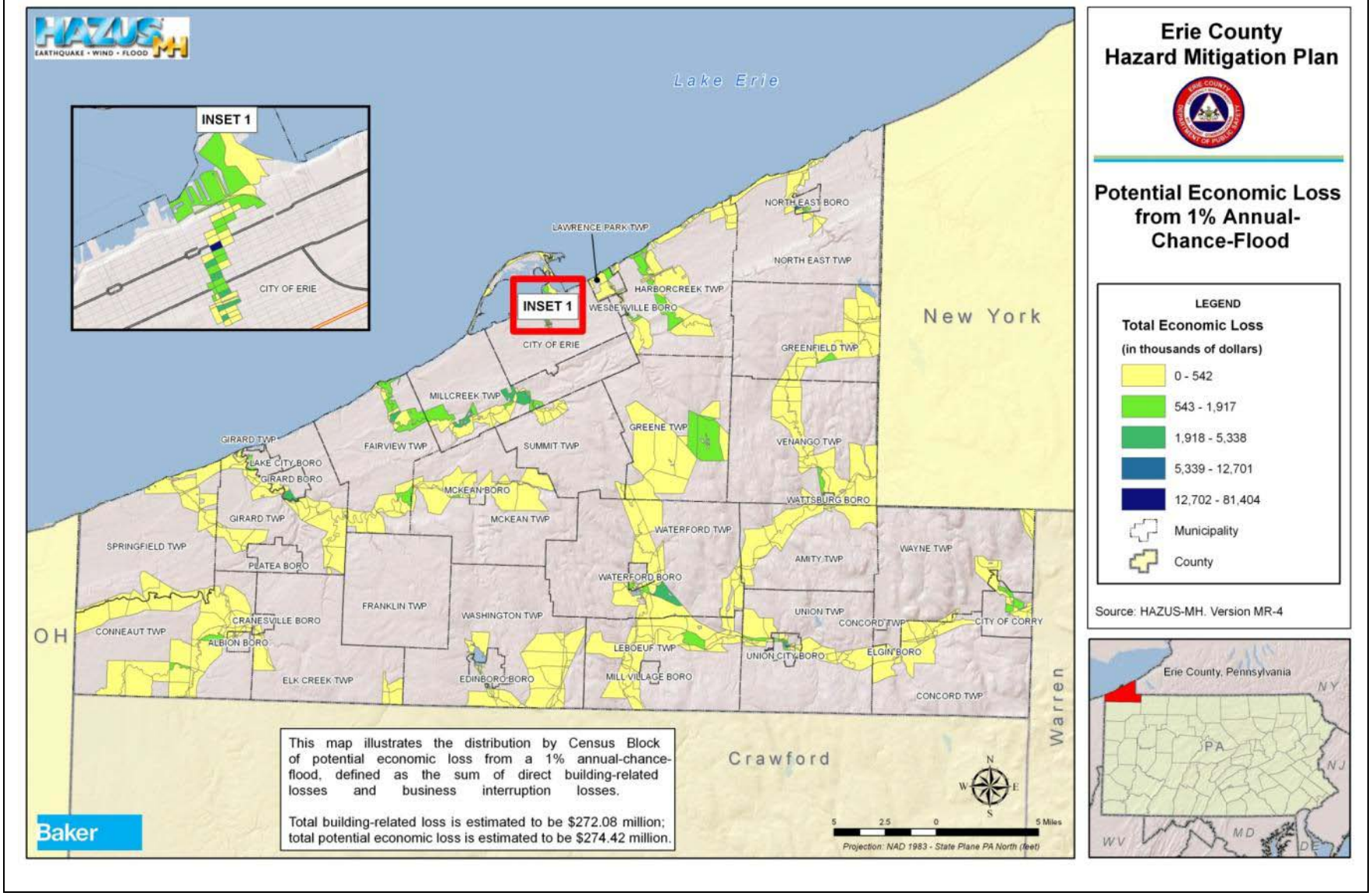
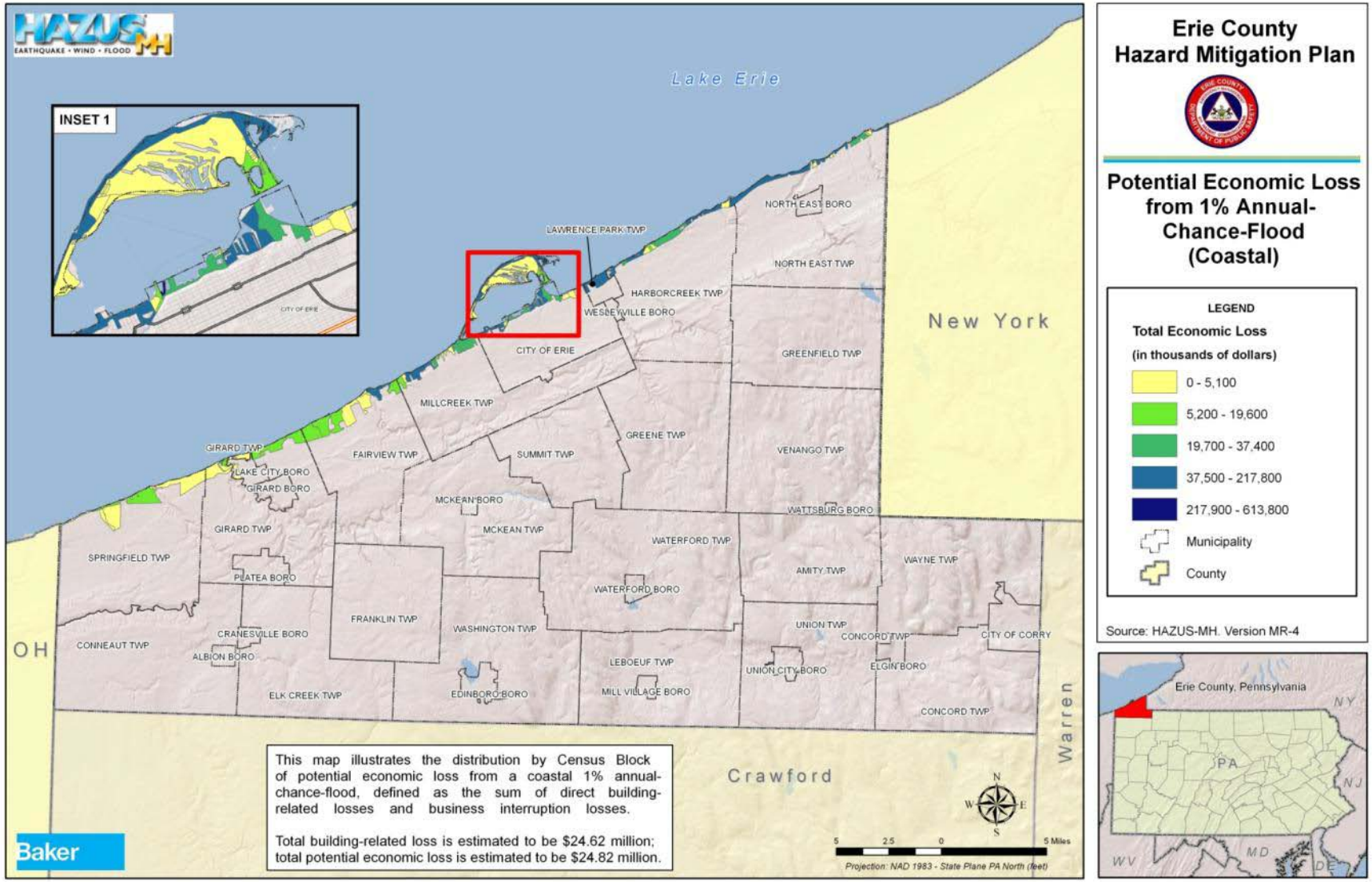


Figure 4.4-3: Erie County potential economic loss from 1% annual-chance coastal flood calculated with HAZUS-MH MR4.

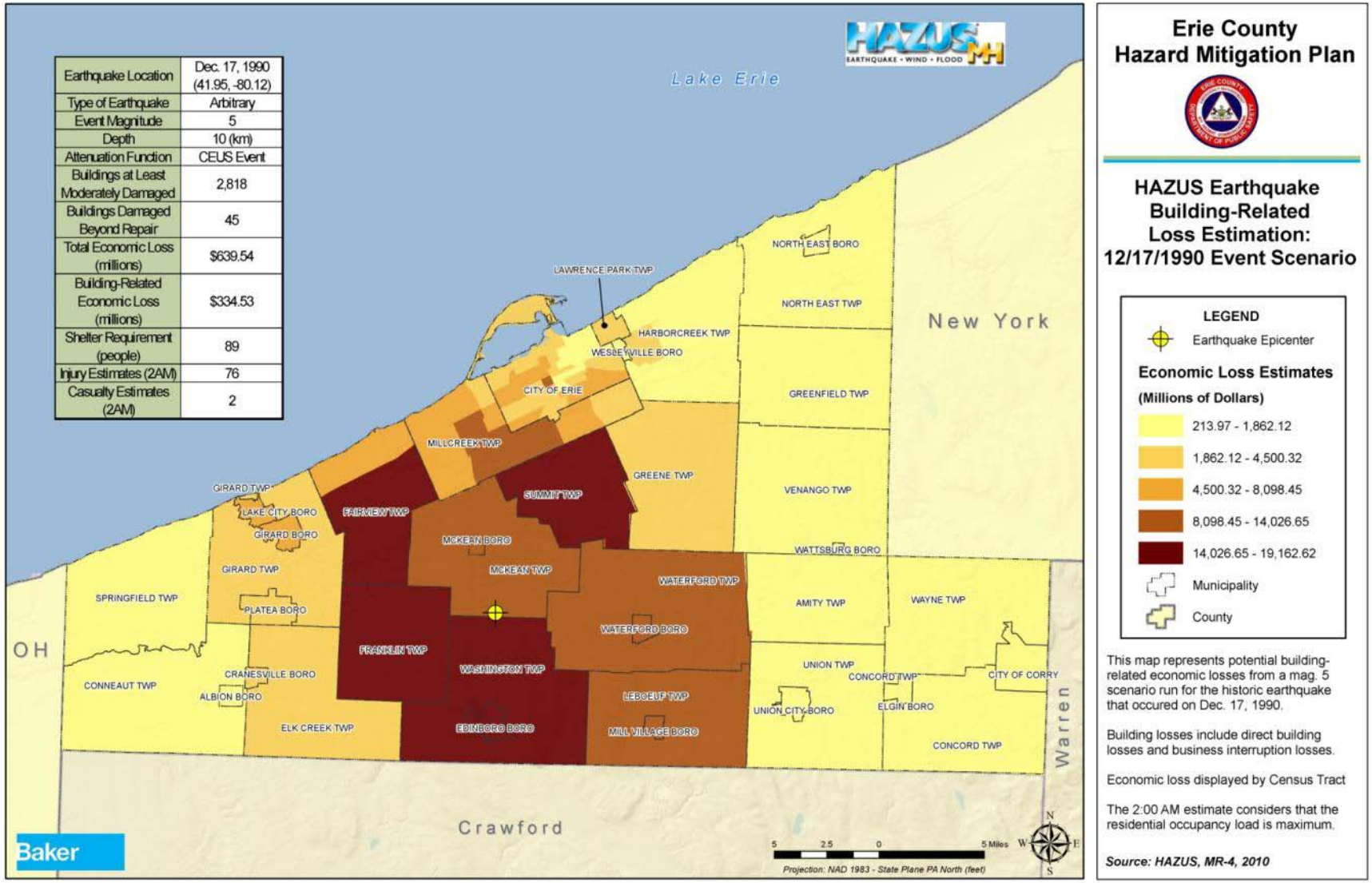


C. EARTHQUAKE

Using HAZUS-MH, a magnitude 5 earthquake with an epicenter in McKean Township was modeled to estimate total economic losses. This model was based on an earthquake that occurred on December 17, 1990 in this location with this magnitude. Economic losses and residential impacts were calculated assuming that the earthquake happened at 2 a.m., which assumes that the majority of residents are home instead of at the workplace. Figure 4.4-4 shows the spatial distribution of total economic losses at the Census tract level as well as a summary of the impacts of the earthquake.

