

Monroe County 2011 Hazard Mitigation Plan Update

Prepared for:
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Table of Acronyms			
ACRONYM	FULL NAME	ACRONYM	FULL NAME
ALPB	Monroe County Agricultural Land Preservation Board	NFPA	National Fire Protection Association
CFR	Code of Federal Regulations	NHC	National Hurricane Center
CRS	Community Ratings System	NOAA	National Oceanic and Atmospheric Association
DCED	Department of Community and Economic Development	NOAA HRD	National Oceanic and Atmospheric Association – Hurricane Research Division
DCNR	Department of Conservation and Natural Resources	NWS	National Weather Service
DCNR-BOF	Department of Conservation and Natural Resources-Bureau of Forestry	PA DEP	Pennsylvania Department of Environmental Protection
DFIRM	Digital Flood Insurance Rate Map	PaGWIS	Pennsylvania Groundwater Information System
EOP	Emergency Operations Plan	PASDA	Pennsylvania Spatial Data Access
EPA	Environmental Protection Agency	PDSI	Palmer Drought Severity Index
EPCRA	Emergency Planning and Community Right-to-Know Act	PEMA	Pennsylvania Emergency Management Agency
EPZ	Emergency Planning Zone	PennDOT	Pennsylvania Department of Transportation
FBFM	Flood Boundary and Floodway Maps	PHGA	Peak Horizontal Ground Acceleration
FEMA	Federal Emergency Management Agency	RF	Risk Factor
FIRM	Flood Insurance Rate Map	SALDO	Subdivision and Land Development Ordinance
HMP	Hazard Mitigation Plan	SARA	Superfund Amendments and Reauthorization Act

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HMPU	Hazard Mitigation Plan Update	SFHA	Special Flood Hazard Area
HMSC	Hazard Mitigation Steering Committee	SFIP	State Flood Insurance Program
HVA	Hazards Vulnerability Analysis	SOG	All-Hazard Mitigation Planning Standard Operating Guide
LEPC	Local Emergency Planning Committee	TRI	Toxic Release Inventory
MCEMA	Monroe County Emergency Management Agency	UCC	Universal Construction Code
MCPC	Monroe County Planning Commission	US DOT	United States Department of Transportation
MRLC	Multi-Resolution Land Characteristics Consortium	USACE	United States Army Corps of Engineers
NCDC	National Climatic Data Center	USDA	United States Department of Agriculture
NDIS	National Drought Information System	USGS	United States Geological Survey
NDMC	National Drought Mitigation center	WYO	Write Your Own
NFIP	National Flood Insurance Program		

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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, sixteen and two of which have included Monroe County. In addition to these Presidential Declarations, there have been nineteen Gubernatorial Declarations or Proclamations affecting Monroe County since 1955. The emergency management community, citizens, elected officials and other stakeholders in Monroe 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 Monroe County Hazard Mitigation Steering Committee (HMSC), composed of government leaders from Monroe 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 Monroe County 2011 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:

Monroe County 2011 Hazard Mitigation Plan Update

- 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: *All-Hazard Mitigation Planning Standard Operating Guide (SOG)*. October 9, 2009.

The following additional guidance document produced by the National Fire Protection Association (NFPA) was used to update this plan:

- NFPA 1600: *Standard on Disaster/Emergency Management and Business Continuity Programs*. 2007.

2. Community Profile

2.1. Geography and Environment

The natural beauty of the forested lands, mountains and creeks in the Poconos and the proximity to urban areas of Monroe County, including Philadelphia and New York, contribute to making Monroe County a tourist destination. The Poconos holds approximately 80 percent of the resorts in Pennsylvania, making this a large industry for the area, Monroe County, and Pennsylvania. Additionally, these factors create an appealing housing market for individuals and families that are willing to commute to these cities or are looking for a second home (USGS, 2008). The growing housing market has contributed to a 22.5 percent population increase between 2000 and 2010, and a projected 70 percent increase between 2000 and 2020.

The natural beauty which is the basis of Monroe County's tourist appeal is preserved though the mostly rural and undeveloped land (see Figure 4.3.1-1). It has a land area of 609 square miles. Monroe County shares a border with Northampton County to the south; Wayne County to the north; Carbon, Luzerne, and Lackawanna Counties to the west; and Warren, Pike and Sussex Counties in New Jersey on the east. A basemap of the County is provided in Figure 2.2-1.

Monroe County is bordered on the east side by the Delaware River, on the west side by the Lehigh River, and on the south side by a ridge of Blue Mountain. Almost seven percent of the land is developed and the undeveloped land mostly contains wooded peaks and valleys (DCED, 2005). In 1999, the County enacted a Comprehensive Plan intended to maintain the pristine environment of the County. Monroe County contains part of Delaware Water Gap National Recreation Area which averages four million visitors a year (MCPC, 1999). Big Pocono State Park and Tobyhanna State Park are also located in Monroe County.

There are twelve watersheds in Monroe County, including the watersheds for the Delaware and Lehigh Rivers. The largest watersheds are the Brodhead Creek, McMichaels Creek and the Tobyhanna Creek watersheds. The watersheds of Monroe County are displayed in Figure 2.2-2.

2.2. Community Facts

Monroe County was formed in 1836 from parts of Northampton and Pike Counties and was named for President James Monroe. Stroudsburg was chosen as the county seat a year later and has remained the seat since then (Monroe County, 2004a). Monroe County consists of 20 total municipalities. These are 16 townships: Barrett, Chestnuthill, Coolbaugh, Eldred, Hamilton, Jackson, Middle Smithfield, Paradise, Pocono, Polk, Price, Ross, Smithfield, Stroud, Tobyhanna and Tunkhannock. There are four boroughs in Monroe County as well: Delaware Water Gap, East Stroudsburg, Mount Pocono, and Stroudsburg.

Monroe County has historically been a tourist-based economy; the Pocono Mountain Vacation Bureau estimates that the County sees nearly 17 million tourists per year, nearly a third of which stay 2 or more nights in the County (Pocono Mountain Vacation Bureau, 2011). Tourists have visited Monroe County year round to enjoy the amenities offered by the mountains, forests and rivers. The first industries in addition to tourism in Monroe County also relied on its natural resources, including lumber and agriculture in the summer and ice in the winter (Monroe

County, 2004a). Currently the top industries are tourism and housing construction and the major occupations relate to these industries. The construction industry has grown in the last decades because the population of Monroe County was the 2nd fastest growing in Pennsylvania into the 21st Century (Monroe County, 2004). While construction has slowed in the current economic climate, the County's growth continues. Monroe County is easily accessed from both Philadelphia and New York, making it a desirable location for commuters or families who want a second home.

Tourist areas include state and national parks as well as the other natural areas including Bushkill Falls and the five lakes. Additionally, the resort areas in the county offer not only access to the natural beauty of the area, but also to recreational activities including golf courses, tennis courts, swimming pools and hiking trails. In the winter there are multiple ski resorts to attract tourists as well.

There are two higher learning institutions in Monroe County – East Stroudsburg University and the Monroe Campus of Northampton Community College. East Stroudsburg University was founded as East Stroudsburg Normal School in 1893 with a faculty of 15 and a student enrollment of 320, and it became a part of the Pennsylvania State System of Higher Education in 1920. The University began as a Teachers School, but added liberal arts and science curricula in 1960.

Figure 2.2-1: Base map of Monroe County (ESRI; DCNR, 2009; PA PGC, 2009; Monroe County GIS Department 2011).

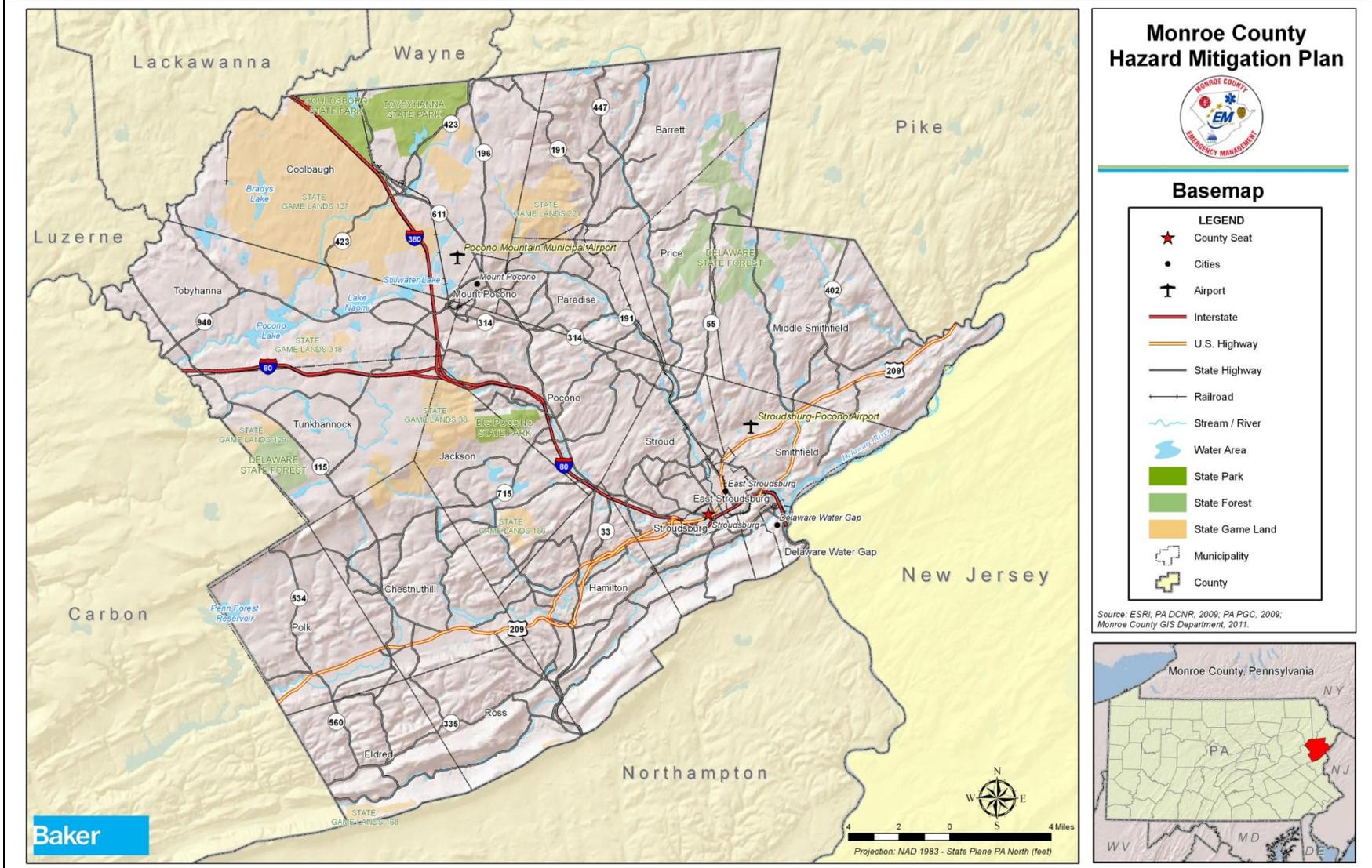
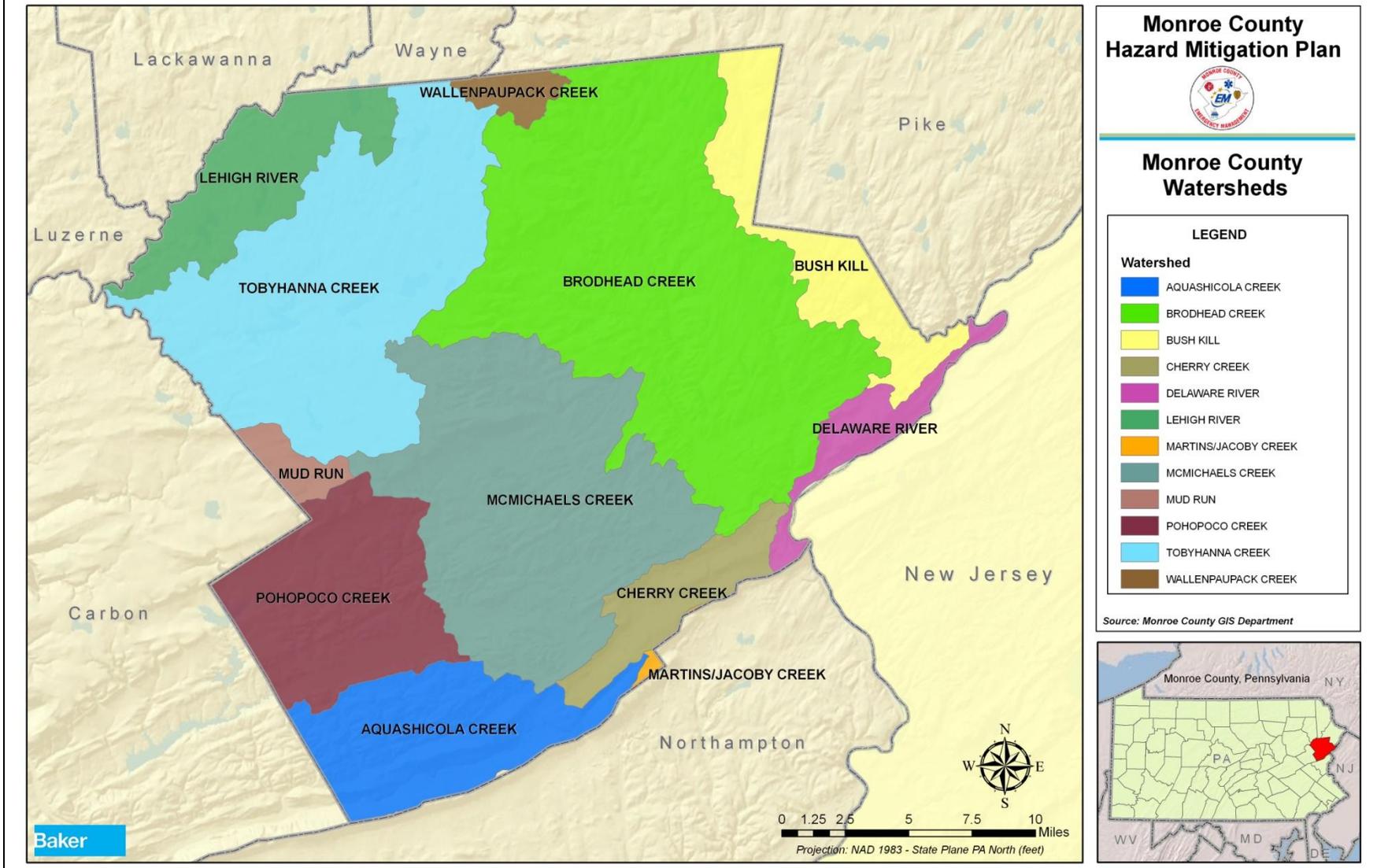


Figure 2.2-2: Watersheds of Monroe County (Monroe County GIS, 2011).



2.3. Population and Demographics

According to the 2000 Census, the population of Monroe County was 138,687. Monroe County's population grew to 169,842 people in the 2010 decennial Census, a 22.5% increase. Table 2.3-1 provides a distribution of County population per municipality. Using this estimate as a base, the population density of the County is approximately 279 persons per square mile. The population has historically been concentrated in the boroughs but recent trends indicate that the townships are experiencing a more rapid rate of population growth.

Table 2.3-1: List of municipalities in Monroe County with associated populations (US Census, 2011).			
MUNICIPALITY	2000 POPULATION	2010 POPULATION	PERCENT CHANGE (%)
Barrett Township	3,880	4,225	8.9%
Chestnuthill Township	14,418	17,156	19.0%
Coolbaugh Township	15,205	20,564	35.2%
Delaware Water Gap Borough	744	746	0.3%
East Stroudsburg Borough	9,888	9,840	-0.5%
Eldred Township	2,665	2,910	9.2%
Hamilton Township	8,235	9,083	10.3%
Jackson Township	5,979	7,033	17.6%
Middle Smithfield Township	11,495	15,997	39.2%
Mount Pocono Borough	2,742	3,170	15.6%
Paradise Township	2,671	3,186	19.3%
Pocono Township	9,607	11,065	15.2%
Polk Township	6,533	7,874	20.5%
Price Township	2,649	3,573	34.9%
Ross Township	5,435	5,940	9.3%
Smithfield Township	5,672	7,357	29.7%
Stroud Township	13,978	19,213	37.5%
Stroudsburg Borough	5,756	5,567	-3.3%
Tobyhanna Township	6,152	8,554	39.0%
Tunkhannock Township	4,983	6,789	36.2%
TOTAL	138,687	169,842	22.5%

The median income of households in Monroe County is \$57,288 (in 2009 inflation-adjusted numbers). This is almost \$6,000 more than the national median household income (U.S. Census ACS, 2005-2009). Over nine percent of the County population lives in poverty.

The median age of the County population is 38.9 years with approximately seventy-five percent of the population over 18 years of age and twelve percent 65 years or older. There are an estimated 78,038 housing units, about seventy-six percent of which are occupied with twenty-four percent being vacant (U.S. Census ACS, 2005-2009). The median value of an owner occupied home in the County is \$198,600. Over eighty-one percent of the County population is White and over eleven percent is Black or African-American.

2.4. Land Use and Development

Monroe County has primarily forested and undeveloped land. In 2005, 6.8 percent of Monroe County was considered developed, which had increased by almost three percent since 1992. Of the 93.2 percent of the county that is undeveloped, almost eighty-six percent of that land is forestland or limited agricultural land (DCED, 2005). While the percent of the County remaining undeveloped may have changed from 2005-2011, it is important to note that the Monroe 2020 Comprehensive Plan aimed to retain a largely undeveloped character in the County, and the County Planning Commission continues to work towards this goal.

In the Monroe 2020 Comprehensive Plan, the County planners and stakeholders identified the preservation of Monroe County's natural environment as a key challenge for the future. The threat to the natural environment and a threat to the fiscal environment came from sprawling sub-development growth patterns throughout the last decade of the 20th Century. Monroe County identified four strategies to impact these trends, including an Open Space Preservation program (MCPC, 1999). This program included \$25 million in bonds to preserve open space.

The stress on development in Monroe County is a result of its rapid population growth - 350 percent since 1960 and, as discussed above, over twenty percent in the last decade. Most of this growth is a result of migration into the county from the New York City area in New York and New Jersey (DCED, 2005). In addition to the Open Space Preservation program, Monroe County is encouraging municipalities to adopt resource protection ordinances in order to protect their natural resources while adapting to the population growth.

There are 349 farms in Monroe County as of the 2007 Agricultural Census, which is an increase of eight percent since 2002 (USDA, 2007). In addition to the programs in place to preserve open space and natural resources in Monroe County, the Agricultural Land Preservation Board has provided agricultural conservation easements to 66 farms in Monroe County (ALPB, 2005).

There are several major highways that traverse the County. The most significant is Interstate 80, which carries east-west traffic across the central portion of the County and continues across the country to California. As one can imagine, this is the most heavily trafficked route in the County. The Interstate 380 spur connects I-80 to Interstates 81 and 84 north of the County. Other significant roadways include US 209, PA 33, and PA 611.

2.5. Data Sources and Limitations

The Monroe County Planning Commission (MCPC) parcel database was used as an inventory of parcels throughout the County. The list of critical facilities provided in Appendix E was developed based on information available from the Federal Emergency Management Agency,

the Pennsylvania Emergency Management Agency, the Pennsylvania Department of Health, the Pennsylvania Department of Environmental Protection, and the Monroe County Planning Commission.

Flood hazard data used in this plan is the County's Q3 data, which is a digital representation of certain features of Flood Insurance Rate Maps (FIRMs), as provided by the MCPC. This data source does not differentiate between detailed and approximate 1%-annual-chance flood zones and is thus all areas are mapped as simply Special Flood Hazard Areas (SFHAs). Monroe County's flood hazard data has not been updated to Digital Flood Insurance Rate Map (DFIRM) data, and the dates of community FIRM maps range from 1976-2000. Using data this old is a significant data limitation, as the mapped flood areas may not capture the current extent of the 1%-annual-chance-flood, especially for a County that has been continually growing. For more information on the state of Monroe County's flood data, please see Section 5.2.2. Other GIS datasets including *roads*, *dam inundation areas*, *water areas*, *parcels*, and *structures* were provided by the MCPC. Data on land use was also provided by the MCPC and the County tax assessment database. Additional data for the base map was provided by the Pennsylvania Game Commission and the Pennsylvania Department of Conservation and Natural Resources.

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 and on each map 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.

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).

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 in Monroe County.

This HMPU 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. This includes law enforcement, emergency response, medical services, and mobile communications. Table 2.5-1 summarizes the critical facilities in Monroe County by type and by municipality. For a complete listing of critical facilities, please see **Appendix E**.

Monroe County 2011 Hazard Mitigation Plan

Table 2.5-1: Critical facilities by type and municipality (MCPC, 2011; PEMA, 2010; PA Department of Health, 2011; PA DEP, 2011; FEMA, 2009).

MUNICIPALITY	AIRPORT	COMMUNI- CATION FACILITIES	EMS	FIRE DEPT	HOSPITA L	NURSING HOMES	POLICE DEPT	SCHOOL	SEWAGE TREATMENT PLANT	SHELTER	GRAND TOTAL
Barrett Township	0	0	0	1	0	0	1	3	0	7	12
Chestnuthill Township	0	0	1	2	0	1	0	3	0	8	15
Coolbaugh Township	1	0	3	2	0	0	1	5	0	2	14
Delaware Water Gap Borough	0	0	0	1	0	0	1	0	1	1	4
East Stroudsburg Borough	0	1	0	1	1	1	2	5	1	4	16
Eldred Township	0	0	0	1	0	0	0	1	0	3	5
Hamilton Township	0	0	1	1	0	1	0	1	1	2	7
Jackson Township	0	3	0	1	0	0	0	0	0	1	5
Middle Smithfield Township	0	0	1	1	0	0	1	2	0	2	7
Mount Pocono Borough	0	0	0	1	0	0	0	0	1	2	4
Paradise Township	0	0	1	1	0	0	0	4	0	4	10
Pocono Township	0	1	1	1	0	0	2	2	0	4	11
Polk Township	0	0	0	1	0	0	0	3	0	4	8
Ross Township	0	0	1	2	0	0	0	0	0	3	6
Smithfield Township	1	1	0	3	0	0	0	5	1	6	17
Stroud Township	0	1	1	4	0	0	0	7	0	6	19
Stroudsburg Borough	0	0	0	1	0	0	0	3	1	9	14

Monroe County 2011 Hazard Mitigation Plan

Table 2.5-1: Critical facilities by type and municipality (MCPC, 2011; PEMA, 2010; PA Department of Health, 2011; PA DEP, 2011; FEMA, 2009).

MUNICIPALITY	AIRPORT	COMMUNI- CATION FACILITIES	EMS	FIRE DEPT	HOSPITA L	NURSING HOMES	POLICE DEPT	SCHOOL	SEWAGE TREATMENT PLANT	SHELTER	GRAND TOTAL
Tobyhanna Township	0	0	1	3	0	0	2	3	0	7	16
Tunkhannock Township	0	1	0	1	0	0	0	0	0	0	2
Grand Total	2	8	11	29	1	3	10	47	6	75	192

When applicable, PEIRS incident data spanning approximately the last 8 years (1/1/2002 - 6/1/2009) was used in the 2011 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: Flood, Flash Flood, and Ice Jam; Wildfire; Dam Failure; Environmental Hazards; Transportation Accident; and Utility Interruption.

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 4.3.3.5 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, the age of housing units reported in Section 4.3.8.5 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.

While data was provided on the use types of parcels in Monroe County, specific use of all structures which are not critical facilities does not exist. The number of mobile home structures was estimated for vulnerability and loss estimates in Section 4 by the number of structures on parcels which were designated for mobile or manufactured homes. This is clearly an estimation of mobile homes but allows a preliminary look at the unique risks faced by this type of structure. This was the only instance where structure designations were estimated in the HMPU.

Estimating potential losses that may occur as a result of hazard events requires a full range of information and accurate data. There are a number of site-specific characteristics that reduce a given structure's vulnerability and consequential losses. Examples include first-floor elevation, the number of stories, construction type, foundation type and the age and condition of the structure. The property tax assessment database includes the building and land assessment value for each parcel but does not include information on key variables that impact vulnerability, such as the age and value of individual structures, specific information on building height, construction type and first floor elevations.

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.

3. Planning Process

3.1. Update Process and Participation Summary

The Monroe County Mitigation Planning Committee, now the HMPT, was first formed in 2004 in order to complete the Monroe County HMP. The Monroe County Planning Commission and Monroe County Emergency Management Agency headed this entity, composed of representatives from the municipalities, the Monroe County Conservation District, PennDOT, and other local agencies. PEMA and FEMA also provided assistance to the Mitigation Planning Committee; the plan was developed over 21 months in 2004-2005. Municipal representatives provided additional information through completing hazard vulnerability questionnaires.