Total building-related losses from this scenario – including wage loss, relocation costs, capital stock loss, and inventory loss – were estimated to be $334.5 million in Erie County. Residential occupancies incurred 56.1% of these total building-related losses, commercial properties incurred 26.2% of these losses, and industrial properties incurred 11.9% of these total building-related losses. Estimates were also generated for damage to transportation systems, including highways, railways, buses, ports, and airports. A total of $7.4 million is estimated to be lost in damage to these systems. Damage to utility systems – potable water, waste water, natural gas, oil systems, electrical power, and communication – were estimated to result in a total economic loss of $297.7 million during this earthquake. The total economic losses in Erie County are estimated to be $639.5 million, which includes all of the losses detailed above. The full HAZUS results report for this scenario as well as two other scenarios based on historical earthquakes in Erie County, can be found in **Appendix F**.

Figure 4.4-4: Erie County potential economic loss from magnitude 5 earthquake calculated with HAZUS-MH MR4.



For the remaining hazards where loss estimates could be determined, loss estimates are generalized based on the historical impact of the hazard. For droughts and nuclear incidents, the losses are largely agricultural; as a result, losses are expected to be some portion of Erie County's $71 million in agricultural production, depending on the magnitude of the event.

Losses associated with particular natural hazard events are sometimes reported to the NCDC with the event. The reporting time frame is 1950-2010. While these historic losses give a glimpse of potential losses in hazard events, they are not reported for all events and should be considered a broad estimate. Flood losses reported to NCDC total $29.53 million and range from $2,000 to $6.3 million. Windstorm events have had losses ranging from $1,000 to $1.5 million depending on the magnitude of the event. For winter storm events, the losses reported from storms caused losses ranging from $5,000 to $5 million per event for a total reported loss of $41.8 million.

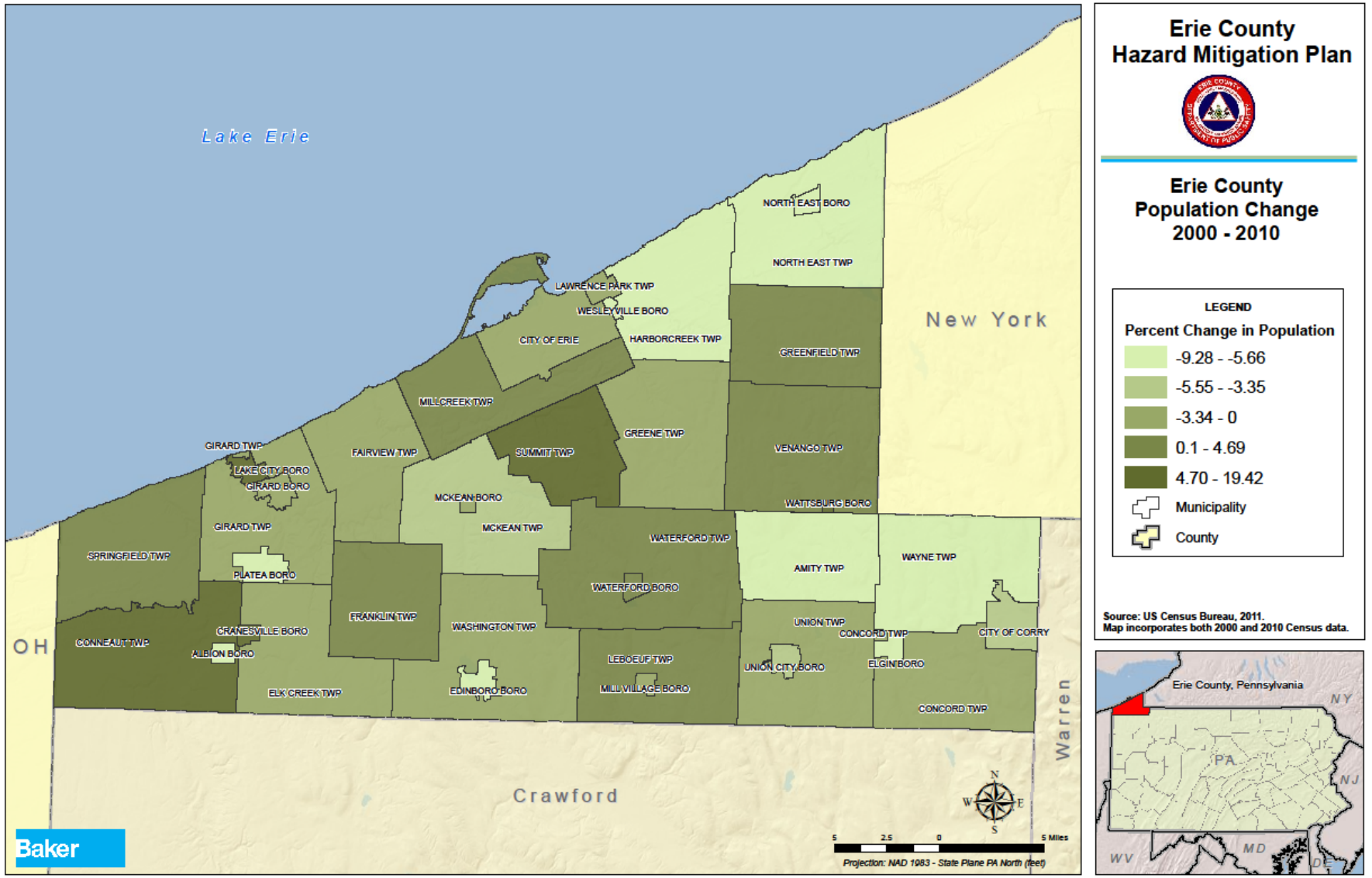
4.4.4. Future Development and Vulnerability

Risk and vulnerability to natural and human-made hazard events are not static. Risk will increase or decrease as counties and municipalities see changes in land use and development as well as changes in population. Erie County is expected to experience a variety of factors that will, in some areas, increase vulnerability to hazards while in other areas, vulnerability may stay static or even be reduced.

Population change and the age of the housing stock are main indicators of vulnerability change in Erie County. As discussed in Section 2.3, the total population of Erie County has decreased slightly, by 0.1%, between 2000 and 2010. The population change in the County can be seen in Figure 4.4-5. Twenty-two of the municipalities decreased during this time period, some more drastically than others – Platea Borough decreased by 9.28% and Edinboro, Elgin and Wesleyville Boroughs by more than 7%, while McKean Borough decreased by 0.3% and Elk Creek Township by 0.1%. Fifteen municipalities increased from 2000 to 2010, again some more drastically than others. Venango Township and Waterford Township increased by the smallest amounts in this time period, by 0.9% and 1.1% respectively. However, three townships increased by over 7% in the last decade: Lake City Borough grew by 7.8%, Conneaut Township by 9.7% and Summit Township by 19.4%. Conneaut Township's growth was in response to the addition of a new correctional facility (the State Correctional Institute of Albion). It was constructed along Route 18 and is not in the SFHA. Of the other two municipalities with large growth percentages, one is a Borough which whose density and age of housing stock make new population growth vulnerable to urban fire and explosion and winter storms. The other municipality is a fast-growing township, however most new population growth is in the northern half of the township away from the special flood hazard areas.

Areas of higher density, in the larger municipalities and growing municipalities, face an increased vulnerability and loss estimates in most hazard events. However, the more remote and sparsely population municipalities face higher vulnerability because they do not have as easy access to care facilities or response personnel.

Figure 4.4-5: Erie County population change from 2000 to 2010 (US Census, 2011).



The aging housing stock in Erie County is another source of current and future vulnerability in many hazard events. As discussed in Section 4.3.8.5, a moderate percentage of the housing stock, over 28 percent, was built before 1940. Erie County can experience gusts of wind up to 250 miles per hour during windstorms or tornadoes. The structure of these older houses may be more at risk of destruction under these strong wind conditions. These structures may also be at risk during flooding and winter storm events if the materials are either not strong enough to withstand the pressure or weight of the precipitation or are liable to leak, causing further risk of destruction to the house. Table 4.3.8-3 shows that the municipalities most vulnerable to these hazards are Cranesville Borough, McKean Borough, Wattsburg Borough, North East Borough, Lake City Borough, and Union City Borough.

The Erie County Comprehensive Plan and Land Use Plan, prepared in 2003, laid out guidelines to help preserve areas of open space as well as outline sensible development guidelines in areas of new growth. These guidelines as well as the Subdivision and Land Development Ordinance passed in 2010 will impact the level of vulnerability faced in different areas of Erie County. The land use plan encourages development in areas with existing infrastructure. It recommends preservation of agricultural lands and natural resources. Concentrating growth may help to reduce isolation-based vulnerability of communities with few access routes, no municipal water supply, and low cell phone reception. On the other hand, higher densities mean that more people are likely to be impacted in a hazard event should it strike those more populated areas.

5. Capability Assessment

5.1. Update Process Summary

Erie County has a number of resources it can access to implement hazard mitigation initiatives including emergency response measures, local planning and regulatory tools, administrative assistance and technical expertise, fiscal capabilities, and participation in local, regional, state, and federal programs. The presence of these resources enables community resiliency through actions taken before, during, and after a hazard event.

The 2006 HMP identified the most commonly used resources available in Erie County to support hazard mitigation with a focus on planning and regulatory tools. Resources were divided into five main categories including human physical, technological, informational and financial. The 2006 HMP indicated the presence of local plans, ordinances, and codes in each municipality. Finally, the 2006 Capability Assessment specified local, state, and non-profit resources available for mitigation efforts including the Pennsylvania CleanWays of Erie County, Red Cross-Greater Erie County Chapter, Erie Conservation District, and DEP-Growing Greener program. Through responses to the *Capability Assessment Survey* distributed to all municipalities and input from the HMSC and the HMPT, the 2012 HMPU provides an updated inventory of the most critical local planning tools available within each municipality and a summary of the fiscal and technical capabilities available through programs and organizations outside of the County. It also identifies emergency management capabilities and the processes used for implementation of the National Flood Insurance Program.

While the capability assessment serves as a good instrument for identifying local capabilities for, it also provides a means for recognizing gaps and weaknesses that can be resolved through future mitigation actions. The results of this assessment lend critical information for developing an effective mitigation strategy.

5.2. Capability Assessment Findings

5.2.1. Emergency Management

The Erie County Department of Public Safety coordinates countywide emergency management efforts. The Emergency Management Agency, which includes the Erie County 911 Center and the Erie County HAZMAT Team, is under the management of Public Safety. Each municipality has a designated local emergency management coordinator who possesses a unique knowledge of the impact hazard events have on their community. A significant amount of information used to develop this plan was obtained from these local emergency management coordinators. The Emergency Management Services Code (PA Title 35) requires that all municipalities in the Commonwealth have a Local Emergency Operations Plan (EOP) which is updated every two years. According to the Capability Assessment Surveys completed by municipal leaders, 21of the jurisdictions in the County have or are in the process of developing an EOP. A countywide EOP also exists.

Communities in Erie County also have additional emergency management capabilities. Eleven jurisdictions have an evacuation plan in place or under development either as a part of the EOP or as a separate plan. Five communities have or are developing continuity of operations plans

that will ensure the consistent functioning of government. The County also has its own continuity of operations plan. Finally, the Department of Public Safety provides training and quality assurance services and 24 hour public safety and dispatch services.

5.2.2. Participation in the National Flood Insurance Program (NFIP)

In Erie County, 37 of 38 municipalities are participants in the NFIP (see Table 5.2-1). The program is managed by local municipalities participating in the program through ordinance adoption and floodplain regulation. Similarly, permitting processes needed for building construction and development in the floodplain are implemented at the municipal level through various ordinances (e.g. zoning, subdivision/land development and floodplain ordinances), but the Planning Commission provides guidance upon request.

FEMA Region III makes available to communities, an ordinance review checklist which lists required provisions for floodplain management ordinances. This checklist helps communities develop an effective floodplain management ordinance that meets federal requirements for participation in the NFIP.

Pennsylvania DCED provides communities, based on their CFR, Title 44, Section 60.3 level of regulations, with a suggested ordinance document to assist municipalities in meeting the minimum requirements of the NFIP along with the Pennsylvania Flood Plain Management Act (Act 166). These suggested or model ordinances contain provisions that are more restrictive than state and federal requirements. Suggested provisions include, but are not limited to:

- Prohibiting manufactured homes in the floodway.
- Prohibiting manufactured homes within the area measured 50 feet landward from the top-of bank of any watercourse within a special flood hazard area.
- Special requirements for recreational vehicles within the special flood hazard area.
- Special requirement for accessory structures.
- Prohibiting new construction and development within the area measured 50 feet landward from the top-of bank of any watercourse within a special flood hazard area.
- Providing the County Conservation District an opportunity to review and comment on all applications and plans for any proposed construction or development in any identified floodplain area.