To begin the HMP update process, the Monroe County Emergency Management Agency held an Initial County Kick-off Meeting in October 2010 with local emergency management coordinators to review the 2005 HMP goals and objectives and establish a timeline for the update. Shortly after this Initial County Kick-off, 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. Even though they had already held one Kick-off Meeting, the Emergency Management Agency decided to hold a second, Baker-County Kick-off Meeting that included a broader list of participants and stakeholders. For this meeting, the Monroe County Emergency Management Agency mailed meeting invitations to the CEO and EMC (when applicable) in each municipality as well as the County Commissioners, adjacent county commissioners, 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 a 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.MonroeHMP.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. Table 3.1-1 lists each municipality along with their specific participation and contributions to the planning process. All twenty of the municipalities in Monroe County participated in the HMPU. 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 2011 Hazard Mitigation Planning Process.

MUNICIPALITY	MEETING					WORKSHEETS/SURVEYS/FORMS			
	INITIAL COUNTY KICK-OFF October 13, 2010	BAKER-COUNTY KICK-OFF January 26, 2011	RISK ASSESSMENT SUMMARY AND MITIGATION SOLUTIONS WORKSHOP March 7, 2011	PLANNING TEAM TELECONFERENCE (optional) March 22, 2011	PUBLIC MEETING April 12, 2011	EVALUATION OF IDENTIFIED HAZARDS AND RISK	CAPABILITY ASSESSMENT SURVEY	GOALS AND OBJECTIVES EVALUATION	MITIGATION ACTION FORM
Barrett Township		X	X			X	X	X	X
Chestnuthill Township	X	X	X			X	X	X	X
Coolbaugh Township	X	X				X	X		X
Delaware Water Gap Borough	X					X	X		X
East Stroudsburg Borough		X				X	X		X
Eldred Township			X			X	X	X	X
Hamilton Township	X	X	X			X	X	X	X
Jackson Township	X	X	X			X	X	X	X
Middle Smithfield Township	X					X	X		X
Mount Pocono Borough	X					X	X		
Paradise Township	X		X			X	X	X	X
Pocono Township				X	X		X		X
Polk Township	X	X	X		X	X	X	X	X
Price Township				X		X	X	X	X
Ross Township				X		X	X		X
Smithfield Township				X		X	X	X	X
Stroud Township					X		X		
Stroudsburg Borough				X		X	X	X	X

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Table 3.1-1: Summary of participation from local municipalities during the 2011 Hazard Mitigation Planning Process.

MUNICIPALITY	MEETING					WORKSHEETS/SURVEYS/FORMS			
	INITIAL COUNTY KICK-OFF October 13, 2010	BAKER-COUNTY KICK-OFF January 26, 2011	RISK ASSESSMENT SUMMARY AND MITIGATION SOLUTIONS WORKSHOP March 7, 2011	PLANNING TEAM TELECONFERENCE (optional) March 22, 2011	PUBLIC MEETING April 12, 2011	EVALUATION OF IDENTIFIED HAZARDS AND RISK	CAPABILITY ASSESSMENT SURVEY	GOALS AND OBJECTIVES EVALUATION	MITIGATION ACTION FORM
Tobyhanna Township				X			X	X	X
Tunkhannock Township	X	X	X			X	X	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 2011 Monroe County HMPU was completed in April 2011. The 2011 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 2011 Monroe County HMP contrasts with the 2005 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 2005 and 2011 versions of the Monroe County HMP.	
2005 HMP SECTION	2011 HMPU SECTION
1. Introduction	
Need for the plan	Section 1
Method of preparation	Section 3
Public Involvement	Section 3.4
2. Problem Description	Section 4
Hazards	Section 4.3
Other community considerations	Section 4.4.4
3. Goals and Objectives	Section 6.2
4. Capability Assessment	Section 5
5. Recommended Measures	Section 6.4
Description, Location, Priority, Estimated Cost, Responsible Entity, Potential Funding Sources	Section 6.4
6. Adoption and Implementation	Sections 7 and 8
7. Appendix	Appendices A-H

3.2. The Planning Team

The 2011 Monroe County HMP update was led by a HMSC, which included:

1. Maryellen Keegan, Hazard Preparedness Planner, Monroe County Emergency Agency,
2. John Woodling, Director of the Monroe County Planning Commission, and
3. Christine Caggiano, Planner at 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, major employers, and 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 2011 HMPT, demonstrating their commitment to actively participate in the planning process by attending meetings, completing

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assessments, surveys, and worksheets, and/or submitting comments. The HMPT consisted of county and local officials including municipal supervisors and council members, emergency management coordinators, Conservation District Staff, and emergency incident staff at two of the County's largest employers, the Tobyhanna Army Depot and Pocono Medical Center.

Table 3.2-1: Participants in the 2011 Monroe County HMP Update.	
MUNICIPALITY/ORGANIZATION	PARTICIPANT(S)
Barrett Township	Jeff Siglin, Grover Cleveland, Ralph Megliola
Chestnuthill Township	Don Zipp
Coolbaugh Township	Jim Fritchey, Jim Frutchey Jr., Jim Frutchey III
Delaware Water Gap Borough	Johanna Moreo
East Stroudsburg Borough	Jim Phillips
Eldred Township	Gary Hoffman
Hamilton Township	Dave Fenner, Will Clark
Jackson Township	Donald Kresge, Jack Rader, Keith Elliott
Middle Smithfield Township	Rick Porvaznik
Mount Pocono Borough	Jeff Woehrle
Paradise Township	Louise Troutman, Logan Evans
Pocono Township	Jane Cilurso, Harold Werkheiser, Frank Hess
Polk Township	Lynn Smith, Brian Ahner, Barry Borger
Price Township	John Brush
Ross Township	Richard Marsili
Smithfield Township	Stephen Carey
Stroud Township	Ed Cramer, Darryl Eppley
Stroudsburg Borough	Barbara Quarentello
Tobyhanna Township	Bob McHale, John Kerrick
Tunkhannock Township	William Byron
Monroe County Commissioners	Theresa Merli
Monroe County Conservation District	Trish Attardo, Craig Todd
Monroe County Emergency Management Agency	Guy Miller, Maryellen Keegan, Jackson Latimore
Monroe County Planning Commission	John Woodling
American Red Cross of the Poconos	Gail Toscano
PEMA	Thomas Hughes
Pocono Medical Center	Ben Capozzi
Sanofi Pasteur	Stephen MacManus (also represented the Local Emergency Planning Committee)

Table 3.2-1: Participants in the 2011 Monroe County HMP Update.

MUNICIPALITY/ORGANIZATION	PARTICIPANT(S)
Tobyhanna Army Depot	Joseph Cassone, Major Pete Mielo

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**.

October 13, 2010: Initial County Kick-off Meeting held at the Monroe County Public Safety Center to provide municipal officials an overview of the existing HMP mitigation goals and to establish a timeline for the development of the HMPU.

December 29, 2010: Internal County Kick-off Meeting teleconference with HMSC discussed scope, schedule, project goals, invitees, available resources, and planning standards.

January 26, 2011: Baker-County Kick-off Meeting held at the Monroe County Public Safety Center 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*.

February 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 2005 plan actions/projects in advance of the entire community reviewing the Mitigation Strategy.

March 7, 2011: Risk Assessment Review and Mitigation Solutions Workshop held at the Monroe County Public Safety Center to review preliminary risk assessment results, discuss mitigation goals and objectives, and select mitigation actions and projects to be included in the HMP.

March 22, 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.

April 12, 2011: Final Public Meeting held at the East Stroudsburg Area School District Administration Building to update the public about the HMP update process and findings. The meeting was advertised in the Pocono Record newspaper both with a public notice and with an article the day of the meeting (see **Appendix C**). Several verbal comments were noted in the meeting minutes and attendees were informed about the timeline and their opportunity to review the entire plan on the HMP update website, www.MonroeHMP.com and provide written comments.

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. Seventeen of the twenty 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. Every community in the County 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).

Community participation and comments were encouraged throughout the planning process, most notably through the HMP update website, www.MonroeHMP.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, press releases were provided to the County at the beginning of the planning process providing information on the HMP update and on opportunities for public and stakeholder involvement and at the end of the process encouraging the public to attend the public meeting and submit plan comments. These press releases led to a story being published on the HMPU in the Pocono Record on February 3, 2011 on the HMPU and a follow-up piece being published in the newspaper on April 12, 2011. A newspaper

Figure 3.4-1: Notice of Public Meeting in the Pocono Record.



notice was published in the Pocono Record to notify the citizens of Monroe County of the date and time of the public meeting. This notice was put in the paper on April 9, 2011 at the request of the County staff; they requested having the notice in the paper the Saturday before the Public Meeting rather than a week in advance because past experience showed that people were less likely to read the classifieds on a weekday, and because they wanted the announcement to be fresh in citizen's minds and calendars. A copy of this newspaper notice is shown in Figure 3.4-1. An additional online article about the Public Meeting followed on April 13.

Notification of the HMP update sent to representatives from neighboring communities is included in **Appendix C** under the Baker-County Kick-off Meeting.

The HMSC posted the draft Monroe County HMP update on the HMP update website, www.MonroeHMP.com, beginning on April 25, 2011 accepted comments through May 25, 2011. The availability of the draft HMP was made public by placing a public notice in the Pocono Record on April 23, 2011 and disseminating the information to the HMPT via email. A copy of the notice will be found in Figure 3.4-2. Comments were submitted in writing to Christine Caggiano, Planning Consultant, or online via the HMP Update website. No public comments were received on the plan.

A paper copy of the draft plan was also available at the Monroe County Public Safety Center so that the 2011 Draft HMPU would be available for review and comment at the Emergency Management Agency's public open house on April 30, 2011. Other mitigation materials were available at this open house, including fact sheets on hazard mitigation planning. The County used this event to further enhance public participation in and interaction with the HMPU.

Figure 3.4-2: Notice of Public Comment in the Pocono Record.



3.5. Multi-Jurisdictional Planning

This HMP update was developed using a multi-jurisdictional approach. With funding support from 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 and, if email addresses were available, received email reminders prior to each session and/or follow-up emails after the meetings. Two HMP teleconferences were 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. In the end, all 20 municipalities in the County participated in the plan, thus achieving 100% participation. This equal to the participation received during the 2005 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 Monroe County Comprehensive Plan, Monroe County Emergency Operations Plan, Monroe County Hazard Vulnerability Analysis (HVA), 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 Monroe County Comprehensive Plan so that vulnerability pertaining to future development could be established. The 2005 HMP 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 Monroe 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 2005 HMP, where each profile included the history, vulnerability/maximum threat, and probability of each hazard. However, all information from the previous plan has been incorporated and/or updated in the 2011 HMPU unless indicated.

The 2005 Monroe County HMP profiled a limited number of significant natural hazards in the County: flood, earthquakes, winter storms, droughts, wildfires, and tornadoes/straight line winds. In discussing development, population, and growth trends in the County, the HMSC determined that it would be essential to include human-made hazards for consideration in the 2011 HMPU. 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 2005 plan and vote on which hazards not previously identified but included in the Pennsylvania Standard State List of Hazards had the potential to impact Monroe County using the Evaluation of Identified Hazard and Risk Form. 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, a number of new hazards were added to the HMP: Dam Failure; Environmental Hazards; Hurricane, Tropical Storm, and Nor'easter; Levee Failure; Nuclear Incidents; Pandemic; Transportation Accidents; and Utility Interruption. Hazard profiles were then developed in order to define the characteristics of each hazard as they apply to Monroe 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 Presidential Disaster and Emergency Declarations issued between 1955 through 2011 that have affected Monroe County. Additional declarations beyond 2011 can be found on the FEMA website at: http://www.fema.gov/news/disasters_state.fema?id=42. It is important to note

Monroe County 2011 Hazard Mitigation Plan

that for instances where hurricanes or tropical storms initiated a disaster declaration, it was largely as a result of the damage caused by the excessive precipitation and flooding effects of coastal storms, not the damaging wind speeds.

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

DECLARATION NUMBER	DATE	EVENT
1649	June, 2006	Severe Storms, Flooding, and Mudslides
3235	September, 2005	Proclamation of Emergency – Hurricane Katrina
1587	April, 2005	Severe Storms and Flooding
1557	September, 2004	Tropical Depression Ivan
1497	September, 2003	Tropical Storms Henri and Isabel
1294	September, 1999	Hurricane Floyd
1219	June, 1998	Flooding, Severe Storms, and Tornadoes
1085	January, 1996	Blizzard
1093	January, 1996	Flooding
1015	January, 1994	Winter Storm, Severe Storm
3105	March, 1993	Severe Snowfall and Winter Storm
400	July, 1973	Flood
340	June, 1972	Tropical Storm Agnes
273	August, 1969	Flood
206	August, 1965	Drought in the Delaware River Basin
40	August, 1955	Flood (Hurricane Diane)

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

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

DATE	TYPE
April, 2007	Proclamation of Emergency - Severe Winter Storm
February, 2007	Proclamation of Emergency - Severe Winter Storm

Table 4.2-2: Monroe County Gubernatorial Proclamations of Emergency.	
DATE	TYPE
February, 2007	Proclamation of Emergency - Regulations
September, 2006	Proclamation of Emergency - Tropical Depression Ernesto
September, 2005	Proclamation of Emergency - Hurricane Katrina
February, 2002	Drought and Water Shortage
July, 1999	Drought
April, 1997	Snowstorm
September, 1995	Drought
November, 1980	Drought Emergency
April, 1978	Fire – East Stroudsburg
February, 1978	Blizzard
January, 1978	Heavy Snow
February, 1974	Truckers Strike
February, 1972	Heavy Snow
July, 1969	Flash Flood
January, 1966	Heavy Snow
September, 1963	Drought
September, 1955	Drought

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

Table 4.2-3: Monroe County Small Business Administration Disaster Assistance Declarations.	
DATE	TYPE
August, 2007	Hail
November, 2006	Severe Storms and Flooding
December, 2006	Severe Storms and Tornadoes
October, 1995	Fire

Table 4.2-3: Monroe County Small Business Administration Disaster Assistance Declarations.

DATE	TYPE
July, 1991	Drought
September, 1985	Flood

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 Monroe 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 2011 HMP; all thirty-four hazards on the list were considered, but following a review of the hazards considered in the 2005 HMP and the risk assessment portion of the Commonwealth of Pennsylvania Hazard Mitigation Plan, the HMPT decided that the 2011 plan should identify, profile, and analyze fourteen hazards. Only hazards considered significant have been profiled in this HMP. The hazards include all hazards profiled in the 2005 plan and the addition of Dam Failure; Environmental Hazards; Hurricane, Tropical Storm, and Nor'easter; Levee Failure; Nuclear Incidents; Pandemic; Transportation Accidents; and Utility Interruption as hazards of concern. Table 4.2-4 contains a complete list of the fourteen hazards that have the potential to impact Monroe County as identified through previous risk assessments, the County Hazards Vulnerability Analysis, and input from those that participated in the 2011 HMP update. Hazard profiles are included in Section 4.3 for each of these hazards.

Table 4.2-4: Hazards identified in the 2011 Monroe County Hazard Mitigation Plan and their respective definitions.

Hazard Name	Hazard Description
NATURAL HAZARDS	
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).

Table 4.2-4: Hazards identified in the 2011 Monroe County Hazard Mitigation Plan and their respective definitions.

Hazard Name	Hazard Description
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).
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. All forms of flooding can damage infrastructure (USACE, 2007).
Hurricane, Tropical Storm, Nor'easter	Hurricanes, tropical storms, and nor'easters are classified as cyclones and are any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise (in the Northern Hemisphere) and whose diameter averages 10-30 miles across. While most of Pennsylvania is not directly affected by the devastating impacts cyclonic systems can have on coastal regions, many areas in the state are subject to the primary damaging forces associated with these storms including high-level sustained winds, heavy precipitation, and tornadoes. Areas in southeastern Pennsylvania could be susceptible to storm surge and tidal flooding. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico during the official Atlantic hurricane season (June through November). (FEMA, 1997).
Pandemic	A pandemic occurs when infection from of a new strain of a certain disease, to which most humans have no immunity, substantially exceeds the number of expected cases over a given period of time. Such a disease may or may not be transferable between humans and animals. (Martin & Martin-Granel, 2006).

Table 4.2-4: Hazards identified in the 2011 Monroe County Hazard Mitigation Plan and their respective definitions.

Hazard Name	Hazard Description
Tornado, Windstorm	<p>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).</p>
Wildfire	<p>A wildfire is a raging, uncontrolled fire that spreads rapidly through vegetative fuels, exposing and possibly consuming structures. Wildfires often begin unnoticed and can spread quickly, creating dense smoke that can be seen for miles. Wildfires can occur at any time of the year, but mostly occur during long, dry hot spells. Any small fire in a wooded area, if not quickly detected and suppressed, can get out of control. Most wildfires are caused by human carelessness, negligence, and ignorance. However, some are precipitated by lightning strikes and in rare instances, spontaneous combustion. Wildfires in Pennsylvania can occur in fields, grass, brush, and forests. 98% of wildfires in Pennsylvania are a direct result of people, often caused by debris burns (DCNR-BOF, 2009).</p>
Winter Storm	<p>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).</p>

Table 4.2-4: Hazards identified in the 2011 Monroe County Hazard Mitigation Plan and their respective definitions.

Hazard Name	Hazard Description
HUMAN-MADE HAZARDS	
Dam Failure	<p>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).</p>
Environmental Hazards	<p>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:</p> <ul style="list-style-type: none"> • 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 Environmental Health Sciences, July 2009; EPA, Natural Disaster PSAs, 2009). • Superfund Facilities; hazards originating from abandoned hazardous waste sites listed on the National Priorities List (EPA, National Priorities List, 2009). • Manure Spills; involving the release of stored or transported agricultural waste, for example (EPA, Environmental Impacts of..., 1998). <p>Product Defect or Contamination; highly flammable or otherwise unsafe consumer products and dangerous foods (Consumer Product Safety Commission, 2003).</p>
Levee Failure	<p>A levee is a human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding (Interagency Levee Policy Review Committee, 2006). Levee failures or breaches occur when a levee fails to contain the floodwaters for which it is designed to control or floodwaters exceed the height of the constructed levee. 51 of Pennsylvania's 67 counties have been identified as having at least one levee (FEMA Region III, 2009).</p>
Nuclear Incidents	<p>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).</p>

Table 4.2-4: Hazards identified in the 2011 Monroe County Hazard Mitigation Plan and their respective definitions.

Hazard Name	Hazard Description
Transportation Accident	<p>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).</p>
Utility Interruption	<p>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:</p> <ul style="list-style-type: none"> • 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) <p>Major Energy, Power, Utility Failure; interruptions of generation and distribution, power outages, for example (United States Department of Energy, 2000).</p>

4.3. Hazard Profiles and Vulnerability Analysis

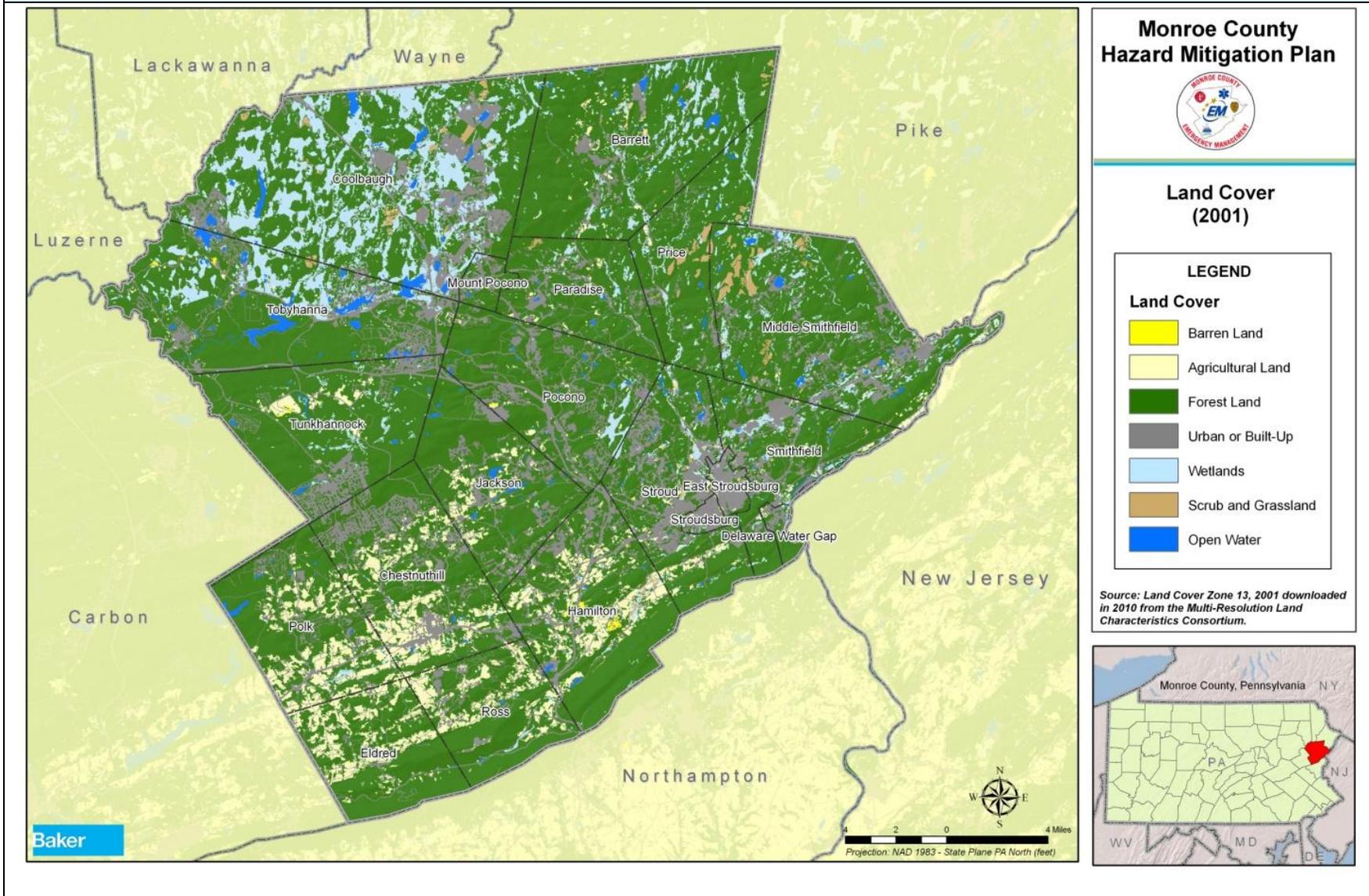
NATURAL HAZARDS

4.3.1. Drought

4.3.1.1. Location and Extent

Droughts are regional climatic events, so when these events occur in Monroe County, impacts are felt across the County as well as in areas outside the County boundaries. The spatial extent for areas of impact can range from localized areas in Pennsylvania to the entire Mid-Atlantic region. Areas with extensive agricultural land uses are particularly vulnerable to drought; as shown in Figure 4.3.1-1, these uses are largely found in the southwestern portion of the County in Hamilton, Chestnuthill, Polk, Eldred, and Ross Townships.

Figure 4.3.1-1: Land cover in Monroe County (MRLC, 2001).



4.3.1.2. 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 4.3.1-1).

Table 4.3.1-1: Palmer Drought Severity Index (PSDI) classifications (NDMC, 2006).	
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

Based on the County's disaster history and other drought occurrence data, the worst drought event on record occurred from July 1964 to April 1966. During this event, the regional PDSI

value for the Pocono Mountains, an area that includes Pike, Wayne, Luzerne, Lackawanna, Pike, and Monroe Counties, hit its lowest at -5.60 in November 1964 (NCDC 2006). In 1965, in the midst of this extended drought period, a President’s Declaration of Major Disaster was proclaimed for the entire Delaware River Basin. Communities across the Commonwealth had to enact mandatory restrictions on water use and provided penalties for violators.

4.3.1.3. Past Occurrence

The Department of Environmental Protection (PA DEP) maintains the most comprehensive data on drought occurrences across Pennsylvania. Declared drought status for Monroe County from 1980 to 2010 is shown in Table 4.3.1-2. Descriptions for drought status categories (i.e. *watch*, *warning*, and *emergency*) are included in Section 4.3.1.2.

Table 4.3.1-2: Past drought events in Monroe County (PA DEP 2011).			
DATE	DROUGHT STATUS	DATE	DROUGHT STATUS
Nov 18, 1980 - Apr 20, 1982	Emergency	Dec 8, 1998 - Dec 14, 1998	Watch
Nov 10, 1982 - Feb 8, 1983	Warning	Dec 14, 1998 - Dec 16, 1998	Warning
Feb 8, 1983 - March 28, 1983	Warning	Dec 16, 1998 - Jan 15, 1999	Warning
Jan 23, 1985 - Apr 26, 1985	Warning	Jan 15, 1999 - Mar 15, 1999	Warning
Apr 26, 1985 - Jul 29, 1985	Emergency	Mar 15, 1999 - Jun 10, 1999	Watch
Jul 29, 1985 - Oct 22, 1985	Emergency	Jun 10, 1999 - Jun 18, 1999	Warning
Oct 22, 1985 - Oct 29, 1985	Emergency	Jun 18, 1999 - Jul 20, 1999	Warning
Oct 29, 1985 - Dec 19, 1985	Emergency	Jul 20, 1999 - Sep 30, 1999	Emergency
Jul 7, 1988 - Aug 24, 1988	Watch	Sep 30, 1999 - Dec 16, 1999	Watch
Aug 24, 1988 - Dec 12, 1988	Watch	Dec 16, 1999 - Feb 25, 2000	Watch
Mar 3, 1989 - May 15, 1989	Warning	Feb 25, 2000 - May 5, 2000	Watch
Jun 28, 1991 - Jul 24, 1991	Watch	Nov 6, 2001 - Dec 5, 2001	Watch
Jul 24, 1991 - Aug 16, 1991	Emergency	Dec 5, 2001 - Feb 12, 2002	Warning
Aug 16, 1991 - Sep 13, 1991	Emergency	Feb 12, 2002 - May 13, 2002	Emergency
Sep 13, 1991 - Oct 21, 1991	Emergency	May 13, 2002 - Jun 14, 2002	Watch
Oct 21, 1991 - Jan 16, 1992	Emergency	Jun 14, 2002 - Aug 9, 2002	Watch
Jan 17, 1992 - Apr 20, 1992	Emergency	Aug 9, 2002 - Sep 5, 2002	Watch

Table 4.3.1-2: Past drought events in Monroe County (PA DEP 2011).

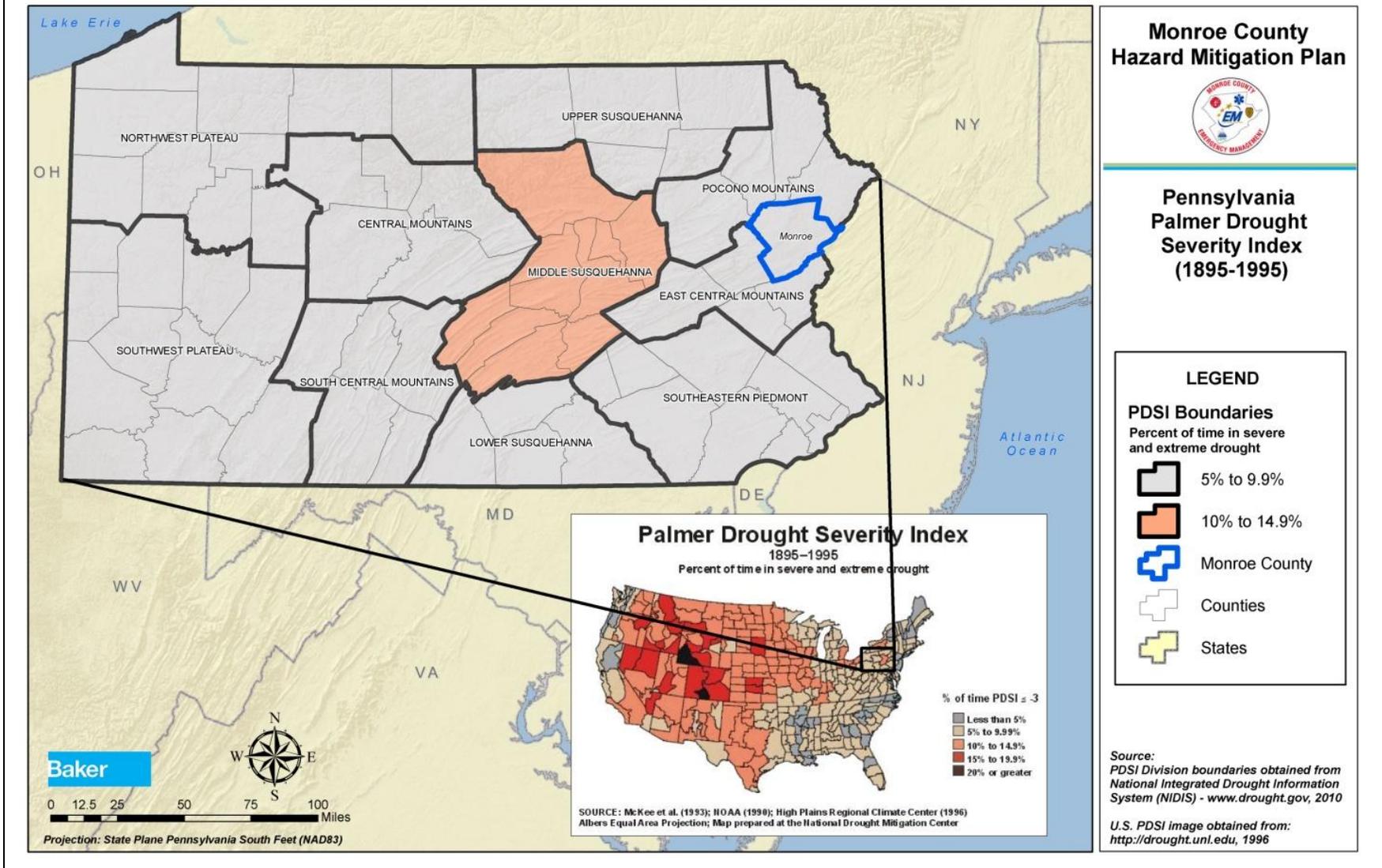
DATE	DROUGHT STATUS	DATE	DROUGHT STATUS
Apr 20, 1992 - Jun 23, 1992	Warning	Sep 5, 2002 - Nov 7, 2002	Watch
Sep 1, 1995 - Sep 20, 1995	Warning	Apr 11, 2006 - Jun 30, 2006	Watch
Sep 20, 1995 - Nov 8, 1995	Emergency	Aug 8, 2007 - Sep 5, 2007	Watch
Nov 8, 1995 - Dec 18, 1995	Emergency	Sep 5, 2007 - Oct 5, 2007	Watch
Oct 27, 1997 - Nov 13, 1997	Warning	Oct 5, 2007 - Jan 11, 2008	Watch
Nov 13, 1997 - Jan 16, 1998	Warning	Sep 16, 2010 – Nov 10, 2010	Warning
Dec 3, 1998 - Dec 8, 1998	Watch		

Monroe County also has a record of drought events before 1980. The County’s disaster history indicates that severe droughts resulted in either Presidential or Gubernatorial disaster emergency declarations in 1963 and 1965.

4.3.1.4. Future Occurrence

It is difficult to forecast the exact severity and frequency of future drought events. However, municipal representatives and County staff report that there has been an increase in drought activity in recent years, and this could be exacerbated as the County continues to grow. Based on national data from 1895 to 1995, Monroe County is in severe or extreme drought approximately five to fifteen percent of the time (see Figure 4.3.1-2). This is equivalent to a PDSI value less than or equal to -3. Therefore, the future occurrence of drought can be considered *possible* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1).

Figure 4.3.1-2: PDSI value for Monroe County (NDIS, 2010).



4.3.1.5. Vulnerability Assessment

The most significant losses resulting from drought events are typically found in the agriculture sector of the County’s economy. For example, drought conditions in 1999 resulted in a Gubernatorial Proclamation of Emergency in part because of significant crop damage. Preliminary damage estimates by the US Department of Agriculture indicated possible crop losses across Pennsylvania in excess of \$500 million. This figure did not include a 20 percent decrease in dairy milk production statewide, which also resulted in million dollar losses (NCDC, 2011).

While these were statewide impacts, they illustrate the potential for droughts to severely impair the local economy in more agricultural communities. Monroe County ranks 60nd of the 67 counties with agricultural production totaling \$7.8 million (USDA, 2007). Nearly 60% of this total is the production of crops, including nursery and greenhouse crops (\$4.5 million); the remaining agricultural production is made up of livestock, poultry, and their products (\$3.3 million).

Water supplies are also vulnerable to the effects of drought. With the exception of the Stroudsburg/East Stroudsburg/Stroud Township area, nearly the entire County relies on wells for their fresh drinking water. Future droughts will quickly affect those systems relying on surface supplies while those on wells should be able to handle short-term droughts without any major problem. However, longer-term droughts which inhibit recharging of groundwater aquifers will extend the problems of well owners for an undetermined length of time.

As a result, Monroe County residents that use private domestic wells are more vulnerable to droughts. Table 4.3.1-3 shows the number of domestic wells per municipality. It is important to note that the well data was obtained from the Pennsylvania Groundwater Information System (PaGWIS). **PaGWIS relies on voluntary submissions of well record data by well drillers; as a result, it is not a complete database of all domestic wells in the County.** This is the most complete dataset of domestic wells available.

Table 4.3.1-3: PaGWIS Data for Monroe County.			
MUNICIPALITY	NUMBER OF REPORTED DOMESTIC WELLS	MUNICIPALITY	NUMBER OF REPORTED DOMESTIC WELLS
Barrett Township	292	Pocono Township	1481
Chestnuthill Township	2114	Polk Township	593
Coolbaugh Township	1177	Price Township	441
Delaware Water Gap Borough	15	Ross Township	501
East Stroudsburg Borough	12	Smithfield Township	563
Eldred Township	296	Stroud Township	594

Table 4.3.1-3: PaGWIS Data for Monroe County.

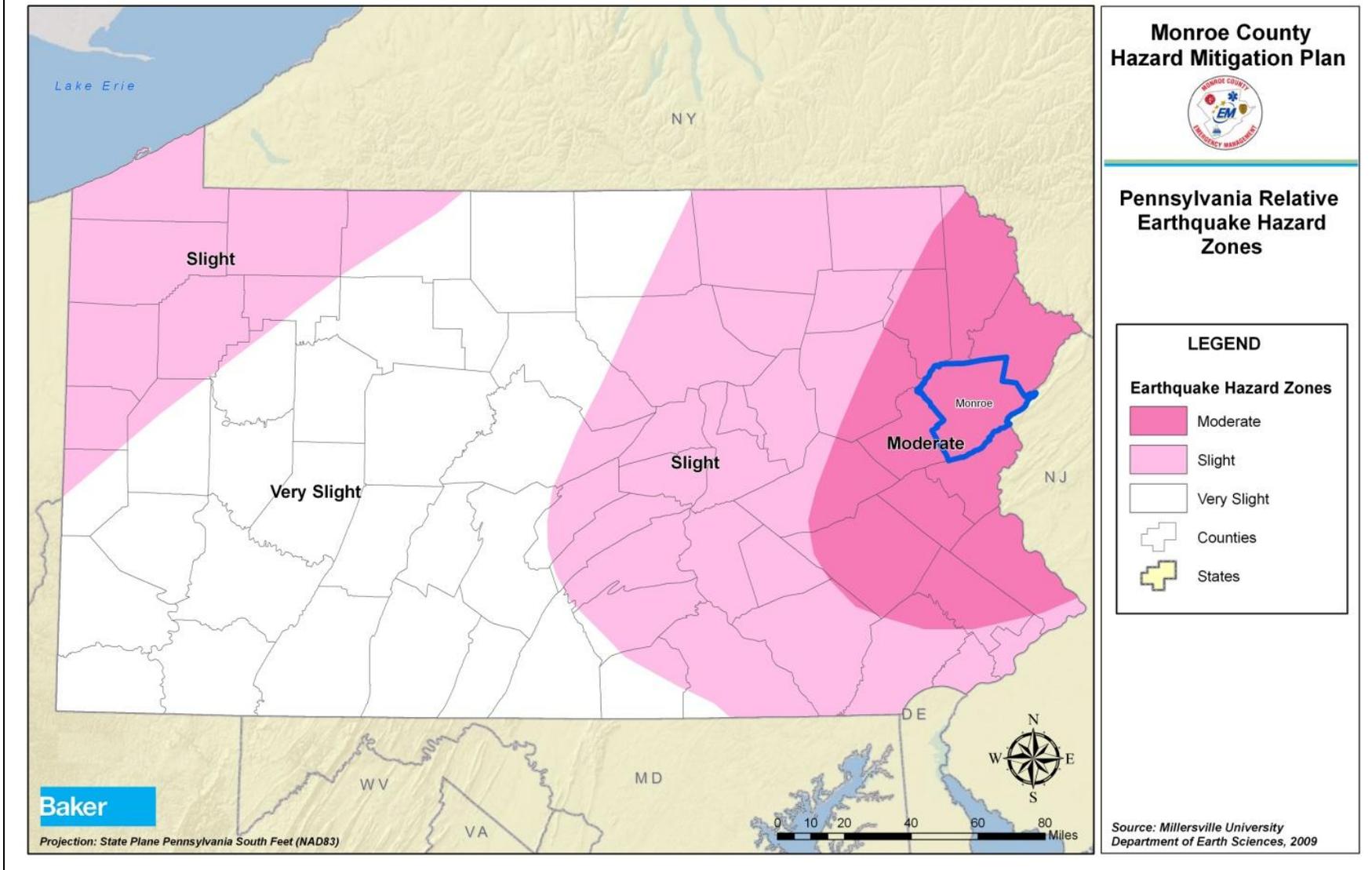
MUNICIPALITY	NUMBER OF REPORTED DOMESTIC WELLS	MUNICIPALITY	NUMBER OF REPORTED DOMESTIC WELLS
Hamilton Township	799	Stroudsburg Borough	2
Jackson Township	640	Tobyhanna Township	2727
Middle Smithfield Township	1194	Tunkhannock Township	1325
Mount Pocono Borough	42	Unknown Municipality	174
Paradise Township	435	TOTAL	15,418

4.3.2. Earthquake

4.3.2.1. Location and Extent

Earthquake events in Pennsylvania do not typically impact areas greater than 100 km from the epicenter of the event and are usually mild events. The Department of Earth Sciences at Millersville University identified relative earthquake hazard zones across the Commonwealth. As seen in Figure 4.3.2-1, the Monroe County falls entirely within the “moderate” zone. However, earthquakes originating in neighboring counties in New Jersey may also impact Monroe County.

Figure 4.3.2-1: Pennsylvania relative earthquake hazard zones (Millersville University Department of Earth Sciences, 2009).



4.3.2.2. 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 4.3.2-1 summarizes Richter Scale Magnitudes as they relate to the spatial extent of impacted areas. A historical survey of earthquakes occurring within 100 km of Monroe County with known magnitudes indicates that earthquakes have generally had magnitudes of up to 4.7 with an average moment magnitude of 2.5. Pennsylvania has not experienced any earthquakes with a magnitude greater than 6.0.

Table 4.3.2-1: 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 Richter Scale does not give any indication of the impact or damage of an earthquake, although it can be inferred that higher magnitude events cause more damage. Instead, the impact of an earthquake event is measured in terms of earthquake intensity, usually measured using the Modified Mercalli Intensity Scale, shown in Table 4.3.2-2. Based on historical data of earthquakes with a recorded Intensity, little damage is expected from earthquake events. However, since the worst earthquake recorded in Pennsylvania was a magnitude 5.2, a worst-case scenario for this hazard would be if an earthquake of similar magnitude occurred in Monroe County or near the border in an adjacent county, causing mild damage in populated areas.

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	<4.2
III	Slight	Felt by people resting; like a truck rumbling by	<4.2
IV	Moderate	Felt by people walking	<4.2
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

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

SCALE	INTENSITY	DESCRIPTION OF EFFECTS	CORRESPONDING RICHTER SCALE MAGNITUDE
VIII	Destructive	Moving cars uncontrollable, masonry fractures, poorly constructed buildings damaged	<6.9
IX	Ruinous	Some houses collapse, ground cracks, pipes break open	<6.9
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

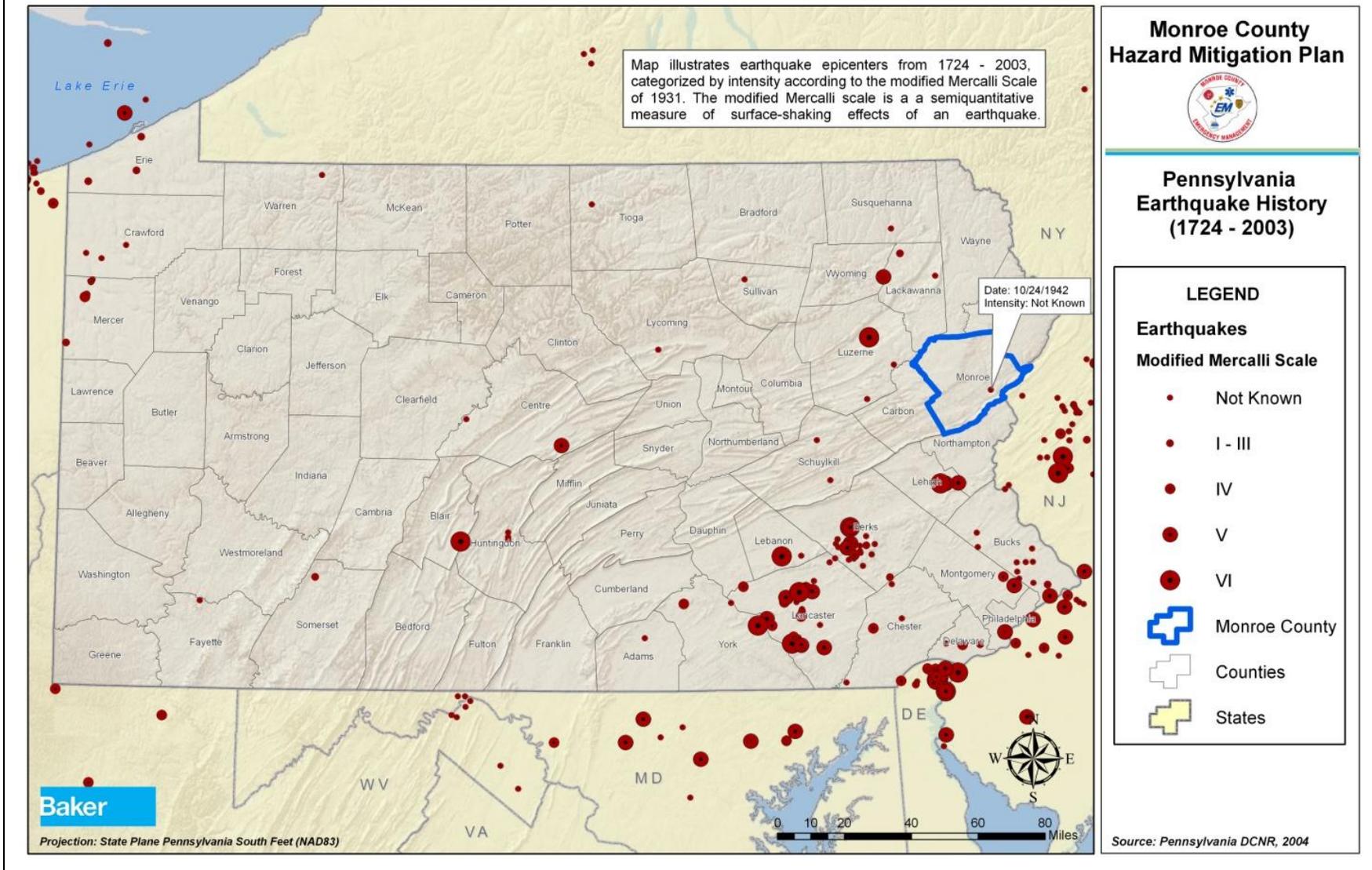
Environmental impacts of earthquakes can be numerous, widespread, and devastating, particularly if indirect impacts like economic impacts are considered. Some examples of these impacts are listed below, but these impacts are unlikely to occur in Monroe County:

1. Induced tsunamis and flooding or landslides and avalanches;
2. Poor water quality;
3. Damage to vegetation; and
4. Breakage in sewage or toxic material containments.

4.3.2.3. Past Occurrence

According to records maintained by the Pennsylvania DCNR, there has been only one recorded earthquake epicenter in Monroe County. That magnitude 3.4 event occurred in 1942. However, as shown in Figure 4.3.2-2, there have been 208 events located within 100 km of Monroe County in both Pennsylvania and New Jersey. It is important to note that some of these events may not have been true earthquakes but instead may have been the result of mine or quarry blasts. On the whole, though, these events have largely been minor events with magnitudes of less than 5.

Figure 4.3.2-2: Monroe County and Pennsylvania earthquake history (DCNR, 2004).



4.3.2.4. *Future Occurrence*

Historical records indicate that the future likelihood of an earthquake is *unlikely* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1). However, one way to express an earthquake's severity is to compare its acceleration to the normal acceleration due to gravity. Peak horizontal ground acceleration (PHGA) measures the strength of ground movements in this manner. PGHA is the percent of *g* (acceleration due to gravity) experienced during the earthquake or 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. In general, an acceleration of 10- to 15- percent of gravity is associated with structural damage to ordinary buildings not designed to withstand earthquakes, although soil conditions at individual sites will impact the amount of damage. The USGS's Earthquake Hazards Program places the PGHA value for Monroe County at between 8 and 12 (USGS, 2008).

4.3.2.5. *Vulnerability Assessment*

Earthquakes of the magnitude seen in Northeast Pennsylvania are small and shallow. Based on the past history of earthquake events in and near Monroe County, the County's vulnerability to this hazard is expected to be low. In the event of an earthquake, unanchored objects may be upset, but few damages are expected.

4.3.3. **Flood, Flash Flood, Ice Jam**

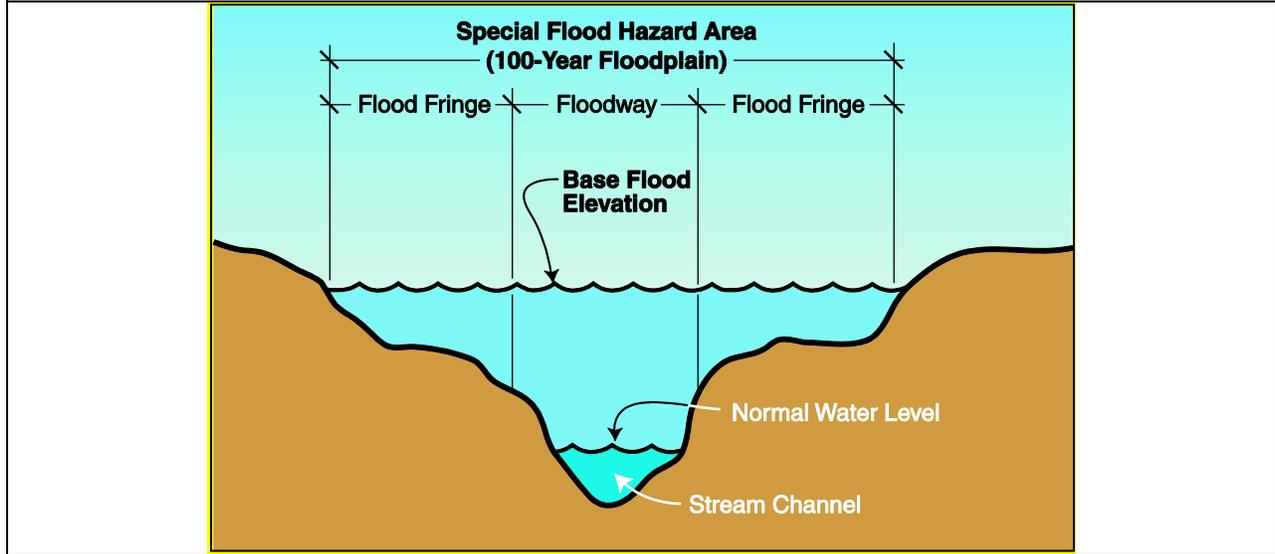
4.3.3.1. *Location and Extent*

Monroe County is located in the Upper and Central Delaware River Basins. The eastern portion of Monroe County is characterized by narrow and steep-sided valleys. The western portion of the county is an older plateau region; streams in this part of the county have relatively steep gradients, move swiftly, and rise to flood stages very quickly. Excess water from rainfall or snowmelt can accumulate in this area and drain into the streams and rivers, which can then overflow onto stream banks and adjacent floodplains. Monroe County, like many other areas in Pennsylvania, is flood prone because of this terrain and because most of the communities are located in the floodplains along these streams and valleys.

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 4.3.3.4. 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.

The National Flood Insurance Program (NFIP), for which FIRMs are published, identifies the 1% annual chance flood. This 1% annual chance flood event is used to delineate the *SFHA* and identify *Base Flood Elevations*. Figure 4.3.3-1 illustrates these terms. The SFHA serves as the primary regulatory boundary used by FEMA, the Commonwealth of Pennsylvania and Monroe County local governments.