Act 166 mandates municipal participation in and compliance with the NFIP. It also establishes higher regulatory standards for new or substantially improved structures which are used for the production or storage of dangerous materials (as defined by Act 166) by prohibiting them in the floodway. Additionally, Act 166 establishes the requirement that a Special Permit be obtained prior to any construction or expansion of any manufactured home park, hospital, nursing home, jail and prison if said structure is located within a special flood hazard area.

Erie County municipalities currently use paper FIRM maps with current effective map dates ranging from 1976-1990; for the exact dates of each community's effective map, please see Table 4.3.3-3. Flood hazard data used in this plan is the County's Q3 data, which is a digital representation of certain features of FIRM maps. The County received copies of preliminary DFIRMs in September of 2009 and the Erie County Department of Planning provided several

municipalities with DFIRM data for their review and comment in addition to paper copies provided to municipalities by FEMA. The new DFIRMS and FIS report are scheduled to go effective in February 2012. Once available, the digital maps will greatly enhance mitigation capabilities as they relate to identifying flood hazards and will represent a significant improvement to the current effective paper Flood Insurance Rate Maps.

As new DFIRMs are published, the Pennsylvania State NFIP Coordinator housed at DCED, works with communities to ensure the timely and successful adoption of an updated floodplain management ordinance by reviewing and providing feedback on existing and draft ordinances. All municipalities in Erie County have indicated that they intend to adopt the Pennsylvania model floodplain management ordinance. In addition, DCED provides guidance and technical support through Community Assistance and Community Assistance Visits.

There are no communities in Erie County currently participating in the NFIP Community Rating System (FEMA CIS, 2011).

5.2.3. Planning and Regulatory Capability

Some of the most important planning and regulatory capabilities that can be utilized for hazard mitigation include comprehensive plans, building codes, floodplain ordinances, subdivision and land development ordinances, and zoning ordinances. These tools provide mechanisms for the implementation of adopted mitigation strategies. Table 5.2-1 summarizes their presence within each municipality.

Table 5.2-1: Summary of planning tools adopted by each municipality in Erie County (HMP Capability Assessment Surveys, 2011)

COMMUNITY	COMPRE-HENSIVE PLAN	BUILDING CODE	FLOODPLAIN ORDINANCE - NFIP PARTICIPANT	SUBDIVISION & LAND DEVELOPMENT ORDINANCE	ZONING ORDINANCE
Albion Borough	Yes Albion-Cranesville Joint Plan	Yes	Yes	Yes	Yes
Amity Township	Yes	Yes	Yes	County	Yes
Concord Township	Yes	Yes	Yes	County	Yes
Conneaut Township	Yes	Yes	Yes	County	No
Corry City	Yes, Corry-Wayne Joint Plan	Yes	Yes	Yes	Yes
Cranesville Borough	No	Yes	Yes	County	Yes
Edinboro Borough	Yes, Edinboro-Franklin-Washington Multi-Municipal Plan	Yes	Yes	Yes	Yes
Elgin Borough	No	Yes	Yes	County	Yes
Elk Creek Township	Yes	Yes	Yes	County	No
Erie City	No	Yes	Yes	Yes	Yes
Fairview Township	Yes	Yes	Yes	Yes	Yes

Table 5.2-1: Summary of planning tools adopted by each municipality in Erie County (HMP Capability Assessment Surveys, 2011)

COMMUNITY	COMPRE-HENSIVE PLAN	BUILDING CODE	FLOODPLAIN ORDINANCE - NFIP PARTICIPANT	SUBDIVISION & LAND DEVELOPMENT ORDINANCE	ZONING ORDINANCE
Franklin Township	Yes, Edinboro-Franklin-Washington Multi-Municipal Plan	Yes	Yes	Yes	Yes
Girard Borough	Yes	Yes	Yes	Yes	Yes
Girard Township	Yes	Yes	Yes	Yes	Yes
Greene Township	Yes	Yes	Yes	Yes	Yes
Greenfield Township	Yes	Yes	Yes	Yes	Yes
Harborcreek Township	Yes	Yes	Yes	Yes	Yes
Lake City Borough	Yes	Yes	Yes	Yes	Yes
Lawrence Park Township	Yes, Lawrence Park-Wesleyville Joint Plan	Yes	Yes	Yes	Yes
LeBoeuf Township	Yes, Mill Village-LeBoeuf Joint Plan	Yes	Yes	County	Yes
McKean Borough	Yes, McKean Boro-McKean Twp Joint Plan	Yes	Yes	Yes	Yes
McKean Township	Yes, McKean Boro-McKean Twp Joint Plan	Yes	Yes	Yes	Yes
Mill Village Borough	Yes, Mill Village-LeBoeuf Joint Plan	Yes	Yes	County	Yes
Millcreek Township	Yes	Yes	Yes	Yes	Yes
North East Borough	Yes, Northeast Boro-Northeast Twp Joint Plan	Yes	Yes	Yes	Yes
North East Township	Yes, Northeast Boro-Northeast Twp Joint Plan	Yes	Yes	Yes	Yes
Platea Borough	No	Yes	No	County	No
Springfield Township	Yes	Yes	Yes	Yes	Yes
Summit Township	Yes	Yes	Yes	Yes	Yes
Union City Borough	Yes	Yes	Yes	Yes	Yes
Union Township	Yes	Yes	Yes	County	Yes
Venango Township	Yes, Venango-Wattsburg Joint Plan	Yes	Yes	Yes	Yes

Table 5.2-1: Summary of planning tools adopted by each municipality in Erie County (HMP Capability Assessment Surveys, 2011)

COMMUNITY	COMPRE-HENSIVE PLAN	BUILDING CODE	FLOODPLAIN ORDINANCE - NFIP PARTICIPANT	SUBDIVISION & LAND DEVELOPMENT ORDINANCE	ZONING ORDINANCE
Washington Township	Yes, Edinboro-Franklin-Washington Multi-Municipal Plan	Yes	Yes	Yes	Yes
Waterford Borough	Yes	Yes	Yes	Yes	Yes
Waterford Township	Yes	Yes	Yes	Yes	Yes
Wattsburg Borough	Yes, Venango-Wattsburg Joint Plan	Yes	Yes	County	Yes
Wayne Township	Yes, Corry-Wayne Joint Plan	Yes	Yes	County	Yes
Wesleyville Borough	Yes, Lawrence Park-Wesleyville Joint Plan	Yes	Yes	Yes	Yes

Comprehensive Plans promote sound land use and regional cooperation among local governments to address planning issues. These plans serve as the official policy guide for influencing the location, type and extent of future development by establishing the basis for decision-making and review processes on zoning matters, subdivision and land development, land uses, public facilities and housing needs over time. The existing countywide Comprehensive Plan for Erie County was developed and adopted in 2003 with the Housing and Transportation Plan portions updated and adopted in 2008. Of the 38 jurisdictions, 34 also have municipal comprehensive plans; 14 of which are joint plans between two or more municipalities (see Table 5.3-1).

County governments are required by law to adopt a comprehensive plan, while local municipalities may do so at their option. Future comprehensive plan updates and improvements will consider 2012 HMP findings.

Building codes regulate construction standards for new construction and substantially renovated buildings. Standards can be adopted that require resistant or resilient building design practices to address hazard impacts common to a given community. In 2003, the Commonwealth of Pennsylvania implemented Act 45 of 1999, the Uniform Construction Code (UCC), a comprehensive building code that establishes minimum regulations for most new construction, including additions and renovations to existing structures. All 38 municipalities in Erie County have “opted in” to this statewide building code. On December 10, 2009 the Commonwealth adopted regulations of the 2009 International Code Council’s codes. The effective date of the regulations is December 31, 2009. Since all municipalities in Erie County are required to abide by the UCC they will are required to enforce the 2009 building code regulations for all building permits submitted after December 31, 2009. If a design or construction contract for proposed

work was signed between December 31, 2006 and December 30, 2009 then the 2006 International Codes must be abided.

Through administration of floodplain ordinances, municipalities can ensure that all new construction or substantial improvements to existing structures located in the floodplain are flood-proofed, dry-proofed, or built above anticipated flood elevations. Floodplain ordinances may also prohibit development in certain areas altogether. The NFIP establishes minimum ordinance requirements which must be met in order for that community to participate in the program. However, a community is permitted and in fact, encouraged, to adopt standards which exceed NFIP requirements. Through participation in the NFIP, 37 of 38 municipalities within the County have floodplain regulations in place, but they vary in age and restrictiveness from community to community.

Subdivision and land development ordinances (SALDOs) are intended to regulate the development of housing, commercial, industrial or other uses, including associated public infrastructure, as land is subdivided into buildable lots for sale or future development. Within these ordinances, guidelines on how land will be divided, the placement and size of roads and the location of infrastructure can reduce exposure of development to hazard events. Twenty-six of the thirty-eight jurisdictions within Erie County have adopted and enforce a subdivision and land development ordinance. The other 12 are subject to the Erie County Subdivision and Land Development Ordinance which was updated and adopted in 2010.

Zoning ordinances allow for local communities to regulate the use of land in order to protect the interested and safety of the general public. Zoning ordinances can be designed to address unique conditions or concerns within a given community. They may be used to create buffers between structures and high-risk areas, limit the type or density of development and/or require land development to consider specific hazard vulnerabilities. Thirty-five of the thirty-eight municipalities in Erie County have zoning regulations.

The Pennsylvania legislature enacted the Stormwater Management Act (Act 167 if 1978), commonly called Act 167. The Act enables the regulation of development and activities that cause accelerated runoff and encourages watershed-based planning and management of stormwater. The Department of Environmental Protection is the public agency charged with overseeing implementation of the Act 167 plans. Act 167 Stormwater Management Plans are intended to improve stormwater management practices, mitigate potential negative impacts from future land uses, and to improve the condition of impaired waterways. The Erie County Act 167 County-Wide Stormwater Management Plan was developed and adopted on February 1, 2011. The plan includes a Model Stormwater Management Ordinance for municipalities. Additionally, Erie County, together with Crawford, Venango and Warren Counties, has developed and made available a *Stormwater Management Implementation Guide for Municipal Officials* which is available on the Department of Planning's website, www.eriecountyplanning.org.

5.2.4. Administrative and Technical Capability

Administrative capability is described by an adequacy of departmental and personnel resources for the implementation of mitigation-related activities. Technical capability relates to an

adequacy of knowledge and technical expertise of local government employees or the ability to contract outside resources for this expertise in order to effectively execute mitigation activities. Common examples of skill sets and technical personnel needed for hazard mitigation include: planners with knowledge of land development/management practices, engineers or professionals trained in construction practices related to buildings and/or infrastructure (e.g. building inspectors), planners or engineers with an understanding of natural and/or human caused hazards, emergency managers, floodplain managers, land surveyors, scientists familiar with hazards in the community, staff with the education or expertise to assess community vulnerability to hazards, personnel skilled in geographic information systems, resource development staff or grant writers, fiscal staff to handle complex grant application processes.

Based on assessment results, municipalities in Erie County have moderate administrative and technical staff needed to conduct hazard mitigation-activities. There seems to be sufficient emergency management and land use planning staff across the County. Many of municipalities have engineering capabilities often by utilizing on-call private firms. Fewer than half of the municipalities have access to personnel for floodplain management, land surveying , GIS, grant writing, and scientific work related to community hazards. Most communities do not feel they have personnel skilled in GIS.

The Erie Conservation District and Erie County Department of Planning provide leading technical assistance roles for municipalities. Other local organizations that could act as partners in mitigating natural and human-made hazards include the Penn State Cooperative Extension, environmental advocacy groups, and watershed associations.

State agencies agency which can provide technical assistance for mitigation activities include, but are not limited to:

- Pennsylvania Department of Community and Economic Development,
- Pennsylvania Department of Conservation and Natural Resources,
- Pennsylvania Department of Environmental Protection, and
- Pennsylvania Department of Transportation.

Federal agencies which can provide technical assistance for mitigation activities include, but are not limited to:

- Army Corp of Engineers,
- Department of Housing and Urban Development,
- Department of Agriculture,
- Economic Development Administration,
- Emergency Management Institute,
- Environmental Protection Agency,
- FEMA, and
- Small Business Administration.