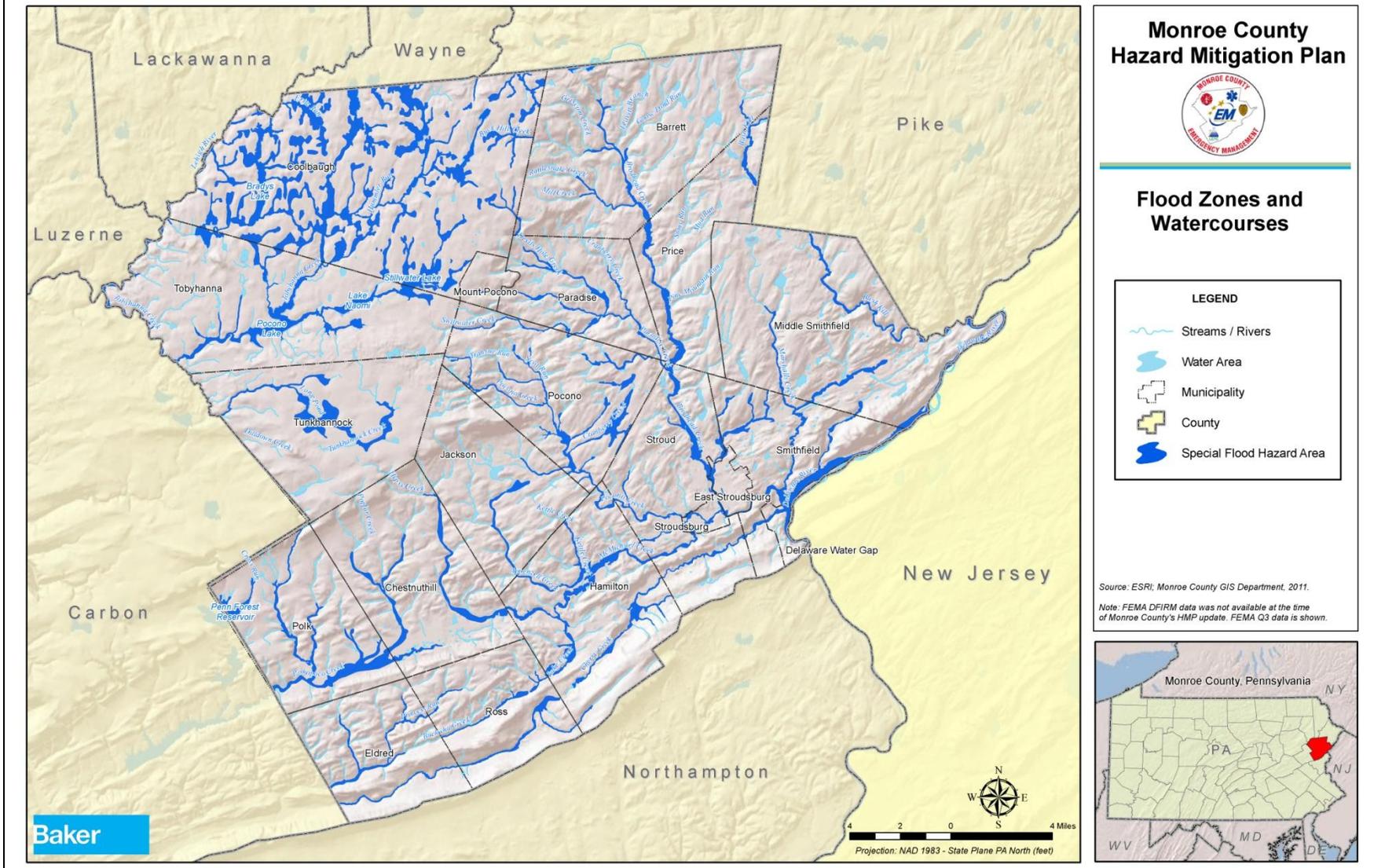
Figure 4.3.3-1: Diagram identifying Special Flood Hazard Area, 1% annual chance (formerly referred to as the 100-year) floodplain, floodway and flood fringe.



Monroe County currently uses paper FIRM maps and Flood Boundary and Floodway Maps (FBFM) dating from 1976-2000, which have been digitized to produce Q3 data that is compatible with GIS. Table 4.3.3-3 lists the current effective date of each community's maps. While the Q3 data means that some flood information is available in digital form, the full flood hazard information from FEMA is available through paper FIRMs. The FIRMs for the entire county, 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 Monroe County were determined to have SFHA.

Flooding occurs in the major watersheds and along the major waterways in Monroe County. The principal watershed is the Brodhead Creek Watershed which drains 287 square miles from its headwaters to its confluence with the Delaware River in the southeast corner of the county. The major tributaries for Brodhead Creek are the McMichaels Creek and the Pocono Creek. These two streams join Brodhead Creek in Stroudsburg. The other major watersheds in the county include the Bushkill Creek and Marshalls Creek in the east, Pohopoco Creek and Aquashicola Creek in the southwest, the Tobyhanna Creek and Tunkhannock Creek in the northwest, and the Cherry Creek in the southeast. Figure 4.3.3-2 shows the location of watercourses and Special Flood Hazard Areas (1%-annual-chance zones).

Figure 4.3.3-2: Monroe County flood zones and watercourses (Monroe County GIS Department, 2011).



4.3.3.2. *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.

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. Since Monroe County has mountainous terrain, this can contribute to more severe floods as runoff reaches receiving water bodies more rapidly over steep terrain. 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.

Winter floods 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. According to the Pennsylvania Emergency Incident Reporting System there has been one incident of ice jamming in 2002 in Monroe County, though there may be other instances that were not classified as ice jamming. The recorded instance took place in Appenzell in Jackson Township, but no other details are provided in the incident report.

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. In addition, the County occasionally experiences intense rainfall from tropical storms in late summer and early fall. The worst-case scenario for flooding occurred in Monroe County in August 1955. Hurricane Diane brought heavy rains causing a massive flooding event in Brodhead Creek and its tributaries. The flood reached almost thirty feet above normal levels along the Brodhead Creek in Smithfield Township. The discharge rates for Brodhead Creek were 3.5 times higher than the previously recorded maximum, McMichaels Creek rates were 1.5 times higher, and Pocono Creek rates were nine times higher. Damages from this flood were estimated at \$10.6 million, in July 1961 prices. More than 40 highway and railroad bridges were washed away in the swift moving floodwaters, and many summer resorts and homes were destroyed. There were a total known amount of 70 fatalities in the entire Brodhead Creek Watershed (MCPC, 2005).

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.

4.3.3.3. Past Occurrence

Monroe County has a long history of flooding events, there were twelve major floods recorded in Monroe County between 1900 and 2005. Flash flooding is a common occurrence in the County. Eleven of the sixteen Presidential Disaster and Emergency Declarations affecting Monroe County have been in response to hazard events related to flooding, including flooding induced by named coastal storms (see Section 4.2.1: Table of Presidential Disaster Declarations). Table 4.3.3-1 lists flood event information from 1993 to 2010 obtained from the National Climatic Data Center and Pennsylvania Emergency Incident Reporting System. Estimated property damage was not available for flooding events.

Table 4.3.3-1: Flood and flash flood events impacting Monroe County from 1993-2010 (NCDC, 2011; PEIRS, 2011). "Countywide" indicates several locations in the County were affected.	
DATE	LOCATION & DESCRIPTION
11/28/93	Multiple Counties. Flood/Flash Flood – A slow-moving storm caused widespread heavy rains and flooding across many counties in Pennsylvania.
1/19/96	Multiple Counties. Flood/Flash Flood – Snowmelt due to unseasonably warm weather combined with one to two inches of rain for flash flood and continued flooding.
1/27/96	Countywide. Flash Flood – Up to 2 inches of rainfall flooded smaller streams with saturated soil from previous event.
4/16/96	Monroe, Berks, Carbon and Lehigh Counties. Flash Flood – Rainfall of up to 3 or 4 inches in Monroe County flooded streams resulting in road closures.
6/22/96	Southern Portion of the County. Flash Flood – Thunderstorm caused in 1.5 to 3 inches of rainfall resulting in flash flooding in small streams in the southern part of Monroe county.
10/19/96	Countywide. Flash Flood – Heavy rainfall of 3 to 5 inches caused flooding on highways, drainage systems, and small creeks.
11/8/96	Countywide. Flash Flood – Rainfall of about 2 inches caused flooding in small stream, complicated by fallen trees and leaves clogging basins and streams.
12/2/96	Monroe and Carbon Counties. Flash Flood – Heavy rain over two days resulted in 3 to 4 inches of rain flooding small creeks and streams.
9/9/99	Monroe, Berks and Northampton Counties. Flood – Thunderstorms and torrential downpours resulted in poor drainage and stream flooding in the southeast portion of Monroe County.
9/16/99	Multiple Counties – Flash Flood – Hurricane Floyd caused heavy rain resulting 6 to 8 inches of rainfall in Monroe County and flash flooding across Eastern Pennsylvania.
12/17/00	Monroe and Carbon Counties. Flood – Heavy rain during a series of storms caused flooding in several ponds and creeks resulting in flooded roads in Monroe County. Later cold caused icy roads.
7/25/01	Southeast Portion of the County. Flash Flood – Torrential downpour from thunderstorms resulted in over 6 inches of rain flooding roadways and creeks in southeast Monroe County.
5/28/02	Monroe, Luzerne and Lackawanna Counties. Flood – Heavy rainfall caused stream, river and poor drainage flooding in northern Monroe County.
6/26/02	Monroe and Carbon Counties. Flood – A series of thunderstorms caused between 4 and 5

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Table 4.3.3-1: Flood and flash flood events impacting Monroe County from 1993-2010 (NCDC, 2011; PEIRS, 2011). “Countywide” indicates several locations in the County were affected.

DATE	LOCATION & DESCRIPTION
	inches of rain in the northern portion of Monroe County.
7/23/02	Monroe and Carbon Counties. Flash Flood – A series of thunderstorms caused between 3 and 4 inches in Mount Pocono Borough resulting in stream and highway flooding.
6/12/03	Southern Portion of the County. Flash Flood – Torrential rain caused two surges of flash flooding in southern Monroe County: first from stream and creek flooding, then from a damaged dam.
6/21/03	Countywide. Flood – A series of storms over two days caused between 3 to 6 inches of rainfall resulting in highway and poor drainage floods.
8/16/03	Southern Portion of the County. Flash Flood – A series of thunderstorms produced 6 to 8 inches of rain in southern townships resulting in flooded creeks, highways and basements.
9/23/03	Countywide. Flood – Heavy rain caused by a slow moving cold front produced 2 to 4 inches of rain.
12/11/03	Countywide. Flood – Rainfall between 2 to 5 inches and melting snow caused flooding of poor drainage areas and small creeks.
8/12/04	Central Portion of the County. Flash Flood – Moisture from Tropical Storm Bonnie contributed to storms in area to cause heavy rains. Rainfall of between 4 to 8 inches caused poor drainage and creek flooding.
9/18/04	Countywide. Flash Flood – Heavy rain caused by cold front and remnants of Hurricane Ivan caused 3 to 6 inches of rainfall. Flooding in poor drainage areas, rivers and creeks; every stream in the county flooded.
9/28/04	Countywide. Flood.
1/14/05	Countywide. Flood – Rain combined with melting snow resulted in flooding in poor drainage areas and some creeks. After 2 inches of rain storm turned to snow.
4/2/05	Countywide. Flood.
4/5/05	Multiple Counties. Flood – Heavy rain caused flooding across the Delaware River Basin area. Monroe County received between 4 to 5 inches of rainfall causing roads to flood and close.
10/8/05	Countywide. Flood – A slow moving cold front and remnants of Tropical Storm Tammy caused heavy rain. Between 4 to 10 inches of rainfall caused flooding and mudslides.
1/18/06	Countywide. Flood – Rain and melting snow caused flooding in smaller streams.
6/27/06	Multiple Counties. Flood/Flash Flood – Days of heavy rains in the Delaware and Lehigh River Basins caused second highest crest of the Delaware River in Monroe County. Rainfall between 8 to 12 inches caused flooding in streams and rivers resulting in 2 drowning deaths.
4/15/07	East Central Portion of the County. Flood – Heavy rain caused creek and poor drainage flooding. Roadways were closed across area as well as a mudslide in Stroud Township.
6/1/07	Stroudsburg Area. Flash Flood – Torrential rain produced flash flooding closing several roads and causing a mudslide in Smithfield Township.
6/14/08	Northeast Portion of the County. Flash Flood – Slow moving storms produced around 5 inches of rain. Flash flooding in smaller streams caused roadway flooding.
8/15/08	Bossardsville. Flash Flood – Heavy rain produced 5 to 6 inches of rain and caused stream, street and poor drainage flooding.
7/29/09	West Central Portion of the County. Flash Flood – Rainfall between 3 to 6 inches caused flooding in small streams and poor drainage areas.
9/30/2010	Monroe and Luzerne Counties. Flood – Heavy rain flooded the Lehigh River at border of Monroe and Luzerne Counties. The river crested at Stoddartsville. Additional flooding of creeks in Northern Monroe County.

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

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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. According to the Pennsylvania State Hazard Mitigation Plan, there were forty repetitive loss properties in Monroe County, four of which have been mitigated either by FEMA or the Increased Cost of Compliance Program (PEMA, 2010). Smithfield Township has over half of these repetitive loss properties, with twenty-two properties; this jurisdiction is also home to all of the County's mitigated properties. The other repetitive loss properties in Monroe County are in Barrett Township, Chestnuthill Township, Delaware Water Gap Borough, Eldred Township, Hamilton Township, Middle Smithfield Township, Ross Township, Stroud Township, and Stroudsburg Borough. Table 4.3.3-2 shows the number of repetitive loss properties by municipality.

Table 4.3.3-2: Summary of the number and type of Repetitive Loss properties by municipality (PEMA, 2010).

MUNICIPALITY	TYPE				SUM OF REPETITIVE LOSS PROPERTIES
	NON-RESIDENTIAL	ASSEMBLED CONDO	2-4 FAMILY	SINGLE FAMILY	
Barrett Township	0	0	0	1	1
Chestnuthill Township	1	0	0	1	2
Coolbaugh Township	0	0	0	0	0
Delaware Water Gap Borough	1	0	1	0	2
East Stroudsburg Borough	0	0	0	0	0
Eldred Township	0	0	0	1	1
Hamilton Township	0	0	1	1	2
Jackson Township	0	0	0	0	0
Middle Smithfield Township	0	0	0	2	2
Mount Pocono Borough	0	0	0	0	0
Paradise Township	0	0	0	0	0
Pocono Township	0	0	0	0	0
Polk Township	0	0	0	0	0
Price Township	0	0	0	0	0
Ross Township	0	0	0	1	1
Smithfield Township	4	1	0	17	22
Stroud Township	4	1	0	1	6
Stroudsburg Borough	0	0	0	1	1
Tobyhanna Township	0	0	0	0	0
Tunkhannock Township	0	0	0	0	0
TOTAL	10	2	2	26	40

There are also four severe repetitive loss properties in Monroe County – three in Smithfield Township and one in Hamilton Township. These four properties are all single-family residences, and none of them have been mitigated by 2010.

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 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 of the municipalities in Monroe County are participating 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 CRS Program. 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 Monroe County participate in CRS.

Table 4.3.3-3 lists the Monroe County municipalities participating in the NFIP, their initial FIRM identification date, and their current effective map dates. Note that all municipalities in the County participate in the program.

Table 4.3.3-3: Monroe County Municipal Participation in the National Flood Insurance Program (FEMA CIS, 2010).				
COMMUNITY	PARTICIPATION STATUS	CID	INITIAL FIRM IDENTIFIED	CURRENT EFFECTIVE MAP DATE
Barrett Township	P	421884	9/2/88	9/2/88
Chestnuthill Township	P	421885	2/17/88	2/17/88
Coolbaugh Township	P	421886	11/4/88	10/16/91
Delaware Water Gap Borough	P	420690	8/16/88	10/20/00
East Stroudsburg Borough	P	420691	9/29/78	9/29/78
Eldred Township	P	421887	2/17/88	2/17/88
Hamilton Township	P	421888	2/4/88	9/6/95
Jackson Township	P	421889	7/2/82	7/2/82
Middle Smithfield Township	P	421890	12/16/88	12/16/88
Mount Pocono Borough	P	420692	5/28/82	5/28/82
Paradise Township	P	421891	9/2/88	9/2/88
Pocono Township	P	421892	8/5/86	8/5/86
Polk Township	P	421893	9/30/87	9/30/87
Price Township	P	421894	9/2/88	9/2/88
Ross Township	P	421895	2/17/88	2/17/88
Smithfield Township	P	421896	3/4/88	12/6/99

Table 4.3.3-3: Monroe County Municipal Participation in the National Flood Insurance Program (FEMA CIS, 2010).				
COMMUNITY	PARTICIPATION STATUS	CID	INITIAL FIRM IDENTIFIED	CURRENT EFFECTIVE MAP DATE
Stroud Township	P	420693	4/15/77	11/16/95
Stroudsburg Borough	P	420694	6/21/74	12/31/76
Tobyhanna Township	P	421897	12/16/88	12/16/88
Tunkhannock Township	P	421898	9/4/85	9/4/85

4.3.3.4. Future Occurrence

In Monroe County, flooding occurs commonly and can occur during any season of the year. Within the flood susceptible areas of Monroe County, it is expected that the character of flooding will remain essentially unchanged from what has been experienced for many years. However, some increase in the severity and frequency of flooding may result due to planned or recent development within the floodplains of the various county streams. The future occurrence of floods in Monroe County can be characterized as *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 percent-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 percent-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 4.3.3-4 shows a range of flood recurrence intervals and associated probabilities of occurrence.

Table 4.3.3-4: Recurrence intervals and associated probabilities of occurrence (FEMA, 2007).	
RECURRENCE INTERVAL	CHANCE OF OCCURRENCE IN ANY GIVEN YEAR (%)
10 year	10
50 year	2
100 year	1
500 year	0.2

4.3.3.5. Vulnerability Assessment

Monroe County is vulnerable to flooding that causes loss of lives, property damage, and road closures. All of the municipalities in Monroe County are flood prone, particularly for flash floods. In addition to the permanent population in Monroe County which is vulnerable to the effects of flooding, consideration must also be given to the second home population and visitors who come to the tourist facilities in the county. The most recent tourist estimate for the County is 16.8 million guests, 5.6 of whom stay overnight two or more nights; many of the tourist facilities are located in or near the county's floodways (MCPC, 2005).

After the flood of 1955, a system of levees was constructed in the Stroudsburg and East Stroudsburg portions of the Brodhead, McMichaels, Pocono and Sambo Creeks. In 1982, work was undertaken to repair and upgrade these levees. Two dry dams were also constructed in the headwaters of the Brodhead Creek on Goose Pond Run and the Leavitt Branch to provide additional flood protection. While the county cannot depend on the levee and dams completely to prevent flooding in this area, these should minimize damage to the homes and businesses from all but the most devastating storms (MCPC, 2005).

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 Q3 digital data.

Table 4.3.3-5 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. It is important to note that the SFHAs used in this analysis are at least eleven years old and at most 37 years old; over the years, the County has grown substantially, and these SFHAs may not accurately reflect current risk, but are the best data available for analysis.

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. These results are shown in Table 4.3.3-5.

Overall, only 2.2% of the addressable structures and 2.9% of the population of the County are most at risk to the 1%-annual-chance flood zone. Coolbaugh and Smithfield Townships each have over 200 structures located in the SFHA. However, proportionally, Delaware Water Gap Borough has the highest percentage of structures in the SFHA; 5.7% of all structures in the municipality are located in the SFHA. Other jurisdictions with a comparatively higher proportion

of addressable structures in the SFHA include Hamilton, Polk, and Smithfield Townships, each of which has between 4-5% of addressable structures in the SFHA. Delaware Water Gap Borough has by far the highest proportion of populations living in the SFHA with over 13.6% of the population falling within the SFHA. The only other jurisdiction with over 10% of the population at risk to the 1%-annual-chance flood is Hamilton Township. Of all the floodprone jurisdictions, Mount Pocono Borough, Middle Smithfield Township, and Tunkhannock Township have comparatively lower structure vulnerability; less than 1% of the total addressable structures in those jurisdictions are located in the SFHA. These are not necessarily the jurisdictions with the lowest proportion of population in the SFHA; Jackson Township, Middle Smithfield Township, Mount Pocono Borough, and Paradise Township each have less than 1% of the population living in the SFHA.

The number and geography of vulnerable mobile homes is quite different from the overall structure vulnerability in the County. East Stroudsburg has the highest number and proportion of mobile home structures in the SFHA at 45 while Ross Township has 34 mobile home structures in the SFHA. Delaware Water Gap, Mount Pocono, and Stroudsburg Boroughs and Eldred, Jackson, Middle Smithfield, Price, Tobyhanna, and Tunkhannock Townships have no mobile home structures in the SFHA.

Table 4.3.3-5: Structure and population vulnerability to floods in Monroe 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)	EST. 2000 POPULATION IN SFHA	% POPULATION IN SFHA
Barrett Township	2587	81	3.1%	22	32	3	3,880	116	3.0%
Chestnuthill Township	6874	153	2.2%	185	193	5	14,418	145	1.0%
Coolbaugh Township	10998	259	2.4%	133	129	11	15,205	719	4.7%
Delaware Water Gap Borough	401	23	5.7%	0	0	0	744	101	13.6%
East Stroudsburg Borough	3294	80	2.4%	12	79	45	9,888	235	2.4%
Eldred Township	1217	41	3.4%	62	65	0	2,665	54	2.0%
Hamilton Township	3890	174	4.5%	104	257	16	8,235	880	10.7%
Jackson Township	3577	23	0.6%	72	86	0	5,979	0	0.0%
Middle Smithfield Township	8363	62	0.7%	209	354	0	11,495	69	0.6%
Mount Pocono Borough	1405	1	0.1%	0	0	0	2,742	0	0.0%
Paradise Township	1560	39	2.5%	9	7	1	2,671	22	0.8%
Pocono Township	5852	156	2.7%	151	283	2	9,607	444	4.6%
Polk Township	3521	153	4.3%	87	147	8	6,533	197	3.0%
Price Township	1766	33	1.9%	106	101	0	2,649	30	1.1%
Ross Township	2315	72	3.1%	213	311	34	5,435	62	1.1%
Smithfield Township	4215	203	4.8%	29	88	7	5,672	260	4.6%
Stroud Township	8178	93	1.1%	54	143	1	13,978	199	1.4%
Stroudsburg Borough	3381	101	3.0%	6	4	0	5,756	311	5.4%
Tobyhanna Township	7409	96	1.3%	68	73	0	6,152	89	1.4%
Tunkhannock Township	3642	1	0.0%	125	172	0	4,983	78	1.6%
TOTAL	84,445	1,844	2.2%	1,647	2,524	133	138,687	4,011	2.9%

Table 4.3.3-6 displays the number of critical facilities that are located in the SFHA by jurisdiction. There are 6 critical facilities that are located in the SFHA, representing just over 3% of the County’s total critical facilities. Chestnuthill Township has the highest number of floodprone critical facilities with 2; other jurisdictions with critical facilities located in the SFHA include Delaware Water Gap Borough, Mount Pocono Borough, Stroudsburg Borough, and Tobyhanna Township.

Table 4.3.3-6: Critical facilities vulnerable to flood by municipality.		
MUNICIPALITY	TOTAL CRITICAL FACILITIES	TOTAL CRITICAL FACILITIES IN SFHA
Barrett Township	12	0
Chestnuthill Township	15	2
Coolbaugh Township	14	0
Delaware Water Gap Borough	4	1
East Stroudsburg Borough	16	0
Eldred Township	5	0
Hamilton Township	7	0
Jackson Township	5	0
Middle Smithfield Township	7	0
Mount Pocono Borough	4	1
Paradise Township	10	0
Pocono Township	11	0
Polk Township	8	0
Price Township	1	0
Ross Township	5	0
Smithfield Township	17	0
Stroud Township	19	0
Stroudsburg Borough	14	1
Tobyhanna Township	16	1
Tunkhannock Township	2	0
TOTAL	192	6

Additional information on flood vulnerability and losses in Monroe 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.

4.3.4. Hurricane, Tropical Storm, Nor’easter

4.3.4.1. Location and Extent

Tropical storms impacting Monroe County develop in tropical or sub-tropical waters found in the Atlantic Ocean, Gulf of Mexico, or Caribbean Sea. Cyclones with maximum sustained winds of less than 39 miles per hour (mph) are called tropical depressions. A tropical storm is a cyclone

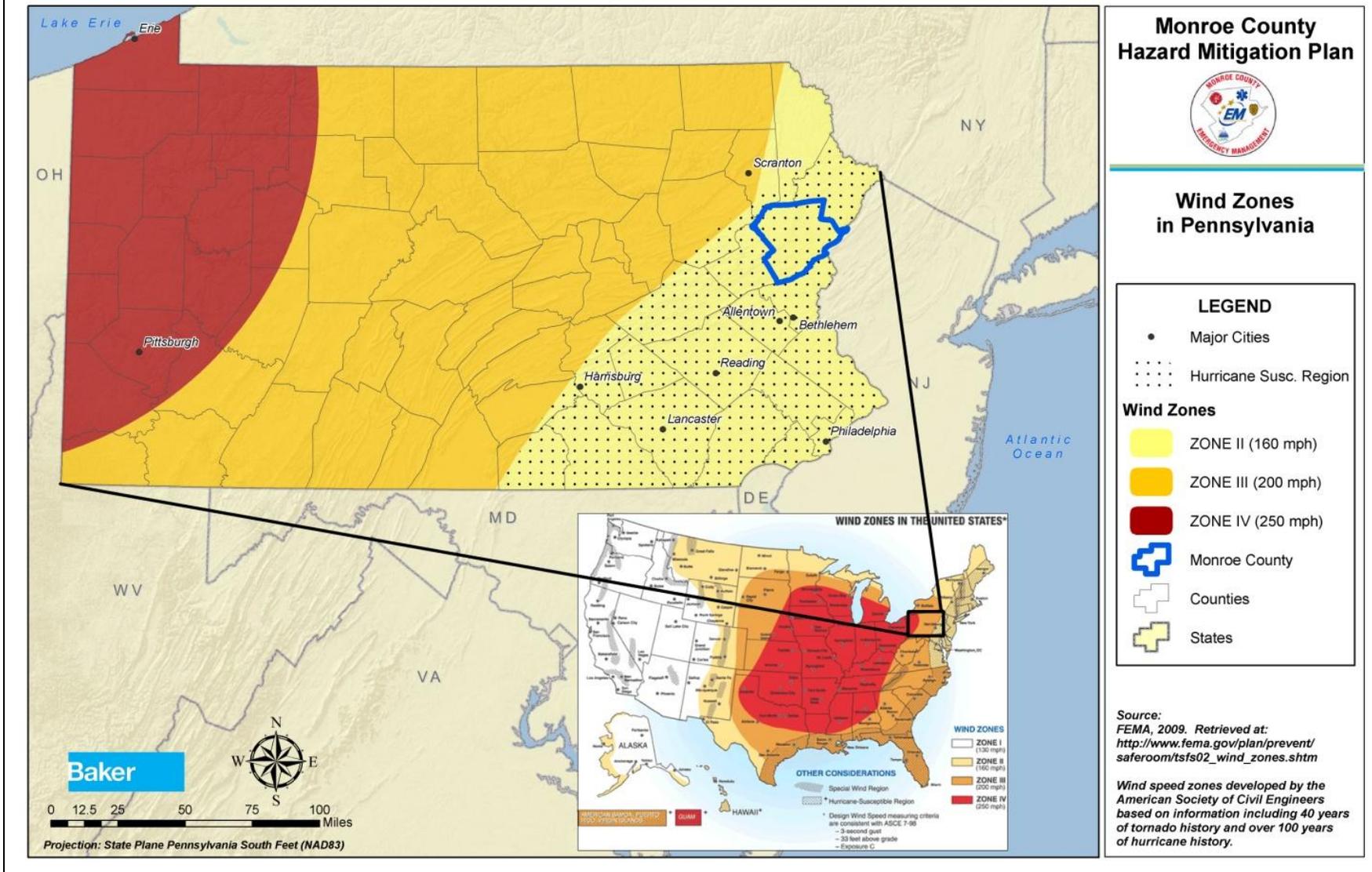
with maximum sustained winds between 39-74 mph. These storms sometimes develop into hurricanes with wind speeds in excess of 74 mph.