5.2.5. Fiscal Capability

The decision and capacity to implement mitigation-related activities is often strongly dependent on the presence of local financial resources. While some mitigation actions are less costly than others, it is important that money is available locally to implement policies and projects. Financial resources are particularly important if communities are trying to take advantage of state or federal mitigation grant funding opportunities that require local-match contributions. Based on survey results, most municipalities within the County perceive fiscal capability to be moderate-to-limited. The most common type of fiscal capability is not a funding source but rather partnering agreements between municipalities that enable resource sharing.

State programs which may provide financial support for mitigation activities include, but are not limited to:

- Community Conservation Partnerships Program,
- Community Revitalization Program,
- Floodplain Land Use Assistance Program,
- Growing Greener Program,
- Keystone Grant Program,
- Local Government Capital Projects Loan Program,
- Land Use Planning and Technical Assistance Program,
- Pennsylvania Heritage Areas Program,
- Pennsylvania Recreational Trails Program,
- Shared Municipal Services, and
- Technical Assistance Program.

Federal programs which may provide financial support for mitigation activities include, but are not limited to:

- Community Development Block Grants (CDBG),
- Disaster Housing Program,
- Emergency Conservation Program,
- Emergency Management Performance Grants (EMPG),
- Emergency Watershed Protection Program,
- Hazard Mitigation Grant Program (HMGP),
- Flood Mitigation Assistance Program,
- Non-insured Crop Disaster Assistance Program,
- Pre-Disaster Mitigation Program,
- Repetitive Flood Claims Program (RFC),
- Section 108 Loan Guarantee Programs,
- Severe Repetitive Loss Grant Program (SRL), and
- Weatherization Assistance Program.

5.2.6. Political Capability

One of the most difficult capabilities to evaluate involves the political will of a jurisdiction to enact meaningful policies and projects designed to mitigate hazard events. The adoption of hazard mitigation measures may be seen as an impediment to growth and economic development. In

many cases, mitigation may not generate interest among local officials when compared with competing priorities. Therefore, the local political climate must be considered when designing mitigation strategies, as it could be the most difficult hurdle to overcome in accomplishing the adoption or implementation of specific actions.

The *Capability Assessment Survey* was used to capture information on each jurisdiction's political capability. Survey respondents were asked to identify examples of political capability, such as guiding development away from hazard areas, restricting public investments or capital improvements within hazard areas, or enforcing local development standards that go beyond minimum state or federal requirements (i.e. building codes, floodplain management ordinances, etc…). These examples were used to guide respondents in scoring their community on a scale of "unwilling" (0) to "very willing" (5) to adopt policies and programs that reduce hazard vulnerabilities. As this is a notably sensitive subject for local government employees, not every jurisdiction provided a political capability score. Based on the information from municipalities providing a political capability rating, scores ranged from 0-5 with an average score of 3.2.

5.2.7. Self-Assessment

In addition to the inventory and analysis of specific local capabilities, the *Capability Assessment Survey* required each local jurisdiction to conduct its own self-assessment of its capability to effectively implement hazard mitigation activities. As part of this process, county and municipal officials were encouraged to consider the barriers to implementing proposed mitigation strategies in addition to the mechanisms that could enhance or further such strategies. In response to the survey questionnaire, local officials classified each of the capabilities as either "limited," "moderate" or "high." Again, because this may be sensitive for local government officials, not every jurisdiction completed the self assessment. Table 5.2-2 summarizes the results of the self-assessment survey as a percentage of the 21 responses received. For example, 47% of communities who responded indicated their community had limited fiscal capabilities.

Table 5.2-2: Summary of self-assessment capability responses expressed as a percentage of responses received.

CAPABILITY CATEGORY	LIMITED	MODERATE	HIGH
Planning & Regulatory	29%	42%	29%
Administrative & Technical	33%	43%	24%
Fiscal	47%	39%	14%
Political	34%	52%	14%

5.2.8. Existing Limitations

As discussed in Section 5.2.2, the communities in Erie County use a wide variety of floodplain regulations with a significant range of restrictiveness, but there is significant technical assistance available at the County level to standardize and use more restrictive ordinances. Municipalities that use the Commonwealth's model floodplain ordinance will have increased awareness of flood risk and NFIP capabilities. This is intricately tied to the age of the County's FIRM maps; many jurisdictions have not updated their ordinances since they received FIRMs at

minimum of 20 years ago. With the rapid rate of population growth and development in the County, it is essential that each municipality have an accurate representation of flood risk with recent data; this limitation will exist until the County receives new DFIRM data in 2012. Having new DFIRM data and the associated new floodplain ordinances that follow the DCED model ordinance could have a significant impact on enhancing NFIP capabilities. Actions 1 and 13 in the 2012 Mitigation Action Plan are intended to help remedy these limitations.

As mentioned, there are no communities in Erie County participating in the NFIP Community Rating System. However, 37 of 38 municipalities in the County have been designated as floodprone. Community participation in this program can provide premium reductions for properties located outside of Special Flood Hazard Areas of up to 10 percent and reductions for properties located in Special Flood Hazard Areas of up to 45 percent. These discounts can be obtained by undertaking public information, mapping and regulations, flood damage reduction and flood preparedness activities (FEMA, 2009). Action 14 in the 2012 Action Plan will encourage participation in CRS.

Numerous roads and intersections exist in the County where flooding issues repeatedly occur. Some of these roads and intersections are state routes. The County and local municipalities face challenges in mitigating flood events on state routes since these roads are owned and maintained by the Commonwealth of Pennsylvania. Local municipalities do not have the authority to independently carry out a mitigation project. In these situations, the Pennsylvania Department of Transportation must decide to undertake the project. Since the Department of Transportation is often most concerned with larger, critical transportation routes, smaller state roads and intersections which significantly affect a local community may not get the attention they need for the Commonwealth to take on a mitigation project.

Finally, limited funding is a critical barrier to the implementation of hazard mitigation activities. The County will need to rely on regional, state and federal partnerships for financial assistance.

6. Mitigation Strategy

6.1. Update Process Summary

Mitigation *goals* are general guidelines that explain what the County wants to achieve. Goals are usually expressed as broad policy statements representing desired long-term results. Mitigation *objectives* describe strategies or implementation steps to attain the identified goals. Objectives are more specific statements than goals; the described steps are usually measurable and can have a defined completion date. There were four goals identified in the 2006 HMP. The four goals were taken from the County's Comprehensive Plan and were not specific to hazard mitigation. When beginning the 2012 HMP update process, the HMSC examined the Pennsylvania State Plan goals and re-evaluated the 2006 Erie County HMP goals. The HMSC decided that with an expanded list of hazards and in light of the State Plan goals, it would be important to conduct a significant overhaul of the goals and objectives so that they reach across hazards and conform to FEMA guidance provided in the 386 series. The 2006 goals have been embodied in the new HMP goals, and objectives were created for each goal. A full review summary based on comments received from stakeholders who participated in the HMP update process is included in Table 6.1-1. These reviews are based on the *5-Year Hazard Mitigation Plan Review Worksheet,* which includes a survey on existing goals and objectives, completed by the HMSC. Municipal officials then provided feedback on the changes to the goals and objectives via the Goals and Objectives Evaluation Form distributed at the Risk Assessment Summary and Mitigation Solutions Workshop. Copies of these evaluations are located in **Appendix C**.

Table 6.1-1: List of 2006 Mitigation Strategy Goals and Objectives.

1. **Goal 1: Protecting the Erie County quality of life as found in open spaces, farmland, and residential neighborhoods.**	
Objective: No objectives listed in 2006 HMP.	**Review:** This goal has been expanded and re-written because of a desire to create a long-term vision for hazard and vulnerability reduction. The goal has been incorporated into the new Goal 1 (see Table 6.2-1) and now has seven associated objectives.
2. **Goal 2: Promoting the revitalization of existing urban places, be they cities, boroughs, or villages.**	
Objective: No objectives listed in 2006 HMP.	**Review:** The goal has been captured in Goal 4 as sensible planning and development are important to revitalization. (see Table 6.2-1).

Table 6.1-1: List of 2006 Mitigation Strategy Goals and Objectives.	
3. **Goal 3: Promoting economic development activities, which create good jobs.**	
Objective: No objectives listed in 2006 HMP.	**Review:** The goal has been captured in Goal 4 as sensible planning and development are important to economic development. (see Table 6.2-1).
4. Goal 4: Suggesting sensible development guidelines	
Objective: No objectives listed in 2006 HMP.	**Review:** This goal has been expanded and re-written because of a desire to create a long-term vision for hazard reduction and enhancement of mitigation capability. The goal has been incorporated into the new Goal 4 (see Table 6.2-1) and now has five associated objectives.

Actions provide more detailed descriptions of specific work tasks to help the County and its municipalities achieve prescribed goals and objectives. There were 11 actions identified in the 2006 Mitigation Strategy. A list of these actions as well as a review and summary of their progress based on comments from the HMSC is included in Table 6.1-2. Actions were evaluated by the HMSC with the intent of carrying over any actions that were incomplete, only partially complete, or continuous but still viable for the next five years. One action was completed which involved the purchase of a payloader by Franklin Township for use in removing snow and repairing washouts. In addition, several actions are in progress or were partially completed include the purchase and installation of generators or warning sirens. These in progress or partially completed actions are being carried over into the 2012 HMPU with anticipated completion shortly.

Table 6.1-2: List and review summary of 2006 mitigation actions.	
ACTION	**REVIEW**
1. Platea Borough: Purchase and Installation of generators and purchase of hand-held radios for Emergency Operations Center and shelter.	This action has been partially completed as generators have been purchased. The municipality will work on securing radios over the next five years. Therefore the Action is included in the 2012 HMPU. See Action 8.
2. Girard Township: Purchase and Installation of generators and purchase of hand-held radios for Emergency Operations Center.	This action has been partially completed as generators have been purchased. The municipality will work on securing radios over the next five years. Therefore the Action is included in the 2012 HMPU. See Action 8.

Table 6.1-2: List and review summary of 2006 mitigation actions.	
ACTION	**REVIEW**
3. Franklin Township: Purchase payloader for use in removing snow and repairing washouts.	This action has been completed.
4. Northeast Borough: The building of infiltration galleys, porous payment, directed downspout drainage and landscaping to control stormwater runoff in municipal parking lots.	This action is continuous and is included in the 2012 HMPU. See Action 30.
5. Lake City Borough: Requesting front-end loader for clean-up efforts, PLC's for sewer lift stations, and hand held radios.	This action is continuous and is included in the 2012 HMPU. See Action 25.
6. Edinboro Borough: To improve the existing storm water drainage system to handle the increased load due to development.	This action is continuous and is included in the 2012 HMPU. See Action 43.
7. Amity Township, Venango Township and Wattsburg Borough: To work to combine the resources (vehicles, fire equipment, communications, manpower, etc.) in an effort to mitigate future natural and man made emergencies.	This action is continuous and is included in the 2012 HMPU. See Action 3.
8. Mill village Borough: To re-install bridge and road and to dig creek bed down to a much lower level throughout the town	Carried over to 2012 HMPU. See Action 39.
9. Girard Township: Obtain necessary equipment for pre-wetting of salt and anti-skid materials. (storage tank and 5 hopper tanks.	This action is continuous and is included in the 2012 HMPU. See Action 23.
10. Girard Borough: The construction of a retention tank for the Waste water treatment plant, distribution of emergency information for borough residents and Radio equipment.	Carried over to 2012 HMPU as three actions. See Actions 4, 8, and 40.
11. McKean Township: Purchase and installation of Warning Sirens to warn residents of disasters.	This action is in progress and is included in the 2012 HMPU. See Action 27.

6.2. Mitigation Goals and Objectives

Based on results of the goals and objectives evaluation exercise and input from the HMSC, a list of four goals and nineteen corresponding objectives was developed. Table 6.2-1 details the mitigation goals and objectives established for the 2012 HMPU.