While Monroe County is located about 75 miles from the Atlantic Coast, tropical storms can track inland causing heavy rainfall and strong winds. These storms are regional events that can impact very large areas hundreds to thousands of miles across over the life the storm. Therefore, all communities within Monroe County are equally subject to the impacts of hurricanes, tropical storms, and Nor'easters that track through or near the County. Areas in Monroe County which are subject to flooding, wind, and winter storm damage are particularly vulnerable.

Figure 4.3.4-1 shows wind speed zones developed by the American Society of Civil Engineers based on information including 40 years of tornado history and over 100 years of hurricane history. It identifies 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.

Monroe County falls within Zone II, meaning design wind speeds for shelters and critical facilities should be able to withstand a 3-second gust of up to 160 mph, regardless of whether the gust is the result of a tornado, hurricane, tropical storm, or windstorm event. Monroe County also falls wholly within the identified Hurricane Susceptibility Region.

Figure 4.3.4-1: Wind zones in Pennsylvania and Monroe County (FEMA, 2009).



4.3.4.2. Range of Magnitude

Tropical cyclones with maximum sustained winds of less than 39 miles per hour (mph) are called *tropical depressions*. A *tropical storm* is a cyclone with maximum sustained winds between 39-74 mph. These storms sometimes develop into *hurricanes* with wind speeds in excess of 74 mph. *Extra-tropical* is a term used to describe a hurricane or tropical storm whose cyclone has lost its “tropical” characteristics and has cold air at its core, rather than warm air. While an extra-tropical storm denotes a change in weather pattern and how a coastal storm is gathering energy, it may still have winds that are tropical storm or hurricane force. The impacts associated with hurricanes and tropical storms are primarily wind damage and flooding. It is not uncommon for tornadoes to develop during these events. Historical tropical storm and hurricane events have brought intense rainfall, sometimes leading to damaging floods, northeast winds, which, combined with waterlogged soils, caused trees and utility poles to fall.

The impact tropical storm or hurricane events have on an area is typically measured in terms of wind speed. Expected damage from hurricane force winds is measured using the Saffir-Simpson Scale. The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential (characteristic of tropical storms and hurricanes, but not a threat to inland locations like Monroe County), which are combined to estimate potential damage. Table 4.3.4-1 lists Saffir-Simpson Scale categories with associated wind speeds and expected damages. Categories 3, 4, and 5 are classified as “major” hurricanes. While major hurricanes comprise only 20 of all tropical cyclones making landfall, they account for over 70 percent of the damage in the United States. The likelihood of these damages occurring in Monroe County is assessed in Section 4.3.4.4, *Future Occurrence*.

Table 4.3.4-1: Saffir-Simpson Scale categories with associated wind speeds and damages (NHC, 2009).		
STORM CATEGORY	WIND SPEED (mph)	DESCRIPTION OF DAMAGES
1	74-95	MINIMAL: Damage is limited primarily to shrubbery and trees, unanchored mobile homes, and signs. No significant structural damage.
2	96-110	MODERATE: Some trees are toppled, some roof coverings are damaged, and major damage occurs to mobile homes. Some roofing material, door, and window damage.
3	111-130	EXTENSIVE: Some structural damage to small residences and utility buildings, with a minor amount of curtain wall failures. Mobile homes are destroyed. Large trees are toppled. Terrain may be flooded well inland.
4	131-155	EXTREME: Extensive damage to roofs, windows, and doors; roof systems on small buildings completely fail. More extensive curtain wall failures. Terrain may be flooded well inland.
5	>155	CATASTROPHIC: Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Massive evacuation of residential areas may be required.

It is important to recognize the potential for flooding events during hurricanes and tropical storms; the risk assessment and associated impact for these events is included Section 4.3.3. Wind impacts in Monroe County generally include downed trees and utility poles, which can spark widespread utility interruptions. Wind impacts are particularly an issue for mobile homes and other manufactured housing; these structures are often not well-anchored and are highly susceptible to wind damage in a hurricane, tropical storm, or Nor'easter.

The worst case hurricane, tropical storm, or Nor'easter event in Monroe County was Hurricane Diane, which struck Pennsylvania in 1955 and resulted in a Presidential Disaster Declaration. Diane made landfall in North Carolina on August 17, taking a west-northwest track that cut through central Virginia, Maryland, southeast Pennsylvania, New Jersey, and New York. The storm never tracked into Pennsylvania, but brought extremely heavy rains to eastern Pennsylvania, including Monroe County. With the soil already saturated from Hurricane Connie a few days before, fast-moving water wreaked havoc in the Brodhead Valley, demolishing dams, structures, and killing some 75 persons in the immediate area (Portsmouth Times 1955). The flood impacts led to water quality issues and an outbreak of dysentery in the County. This storm is considered the ninth most costly hurricane event (adjusted costs to 1994 dollars), with cumulative damages of \$7 million in the Northeastern US.

4.3.4.3. Past Occurrence

The National Oceanic and Atmospheric Administration's Coastal Services Center maintains records of all coastal storms occurring in the United States since the 1850s. Table 4.3.4-2 lists all coastal storms having centers of circulation to pass through or within 20 miles of Monroe County.

Table 4.3.4-2: Previous coastal storms tracking through or near Monroe County.		
YEAR	EVENT	STRENGTH IN/NEAR MONROE COUNTY
1994	Beryl	Tropical Depression
1952	Able	Tropical Storm
1949	Not Named	Tropical Storm
1945	Not Named	Extra-tropical Storm
1939	Not Named	Tropical Depression
1929	Not Named	Extra-tropical Storm
1903	Not Named	Tropical Storm
1899	Not Named	Extra-tropical Storm
1893	Not Named	Tropical Storm
1888	Not Named	Tropical Storm
1878	Not Named	Category 1 Hurricane

It is important to note that a number of hurricane, tropical storm, and nor'easter events have impacted the County without tracking through or near it; these storm events include Hurricanes

Diane (1955), Agnes (1972), Floyd (1999), and Isabel (2003) and Tropical Depression Ivan (2004). Each of these storm events resulted in a Presidential Disaster Declaration.

4.3.4.4. Future Occurrence

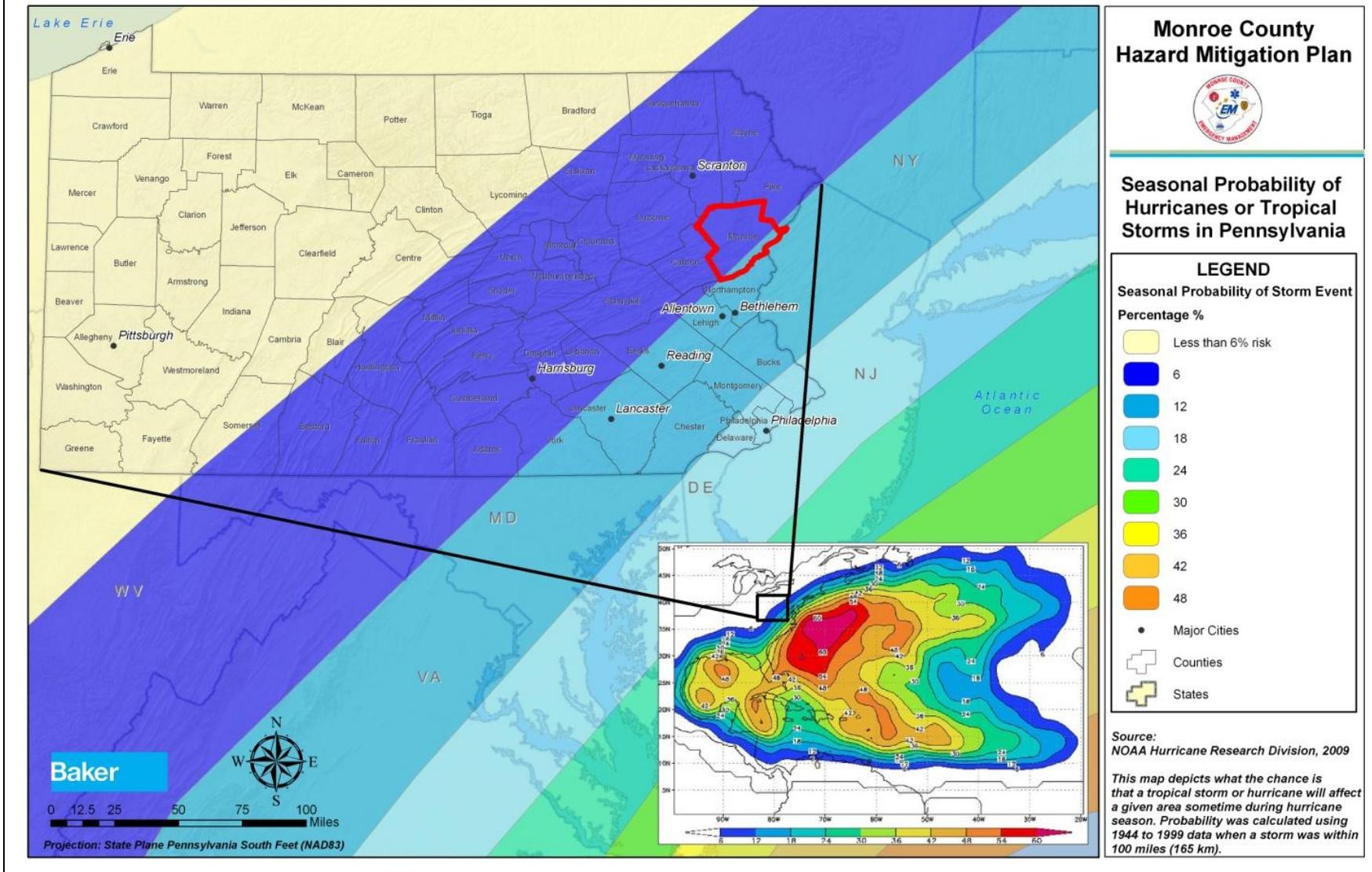
Although hurricanes and tropical storms can cause flood events consistent with 1 percent- and 2 percent- level frequency, their probability of occurrence is measured relative to wind speed. Table 4.3.4-3 shows the probability of winds that reach the strength of tropical storms and hurricane conditions in Monroe County and surrounding areas based on a statistical sample region of more than 30,000 square miles over a period of 46 years.

Table 4.3.4-3: Annual probability of tropical storm and hurricane strength wind speeds for (FEMA, 2000).		
WIND SPEED (mph)	CORRESPONDING SAFFIR-SIMPSON TROPICAL STORM/HURRICANE CATEGORIES	ANNUAL PROBABILITY OF OCCURRENCE (%)
45-77	Tropical Storms and Category 1 Hurricanes	91.59
78-118	Category 1 to 2 Hurricanes	8.32
119-138	Category 3 to 4 Hurricanes	0.0766
139-163	Category 4 to 5 Hurricanes	0.0086
164-194	Category 5 Hurricanes	0.00054
195+	Category 5 Hurricanes	0.00001

Table 4.3.4-3 includes wind speeds for all types of storms and is not specific to cyclonic winds. In Monroe County and surrounding areas, the annual probability for winds that equal the strength of tropical storms (over 39 mph) is over 90 percent. The probability for winds at category 1 or 2 hurricane strength (78-118 mph) is greater than 8 percent in any given year. Using Table 4.3.4-1, these wind speeds correspond to *minimal* or *moderate* expected damages. The annual probability of winds exceeding 118 mph is less than 0.1.

The National Oceanic and Atmospheric Administration Hurricane Research Division published the map included as Figure 4.3.4-2 showing the chance that a tropical storm or hurricane will affect a given area during the entire Atlantic hurricane season spanning from June to November. Note that this figure does not provide information on the probability of various storm intensities. However, based on historical data between 1944 and 1999, this map reveals there is approximately a 6 percent chance of experiencing a tropical storm or hurricane event between June and November of any given year in most of the County; the extreme southeast portions of the County have a seasonal probability of up to 12% annually, or *possible* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1).

Figure 4.3.4-2: Seasonal probability of a hurricane or tropical storm affecting Monroe County (NOAA HRD, 2009).



4.3.4.5. *Vulnerability Assessment*

A vulnerability assessment for hurricanes and tropical storms focuses on the impacts of flooding and severe wind. Therefore, the assessment for flood-related vulnerability is addressed in Section 4.3.3.5. and vulnerability to wind damage is addressed in Section 4.3.6.5. The County is also vulnerable to severe winter weather impacts caused by Nor'easters which are evaluated in 4.3.7.5.

4.3.5. **Pandemic**

4.3.5.1. *Location and Extent*

Pandemic is defined as a disease affecting or attacking the population of an extensive region, including several countries, and/or continent(s). It is further described as extensively epidemic. Generally, pandemic diseases cause sudden, pervasive illness in all age groups on a global scale. Pandemic events cover a wide geographic area and can affect large populations, including the entire population of Monroe County, depending on the disease. The exact size and extent of an infected population is depending up on how easily the illness is spread, the mode of transmission, and the amount of contact between infected in non-infected persons.

Monroe County is primarily concerned with the possibility of a pandemic influenza outbreak. Pandemic influenza planning began in response to the H5N1 (avian) flu outbreak in Asia, Africa, Europe, the Pacific, and the Near East in the late 1990s and early 2000s. H5N1 did not reach pandemic proportions in the United States, but the County began actively planning for an occurrence of an influenza pandemic. As stated in the Pennsylvania Department of Health Influenza Pandemic Response Plan, "an influenza pandemic is inevitable and will probably give little warning" (PA Department of Health, 2005). Influenza, also known as "the flu", is a contagious disease that is caused by the influenza virus and most commonly attacks the respiratory tract in humans. Influenza is considered to have pandemic potential if it is novel, meaning that people have no immunity to it, virulent, meaning that it causes deaths in normally healthy individuals, and easily transmittable from person-to-person.

4.3.5.2. *Range of Magnitude*

The magnitude of a pandemic in Monroe County will range significantly depending on the aggressiveness of the virus in question and the ease of transmission. Pandemic influenza is fairly easily transmitted from person-to-person, but advances in medical technologies have greatly reduced the number of deaths caused by influenza over time. In terms of lives lost, the impact various pandemic influenza outbreaks have had globally over the last century has declined (see Table 4.3.5-1). The 1918 Spanish flu pandemic remains the worst-case pandemic event on record. While mortality figures were probably under-reported, in the first month of the pandemic alone, 8,000 Pennsylvanians died from the flu or its complications (US Department of Health and Human Services, 2010).

In contrast, the severity of illness from the 2009 H1N1 influenza flu virus has varied, with the gravest cases occurring mainly among those considered at high risk. High risk populations considered more vulnerable include children, the elderly, pregnant women, and chronic disease patients with reduced immune system capacity. Most people infected with H1N1 in 2009 have recovered without needing medical treatment. However, the virus has resulted in many deaths, though none have occurred in Monroe County. According to the CDC, about 70% of those who

have been hospitalized with the 2009 H1N1 flu virus in the United States have belonged to a high risk group (CDC, 2009).

The magnitude of a pandemic may be exacerbated by the fact that an influenza pandemic will cause outbreaks across the United States, limiting the ability to transfer assistance from one jurisdiction to another. Additionally, effective preventative and therapeutic measures, including vaccines and other medications, will likely be in short supply or will not be available.

There are no true environmental impacts in pandemic disease outbreaks, but there may be significant economic and social costs beyond the possibility of deaths. Widespread illness may increase the likelihood of shortages of personnel to perform essential community services. In addition, high rates of illness and worker absenteeism occur within the business community, and these contribute to social and economic disruption. Social and economic disruptions could be temporary but may be amplified in today’s closely interrelated and interdependent systems of trade and commerce. Social disruption may be greatest when rates of absenteeism impair essential services, such as power, transportation, and communications.

4.3.5.3. Past Occurrence

There have been several pandemic influenza outbreaks which have occurred over the past 100 years. A list of events worldwide is shown in Table 4.3.5-1.

Table 4.3.5-1: List of previous significant outbreaks of influenza over the past century (Global Security, 2009; World Health Organization, 2009).		
DATE	PANDEMIC NAME/SUBTYPE	WORLDWIDE DEATHS (APPROXIMATE)
1918-1920	Spanish Flu / H1N1	50 million
1957-1958	Asian Flu / H2N2	1.5-2 million
1968-1969	Hong Kong Flu / H3N2	1 million
2009-2010	Swine Flu / 2009 H1N1	17,700

Deaths occurred in the United States as a result of the Spanish Flu, Asian flu, and Hong Kong Flu outbreaks. The Spanish Flu claimed 500,000 lives in the United States, and there were 350,000 cases in Pennsylvania. Most deaths resulting from the Asian flu occurred between September, 1957 and March, 1958; there were about 70,000 deaths in the United States and approximately 15% of the population of Pennsylvania was affected. The first cases of the Hong Kong Flu in the U.S. were detected in September of 1968 with deaths peaking between December, 1968 and January, 1969 (Global Security, 2009). More recently, 167 cases of 2009 H1N1 have been confirmed in Monroe County, though no deaths have occurred (Pennsylvania Department of Health, 2010). The 2009 H1N1 outbreak did cause one school in the County to temporarily close for cleaning and decontamination.

4.3.5.4. Future Occurrence

Based on historical events, Monroe County is expected to experience pandemic influenza outbreaks approximately every 11 to 41 years. The precise timing of pandemic influenza is uncertain, but occurrences are most likely when the Influenza Type A virus makes a dramatic change, or antigenic shift, that results in a new or “novel” virus to which the population has no

immunity. This emergence of a novel virus is the first step toward a pandemic (US Health and Human Services, 2009). As a result, future pandemic events are considered possible as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1).

4.3.5.5. *Vulnerability Assessment*

Certain population groups are at higher risk of pandemic flu infection. This population group includes people 65 years and older, children younger than 5 years old, pregnant women and people of any age with certain chronic medical conditions. Such conditions include but are not limited to diabetes, heart disease, asthma and kidney disease (CDC, 2009). Schools, convalescent centers, and other institutions serving those younger than 5 years old and older than 65 years old, are locations conducive to faster transmission of pandemic influenza since populations identified as being at high risk are concentrated at these facilities. The highest concentration of these institutions is found in the Stroudsburg/East Stroudsburg area.

4.3.6. **Tornado, Windstorm**

4.3.6.1. *Location and Extent*

Tornadoes and wind storms can occur throughout Monroe County though events are usually localized. However, severe thunderstorms may result in conditions favorable to the formation of numerous or long-lived tornadoes. Tornadoes can occur at any time during the day or night, but are most frequent during late afternoon into early evening, the warmest hours of the day, and most likely to occur during the spring and early summer months of March through June.

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.

4.3.6.2. *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. 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 4.3.6-1, 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 4.3.6-1 since the magnitude of previous tornado occurrences is based on the F-Scale.

Table 4.3.6-1: 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.

Section 4.3.4.1 described the wind speed zones developed by the American Society of Civil Engineers based on tornado and hurricane historical events. These wind speed zones are intended to guide the design and evaluation of the structural integrity of shelters and critical facilities. Since Monroe County falls within Zone II, design wind speeds for shelters and critical facilities should be able to withstand a 3-second gust of up to 160 mph, regardless of whether the gust is the result of a tornado, coastal storm, or windstorm event. Therefore, these structures should be able to withstand the wind speeds experienced in an EF3 tornado event.

The worst tornado on record in Monroe County occurred in March, 1976. This F3 event was 100 yards wide and, in the course of its half-mile track through downtown Stroudsburg, caused an estimated \$2.5 million in damage (NCDC 2011).

Since tornado 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 4.3.1-1 in order to prevent release of hazardous materials into the environment.

4.3.6.3. 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. One of the deadliest tornadoes in the Commonwealth occurred during a May, 1985 storm which killed six people, injured sixty, and destroyed campers, mobile homes, and businesses across Lycoming, Union, and Northumberland Counties. One tornado touched down in Monroe County during this storm. A list of tornado events that have occurred in Monroe County between 1950 and 2010 is shown in Table 4.3.6-2 with an associated Fujita Tornado Scale magnitude. Injuries have been limited in Monroe County's tornado events; the only reported injuries occurred during the Bossardsville event, when two men were injured at the Blakeslee Farm. A map showing the approximate location of previous events from 1950-2004 is included in Figure 4.3.6-1.

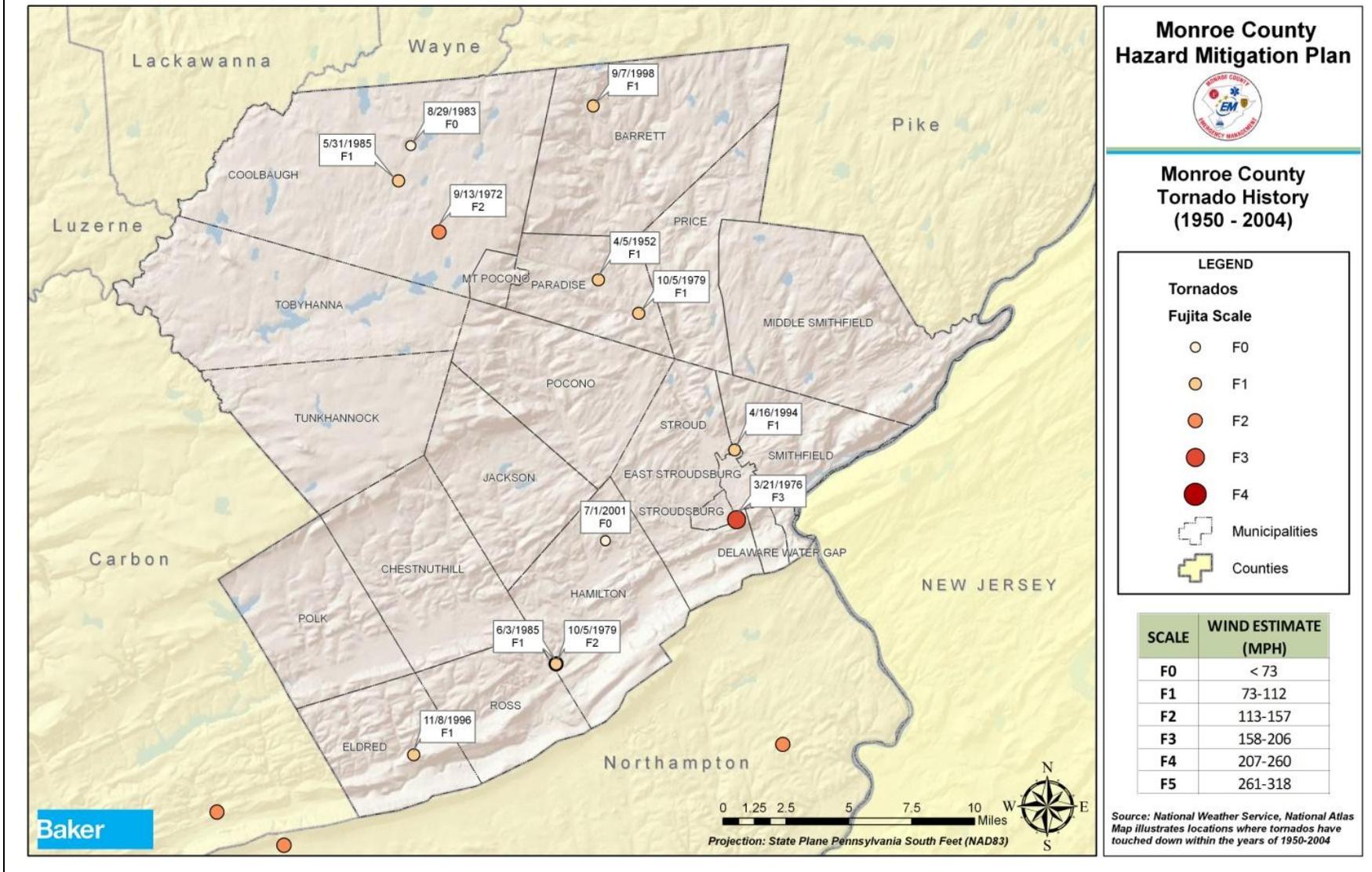
LOCATION	DATE	ESTIMATED LENGTH	ESTIMATED WIDTH	MAGNITUDE	ESTIMATED PROPERTY DAMAGE (\$)
Monroe County	4/5/1952	1.0 mi	33 yards	F1	3000
Monroe County	9/13/1972	0.1 mi	100 yards	F2	3000
Monroe County	3/21/1976	0.5 mi	100 yards	F3	2,500,000
Monroe County	10/5/1979	0.3 mi	20 yards	F0	3000
Monroe County	10/5/1979	0.3 mi	100 yards	F2	25,000
Monroe County	10/5/1979	0.3 mi	80 yards	F1	3000
Monroe County	8/29/1983	1.0 mi	10 yards	F0	0
Monroe County	5/31/1985	0.2 mi	17 yards	F1	3000
Monroe County	6/3/1985	0.2 mi	17 yards	F1	25,000
Kunkletown	11/8/1996	10.0 mi	67 yards	F1	400,000

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Table 4.3.6-2: Previous tornado events between 1950 and 2010 in Monroe County (NCDC, 2011).