Table 6.2-1: List of Mitigation Strategy Goals and Objectives.	
GOAL 1	***Protect life and property in Erie County by reducing vulnerability to identified natural and human-made hazards.***
Objective 1.1	*Identify and evaluate potential protection measures for existing critical facilities with the highest relative vulnerability in the 100-year floodplain.*
Objective 1.2	*Increase advance warning capabilities.*
Objective 1.3	*Increase coordination, prioritization, and funding availability to address community needs for stormwater management related mitigation projects.*

Table 6.2-1: List of Mitigation Strategy Goals and Objectives.	
Objective 1.4	*Ensure that existing drainage systems such as pipes, culverts and channels are adequate and functioning properly.*
Objective 1.5	*Ensure that Emergency Services are in place and solvent.*
Objective 1.6	*Identify and evaluate mitigation measures for utility interruption.*
Objective 1.7	*Encourage communication between municipal and state snow removal entities.*
GOAL 2	***Provide a framework for active hazard mitigation planning and implementation through consistent coordination and communication among stakeholders.***
Objective 2.1	*Work with Pennsylvania Emergency Management Agency (PEMA) to encourage each participating jurisdiction to secure funding and initiate mitigation actions.*
Objective 2.2	*Promote integration of mitigation goals, objectives, and actions where appropriate in other local planning initiatives.*
Objective 2.3	*Expand working relationships with identified organizations (professional, non-profit, government agency, etc.) to improve mitigation efforts within the Commonwealth.*
GOAL 3	***Increase public awareness and understanding of natural and human-made hazard risks, preparedness and mitigation.***
Objective 3.1	*Work with FEMA and DCED to disseminate information about new Flood Insurance Rate Maps to the public in 2012.*
Objective 3.2	*Provide public outreach/education regarding updated Hazard Mitigation Plan and mitigation action implementation.*
Objective 3.3	*Encourage and support participation in FEMA's Community Rating System (CRS).*
Objective 3.4	*Encourage and support public participation in emergency management functions.*
GOAL 4	***Encourage and promote the development of sensible planning and regulatory guidelines in Erie County.***
Objective 4.1	*Support development and/or update of municipal zoning ordinances.*
Objective 4.2	*Support update of municipal floodplain management ordinances in 2012.*
Objective 4.3	*Support development and/or update of municipal stormwater ordinances in 2012.*

Table 6.2-1: List of Mitigation Strategy Goals and Objectives.	
Objective 4.4	*Support development and/or update of municipal subdivision and land development ordinances*
Objective 4.5	*Encourage local officials to incorporate the hazard mitigation plan into other planning mechanisms.*

6.3. Identification and Analysis of Mitigation Techniques

Appendix 7 of the SOG developed by PEMA provides a comprehensive list of hazard mitigation ideas. Erie County used this guide to identify mitigation techniques and develop mitigation actions. There are six categories of mitigation actions which Erie County considered in developing its Mitigation Action Plan. Those categories include:

- **Prevention:** Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning, zoning, building codes, subdivision regulations, hazard specific regulations (such as floodplain regulations), capital improvement programs, and open-space preservation and stormwater regulations.

- **Property Protection:** Actions that involve modifying or removing existing buildings or infrastructure to protect them from a hazard. Examples include the acquisition, elevation and relocation of structures, structural retrofits, flood-proofing, storm shutters, and shatter-resistant glass. Most of these property protection techniques are considered to involve “sticks and bricks;” however, this category also includes insurance.

- **Public Education and Awareness:** Actions to inform and educate citizens, elected officials, and property owners about potential risks from hazards and potential ways to mitigate them. Such actions include hazard mapping, outreach projects, library materials dissemination, real estate disclosures, the creation of hazard information centers, and school age / adult education programs.

- **Natural Resource Protection:** Actions that, in addition to minimizing hazard losses also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, forest and vegetation management, wetlands restoration or preservation, slope stabilization, and historic property and archeological site preservation.

- **Structural Project Implementation:** Mitigation projects intended to lessen the impact of a hazard by using structures to modify the environment. Structures include stormwater controls (culverts); dams, dikes, and levees; and safe rooms.

- **Emergency Services:** Actions that typically are not considered mitigation techniques but reduce the impacts of a hazard event on people and property. These actions are often taken prior to, during, or in response to an emergency or disaster. Examples

include warning systems, evacuation planning and management, emergency response training and exercises, and emergency flood protection procedures.

Table 6.3-1 provides a matrix identifying the mitigation techniques used for the hazards in the County. The specific actions associated with these techniques are included in Table 6.4-1. Table 6.3-1: Mitigation techniques used for hazards in Erie County.

HAZARD	MITIGATION TECHNIQUE					
	PREVENTION	PROPERTY PROTECTION	PUBLIC EDUCATION AND AWARENESS	NATURAL RESOURCE PROTECTION	STRUCTURAL PROJECT IMPLEMENTATION	EMERGENCY SERVICES
Coastal Erosion	X		X			X
Dam Failure	X		X			X
Drought			X			
Earthquake			X			
Environmental Hazards			X			
Flood, Flash Flood, Ice Jam	X	X	X	X	X	X
Invasive Species	X		X			X
Landslide	X	X	X	X	X	X
Nuclear Incident	X		X			
Tornado, Wind Storm	X		X			X
Transportation Accidents		X	X	X	X	X
Urban Fire and Explosion			X			
Utility Interruption	X		X	X	X	X
Winter Storm	X		X			X

6.4. Mitigation Action Plan

Following the Risk Assessment stage of the HMP update process, the Risk Assessment Review and Mitigation Solutions Workshop was held on March 24, 2011 to develop a framework for the Mitigation Action Plan (see meeting minutes in **Appendix C**). Following the goals and objectives review and evaluation during the Mitigation Workshop, the group went over Mitigation Techniques using PEMA's *Mitigation Ideas* document. Municipalities were informed that they needed to have at least one hazard-related mitigation action for each municipality. Municipal

representatives were given Mitigation Action Forms and were encouraged to complete one for each action they wished to pursue in the 2012 HMPU. In this way they largely self-selected their actions, but it is important to note that many of the actions were consolidated if they were similar and generalized to remove location-specific information (i.e. Eliminate flooding at 123 Main Street) per FEMA guidance. The final list of 45 mitigation actions is made up of actions developed by the HMSC from the 2006 Mitigation Action Plan, and the new actions developed at the Mitigation Solutions Workshop. Actions were selected and included in the plan based on information provided on Mitigation Action Forms, current ongoing or continued actions from the existing plan, information provided during meeting teleconferences, and HMSC discussion and evaluation.

Table 6.4-1 lists all the mitigation actions for the 2012 HMPU. At least one mitigation action was established for each moderate and high-risk hazard in Erie County, but more than one action is identified for several hazards. Each jurisdiction has at least one action. Each mitigation action is intended to address one or more of the goals and objectives identified in Section 6.2. Actions 1, 13, 14, and 44 will contribute to continued compliance with and participation in the NFIP.

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.

COMMUNITY: Albion Borough, Amity Township; Concord Township; Conneaut Township; Corry City; Cranesville Borough; Edinboro Borough; Elgin Borough; Elk Creek Township; Erie City; Fairview Township; Franklin Township; Girard Borough; Girard Township; Greene Township; Greenfield Township; Harborcreek Township; Lake City Borough; Lawrence Park Township; LeBoeuf Township; McKean Borough; McKean Township; Mill Village Borough; Millcreek Township; North East Borough; North East Township; Platea Borough; Springfield Township; Summit Township; Union City Borough; Union Township; Venango Township; Washington Township; Waterford Borough; Waterford Township; Wattsburg Borough; Wayne Township; Wesleyville Borough	**ACTION:** Update and adopt floodplain management ordinance when new flood maps become available using guidance in Pennsylvania Suggested Floodplain Management Provisions.

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
ACTION NO: 1	
Category:	NFIP; Prevention
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Municipality
Implementation Schedule:	March 2012
Funding Source:	Municipal and County staff time
COMMUNITY: Albion Borough, Amity Township; Concord Township; Conneaut Township; Corry City; Cranesville Borough; Edinboro Borough; Elgin Borough; Elk Creek Township; Erie City; Fairview Township; Franklin Township; Girard Borough; Girard Township; Greene Township; Greenfield Township; Harborcreek Township; Lake City Borough; Lawrence Park Township; LeBoeuf Township; McKean Borough; McKean Township; Mill Village Borough; Millcreek Township; North East Borough; North East Township; Platea Borough; Springfield Township; Summit Township; Union City Borough; Union Township; Venango Township; Washington Township; Waterford Borough; Waterford Township; Wattsburg Borough; Wayne Township; Wesleyville Borough	**ACTION:** Update and adopt stormwater ordinance.
ACTION NO: 2	
Category:	Prevention
Hazard(s) Addressed:	Flood, Flash Flood; Ice Jam
Lead Agency/Department:	Municipality; Erie County Department of Planning

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
Implementation Schedule:	2011
Funding Source:	Municipal and County Staff time
COMMUNITY: Amity Township, Venango Township, Wattsburg Borough **ACTION NO: 3**	**ACTION:** Work to combine the resources (vehicles, fire equipment, communications, manpower, etc.) in an effort to mitigate future natural and man-made emergencies.
Category:	Prevention
Hazard(s) Addressed:	Coastal Erosion; Drought; Earthquake; Flood, Flash Flood, Ice Jam; Invasive Species; Landslide; Tornado, Windstorm; Winter Storm; Dam Failure; Environmental Hazards; Nuclear Incidents; Transportation Accidents; Urban Fire and Explosion; Utility Interruption
Lead Agency/Department:	Individual Municipalities
Implementation Schedule:	Continuous and ongoing
Funding Source:	Staff time
COMMUNITY: Concord Township; Elgin Township; Girard Borough, Harborcreek Township; Wayne Township **ACTION NO: 4**	**ACTION:** Develop and distribute an Emergency Services Newsletter.
Category:	Public Education and Awareness
Hazard(s) Addressed:	Coastal Erosion; Drought; Earthquake; Flood, Flash Flood, Ice Jam; Invasive Species; Landslide; Tornado, Windstorm; Winter Storm; Dam Failure; Environmental Hazards; Nuclear Incidents; Transportation Accidents; Urban Fire and Explosion; Utility Interruption
Lead Agency/Department:	Municipal EMA's
Implementation Schedule:	2012 or Annual
Funding Source:	Municipality; FEMA-HMPG
COMMUNITY: Corry City **ACTION NO: 5**	**ACTION:** Host Public Forum to discuss personal planning protection for citizens.

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
Category:	Public Education and Awareness
Hazard(s) Addressed:	Coastal Erosion; Drought; Earthquake; Flood, Flash Flood, Ice Jam; Invasive Species; Landslide; Tornado, Windstorm; Winter Storm; Dam Failure; Environmental Hazards; Nuclear Incidents; Transportation Accidents; Urban Fire and Explosion; Utility Interruption
Lead Agency/Department:	City of Corry
Implementation Schedule:	12-18 months
Funding Source:	Staff time; general fund
COMMUNITY: Corry City **ACTION NO: 6***	**ACTION:** Install generator at Corry Community Center for shelter operation.
Category:	Emergency Services; Prevention
Hazard(s) Addressed:	Utility Interruption; Winter Storm; Tornado; Flood, Flash Flood, Ice Jam
Lead Agency/Department:	City of Corry
Implementation Schedule:	5 years
Funding Source:	Corry general fund; CDBG
COMMUNITY: Cranesville Borough **ACTION NO: 7**	**ACTION:** Lift Station improvement including streambank stabilization, manhole reinforcement and back-up generator installation.
Category:	Natural Resource Protection; Structural Project
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam; Utility Interruption
Lead Agency/Department:	Borough; DEP
Implementation Schedule:	5 years
Funding Source:	Borough; DEP

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
COMMUNITY: Cranesville Borough; Elk Creek Township; Franklin Township; Girard Borough, Girard Township; Lake City Borough; McKean Township; Platea Borough; Washington Township **ACTION NO: 8***	**ACTION:** Purchase hand-held radios for Emergency Operations Center and shelter.
Category:	Emergency Services
Hazard(s) Addressed:	Coastal Erosion; Drought; Earthquake; Flood, Flash Flood, Ice Jam; Invasive Species; Landslide; Tornado, Windstorm; Winter Storm; Dam Failure; Environmental Hazards; Nuclear Incidents; Transportation Accidents; Urban Fire and Explosion; Utility Interruption
Lead Agency/Department:	West Erie County EMA
Implementation Schedule:	2013
Funding Source:	Municipality; County; FEMA
COMMUNITY: Edinboro Borough **ACTION NO: 9**	**ACTION:** Provide overtopping protection to Edinboro Lake Dam.
Category:	Structural Project
Hazard(s) Addressed:	Dam Failure; Flood, Flash Flood, Ice Jam
Lead Agency/Department:	DEP Dam Safety
Implementation Schedule:	5+ years
Funding Source:	DEP H2O; DCED
COMMUNITY: Elk Creek Township **ACTION NO: 10**	**ACTION:** Construct retention pond at previously identified vulnerable area.
Category:	Structural Project
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Township

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
Implementation Schedule:	5 years
Funding Source:	Litigation Grant
COMMUNITY: Erie City **ACTION NO: 11***	**ACTION:** Obtain and install portable generators at critical facilities to ensure heat, meals and medical equipment are available and operating.
Category:	Emergency Services; Prevention
Hazard(s) Addressed:	Utility Interruption; Winter Storm; Tornado; Flood, Flash Flood, Ice Jam
Lead Agency/Department:	City
Implementation Schedule:	Within 5 years
Funding Source:	City; FEMA
COMMUNITY: Erie County **ACTION NO: 12**	**ACTION:** BMP Implementation at previously identified problem areas
Category:	Natural Resource Protection; Structural Project
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	ECCD
Implementation Schedule:	Ongoing; as needed
Funding Source:	PennVest; GG; DEP/319
COMMUNITY: Erie County **ACTION NO: 13**	**ACTION:** Work with DCNR and FEMA to disseminate updated flood map information
Category:	NFIP; Prevention; Public Outreach and Education
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Erie County Department of Planning
Implementation Schedule:	2012
Funding Source:	County staff time.

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
COMMUNITY: Erie County; Albion Borough, Amity Township; Concord Township; Conneaut Township; Corry City; Cranesville Borough; Edinboro Borough; Elgin Borough; Elk Creek Township; Erie City; Fairview Township; Franklin Township; Girard Borough; Girard Township; Greene Township; Greenfield Township; Harborcreek Township; Lake City Borough; Lawrence Park Township; LeBoeuf Township; McKean Borough; McKean Township; Mill Village Borough; Millcreek Township; North East Borough; North East Township; Platea Borough; Springfield Township; Summit Township; Union City Borough; Union Township; Venango Township; Washington Township; Waterford Borough; Waterford Township; Wattsburg Borough; Wayne Township; Wesleyville Borough	**ACTION:** Increase awareness of and participation in FEMA's Community Rating System (CRS) Program in cooperation with DCED.
ACTION NO: 14	
Category:	NFIP; Prevention; Public Outreach and Education
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Erie County Department of Public Safety
Implementation Schedule:	2 years
Funding Source:	County and Municipal staff time
COMMUNITY: Erie County	**ACTION:** Update the Ingestion Pathway Plan with assistance from key stakeholders including municipal, county and commonwealth officials.
ACTION NO: 15	
Category:	Prevention
Hazard(s) Addressed:	Nuclear Incident

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
Lead Agency/Department:	Erie County Department of Public Safety
Implementation Schedule:	2 years
Funding Source:	County; FEMA/HMGP
COMMUNITY: Fairview Township **ACTION NO: 16**	**ACTION:** Debris removal on Trout Run
Category:	Natural Resource Protection
Hazard(s) Addressed:	Flood, Flash Flood, and Ice Jam
Lead Agency/Department:	Township
Implementation Schedule:	2 years
Funding Source:	Township
COMMUNITY: Fairview Township **ACTION NO: 17***	**ACTION:** Install Generator at Emergency Community Shelter, Fairview School
Category:	Emergency Services; Prevention
Hazard(s) Addressed:	Utility Interruption; Winter Storm; Tornado; Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Township
Implementation Schedule:	3 years
Funding Source:	Township; School District; FEMA/HMGP
COMMUNITY: Franklin Township **ACTION NO: 18**	**ACTION:** Increase capacity of crosspipes at 9 previously identified vulnerable locations.
Category:	Structural Project
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Township Roadmaster
Implementation Schedule:	As funds become available

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
Funding Source:	Township
COMMUNITY: Girard Borough **ACTION NO: 19***	**ACTION:** Replace Hazard Siren
Category:	Emergency Services
Hazard(s) Addressed:	All; Tornado
Lead Agency/Department:	Borough
Implementation Schedule:	5 years
Funding Source:	Borough; Dobler Hose & Ladder; FEMA HMGP
COMMUNITY: Girard Borough **ACTION NO: 20***	**ACTION:** Obtain and install back-up generator for municipal electric
Category:	Emergency Services; Prevention
Hazard(s) Addressed:	Utility Interruption
Lead Agency/Department:	Borough
Implementation Schedule:	5 years
Funding Source:	Borough Electric; DCNR
COMMUNITY: Girard Township **ACTION NO: 21**	**ACTION:** Tube replacement at 4 previously identified vulnerable locations.
Category:	Structural Project
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Township Road Crew
Implementation Schedule:	2 years
Funding Source:	Township
COMMUNITY: Girard Township	**ACTION:** Stabilize and build up bank and headwalls at 2 previously identified vulnerable locations to prevent road from

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
ACTION NO: 22	washing out during flood event.
Category:	Property Protection; Natural Resource Protection; Structural Projects
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam; Landslide
Lead Agency/Department:	Township
Implementation Schedule:	2 years
Funding Source:	Township
COMMUNITY: Girard Township	**ACTION:** Obtain necessary equipment for pre-wetting of salt and anti-skid materials. (storage tank and 5 hopper tanks)
ACTION NO: 23	
Category:	Emergency Services; Structural Projects
Hazard(s) Addressed:	Transportation Accidents; Winter Storm
Lead Agency/Department:	Township
Implementation Schedule:	1 year
Funding Source:	Township
COMMUNITY: Greene Township	**ACTION:** Eliminate crosspipes at previously identified vulnerable locations.
ACTION NO: 24	
Category:	Structural Project; Natural Resource Protection
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Township Road Department
Implementation Schedule:	As funds become available
Funding Source:	Township
COMMUNITY: Edinboro Borough, Lake City Borough	**ACTION:** Repair and increase capacity of stormwater system.
ACTION NO: 25	

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
Category:	Structural Project
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Borough
Implementation Schedule:	Ongoing; As funds become available
Funding Source:	Borough; CDBG; EPA/DEP
COMMUNITY: McKean Township **ACTION NO: 26**	**ACTION:** Watershed restoration including streambank stabilization at previously identified vulnerable locations.
Category:	Property Protection; Natural Resource Protection
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Erie County Conservation District
Implementation Schedule:	5 years
Funding Source:	Conservation District; DEP-Growing Greener; Township
COMMUNITY: McKean Township **ACTION NO: 27***	**ACTION:** Purchase and installation of Warning Sirens to warn residents of disasters.
Category:	Emergency Services
Hazard(s) Addressed:	Coastal Erosion; Drought; Earthquake; Flood, Flash Flood, Ice Jam; Invasive Species; Landslide; Tornado, Windstorm; Winter Storm; Dam Failure; Environmental Hazards; Nuclear Incidents; Transportation Accidents; Urban Fire and Explosion; Utility Interruption
Lead Agency/Department:	West Erie County EMA
Implementation Schedule:	5 years
Funding Source:	Township; FEMA
COMMUNITY: Millcreek Township **ACTION NO: 28**	**ACTION:** Complete stormwater conveyance and detention planning and construction.

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
Category:	Structural Project
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Township Engineering Department
Implementation Schedule:	Ongoing
Funding Source:	Township; EPA/DEP; FEMA
COMMUNITY: Northeast Borough; Northeast Township **ACTION NO: 29**	**ACTION:** Develop a public outreach campaign to increase community awareness about local mitigation actions.
Category:	Public Outreach and Education
Hazard(s) Addressed:	Coastal Erosion; Drought; Earthquake; Flood, Flash Flood, Ice Jam; Invasive Species; Landslide; Tornado, Windstorm; Winter Storm; Dam Failure; Environmental Hazards; Nuclear Incidents; Transportation Accidents; Urban Fire and Explosion; Utility Interruption
Lead Agency/Department:	North East Area EMA
Implementation Schedule:	Summer; Ongoing
Funding Source:	Municipal; FEMA/HMGP
COMMUNITY: Northeast Borough **ACTION NO: 30**	**ACTION:** The building of infiltration galleys, porous payment, directed downspout drainage and landscaping to control stormwater runoff in municipal parking lots.
Category:	Natural Resource Protection; Property Protection, Structural Project
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Borough
Implementation Schedule:	Ongoing
Funding Source:	Borough; DEP-Growing Greener
COMMUNITY: Elk Creek Township, Franklin Township, Girard Township, Platea Borough, Washington Township	**ACTION:** Repair or purchase Tornado Warning Sirens with radio receivers.

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
ACTION NO: 31*	
Category:	Emergency Services; Prevention
Hazard(s) Addressed:	Tornado
Lead Agency/Department:	Municipality; FEMA HMGP
Implementation Schedule:	1 year
Funding Source:	Borough
COMMUNITY: Venango Township	**ACTION:** Purchase another used snowplow for snow removal.
ACTION NO: 32*	
Category:	Emergency Services
Hazard(s) Addressed:	Winter Storm; Transportation Accident
Lead Agency/Department:	Township
Implementation Schedule:	2012
Funding Source:	Township; DCED
COMMUNITY: Venango Township	**ACTION:** Add sluice pipes and elevate Knoyle Road
ACTION NO: 33	
Category:	Structural Projects
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam; Traffic Accident
Lead Agency/Department:	Township
Implementation Schedule:	3 years
Funding Source:	Conservation District
COMMUNITY: Washington Township	**ACTION:** Direct infiltration protection from flood waters into key sewage lift station (possibly dike).
ACTION NO: 34	
Category:	Structural Project

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam; Utility Interruption
Lead Agency/Department:	Township Sewer Fund
Implementation Schedule:	5 years
Funding Source:	Township Sewer Department
COMMUNITY: Waterford Township **ACTION NO: 35**	**ACTION:** Replace crosspipe at Baghad Road
Category:	Structural Project
Hazard(s) Addressed:	Flood, Flash Flood, and Ice Jam; Transportation Accident
Lead Agency/Department:	Township
Implementation Schedule:	1 year
Funding Source:	Conservation District; PennDOT
COMMUNITY: Wattsburg Borough **ACTION NO: 36**	**ACTION:** Obtain signage for re-routing traffic during high water events
Category:	Prevention; Public Outreach and Education
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam; Transportation Accident
Lead Agency/Department:	Borough
Implementation Schedule:	3 years
Funding Source:	Borough; FEMA/HMGP
COMMUNITY: Wayne Township **ACTION NO: 37**	**ACTION:** Investigate residents' knowledge/interest in using social media for emergency notifications via survey/questionnaire.
Category:	Public Outreach and Education; Emergency Services

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
Hazard(s) Addressed:	Coastal Erosion; Drought; Earthquake; Flood, Flash Flood, Ice Jam; Invasive Species; Landslide; Tornado, Windstorm; Winter Storm; Dam Failure; Environmental Hazards; Nuclear Incidents; Transportation Accidents; Urban Fire and Explosion; Utility Interruption
Lead Agency/Department:	Township Secretary
Implementation Schedule:	1 year
Funding Source:	Township
COMMUNITY: Wayne Township **ACTION NO: 38**	**ACTION:** Consider more restrictive provisions during zoning ordinance update.
Category:	Prevention
Hazard(s) Addressed:	Coastal Erosion; Drought; Earthquake; Flood, Flash Flood, Ice Jam; Invasive Species; Landslide; Tornado, Windstorm; Winter Storm; Dam Failure; Environmental Hazards; Nuclear Incidents; Transportation Accidents; Urban Fire and Explosion; Utility Interruption
Lead Agency/Department:	Township
Implementation Schedule:	2012
Funding Source:	Township; DCED; DEP
COMMUNITY: Mill Village Borough **ACTION NO: 39**	**ACTION:** Re-install bridge and road and to dig creek bed down to a much lower level throughout the town.
Category:	Structural Project
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Borough
Implementation Schedule:	5 yrs.
Funding Source:	TBD
COMMUNITY: Girard Borough	**ACTION:** Construct retention tank for the waste water treatment plant.

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
ACTION NO: 40	
Category:	Structural Project
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam; Utility Interruption
Lead Agency/Department:	Municipality
Implementation Schedule:	5 yrs.
Funding Source:	DEP; Municipality
COMMUNITY: Erie County **ACTION NO: 41**	**ACTION:** Collect additional information (maintenance, ownership, inspection etc) about the fourteen dams in Erie County for inclusion in next Hazard Mitigation Plan Update.
Category:	Prevention
Hazard(s) Addressed:	Dam Failure
Lead Agency/Department:	Erie County Department of Planning
Implementation Schedule:	5 yrs.
Funding Source:	DEP; Municipality
COMMUNITY: Erie County **ACTION NO: 42**	**ACTION:** Identify and coordinate with appropriate partners and agencies to arrange for data collection of flood and structure data necessary to perform a level 2 HAZUS analysis for the next hazard mitigation plan update (i.e. Building Value, Lowest Floor Elevation, Building Type, Occupancy Type, Foundation Type, Number of Stories and Square Footage).
Category:	Prevention; Public Education and Outreach
Hazard(s) Addressed:	Flood, Flash Flood, and Ice Jam
Lead Agency/Department:	Erie County Department of Planning
Implementation Schedule:	Within 2 years
Funding Source:	County; PEMA/FEMA
COMMUNITY: Erie County **ACTION NO: 43**	**ACTION:** Develop a countywide Winter Storm Task Force to meet regularly to address winter storm preparedness and operations.