LOCATION	DATE	ESTIMATED LENGTH	ESTIMATED WIDTH	MAGNITUDE	ESTIMATED PROPERTY DAMAGE (\$)
Buck Hill Falls	9/7/1998	3.0 mi	30 yards	F1	0
Snydersville	7/1/2001	0.2 mi	50 yards	F0	0
Bossardsville	7/29/2009	5.0 mi	100 yards	F2	1,000,000

Figure 4.3.6-1: Previous tornado events in Monroe County (National Atlas, 2008).



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Windstorm events may be the result of thunderstorms, hurricanes, tropical storms, winter storms, or nor'easters. There have been 83 events with wind speeds of greater than 50 knots. In 1997 the County experienced high winds from a thunderstorm in excess of 74 knots, or 85.2 miles per hour. This storm caused straight-line wind damage across the county, especially along the southern tier. In this event, three people were injured within the Delaware Water Gap National Recreational Area, and trees were uprooted across the county. In this event, the worst damage occurred in and around Smithfield Township; uprooted trees disrupted road transportation, damaged at least three homes, and windows were blown out at East Stroudsburg High School. This event also led to widespread power outages, with 8,000 homes and businesses losing power. A list of events greater than 50 knots that have occurred since 1950 is shown in Table 4.3.6-3.

LOCATION	DATE	ESTIMATED WIND SPEED	DEATHS	INJURIES	ESTIMATED PROPERTY DAMAGE (\$)
Countywide	6/23/1961	50 kts.	0	0	0
Eastern PA (Regional Event)	3/19/1996	52 kts.	0	0	0
Skytop	5/19/1997	50 kts.	0	0	0
Kresgeville	8/16/1997	74 kts.	0	3	0
Stroudsburg	6/16/1998	55 kts.	0	0	0
Countywide	6/30/1998	50 kts.	0	0	0
Snydersville	9/2/1998	50 kts.	0	0	0
Countywide	8/13/1999	56 kts.	0	0	0
Snydersville	9/9/1999	57 kts.	0	0	0
Eastern PA (Regional Event)	9/16/1999	50 kts.	0	0	\$ 2,800,000
Eastern PA (Regional Event)	11/2/1999	58 kts.	0	1	0
Blakeslee	5/10/2000	50 kts.	0	0	0
Kunkletown	5/13/2000	50 kts.	0	0	0
Pocono Lake	5/18/2000	50 kts.	0	0	0
East Stroudsburg	5/18/2000	57 kts.	0	0	0
Tannersville	5/24/2000	50 kts.	0	0	0
Gilbert	6/2/2000	52 kts.	0	0	0
Tannersville	6/11/2000	52 kts.	0	0	0
Eastern PA (Regional Event)	12/12/2000	51 kts.	1	1	\$ 360,000
Long Pond	4/9/2001	52 kts.	0	0	0
Tannersville	6/11/2001	50 kts.	0	0	0
Long Pond	7/1/2001	50 kts.	0	0	0
Snydersville	7/10/2001	52 kts.	0	0	0
Effort	7/11/2001	56 kts.	0	0	0
Marshalls Creek	7/25/2001	52 kts.	0	0	0
Countywide	3/10/2002	50 kts.	0	0	0
Long Pond	6/26/2002	52 kts.	0	0	0
Mt Pocono	6/26/2002	52 kts.	0	0	0
Tobyhanna	6/26/2002	52 kts.	0	0	0
Mt Pocono Arpt	7/23/2002	52 kts.	0	0	0
Pocono Pines	7/23/2002	52 kts.	0	0	0

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Table 4.3.6-3: Previous windstorm events greater than 50 knots in Monroe County between 1950 and 2010 (NCDC, 2010).

LOCATION	DATE	ESTIMATED WIND SPEED	DEATHS	INJURIES	ESTIMATED PROPERTY DAMAGE (\$)
Blakeslee	7/23/2002	52 kts.	0	0	0
Tobyhanna	8/2/2002	52 kts.	0	0	0
Blakeslee	8/5/2002	52 kts.	0	0	0
Countywide	7/21/2003	56 kts.	0	0	0
Kresgeville	8/16/2003	56 kts.	0	0	0
Brodheadsville	8/16/2003	56 kts.	0	0	0
Eastern PA (Regional Event)	9/18/2003	52 kts.	0	0	\$ 32,200,000
Eastern PA (Regional Event)	11/13/2003	52 kts.	1	3	\$ 2,200,000
Snydersville	8/12/2004	52 kts.	0	0	0
Tannersville	6/6/2005	52 kts.	0	0	0
Snydersville	6/9/2005	56 kts.	0	0	0
Stroudsburg	7/27/2005	52 kts.	0	0	0
Long Pond	8/12/2005	50 kts.	0	0	0
Paradise Vly	8/14/2005	52 kts.	0	0	0
Tobyhanna	8/14/2005	50 kts.	0	0	0
Delaware Water Gap	8/14/2005	50 kts.	0	0	0
Eastern PA (Regional Event)	1/14/2006	53 kts.	0	0	\$ 600,000
Eastern PA (Regional Event)	2/17/2006	50 kts.	0	0	\$ 250,000
Shawnee On Delaware	5/30/2006	56 kts.	0	0	0
Long Pond	6/30/2006	50 kts.	0	0	0
Pocono Pines	7/18/2006	52 kts.	0	0	0
Countywide	7/27/2006	50 kts.	0	0	0
Blakeslee	12/1/2006	52 kts.	0	0	0
Echo Lake	6/1/2007	50 kts.	0	0	0
Marshalls Creek	6/1/2007	52 kts.	0	0	0
Shawnee On Delaware	6/1/2007	52 kts.	0	0	0
Mt Pocono	6/19/2007	52 kts.	0	0	0
Effort	6/19/2007	52 kts.	0	0	0
Stroudsburg	6/19/2007	52 kts.	0	0	0
Stroudsburg	6/27/2007	52 kts.	0	0	0
Analomink	7/10/2007	52 kts.	0	0	0
Tobyhanna	7/27/2007	52 kts.	0	0	0
Marshalls Creek	8/3/2007	50 kts.	0	0	0
Brodheadsville	8/25/2007	50 kts.	0	0	0
Brodheadsville	8/25/2007	50 kts.	0	0	0
Mountainhome	4/1/2008	52 kts.	0	0	0
Swiftwater	5/31/2008	52 kts.	0	0	0
Skytop	6/4/2008	50 kts.	0	0	0
Tobyhanna	6/10/2008	52 kts.	0	0	0
Saylorsburg	6/10/2008	52 kts.	0	0	\$ 25,000
Stroudsburg	6/16/2008	52 kts.	0	0	\$ 25,000
Paradise Valley	9/9/2008	52 kts.	0	0	0
Deleware Water Gap	5/24/2009	50 kts.	0	0	0
Tobyhanna	6/26/2009	50 kts.	0	0	0

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Table 4.3.6-3: Previous windstorm events greater than 50 knots in Monroe County between 1950 and 2010 (NCDC, 2010).

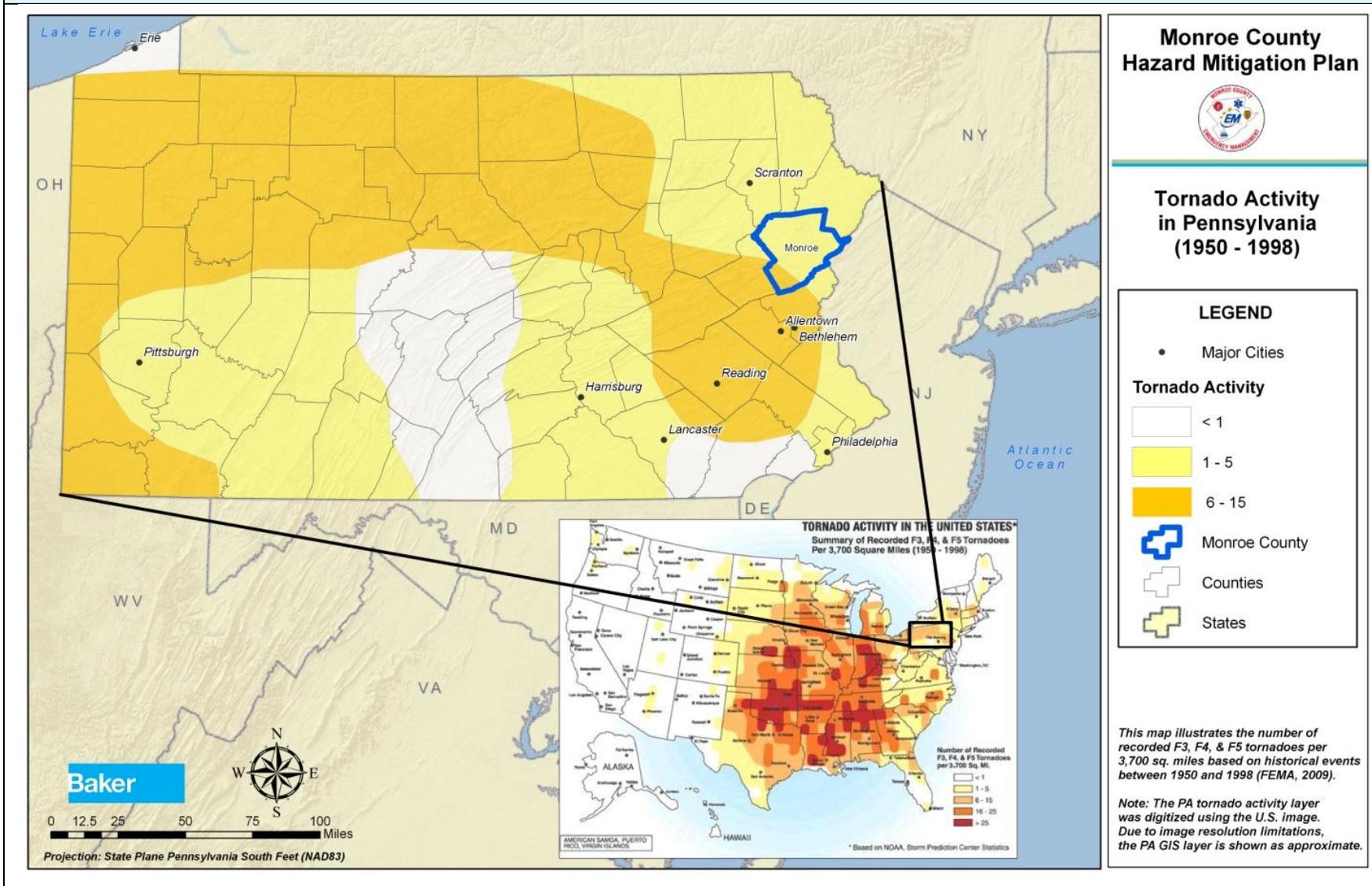
LOCATION	DATE	ESTIMATED WIND SPEED	DEATHS	INJURIES	ESTIMATED PROPERTY DAMAGE (\$)
Kresgeville	6/26/2009	50 kts.	0	0	0
Bossardsville	7/29/2009	61 kts.	0	0	\$ 50,000
Tobyhanna	8/21/2009	50 kts.	0	0	0
Rossland	8/21/2009	52 kts.	0	0	0
Mt Pocono Airport	12/3/2009	52 kts.	0	0	0
Countywide	1/3/2010	51 kts.	0	0	\$ 10,000
Countywide	5/8/2010	50 kts.	0	0	0
Marshalls Creek	6/6/2010	52 kts.	0	0	0
Monroe and Chester Counties	12/27/2010	52 kts.	0	0	\$5,000
TOTAL			2	8	\$ 38,525,000

4.3.6.4. 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.

Based on tornado activity information for Pennsylvania between 1950 and 1998, most of Monroe County lies within an area that has experienced 1 to 5 F3, F4, or F5 tornadoes per 3,700 square miles (see Figure 4.3.6-2). A small portion in the southwestern portion of the county has experienced up to 15 F3, F4, or F5 tornadoes per 3,700 square miles. This equals a 12 percent to 31 percent chance that the planning area will be affected by a Category F3, F4, or F5 tornado each year. However, the high historical number of windstorms with winds over 50 knots indicates that annual chance of a windstorm is higher. Holistically, tornado and windstorm events can be considered *likely*, as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1). Additionally, based on historic patterns, tornadoes are unlikely to remain on the ground for long distances, especially in areas of the County with hilly terrain.

Figure 4.3.6-1: Tornado activity in Monroe County (FEMA, 2009).



4.3.6.5. Vulnerability Assessment

Based on historical tornado events, windstorm events are likely to occur across the County, and tornado events are more likely on the County’s northwestern plateau and in the southern tier. 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 4.3.6-4 lists the number of each of these structures in each municipality, estimated by examining the numbers of addressable structures that fall within parcels with the land use “mobile home” in each municipality. While clearly an estimate, this enables the County to take a preliminary look at which jurisdictions are more vulnerable to mobile home damage. Countywide there are approximately 2,500 addressable structures in mobile home parcels. Neither Mount Pocono Borough nor Delaware Water Gap Borough has any addressable structures in mobile home parcels, so it is expected that these jurisdictions will not be as vulnerable to wind impacts. At the other end of the spectrum, Ross and Middle Smithfield Townships each have over 300 addressable structures in mobile home parcels, indicating that they may be more vulnerable to tornado and windstorm events.

Table 4.3.6-4: Number of mobile home parcels and addressable structures in mobile home parcels (Monroe County GIS, 2011).		
MUNICIPALITY	# OF MOBILE HOME PARCELS	# OF ADDRESSABLE STRUCTURES IN MOBILE HOME PARCELS
Barrett Township	22	32
Chestnuthill Township	185	193
Coolbaugh Township	133	129
Delaware Water Gap Borough	0	0
East Stroudsburg Borough	12	79
Eldred Township	62	65
Hamilton Township	104	257
Jackson Township	72	86
Middle Smithfield Township	209	354
Mount Pocono Borough	0	0
Paradise Township	9	7
Pocono Township	151	283
Polk Township	87	147
Price Township	106	101
Ross Township	213	311
Smithfield Township	29	88
Stroud Township	54	143
Stroudsburg Borough	6	4
Tobyhanna Township	68	73
Tunkhannock Township	125	172
TOTAL	1,647	2,524

4.3.7. Wildfire

4.3.7.1. Location and Extent

Wildfires take place in less developed or completely undeveloped areas, spreading rapidly through vegetative fuels. They can occur any time of the year, but mostly occur during long, dry, hot spells. Any small fire, if not quickly detected and suppressed, can get out of control. Most wildfires are caused by human carelessness, negligence, and ignorance. However, some are precipitated by lightning strikes and in rare instances, spontaneous combustion. Wildfires in Pennsylvania can occur in open fields, grass, dense brush, and forests.

Because a majority - almost 68 percent - of Monroe County's land cover is forestland, the potential geographic extent of wildfires is quite large. Under dry conditions or droughts, wildfires have the potential to burn forests as well as croplands. The greatest potential for wildfires is in the spring months of March, April, and May, and the autumn months of October and November; 83% of all Pennsylvania wildfires occur in these two time periods. In the spring, bare trees allow sunlight to reach the forest floor, drying fallen leaves and other ground debris. In the fall, dried leaves are also fuel for fires.

There is a heavy debris cover in Monroe County as a result of a 2005 ice and snow storm which fell many trees, and took down the branches and tops of others. There has not been a major burn in the Pocono Plateau since this storm, and the debris from this storm has not been cleared, adding potential fuel sources in the area for a wildfire.

4.3.7.2. Range of Magnitude

Wildfire events can range from small fires that can be managed by local firefighters to large fires impacting many acres of land. Small fires are usually limited in scope and consume brush and trees but not homes. Large events may require evacuation from one or more communities and necessitate regional or national firefighting support. The impact of a severe wildfire can be devastating. A worst case scenario for wildfires occurred in Monroe County in April 2008 when drier than normal conditions led to an above average number of wildfires, stretching firefighting capabilities thin. Strong west winds helped to spread the blazes, the largest of which burned over 30 acres and had an origin point in Tobyhanna Township.

In addition to the risk wildfires pose to the general public and property owners, the safety of firefighters is also a concern. Although loss of life among firefighters does not occur often in Pennsylvania, it is always a risk. More common firefighting injuries include falls, sprains, abrasions or heat-related injuries such as dehydration. Response to wildfires also exposes emergency responders to the risk of motor vehicle accidents and can place them in remote areas away from the communities that they are chartered to protect.

Some fires are part of natural succession processes that can kill people, livestock, fish and wildlife. They often destroy property, valuable timber, forage and recreational and scenic values. The most significant environmental impact is the potential for severe erosion, silting of stream beds and reservoirs, and flooding due to ground-cover loss following a fire event. Wildfire can also have a positive environmental impact in that they burn dead trees, leaves, and grasses to allow more open spaces for new vegetation to grow and receive sunlight. Another

positive effect is that it stimulates the growth of new shoots on trees and shrubs and its heat can open pine cones and other seed pods.

4.3.7.3. Past Occurrence

There have been 261 wildfire events reported to the Pennsylvania Department of Conservation and Natural Resources Bureau of Forestry from 2002-2008. Members of the HMPT noted this is probably a low estimate of wildfire events, as it does not include wildfires that were not reported to DCNR, fires without a known origin, or events that were controlled solely by the volunteer fire departments in the County, but this is the most comprehensive list of wildfire occurrences available for Monroe County. Table 4.3.7-1 shows the list of wildfire events reported to the DCNR as well as those reported to the PEIRS from 2002 to 2009. PEIRS is a voluntary reporting system, so they also do not provide a comprehensive list of events.

Of all of Monroe County’s jurisdictions, Middle Smithfield, Chestnuthill Township, and Pocono Township had the most wildfires with 33, 32, and 31 respectively between 2002 and 2008 according to DCNR. Barrett Township had the most area burn during this time period, with over 77 acres burned by wildfires. Coolbaugh Township had the second most burned during this time period with over 65 acres burned by wildfires.

Table 4.3.7-1: List of wildfire events reported in Monroe County from 2002-2009 (DCNR, 2010; PEIRS, 2011).					
YEAR	MUNICIPALITY	AREA (acres)	YEAR	MUNICIPALITY	AREA (acres)
2002	Paradise Township	3.50	2006	Jackson Township	0.25
2002	Tobyhanna Township	0.25	2006	Paradise Township	0.10
2002	Price Township	14.00	2006	Chestnuthill Township	0.75
2002	Coolbaugh Township	9.00	2006	Middle Smithfield Township	0.10
2002	Coolbaugh Township	5.00	2006	Hamilton Township	0.10
2002	Tunkhannock Township	0.01	2006	Jackson Township	0.10
2002	Pocono Township	3.00	2006	Middle Smithfield Township	0.25
2002	Pocono Township	1.00	2006	Polk Township	1.00
2002	Barrett Township	8.00	2006	Tunkhannock Township	0.10
2002	Barrett Township	29.00	2006	Middle Smithfield Township	0.50
2002	Chestnuthill Township	0.75	2006	Polk Township	0.75
2002	Jackson Township	3.50	2006	Coolbaugh Township	0.10
2002	Coolbaugh Township	2.00	2006	Chestnuthill Township	0.25
2002	Middle Smithfield Township	0.10	2006	Middle Smithfield Township	0.50
2002	Barrett Township	17.00	2006	Middle Smithfield Township	0.10
2002	Tunkhannock Township	0.75	2006	Coolbaugh Township	0.10
2002	Tunkhannock Township	0.50	2006	Jackson Township	4.00
2002	Pocono Township	0.25	2006	Middle Smithfield Township	5.00
2002	Barrett Township	3.00	2006	Middle Smithfield Township	0.20
2002	Middle Smithfield Township	0.50	2006	Pocono Township	1.50
2002	Smithfield Township	3.00	2006	Pocono Township	1.50

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Table 4.3.7-1: List of wildfire events reported in Monroe County from 2002-2009 (DCNR, 2010; PEIRS, 2011).

YEAR	MUNICIPALITY	AREA (acres)	YEAR	MUNICIPALITY	AREA (acres)
2002	Ross Township	0.50	2006	Polk Township	0.10
2002	Tunkhannock Township	0.25	2006	Tunkhannock Township	0.50
2003	Coolbaugh Township	0.20	2007	Middle Smithfield Township	0.10
2003	Hamilton Township	0.01	2007	Chestnuthill Township	0.50
2003	Jackson Township	0.90	2007	Eldred Township	0.00
2003	Pocono Township	8.20	2007	Jackson Township	0.00
2003	Hamilton Township	0.10	2007	Jackson Township	1.00
2003	Coolbaugh Township	1.00	2007	Middle Smithfield Township	0.01
2003	Price Township	0.60	2007	Pocono Township	0.10
2003	Jackson Township	4.40	2007	Middle Smithfield Township	0.10
2003	Coolbaugh Township	3.00	2007	Barrett Township	1.00
2003	Hamilton Township	0.90	2007	Pocono Township	3.00
2003	Middle Smithfield Township	1.00	2007	Jackson Township	1.00
2004	Pocono Township	0.10	2007	Polk Township	0.00
2004	Tobyhanna Township	0.40	2007	Polk Township	0.20
2004	Pocono Township	0.01	2007	Coolbaugh Township	0.10
2004	Middle Smithfield Township	0.10	2007	Barrett Township	0.10
2004	Middle Smithfield Township	0.10	2007	Jackson Township	0.25
2004	Eldred Township	2.00	2007	Hamilton Township	1.20
2004	Pocono Township	2.00	2007	Pocono Township	1.00
2004	Coolbaugh Township	0.10	2007	Smithfield Township	0.10
2004	Polk Township	2.00	2007	Chestnuthill Township	1.75
2004	Tunkhannock Township	0.80	2007	Hamilton Township	1.25
2004	Barrett Township	12.50	2007	Middle Smithfield Township	0.00
2004	Pocono Township	0.25	2007	Smithfield Township	1.00
2004	Smithfield Township	7.50	2007	Tobyhanna Township	0.10
2005	Barrett Township	1.50	2007	Tunkhannock Township	0.20
2005	Chestnuthill Township	0.25	2007	Pocono Township	0.00
2005	Chestnuthill Township	0.50	2007	Tobyhanna Township	0.10
2005	Tunkhannock Township	0.50	2007	Chestnuthill Township	1.00
2005	Pocono Township	0.25	2007	Jackson Township	0.10
2005	Ross Township	0.10	2007	Chestnuthill Township	0.00
2005	Chestnuthill Township	6.50	2007	Stroud Township	0.10
2005	Tunkhannock Township	0.50	2007	Polk Township	0.50
2005	Ross Township	0.10	2007	Stroud Township	9.00
2005	Middle Smithfield Township	2.50	2007	Tunkhannock Township	3.50
2005	Chestnuthill Township	1.00	2007	Paradise Township	0.01

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Table 4.3.7-1: List of wildfire events reported in Monroe County from 2002-2009 (DCNR, 2010; PEIRS, 2011).