Table 6.4-1: List of 2012 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule. Emergency Services actions have been highlighted in peach and marked with an asterisk to distinguish them.	
Category:	Prevention
Hazard(s) Addressed:	Winter Storm
Lead Agency/Department:	Municipalities and Erie County Department of Public Safety
Implementation Schedule:	Ongoing
Funding Source:	Municipalities; County; PEMA/FEMA
COMMUNITY: Erie County **ACTION NO: 44**	**ACTION:** Work with municipalities to update local floodplain management ordinances and collect and record information on provisions for freeboard, restriction of hazardous materials in the floodplain, and restriction of critical facilities in the floodplain.
Category:	Prevention; NFIP
Hazard(s) Addressed:	Flood, Flash Flood, and Ice Jam
Lead Agency/Department:	Erie County Department of Planning
Implementation Schedule:	Within 1 year
Funding Source:	County; PEMA/FEMA
COMMUNITY: Erie County **ACTION NO: 45**	**ACTION:** Identify and implement structural and property protection projects to reduce the impacts from flooding including acquisition, elevation and relocation projects.
Category:	Property Protection; Structural Project Implementation
Hazard(s) Addressed:	Flood, Flash Flood, and Ice Jam
Lead Agency/Department:	Municipalities
Implementation Schedule:	Ongoing
Funding Source:	Municipalities; PEMA/FEMA

Table 6.4-1 lists 45 mitigation actions, many of which will require substantial time commitments from staff at the County and local municipalities. Those that participated in the development of the 2012 HMP believe that these actions are attainable and can be implemented over the next five-year cycle. While all activities will be pursued over the next five years, the reality of limited time and resources requires the identification of high-priority mitigation actions. Prioritization

allows the individuals and organizations involved to focus their energies and ensure progress on mitigation activities.

Mitigation actions were evaluated using the seven criteria which frame the *PASTEEL* method. These feasibility criteria include:

- **Political:** Does the action have public and political support?
- **Administrative:** Is there adequate staffing and funding available to implement the action in a timely manner?
- **Social:** Will the action be acceptable by the community or will it cause any one segment of the population to be treated unfairly?
- **Technical:** How effective will the action be in avoiding or reducing future losses?
- **Economic:** What are the costs and benefits of the action and does it contribute to community economic goals?
- **Environmental:** Will the action provide environmental benefits and will it comply with local, state and federal environmental regulations?
- **Legal:** Does the community have the authority to implement the proposed measure?

The *PASTEEL* method use political, administrative, social, technical, economic, environmental and legal considerations as a basis means of evaluating which of the identified actions should be considered most critical. Economic considerations are particularly important in weighing the costs versus benefits of implementing one action prior to another.

FEMA mitigation planning requirements indicate that any prioritization system used shall include a special emphasis on the extent to which benefits are maximized according to a cost-benefit review of the proposed projects. To do this in an efficient manner that is consistent with FEMA's guidance on using cost-benefit review in mitigation planning, the *PASTEEL* method was adapted to include a higher weighting for two elements of the *economic* feasibility factor – Benefits of Action and Costs of Action. This method incorporates concepts similar to those described in Method C of FEMA 386-5: Using Benefit Cost Review in Mitigation Planning (FEMA, 2007).

Those participating in the 2012 HMPU process provided comments which allowed for the prioritization of the mitigation actions listed in Table 6.4-1 using the seven *PASTEEL* criteria. In order to evaluate and prioritize the mitigation actions, *favorable* and *less favorable* factors were identified for each action. Table 6.4-2 summarizes the evaluation methodology and provides the results of this evaluation for all mitigation actions. The first results column includes a summary of the feasibility factors, placing equal weight on all factors. The second results column reflects feasibility scores with benefits and costs weighted more heavily; and therefore, given greater priority. A weighting factor of three was used for each benefit and cost element. Therefore, a "+" benefit factor rating equals three pluses and a "-" benefit factor rating equals three minuses in the total prioritization score.

Figure 6.4-2: Summary of mitigation action prioritization using PASTEEL methodology.

MITIGATION ACTIONS		*PA STEEL* CRITERIA CONSIDERATIONS (+) *Favorable* (-) *Less favorable* (N) *Not Applicable*																						
		P Political			**A** Administrative			**S** Social		**T** Technical			**E** Economic				**E** Environmental					**L** Legal				
NO.	**NAME**	Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	**Benefit of Action (x3)**	**Cost of Action (x3)**	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HAZMAT / Waste Site	Consistent w/ Community Environmental Goals	Consistent w/ Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge	**SUMMARY (EQUAL WEIGHTING)**	**SUMMARY (BENEFITS & COSTS PRIORITIZED)**
1	Update and adopt floodplain management ordinance when new flood maps become available using guidance in Pennsylvania Suggested Floodplain Management Provisions.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	+	+	+	+	+	21 (+) 0 (-) 2 (N)	25 (+) 0 (-) 2 (N)
2	Update and adopt stormwater ordinance.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	+	+	+	+	+	21 (+) 0 (-) 2 (N)	25 (+) 0 (-) 2 (N)
3	Work to combine the resources (vehicles, fire equipment, communications, manpower, etc.) in an effort to mitigate future natural and human-made emergencies.	+	+	+	-	+	-	+	N	+	N	N	+	+	+	+	N	N	N	N	N	N	+	+	12 (+) 2 (-) 9 (N)	16 (+) 2 (-) 9 (N)
4	Develop and distribute an Emergency Services Newsletter	+	+	+	-	-	+	+	+	+	+	+	+	+	N	+	N	N	N	N	N	N	+	N	13 (+) 2 (-) 8 (N)	17(+) 2 (-) 8 (N)
5	Host Public Forum to discuss personal planning protection for citizens.	+	+	+	-	-	+	+	+	+	+	+	+	+	N	+	N	N	N	N	N	N	+	N	13 (+) 2 (-) 8 (N)	17(+) 2 (-) 8 (N)

Figure 6.4-2: Summary of mitigation action prioritization using PASTEEL methodology.

MITIGATION ACTIONS		*PA STEEL* CRITERIA CONSIDERATIONS (+) *Favorable* (-) *Less favorable* (N) *Not Applicable*																						
		P Political			**A** Administrative			**S** Social		**T** Technical			**E** Economic				**E** Environmental					**L** Legal				
NO.	**NAME**	Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	**Benefit of Action (x3)**	**Cost of Action (x3)**	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HAZMAT / Waste Site	Consistent w/ Community Environmental Goals	Consistent w/ Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge	**SUMMARY (EQUAL WEIGHTING)**	**SUMMARY (BENEFITS & COSTS PRIORITIZED)**
6*	Install generator at Corry Community Center for shelter operation.	+	+	+	+	-	-	+	+	+	+	N	+	-	N	-	N	N	N	+	N	N	+	N	11 (+) 4 (-) 8 (N)	13 (+) 6 (-) 8 (N)
7	Lift Station improvement including streambank stabilization, manhole reinforcement and back-up generator installation	+	+	+	+	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	N	N	+	N	12 (+) 4 (-) 7 (N)	14 (+) 6 (-) 7 (N)
8*	Purchase hand-held radios for Emergency Operations Center and shelter.	+	+	+	+	-	-	+	+	+	+	N	+	-	N	-	N	N	N	+	N	N	+	N	11 (+) 4 (-) 8 (N)	13 (+) 6 (-) 8 (N)
9	Provide overtopping protection to Edinboro Lake Dam	+	+	+	+	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	N	-	+	N	12 (+) 5 (-) 6 (N)	14 (+) 7 (-) 6 (N)
10	Construct retention pond at previously identified vulnerable area.	+	+	+	+	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	-	-	+	N	12 (+) 6 (-) 6 (N)	14 (+) 9 (-) 6 (N)
11*	Obtain and install portable generators at critical facilities to ensure heat, meals and medical equipment are available	+	+	+	+	-	-	+	+	+	+	N	+	-	N	-	N	N	N	+	N	N	+	N	11 (+) 4 (-) 8 (N)	13 (+) 6 (-) 8 (N)

Figure 6.4-2: Summary of mitigation action prioritization using PASTEEL methodology.

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	and operating.																								
12	BMP Implementation at previously identified problem areas	+	+	+	+	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	+	+	+	N	14 (+) 4 (-) 5 (N)	16 (+) 6 (-) 5 (N)
13	Work with DCED and FEMA to disseminate updated flood map information	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	N	N	N	+	+	+	N	18 (+) 1 (-) 4 (N)	22(+) 1 (-) 4 (N)
14	Increase awareness of and participation in FEMA's Community Rating System (CRS) Program in cooperation with DCED.	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	N	N	N	+	N	+	N	17 (+) 1 (-) 5 (N)	21(+) 1 (-) 5 (N)
15	Update the Ingestion Pathway Plan with assistance from key stakeholders including municipal, county and commonwealth officials.	+	+	+	-	-	-	+	+	+	+	N	+	+	+	+	N	N	N	N	N	N	+	N	12 (+) 3 (-) 8 (N)	16 (+) 3 (-) 8 (N)
16	Debris removal on Trout Run	+	+	+	-	-	-	+	+	+	+	+	+	+	+	-	+	N	N	+	N	-	-	N	13 (+) 6 (-) 4 (N)	15 (+) 6 (-) 4 (N)

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17*	Install Generator at Emergency Community Shelter, Fairview School	+	+	+	-	+	+	+	+	+	+	+	+	+	+	-	N	N	+	+	+	+	+	N	18 (+) 2 (-) 3(N)	22(+) 2 (-) 3 (N)
18	Increase capacity of crosspipes at 9 previously identified vulnerable locations.	+	+	+	-	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	-	-	+	N	11 (+) 7 (-) 5 (N)	13 (+) 9 (-) 5 (N)
19*	Replace Hazard Siren.	+	+	+	+	+	-	+	+	+	+	N	+	+	N	+	N	N	N	N	N	N	+	N	13 (+) 1 (-) 9 (N)	17 (+) 1 (-) 9 (N)
20*	Obtain and install back-up generator for municipal electric.	+	+	+	+	-	-	+	+	+	+	N	+	-	N	-	N	N	N	+	N	N	+	N	11 (+) 4 (-) 8 (N)	13 (+) 6 (-) 8 (N)
21	Tube replacement at 4 previously identified vulnerable locations.	+	+	+	-	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	-	-	+	N	11 (+) 7 (-) 5 (N)	13 (+) 9 (-) 5 (N)
22	Stabilize and build up bank and headwalls at 2 previoulsly identified vulnerable locations to prevent road from washing out during flood event.	+	+	+	+	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	N	-	+	N	12 (+) 5 (-) 6 (N)	14 (+) 7 (-) 6 (N)

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23	Obtain necessary equipment for pre-wetting of salt and anti-skid materials. (storage tank and 5 hopper tanks).	+	+	+	+	-	-	+	+	+	+	N	+	-	N	-	N	N	N	N	N	+	+	N	12 (+) 4 (-) 8 (N)	14 (+) 6 (-) 8 (N)
24	Eliminate crosspipes at previously identified vulnerable locations.	+	+	+	-	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	N	N	+	N	11 (+) 5 (-) 7 (N)	13 (+) 7 (-) 7 (N)
25	Repair and increase capacity of stormwater system.	+	+	+	-	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	+	-	-	N	11 (+) 7 (-) 5 (N)	13 (+) 9 (-) 5 (N)
26	Watershed restoration including streambank 208tabilization at previously identified vulnerable locations.	+	+	+	-	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	N	-	-	N	11 (+) 6 (-) 7 (N)	13 (+) 8 (-) 7 (N)
27*	Purchase and installation of Warning Sirens to warn residents of disasters.	+	+	+	+	+	-	+	+	+	+	N	+	+	N	+	N	N	N	N	N	N	+	N	13 (+) 1 (-) 9 (N)	17 (+) 1 (-) 9 (N)
28	Complete stormwater conveyance and detention planning and construction.	+	+	+	-	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	-	-	+	N	11 (+) 7 (-) 5 (N)	13 (+) 9 (-) 5 (N)

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29	Develop a public outreach campaign to increase community awareness about local mitigation actions.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	+	+	+	+	+	21 (+) 0 (-) 2 (N)	25 (+) 0 (-) 2 (N)
30	Build infiltration galleys, porous payment, directed downspout drainage and landscaping to control stormwater runoff in municipal parking lots.	+	+	+	-	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	N	-	+	N	11 (+) 6 (-) 6 (N)	13 (+) 8 (-) 6 (N)
31*	Repair or purchase Tornado Warning Sirens with radio receivers.	+	+	+	+	+	-	+	+	+	+	N	+	+	N	+	N	N	N	N	N	N	+	N	13 (+) 1 (-) 9 (N)	17 (+) 1 (-) 9 (N)
32*	Purchase another used snowplow for snow removal.	+	+	+	+	-	-	+	+	+	+	N	+	-	N	-	N	N	N	N	N	+	+	N	12 (+) 4 (-) 8 (N)	14 (+) 6 (-) 8 (N)
33	Add sluice pipes and elevate Knoyle Road	+	+	+	-	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	+	-	-	N	11 (+) 7 (-) 5 (N)	13 (+) 9 (-) 5 (N)
34	Direct infiltration protection from flood waters into key sewage lift station	+	+	+	+	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	N	-	+	N	12 (+) 5 (-) 6 (N)	14 (+) 7 (-) 6 (N)

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	(possibly dike).																									
35	Replace crosspipe at Baghad Road	+	+	+	-	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	N	N	+	N	11 (+) 5 (-) 7 (N)	13 (+) 7 (-) 7 (N)
36	Obtain signage for re-routing traffic during high water events	+	+	+	-	-	-	+	+	+	N	N	+	+	N	-	N	N	N	N	+	N	+	N	10 (+) 4 (-) 9 (N)	14(+) 4 (-) 9 (N)
37	Investigate residents knowledge/interest in using social media for emergency notifications via survey/questionnaire.	+	+	+	-	-	+	+	+	+	+	+	+	+	N	+	N	N	N	N	N	N	+	N	13 (+) 2 (-) 8 (N)	17(+) 2 (-) 8 (N)
38	Consider more restrictive provisions during zoning ordinance update.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	+	+	+	+	+	21 (+) 0 (-) 2 (N)	25 (+) 0 (-) 2 (N)
39	Re-install bridge and road and to dig creek bed down to a much lower level throughout the town.	+	-	+	-	-	-	+	+	+	-	N	+	-	N	-	+	N	N	-	N	-	+	N	8 (+) 9 (-) 6 (N)	10 (+) 11 (-) 6 (N)
40	Construct retention tank for the waste water treatment plant.	+	+	+	+	-	-	+	+	+	+	N	+	-	N	-	+	N	N	+	-	-	+	N	12 (+) 6 (-) 6 (N)	14 (+) 9 (-) 6 (N)

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41	Collect additional information (maintenance, ownership, inspection etc) about the fourteen dams in Erie County for inclusion in next Hazard Mitigation Plan Update.	+	+	+	+	N	+	+	+	+	N	+	+	+	+	N	+	N	N	+	+	+	+	N	17 (+) 0 (-) 6 (N)	21 (+) 0 (-) 6 (N)
42	Identify and coordinate with appropriate partners and agencies to arrange for data collection of flood and structure data necessary to perform a level 2 HAZUS analysis for the next hazard mitigation plan update (i.e. Building Value, Lowest Floor Elevation, Building Type, Occupancy Type, Foundation Type, Number of Stories and Square Footage).	+	+	+	-	-	N	+	+	+	N	+	+	+	+	-	N	N	N	N	+	+	+	+	N	13 (+) 3 (-) 7(N)	17 (+) 3 (-) 7(N)

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43	Develop a countywide Winter Storm Task Force to meet regularly to address winter storm preparedness and operations.	+	+	+	+	N	-	+	+	+	N	+	+	+	+	N	N	N	N	N	+	+	+	N	14 (+) 1 (-) 8 (N)	18 (+) 1 (-) 8 (N)
44	Work with municipalities to update local flood plain management ordinances and collect and record information on provisions for freeboard, restriction of hazardous materials in the floodplain, and restriction of critical facilities in the floodplain.	+	+	+	-	-	+	+	+	+	+	+	+	+	N	+	N	N	N	N	N	N	+	N	13 (+) 2 (-) 8 (N)	17(+) 2 (-) 8 (N)
45	Identify and implement structural and property protection projects to reduce the impacts from flooding including acquisition, elevation and relocation projects.	+	+	+	-	-	-	+	+	+	+	+	+	+	+	-	+	N	N	+	+	+	+	+	-	16 (+) 5 (-) 2 (N)	20 (+) 5 (-) 2 (N)

7. Plan Maintenance

7.1. Update Process Summary

Monitoring, evaluating and updating this plan, is critical to maintaining its value and success in Erie County's hazard mitigation efforts. Ensuring effective implementation of mitigation activities paves the way for continued momentum in the planning process and gives direction for the future. This section explains who will be responsible for maintenance activities and what those responsibilities entail. It also provides a methodology and schedule of maintenance activities including a description of how the public will be involved on a continued basis. The plan maintenance described here differs from the 2006 maintenance procedures. The 2006 plan implementation stated that the Erie County Department of Planning would responsible for implementing the plan as resources became available and that the Plan would be updated every five years or within one year of a significant disaster. The 2012 Plan Maintenance section was drafted with additional procedures and the HMSC reviewed the update and concurred. More frequent updates and plan maintenance procedures are outlined in the 2012 HMP in order to comply with PEMA's new plan update standards as found in the Standard Operating Guide.

The HMSC recognizes the importance of monitoring, evaluating, and updating the plan and decided to alter the 2006 maintenance procedures to establish annual evaluations with each municipality providing information as needed. This HMPU also defines the municipalities' role in updating and evaluating the plan. Finally, the 2012 HMPU elaborates upon continued public involvement and how this plan may be integrated into other planning mechanisms in the County.

7.2. Monitoring, Evaluating and Updating the Plan

The HMSC established for the 2012 HMPU is designated to administer the plan maintenance processes of monitoring, evaluation and updating with support and representation from all participating municipalities. Dale Robinson, Emergency Management Coordinator at the Erie County Department of Public Safety, in coordination with and cooperation of Jake Welsh, the Director of the Erie County Department of Planning, will lead the HMSC in all associated plan maintenance requirements, including annual reviews. The HMSC will coordinate maintenance efforts, but the input needed for effective periodic evaluations will come from community representatives, local emergency management coordinators and planners, the general public and other important stakeholders. The HMSC will oversee the progress made on the implementation of action items identified in the 2012 HMPU and modify actions, as needed, to reflect changing conditions. The HMSC will meet annually on or around the anniversary of plan adoption to discuss specific coordination efforts that may be needed with other stakeholders. Should a significant disaster occur within the County, the HMSC will reconvene within 30 days of the disaster to review and update the 2012 HMP. Meeting minutes and attendance sheets will be captured for each meeting and included in the 2016 HMP update.

Each municipality will designate a community representative to monitor mitigation activities and hazard events within their respective communities. The local emergency management coordinator would be suitable for this role as well as municipal supervisors or managers. This

individual will be asked to work with the HMSC to provide updates on applicable mitigation actions and feedback on changing hazard vulnerabilities within their community.

Upon each HMPU evaluation, the HMSC will consider whether applications should be submitted for existing mitigation grant programs. A decision to apply for funding will be based on appropriate eligibility and financial need requirements. The Erie County Planning Commission will review the projects submitted and provide recommendations to the Erie County Executive and County Council stating which projects should receive the highest priority. County Council will vote on which projects are submitted for funding and the County Executive will sign or veto the ordinance.

The HMSC will also support local and county officials in applying for post-disaster mitigation funds when they are available. All state and federal mitigation funding provided to the County or local municipalities will be reported in subsequent plan updates. In addition, new plans and programs being developed within the County will be evaluated as to the ability and necessity to incorporate the 2012 HMPU into them.

The Erie County Department of Planning with assistance from the Erie County Department of Public Safety will continue identify potential hazard mitigation projects that are contained in Community Development Block Grants, the Erie County Comprehensive Plan, Coastal Zone Management Plan, and other plans developed by the Planning Department.

The 2012 HMPU will be updated every five years, as required by the Disaster Mitigation Act of 2000, or following a disaster event. Future plan updates will account for any new hazard vulnerabilities, special circumstances, or new information that becomes available. During the five-year review process, the following questions will be considered as criteria for assessing the effectiveness the Erie County HMPU.

- Has the nature or magnitude of hazards affecting the County changed?
- Are there new hazards that have the potential to impact the County?
- Do the identified goals and actions address current and expected conditions?
- Have mitigation actions been implemented or completed?
- Has the implementation of identified mitigation actions resulted in expected outcomes?
- Are current resources adequate to implement the Plan?
- Should additional local resources be committed to address identified hazards?

Issues that arise during monitoring and evaluation which require changes to the risk assessment, mitigation strategy and other components of the plan will be incorporated during future updates.

7.3. Incorporation into Other Planning Mechanisms

Moving forward, based on the comprehensive nature of this plan, the HMSC believes that this document will be very useful when updating and developing other planning mechanisms in the County. Specific documents that the HMSC will actively incorporate information from the 2012 HMPU into include:

- Erie County Comprehensive Plan: Section 4.4.4, Future Development and Vulnerability, will provide information for the development of the next County Comprehensive Plan by making available specific risk and vulnerability information for the entire county but more specifically the potential areas of growth.
- Regional and Municipal Comprehensive Plans: The 2012 HMPU will provide information for the development or update of regional comprehensive plans. The in-depth discussion of risk and vulnerability on a jurisdiction-by-jurisdiction basis will help inform future land use, zoning, and open space decisions.
- Erie County Emergency Operations Plan: The 2012 HMPU will provide information on risk and vulnerability that will be extremely important to consider and incorporate into the next County EOP. Probability and vulnerability can direct emergency management efforts and response.
- Local Emergency Operations Plans: The 2012 HMPU will provide information on risk and vulnerability that will assist municipalities in developing their EOPs.
- Erie County Hazard Vulnerability Analysis: The County's most recent HVA was completed in 2010; the 2012 HMPU will be used to aid in goal and objective development, hazard identification, and risk assessment in the next County HVA. The 2010 HVA was used to strengthen hazard profiles in the 2012 HMPU including past occurrence information.
- Municipality Local Land Use Regulations: The Hazard Mitigation Plan provides supporting information for development of local land use regulations. These regulations help guide development away from hazard prone areas.
- Act 167 Stormwater Management Plans: The Erie County Act 167 County-Wide Stormwater Management Plan was completed in February 2011. The results of the 2012 HMPU vulnerability analysis, particularly for flooding, will be taken into consideration when updating the stormwater management plan.

7.4. Continued Public Involvement

As was done during the development of the 2012 HMPU, the HMSC will involve the public during the evaluation and update of the HMPU through various workshops and meetings. The public will have access to an electronic copy of the current HMPU through their local municipal office, Erie County Department of Public Safety or the Erie County Department of Planning. Information on upcoming events related to the HMPU or solicitation for comments will be announced via newsletters, newspapers, mailings, and on the County website (http://eriecountygov.org). The HMSC will incorporate all relevant comments during the next update of the HMPU.

8. Plan Adoption

The Plan was submitted to the Pennsylvania State Hazard Mitigation Officer on July 15, 2011. It was forwarded to FEMA for final review and approval-pending-adoption on August 4, 2011. FEMA granted approval-pending-adoption on March 20, 2012. Full approval from FEMA was received on *<Month Day, Year>*.

This section of the plan includes copies of the local adoption resolutions passed by Erie County and its municipal governments; a completed Local Mitigation Plan Review Crosswalk can be found in **Appendix B**. Adoption resolution templates are provided to assist the County and municipal governments with recommended language for future adoption of the HMP.

9. Appendices

Appendix A – Bibliography
Appendix B – Local Mitigation Plan Review Crosswalk
Appendix C – Meeting and Other Participation Documentation
Appendix D – Local Municipality Flood Vulnerability Maps
Appendix E – Critical Facilities
Appendix F – HAZUS Reports
Appendix G – Dam Failure Hazard Profile (Section 4.3.9)