YEAR	MUNICIPALITY	AREA (acres)	YEAR	MUNICIPALITY	AREA (acres)
2005	Ross Township	0.10	2007	Middle Smithfield Township	0.01
2005	Tunkhannock Township	0.10	2007	Jackson Township	0.00
2005	Tobyhanna Township	0.10	2007	Price Township	0.20
2005	Ross Township	0.50	2007	Jackson Township	0.00
2005	Coolbaugh Township	4.00	2007	Jackson Township	0.10
2005	Paradise Township	0.25	2007	Stroud Township	3.00
2005	Coolbaugh Township	0.10	2007	Middle Smithfield Township	0.10
2005	East Stroudsburg Borough	0.10	2007	Polk Township	0.00
2005	Tobyhanna Township	0.25	2007	Barrett Township	0.00
2005	Price Township	1.00	2007	Jackson Township	1.00
2005	Chestnuthill Township	12.00	2007	Pocono Township	1.00
2005	Pocono Township	4.00	2007	Stroud Township	4.00
2005	Barrett Township	3.50	2008	Chestnuthill Township	0.00
2005	Paradise Township	0.25	2008	Hamilton Township	0.00
2005	Ross Township	1.80	2008	Chestnuthill Township	0.10
2005	Barrett Township	0.25	2008	Coolbaugh Township	0.10
2005	Chestnuthill Township	0.25	2008	Jackson Township	1.25
2005	Coolbaugh Township	4.50	2008	Jackson Township	0.50
2005	Coolbaugh Township	7.50	2008	Polk Township	0.25
2005	Coolbaugh Township	0.50	2008	Paradise Township	0.10
2005	Pocono Township	2.00	2008	Barrett Township*	
2005	Tunkhannock Township	0.10	2008	Paradise Township	0.40
2005	Price Township	0.50	2008	Polk Township	1.00
2005	Smithfield Township	0.50	2008	Jackson Township	0.10
2005	Coolbaugh Township	1.50	2008	Chestnuthill Township	0.10
2005	Hamilton Township	1.50	2008	Stroud Township	1.00
2005	Pocono Township	0.50	2008	Chestnuthill Township	0.00
2005	Middle Smithfield Township	1.50	2008	Polk Township	0.75
2005	Barrett Township	2.00	2008	Paradise Township	0.10
2005	Chestnuthill Township	0.10	2008	Chestnuthill Township	0.00
2005	Coolbaugh Township	0.10	2008	Chestnuthill Township	0.10
2005	Middle Smithfield Township	3.00	2008	Jackson Township	0.20
2005	Pocono Township	0.10	2008	Polk Township	2.20
2005	Polk Township	0.25	2008	Tunkhannock Township	0.02
2006	Chestnuthill Township	1.50	2008	Polk Township	0.50
2006	Jackson Township	0.10	2008	Tobyhanna Township	30.40
2006	Chestnuthill Township	0.25	2008	Chestnuthill Township	2.25

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Table 4.3.7-1: List of wildfire events reported in Monroe County from 2002-2009 (DCNR, 2010; PEIRS, 2011).

YEAR	MUNICIPALITY	AREA (acres)	YEAR	MUNICIPALITY	AREA (acres)
2006	Price Township	0.10	2008	East Stroudsburg Borough	0.10
2006	Chestnuthill Township	1.00	2008	Coolbaugh Township	0.00
2006	Chestnuthill Township	0.75	2008	Polk Township	1.00
2006	Coolbaugh Township	6.00	2008	Chestnuthill Township	0.75
2006	Middle Smithfield Township	0.60	2008	Coolbaugh Township	5.00
2006	Chestnuthill Township	0.10	2008	Pocono Township	0.10
2006	Polk Township	2.00	2008	Tobyhanna Township	0.60
2006	Chestnuthill Township	0.10	2008	Middle Smithfield Township	4.50
2006	Middle Smithfield Township	0.10	2008	Middle Smithfield Township	0.20
2006	Pocono Township	1.00	2008	Middle Smithfield Township	0.25
2006	Hamilton Township	2.00	2008	Jackson Township	0.30
2006	Pocono Township	1.00	2008	Pocono Township	0.25
2006	Pocono Township	0.25	2008	Tobyhanna Township	1.25
2006	Middle Smithfield Township	0.10	2008	Tobyhanna Township	1.35
2006	Chestnuthill Township	1.00	2008	Chestnuthill Township	0.30
2006	Pocono Township	10.00	2008	Coolbaugh Township	0.10
2006	Ross Township	0.25	2008	Smithfield Township	1.10
2006	Coolbaugh Township	0.10	2008	Polk Township	0.00
2006	Pocono Township	0.10	2008	Coolbaugh Township	0.60
2006	Paradise Township	0.25	2008	Ross Township	0.50
2006	Jackson Township	4.00	2008	Polk Township	0.10
2006	Polk Township	0.25	2008	Ross Township	0.60
2006	Coolbaugh Township	3.00	2008	Tobyhanna Township	0.25
2006	Coolbaugh Township	2.00	2008	Coolbaugh Township	7.00
2006	Middle Smithfield Township	1.00	2008	Pocono Township	0.00
2006	Middle Smithfield Township	0.25	2008	Chestnuthill Township	0.00
2006	Jackson Township	0.25	2008	Paradise Township	0.18
2006	Pocono Township	0.10	2008	Polk Township	0.10
2006	Tobyhanna Township*		2008	Smithfield Township	1.00
2006	Middle Smithfield Township	0.10	2008	Polk Township	0.50
2006	Middle Smithfield Township	0.50	2008	Coolbaugh Township	2.25
2006	Polk Township	1.00	2008	Coolbaugh Township	0.20
2006	Ross Township	3.00	2008	Eldred Township	20.00
2006	Middle Smithfield Township	0.10	2008	Pocono Township	0.75
2006	Pocono Township	0.25	2008	Smithfield Township	0.10
2006	Middle Smithfield Township	0.10	2009	Polk Township*	
2006	Hamilton Township	0.25	2009	Price Township*	

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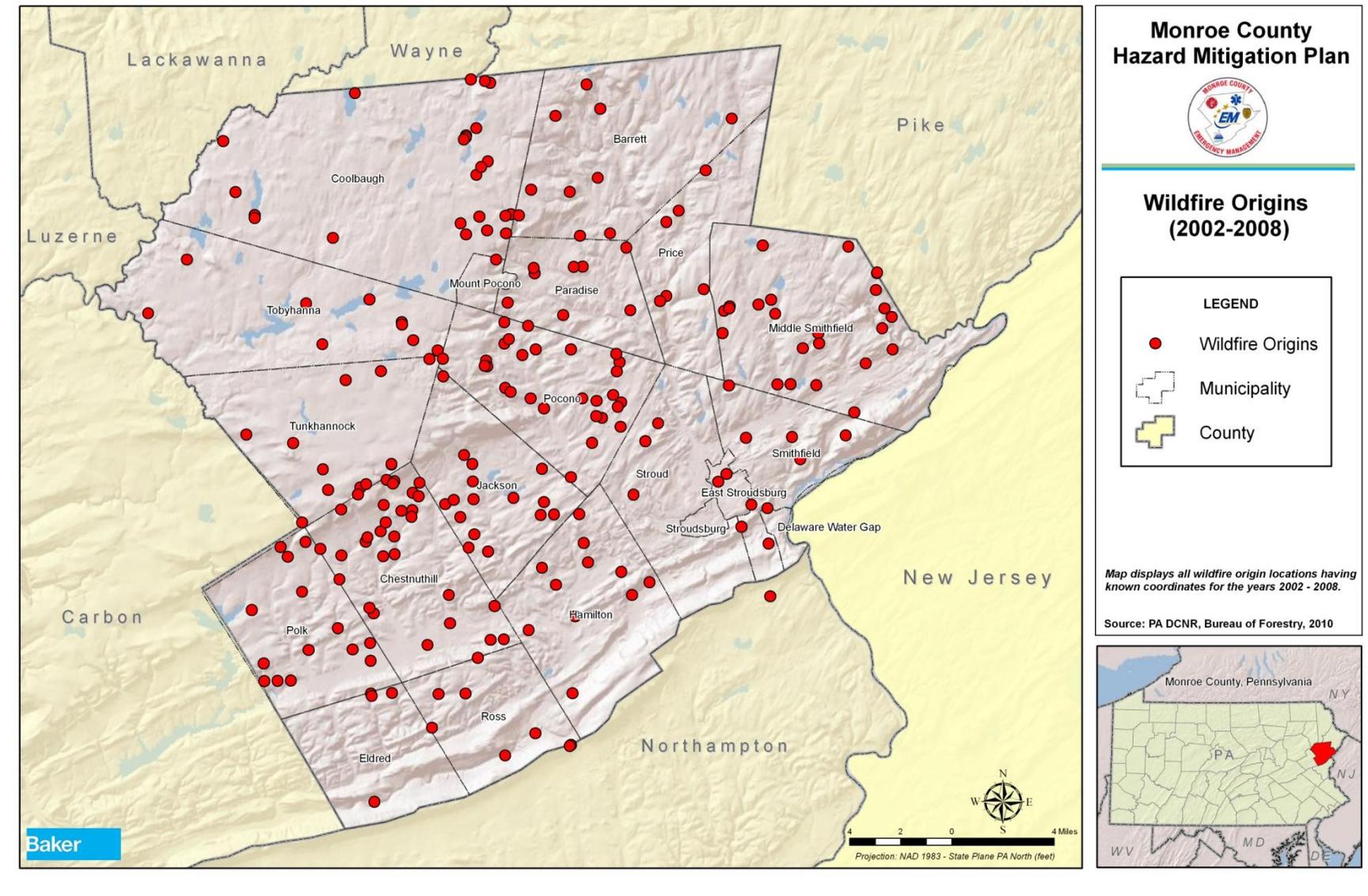
Table 4.3.7-1: List of wildfire events reported in Monroe County from 2002-2009 (DCNR, 2010; PEIRS, 2011).

YEAR	MUNICIPALITY	AREA (acres)	YEAR	MUNICIPALITY	AREA (acres)
2006	Chestnuthill Township	0.10	2009	Barrett Township*	
				TOTAL	414.66

**Events only reported in PEIRS data.*

Figure 4.3.7-1 maps the origins of the wildfire events which were reported to the DCNR listed in Table 4.3.7-1 above; it does not include PEIRS-reported fires. It is important to note that this is not an inclusive map of all wildfires, just those with known locations. The map shows that previous occurrences of wildfires have occurred throughout the entire County instead of concentrated in a single jurisdiction or area of Monroe County.

Figure 4.3.7-1: Wildfire origins in Monroe County between 2002 and 2008. (DCNR-BOF, 2009)



4.3.7.4. Future Occurrence

Over the five year period between 2003 and 2007, 18,132 acres of state forest have burned in Pennsylvania and over 414 acres of land have burned in Monroe County in the wildfire events shown in Figure 4.3.7-1. Previous events indicate that wildfire events will continue to occur annually. Weather conditions like drought can increase the likelihood of wildfires occurring. Any fire, without the quick response or attention of fire-fighters, forestry personnel, or visitors to the forest, has the potential to become a wildfire.

The probability of a wildfire occurring in Monroe County is *highly likely* in any given year as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1). However, the likelihood of one of those fires attaining significant size and intensity is unpredictable and highly dependent on environmental conditions and firefighting response.

The DCNR has raised the hazard level of the Pocono Plateau area in the northern part of Monroe County to *extreme* because of the amount of debris left on the ground after the ice and snow storm described in more detail in Section 4.3.8.2. The storm caused many trees to fall in the forestland in this area, as well as knocked off the branches and tops of trees of the trees left standing. This heavy cover of debris has resulted in more fuel for a potential wildfire, and has not been cleared or burned since 2005.

4.3.7.5. Vulnerability Assessment

The Pennsylvania Bureau of Forestry has conducted an independent wildfire hazard risk assessment for the various municipalities across Monroe County. Results of that assessment are shown in Figure 4.3.7-2. *Wildfire hazard* is defined based on conditions that affect wildfire ignition and/or behavior such as fuel, topography and local weather. Based on this assessment, twelve jurisdictions in northern Monroe County have a *high* wildfire rating: Tunkhannock, Tobyhanna, Coolbaugh, Barrett, Paradise, Price, Middle Smithfield, Smithfield, Stroud, Pocono, and Jackson Townships and Delaware Water Gap Borough. Table 4.3.7-2 shows the total addressable structures and critical facilities in the high wildfire hazard areas.

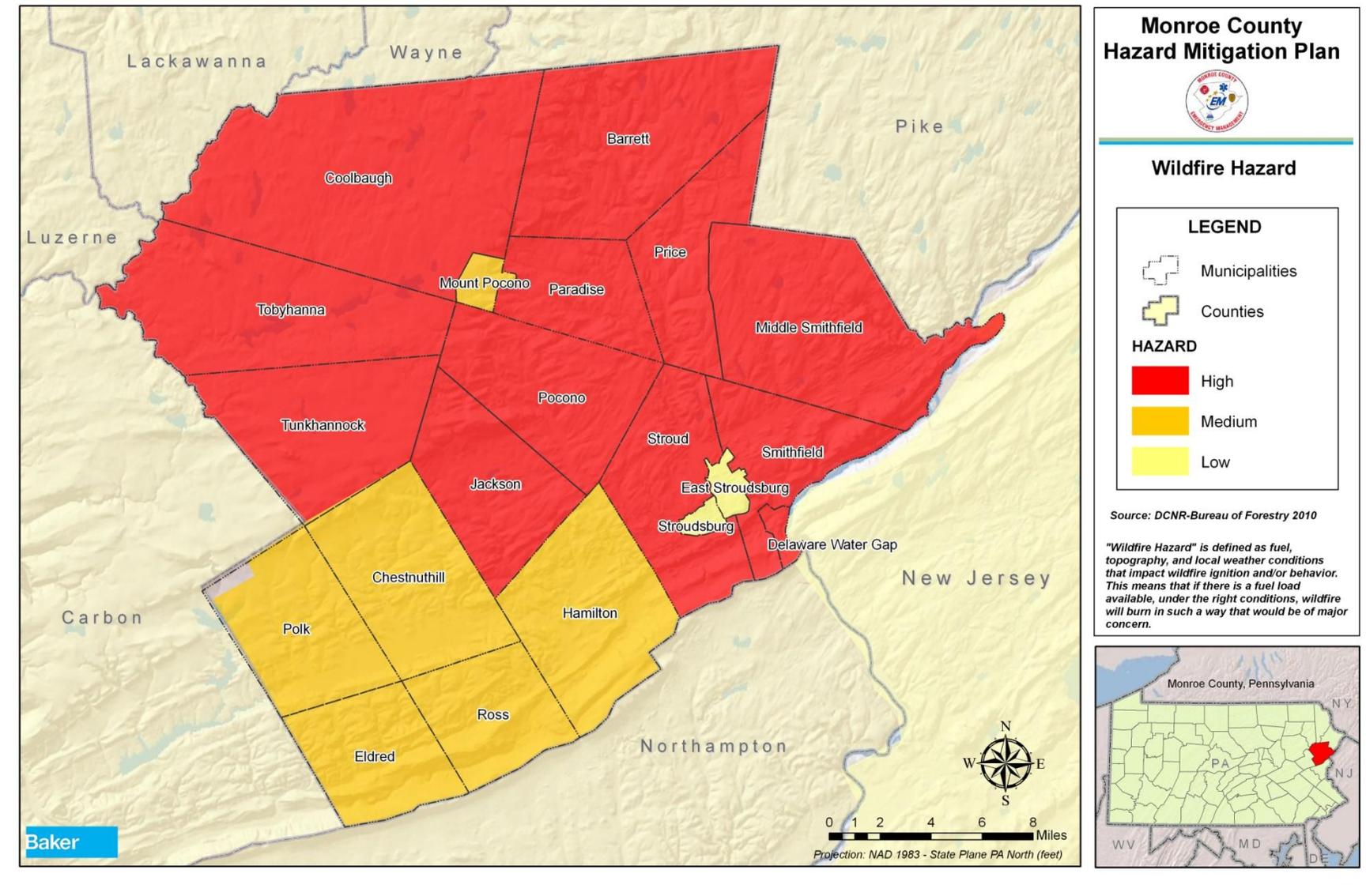
Six municipalities within Monroe County have a *medium* wildfire hazard potential: Chestnuthill, Polk, Ross, Eldred, and Hamilton Townships and Mount Pocono Borough. Only Stroudsburg and East Stroudsburg Boroughs are considered to have *low* wildfire hazard potential. The individual vulnerability of communities will differ based on the design of the urban/wildland interface, the number of ingress and egress points into a community, and the availability of water to fight fires. However, as this assessment suggests, Monroe County's boroughs are relatively less vulnerable to wildfire events than its townships.

Table 4.3.7-2: Addressable structures and critical facilities in Wildfire High Hazard Areas.			
MUNICIPALITY	TOTAL ADDRESSABLE STRUCTURES	TOTAL ADDRESSABLE STRUCTURES IN HIGH WILDFIRE HAZARD AREAS	TOTAL CRITICAL FACILITIES IN HIGH WILDFIRE HAZARD AREAS
Barrett Township	2,587	81	12
Chestnuthill Township	6,874	0	0

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Table 4.3.7-2: Addressable structures and critical facilities in Wildfire High Hazard Areas.			
MUNICIPALITY	TOTAL ADDRESSABLE STRUCTURES	TOTAL ADDRESSABLE STRUCTURES IN HIGH WILDFIRE HAZARD AREAS	TOTAL CRITICAL FACILITIES IN HIGH WILDFIRE HAZARD AREAS
Coolbaugh Township	10,998	259	14
Delaware Water Gap Borough	401	23	4
East Stroudsburg Borough	3,294	0	0
Eldred Township	1,217	0	0
Hamilton Township	3,890	0	0
Jackson Township	3,577	23	5
Middle Smithfield Township	8,363	62	7
Mount Pocono Borough	1,405	0	0
Paradise Township	1,560	39	10
Pocono Township	5,852	156	11
Polk Township	3,521	0	0
Price Township	1,766	33	1
Ross Township	2,315	0	0
Smithfield Township	4,215	203	17
Stroud Township	8,178	93	19
Stroudsburg Borough	3,381	0	0
Tobyhanna Township	7,409	96	16
Tunkhannock Township	3,642	1	2
TOTAL	84,445	1,069	118

Figure 4.3.7-2: Wildfire hazard potential per municipality in Monroe County (DCNR-BOF, 2010).



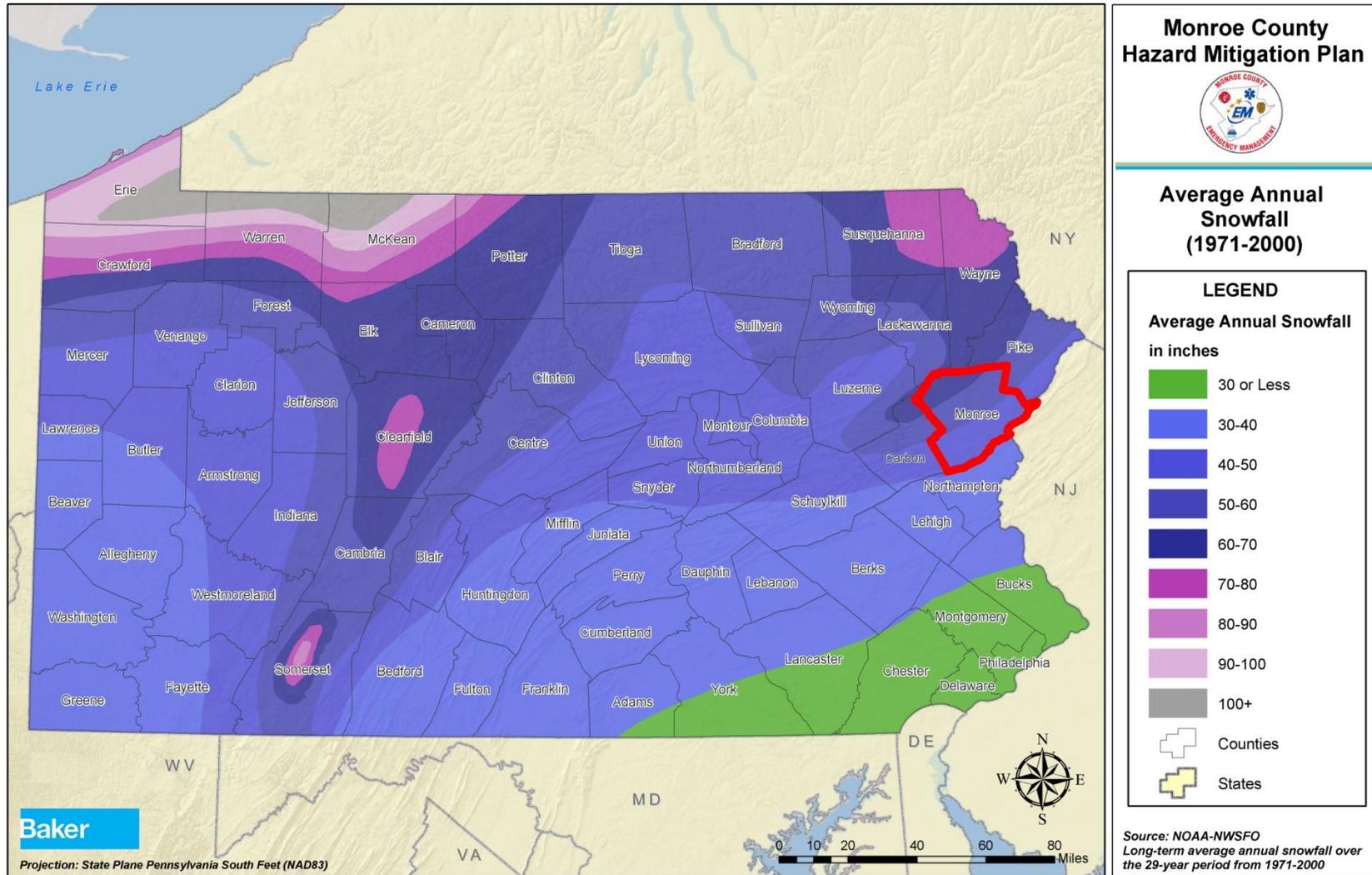
4.3.8. Winter Storm

4.3.8.1. Location and Extent

Winter storms are regional events. Every county in the Commonwealth, including Monroe, is subject to severe winter storms.

Within Monroe County there are variations in the average amount of snowfall that is received throughout different parts of the County because of terrain differences; higher elevations experience greater snowfalls than lower-lying areas. Generally, the average annual snowfall in the County increases from the southeast with an annual average of 40 to 50 inches to the northwest, which has an annual average snowfall of 60 to 70 inches, as shown in Figure 4.3.8-1.

Figure 4.3.8-1: Mean Annual Snowfall for Pennsylvania and Monroe County (NOAA –NWS).



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.

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 4.3.8-1 shows mean annual snowfall in Monroe County to be between 40 and 70 inches. Three of the sixteen Presidential Disaster and Emergency Declarations affecting Monroe 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.

Monroe County experienced major winter storms in 1972, 1977, two storms in 1978, 1981, 1983, 1993, and 1996. There have been numerous other winter storms recorded every year, those that occurred after 1993 are listed in Table 4.3.8-1. These storms have caused power

failures and communications outages of four hours or more, road closings, stranded motorists requiring emergency transportation or temporary shelter, as well as county residents requiring provisions.

The worst-case scenario for Monroe County happened in the winter of 2005. Rain began to fall across the region on January 5, 2005, but this turned to freezing rain later that day accumulating between $\frac{1}{2}$ of an inch to $\frac{3}{4}$ of an inch across the Poconos. One to three inches of snow then fell in the area, with up to three inches of accumulation on top of the ice across Monroe County and the Pocono Plateau part of Carbon County. The ice and snow combination reduced mobility across the Poconos, felling trees and closing too many roads for officials to keep record of, some of which were not able to be reopened before January 10th. A second ice storm on January 8, 2005 in the region hindered recovery efforts. The ice and snow caused so much destruction to the trees and power lines across the area that the Pocono Plateau was referred to as a war zone (NCDC, 2011).

Throughout the region over 238,000 customers lost power across the region, over 30,000 of these still did not have power when the second ice storm struck the area on January 8th. Over \$25 million of repairs were needed to restore power lines and clear roads. There were two deaths and dozens of additional hospitalizations in Monroe County from residents running generators in their houses for power without proper ventilation. Another serious injury was reported when a tree fell on a PennDOT worker who was trying to clear the roads.

4.3.8.3. *Past Occurrence*

Monroe County and the Commonwealth of Pennsylvania have a long history of severe winter weather. There have been 234 winter storm events that have affected Monroe 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 January 2005 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. 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.

Table 4.3.8-1: Previous winter storm events impacting Monroe County since 1994 (NCDC, 2011). Events with the location "Multiple Counties" include Monroe County.		
LOCATION	DATE	TYPE
Monroe, Lehigh, Northampton, Pike Counties	11/27/94	Winter Storm
Multiple Counties	12/14/94	Freezing Drizzle
Multiple Counties	12/31/94	Freezing Rain
Multiple Counties	1/6/95	Winter Storm
Multiple Counties	1/11/95	Freezing Rain
Multiple Counties	1/31/95	Freezing Rain
Multiple Counties	2/3/95	Heavy Snow
Multiple Counties	2/15/95	Freezing Rain
Multiple Counties	2/26/95	Freezing Rain, Sleet and Light Snow
Monroe, Carbon, Northern Wayne and Pike Counties	2/28/95	Freezing Rain
Multiple Counties	3/8/95	Snow
Monroe and Carbon Counties	11/14/95	Heavy Snow
Multiple Counties	11/29/95	Snow
Monroe and Carbon Counties	12/9/95	Heavy Snow
Monroe, Berks, Carbon, Lehigh and Northampton Counties	12/14/95	Wintry Mix
Multiple Counties	12/16/95	Snow
Monroe and Carbon Counties	12/19/95	Heavy Snow
Monroe, Carbon and Northampton Counties	1/2/96	Winter Storm
Multiple Counties	1/12/96	Heavy Snow
Multiple Counties	3/7/96	Winter Storm

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

LOCATION	DATE	TYPE
Monroe, Carbon, Lehigh and Northampton Counties	3/28/96	Ice Storm
Monroe, Carbon and Berks Counties	12/5/96	Heavy Snow
Monroe and Carbon Counties	12/7/96	Heavy Snow
Monroe and Carbon Counties	12/13/96	Heavy Snow
Monroe and Carbon Counties	1/9/97	Snow
Monroe, Carbon, Lehigh and Northampton Counties	1/16/97	Winter Storm
Monroe, Berks, Carbon, Lehigh and Northampton Counties	1/24/97	Wintry Mix
Monroe, Carbon, Lehigh, Northampton Counties	1/27/97	Snow
Monroe and Carbon Counties	2/4/97	Wintry Mix
Monroe, Carbon, Lehigh and Northampton Counties	2/14/97	Winter Storm
Monroe County	3/3/97	Heavy Storm
Multiple Counties	3/14/97	Wintry Mix
Multiple Counties	3/31/97	Heavy Snow
Multiple Counties	4/1/97	Heavy Snow
Monroe and Carbon Counties	11/13/97	Winter Storm
Monroe and Carbon Counties	12/10/97	Heavy Snow
Monroe, Bucks, Carbon, Lehigh and Northampton Counties	12/22/97	Winter Storm
Monroe and Carbon Counties	12/24/97	Freezing Rain
Monroe and Carbon Counties	12/29/97	Winter Storm
Monroe, Bucks, Carbon, Lehigh and Northampton Counties	1/16/98	Ice Storm
Monroe and Carbon Counties	1/23/98	Winter Storm
Multiple Counties	1/24/98	Snow
Monroe, Berks, Carbon, Lehigh and Northampton Counties	2/4/98	Wintry Mix
Monroe and Carbon Counties	2/17/98	Freezing Rain
Monroe County	2/23/98	Winter Storm
Monroe and Carbon Counties	3/18/98	Wintry Mix
Monroe and Carbon Counties	3/21/98	Winter Storm
Monroe County	4/9/98	Heavy Snow
Monroe and Carbon Counties	12/29/98	Wintry Mix
Monroe and Carbon Counties	1/2/99	Winter Storm
Monroe and Carbon Counties	1/8/99	Winter Storm

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

LOCATION	DATE	TYPE
Multiple Counties	1/13/99	Winter Storm
Monroe, Carbon and Northampton Counties	2/1/99	Freezing Rain
Monroe County	2/7/99	Heavy Snow
Monroe and Carbon County	3/6/99	Snow
Multiple Counties	3/14/99	Heavy Snow
Monroe County	3/22/99	Heavy Snow
Monroe and Carbon County	12/14/99	Wintry Mix
Monroe, Berks, Carbon, Lehigh and Northampton Counties	12/20/99	Freezing Rain
Monroe and Carbon Counties	1/13/00	Snow
Multiple Counties	1/20/00	Snow
Monroe, Berks, Carbon, Lehigh and Northampton Counties	1/25/00	Heavy Snow
Monroe and Carbon Counties	1/30/00	Heavy Snow
Multiple Counties	2/3/00	Snow
Monroe and Carbon Counties	2/13/00	Ice Storm
Monroe, Berks, Carbon, Lehigh and Northampton Counties	2/18/00	Winter Storm
Monroe County	4/8/00	Heavy Snow
Multiple Counties	4/9/00	Snow
Monroe County	11/17/00	Light Snow
Monroe and Carbon Counties	11/25/00	Freezing Rain
Multiple Counties	12/13/00	Winter Storm
Monroe and Carbon Counties	12/16/00	Freezing Rain
Monroe and Carbon Counties	12/19/00	Heavy Snow
Multiple Counties	12/30/00	Heavy Snow
Multiple Counties	1/5/01	Snow
Monroe, Carbon, Lehigh and Northampton Counties	1/8/01	Snow
Monroe and Carbon Counties	1/15/01	Freezing Rain
Monroe and Carbon Counties	1/19/01	Wintry Mix
Multiple Counties	1/20/01	Winter Storm
Multiple Counties	1/30/01	Freezing Rain
Monroe, Berks, Carbon, Lehigh and Northampton Counties	2/5/01	Heavy Snow
Monroe County	2/9/01	Freezing Rain
Monroe County	2/16/01	Ice Storm

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

LOCATION	DATE	TYPE
Multiple Counties	2/22/01	Heavy Snow
Monroe and Carbon County	2/25/01	Winter Storm
Multiple Counties	3/4/01	Winter Storm
Monroe, Carbon, Lehigh and Northampton Counties	3/9/01	Snow
Monroe and Carbon Counties	3/12/01	Ice Storm
Monroe County	3/29/01	Ice Storm
Monroe and Carbon Counties	12/8/01	Wintry Mix
Monroe County	12/17/01	Freezing Rain
Monroe and Carbon Counties	1/6/02	Heavy Snow
Multiple Counties	1/7/02	Snow
Multiple Counties	1/9/02	Wintry Mix
Monroe, Bucks, Chester, Lehigh and Montgomery Counties	1/19/02	Heavy Snow
Monroe and Carbon Counties	1/31/02	Freezing Rain
Monroe and Carbon Counties	2/1/02	Freezing Rain
Multiple Counties	2/4/02	Snow Showers
Multiple Counties	3/17/02	Wintry Mix
Monroe and Carbon Counties	3/20/02	Snow
Monroe and Carbon Counties	3/21/02	Snow Squalls
Monroe and Carbon Counties	3/26/02	Ice Storm
Monroe County	11/16/02	Winter Storm
Multiple Counties	11/26/02	Snow
Multiple Counties	12/5/02	Heavy Snow
Multiple Counties	12/11/02	Winter Storm
Monroe, Berks, Carbon, Lehigh and Northampton Counties	12/24/02	Winter Storm
Monroe County	12/30/02	Winter Weather/Mix
Monroe County	1/1/03	Winter Weather/Mix
Monroe, Berks, Carbon, Lehigh and Northampton Counties	1/2/03	Winter Storm
Monroe and Carbon Counties	2/1/03	Winter Storm
Multiple Counties	2/6/03	Heavy Snow
Multiple Counties	2/10/03	Winter Weather/Mix
Multiple Counties	2/16/03	Heavy Snow
Monroe and Carbon Counties	2/20/03	Winter Weather/Mix
Multiple Counties	2/23/03	Winter Weather/Mix

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

LOCATION	DATE	TYPE
Monroe and Carbon Counties	3/1/03	Winter Weather/Mix
Monroe, Berks, Carbon, Lehigh and Northampton Counties	3/5/03	Winter Weather/Mix
Monroe County	3/6/03	Heavy Snow
Monroe and Carbon Counties	3/13/03	Winter Weather/Mix
Monroe and Carbon Counties	3/19/03	Winter Weather/Mix
Monroe County	4/1/03	Winter Weather/Mix
Monroe and Carbon Counties	4/4/03	Winter Weather/Mix
Multiple Counties	4/7/03	Winter Weather/Mix
Monroe and Carbon Counties	4/9/03	Winter Weather/Mix
Monroe, Bucks, Carbon, Lehigh and Northampton Counties	12/2/03	Winter Weather/Mix
Multiple Counties	12/5/03	Winter Storm
Monroe, Berks, Carbon, Lehigh and Northampton Counties	12/14/03	Winter Storm
Monroe and Carbon Counties	1/2/04	Winter Weather/Mix
Monroe and Carbon Counties	1/4/04	Ice Storm
Monroe County	1/6/04	Winter Weather/Mix
Monroe County	1/14/04	Heavy Snow
Multiple Counties	1/17/04	Winter Weather/Mix
Monroe, Berks, Carbon, Lehigh and Northampton Counties	1/27/04	Winter Storm
Monroe and Carbon Counties	2/3/04	Winter Storm
Monroe, Berks, Carbon, Lehigh and Northampton Counties	2/5/04	Winter Storm
Monroe and Carbon Counties	2/20/04	Winter Weather/Mix
Multiple Counties	2/24/04	Winter Weather/Mix
Monroe and Carbon Counties	3/8/04	Winter Weather/Mix
Monroe and Carbon Counties	3/9/04	Winter Weather/Mix
Monroe, Carbon and Northampton Counties	3/16/04	Winter Storm
Monroe, Berks, Carbon, Lehigh and Northampton Counties	3/18/04	Winter Storm
Monroe and Carbon Counties	11/12/04	Winter Weather/Mix
Monroe and Carbon Counties	12/6/04	Winter Weather/Mix
Multiple Counties	12/19/04	Winter Weather/ix
Multiple Counties	12/26/04	Winter Weather/Mix

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

LOCATION	DATE	TYPE
Monroe, Carbon, Lehigh and Northampton Counties	1/5/05	Winter Storm
Monroe, Carbon, Lehigh and Northampton Counties	1/7/05	Ice Storm
Monroe, Berks, Carbon, Lehigh and Northampton Counties	1/11/05	Winter Weather/Mix
Multiple Counties	1/19/05	Winter Weather/Mix
Multiple Counties	1/22/05	Heavy Snow
Multiple Counties	1/24/05	Winter Weather/Mix
Monroe and Carbon Counties	2/14/05	Winter Weather/Mix
Monroe and Carbon Counties	2/17/05	Winter Weather/Mix
Monroe and Carbon Counties	2/20/05	Winter Storm
Monroe, Carbon, Lehigh and Northampton Counties	2/24/05	Winter Weather/Mix
Multiple Counties	2/28/05	Heavy Snow
Multiple Counties	3/1/05	Heavy Snow
Multiple Counties	3/8/05	Winter Weather/Mix
Monroe and Carbon Counties	3/11/05	Winter Weather/Mix
Monroe and Carbon Counties	3/20/05	Winter Weather/Mix
Monroe and Carbon Counties	3/23/05	Winter Storm
Monroe and Carbon Counties	3/27/05	Winter Weather/Mix
Multiple Counties	12/4/05	Winter Weather/Mix
Monroe, Berks, Carbon, Lehigh and Northampton Counties	12/9/05	Heavy Snow
Multiple Counties	12/15/05	Winter Storm
Monroe and Carbon Counties	12/23/05	Winter Weather/Mix
Monroe and Carbon Counties	12/26/05	Winter Weather/Mix
Monroe, Berks, Carbon, Lehigh and Northampton Counties	12/31/05	Winter Weather
Monroe and Carbon Counties	1/3/06	Winter Storm
Monroe and Carbon Counties	1/4/06	Winter Weather
Monroe and Carbon Counties	1/17/06	Winter Weather
Monroe, Carbon, Lehigh and Northampton Counties	1/23/06	Winter Storm
Monroe and Carbon Counties	1/24/06	Winter Weather
Multiple Counties	2/12/06	Winter Storm
Multiple Counties	3/2/06	Winter Storm

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

LOCATION	DATE	TYPE
Monroe, Carbon and Northampton Counties	4/5/06	Winter Weather
Monroe, Carbon and Northampton Counties	4/8/06	Winter Weather
Monroe and Carbon Counties	11/23/06	Winter Weather
Monroe and Carbon Counties	12/7/06	Winter Weather
Monroe and Carbon Counties	12/8/06	Winter Weather
Monroe and Carbon Counties	12/22/06	Winter Weather
Monroe and Carbon Counties	1/15/07	Winter Weather
Monroe and Carbon Counties	1/25/07	Winter Weather
Monroe County	2/13/07	Winter Storm
Monroe and Carbon Counties	3/1/07	Winter Weather
Monroe and Carbon Counties	3/7/07	Winter Weather
Monroe and Carbon Counties	3/16/07	Heavy Snow
Monroe and Carbon Counties	4/11/07	Winter Weather
Monroe and Carbon Counties	4/15/07	Winter Weather
Monroe and Carbon Counties	11/9/07	Winter Weather
Monroe and Carbon Counties	11/18/07	Heavy Snow
Monroe and Carbon Counties	11/20/07	Winter Weather
Monroe and Carbon Counties	12/1/07	Winter Weather
Monroe and Carbon Counties	12/4/07	Winter Weather
Monroe and Carbon Counties	12/7/07	Winter Weather
Monroe and Carbon Counties	12/9/07	Winter Weather
Monroe and Bucks Counties	12/15/07	Winter Storm
Monroe and Carbon Counties	12/26/07	Winter Weather
Monroe and Carbon Counties	12/30/07	Winter Weather
Monroe and Carbon Counties	1/1/08	Winter Weather
Monroe and Carbon Counties	1/11/08	Winter Weather
Monroe and Carbon Counties	1/13/08	Winter Weather
Monroe and Carbon Counties	1/29/08	Winter Weather
Monroe and Carbon Counties	2/1/08	Winter Storm
Monroe and Carbon Counties	2/4/08	Winter Weather
Monroe and Carbon Counties	2/9/08	Winter Weather
Monroe and Carbon Counties	2/10/08	Winter Weather
Monroe County	10/27/08	Heavy Snow
Monroe and Carbon Counties	11/24/08	Winter Weather

Table 4.3.8-1: Previous winter storm events impacting Monroe County since 1994 (NCDC, 2011). Events with the location "Multiple Counties" include Monroe County.		
LOCATION	DATE	TYPE
Monroe and Carbon Counties	11/30/08	Winter Weather
Monroe and Carbon Counties	12/1/08	Winter Weather
Monroe and Carbon Counties	12/10/08	Winter Storm
Monroe and Carbon Counties	12/16/08	Winter Weather
Monroe and Carbon Counties	12/19/08	Winter Storm
Monroe and Carbon Counties	12/26/08	Winter Weather
Monroe and Carbon Counties	12/31/08	Winter Weather
Monroe and Carbon Counties	1/6/09	Winter Storm
Monroe and Carbon Counties	1/10/09	Winter Storm
Monroe and Carbon Counties	1/17/09	Winter Weather
Monroe and Carbon Counties	2/3/09	Winter Weather
Monroe and Carbon Counties	3/2/09	Winter Weather
Monroe and Carbon Counties	10/15/09	Winter Weather
Monroe and Carbon Counties	12/5/09	Winter Weather
Monroe and Carbon Counties	12/19/09	Winter Weather
Monroe and Carbon Counties	12/25/09	Winter Weather
Monroe and Carbon Counties	12/31/09	Winter Weather
Monroe and Carbon Counties	1/17/10	Ice Storm & Winter Weather
Monroe and Carbon Counties	1/24/10	Winter Weather
Monroe, Bucks and Montgomery Counties	1/28/10	Winter Weather
Monroe and Carbon Counties	2/9/10	Winter Storm
Monroe and Carbon Counties	2/22/10	Winter Storm & Weather
Monroe and Carbon Counties	3/30/10	Winter Weather
Monroe and Carbon Counties	11/25/10	Winter Weather

4.3.8.4. Future Occurrence

Winter storms are a regular, annual occurrence in Monroe County and should be considered *highly likely* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1). Approximately thirty-five winter storm events occur across Pennsylvania and about five in Monroe County annually (MCPC, 2005). Table 4.3.8-2 shows the probability of receiving measureable snowfall by month in Monroe 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 Monroe County.

Table 4.3.8-2: Probability of Measurable Snowfall in Monroe County by Snow Station Location (NCDC, 2011a).

MONTH	PROBABILITY (%)			
	LONG POND 2 E	MOUNT POCONO 2 N	STROUDSBURG	TOBYHANNA
January	100%	100%	98.9%	100%
February	100%	97.8%	100%	100%
March	100%	95.7%	91.7%	100%
April	84.3%	88.9%	44.7%	75.7%
May	3.9%	5.9%	0%	7.9%
June	0%	0%	0%	0%
July	0%	0%	0%	0%
August	0%	0%	0%	0%
September	0%	0%	0%	0%
October	20.8%	27.0%	6.3%	30.8%
November	88.5%	78.7%	54.2%	86.5%
December	100%	97.9%	94.1%	100%

4.3.8.5. Vulnerability Assessment

Based on the information available, all communities in Monroe County are essentially equally vulnerable to the direct impacts of winter storms. However, residents of the mountainous areas of the County may be more susceptible during severe storms, especially when emergency medical assistance is required. There are rural areas which are susceptible to isolation due to winter storms, however these are decreasing as new roads and development continues. Only in private developments where the roads are unpaved or not maintained by the local political subdivision is isolation still a potential problem (MCPC, 2005).

Vulnerability to the effects of winter storms on buildings is also 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 Monroe County have been built since 1940 (US Census ACS, 2005-2009). Less than 10,000 housing units, or 12.36% of the total housing units, are 60 or more years old. This does not, however, 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. However, based on the available information Delaware Water Gap Borough and Stroudsburg Borough face the largest risk to their housing structures, with 62.63% and 50.98% of their units built before 1940 respectively.

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

MUNICIPALITY	NUMBER OF HOUSING UNITS BUILT PRIOR TO 1940	PERCENT OF TOTAL HOUSING UNITS
Barrett Township	697	28.84%
Chestnutnill Township	528	8.17%
Coolbaugh Township	551	5.06%
Delaware Water Gap Borough	243	62.63%
East Stroudsburg Borough	968	28.83%
Eldred Township	421	31.23%
Hamilton Township	646	16.44%
Jackson Township	225	6.67%
Middle Smithfield Township	265	3.90%
Mount Pocono Borough	279	20.81%
Paradise Township	396	26.17%
Pocono Township	497	9.34%
Polk Township	341	10.74%
Price Township	61	3.68%
Ross Township	244	10.30%
Smithfield Township	544	15.44%
Stroud Township	661	9.55%
Stroudsburg Borough	1,382	50.98%
Tobyhanna Township	654	9.43%
Tunkhannock Township	43	1.19%
Total	9,646	12.36%

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.

Additional vulnerability exists due to icy and snow covered roads. This is a potential risk on all roads, even the most commonly used interstates in the County. Icy and snow covered roadways have caused problems all along these interstates, but most of the problems occur at the junction of I-80 and I-380 and from the junction to Tannersville on I-80 due to a steep gradient (MCPC, 2005).

HUMAN-MADE HAZARDS

4.3.9. Dam Failure

For the Dam Failure Profile, please see Appendix G.

4.3.10. Environmental Hazards

4.3.10.1. Location and Extent

Environmental hazards in Monroe County are primarily caused by hazardous material releases, as there are only two oil and gas wells in the entire County. 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. Any release can result in injury and death and may contaminate air, water and/or 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.

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

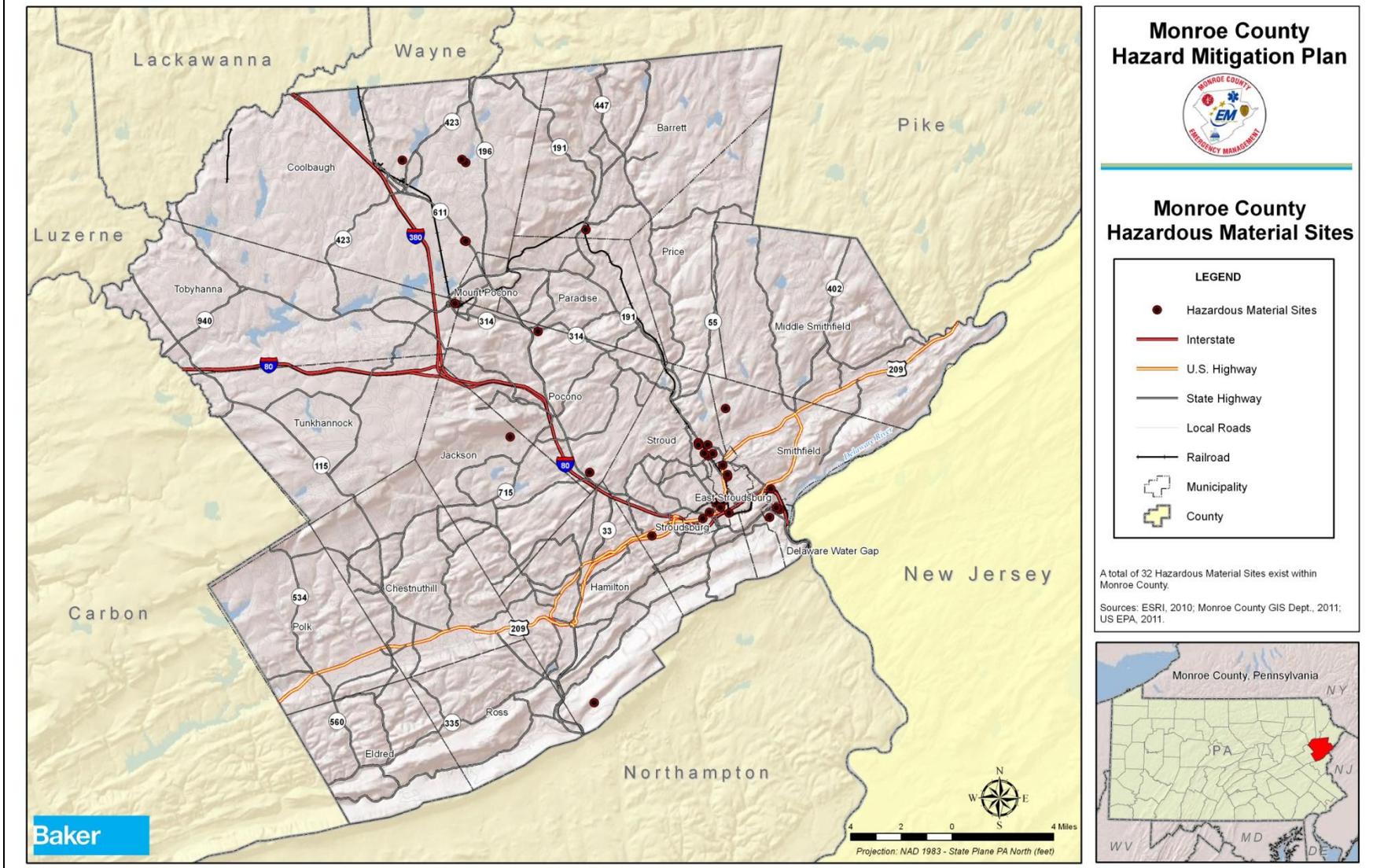
- Superfund National Priorities List sites,
- RCRAInfo (EPA and state treatment, storage, disposal) facilities,
- Toxic Release Inventory System sites,
- Integrated Compliance Information System and Permit Compliance System - National Pollutant Discharge Elimination System Majors,
- RCRAInfo - Large Quantity Generators,
- Air Facility System - 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. Monroe County has 32 EPA-identified hazardous materials sites throughout the County, shown in Figure 4.3.10-1. Stroud Township has the most hazardous materials facilities with seven, followed by Coolbaugh Township and East Stroudsburg Borough which each host five facilities. Other jurisdictions hosting TRI sites include Barrett, Hamilton, Jackson, Pocono, Smithfield and Tobyhanna Townships and Delaware Water Gap and Stroudsburg Boroughs. For a complete listing of TRI sites, please see **Appendix H**.

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.

Monroe County has an extensive highway and railway network that pose a high risk for hazardous material incidents. These networks transport hazardous material daily, on interstate 80, as well as US Route 209 and Pennsylvania Routes 33 and 611. These major roads pass through very populous areas. Similarly, rail lines pass through cities and boroughs where large numbers of people could be vulnerable should a serious accident occur in these places. These major transportation routes are shown in Figure 4.3.10-1.

Figure 4.3.10-1: Monroe County hazardous material facilities and major roadways.



4.3.10.2. Range of Magnitude

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 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.

On the lower end of the range of magnitude, and environmental hazard triggers an evacuation of the surrounding area and a cleanup. The worst case scenario for a hazardous material release occurred in 2004 when a chemical being transported was released, resulting in both injuries and a major access route to be closed down. An acid leaked while it was being transported by a FedEx truck through Monroe County. Interstate 80 was closed near Delaware Water Gap Borough while the acid was contained and cleaned up. Ten people were treated during after being exposed to this acid.

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 3,942,063 pounds of chemicals released from fixed sites in Monroe County between 1987 and 2008 (EPA, 2008).

There have been a total of 55 incidences of hazardous material releases in Monroe County from 2002 to 2009. Thirteen of these incidences were from a fixed facility and 26 incidences happened during transit. Table 4.3.10-1 shows the compiled list of incidents reported to PEIRS during this time period. Since the PEIRS data is from a voluntary reporting system this may not be a complete data set.

Table 4.3.10-1: Previous hazardous materials incidents in Monroe County between 2002 and 2009 (PEIRS, 2002-2009).			
DATE	LOCATION	MATERIAL INVOLVED	TYPE OF INCIDENT/DETAILS
1/23/2002	Hamilton Township	Unknown	Chemical Release
2/19/2002	Bartonsville	Unknown	Chemical Release
2/20/2002	Mount Pocono Borough	Kerosene	Kerosene Spill
4/6/2002	Stroud Township	Unknown	Hazardous Waste Materials
4/9/2002	Delaware Water Gap Borough	Diesel Fuel	Diesel Fuel Spill - Tank on tanker truck ruptured.
5/2/2002	East Stroudsburg Borough	Unknown	Chemical Spill
5/3/2002	Delaware Water Gap Borough	Unknown	Chemical Release
5/9/2002	Delaware Water Gap Borough	Unknown	Gasoline Spill
8/9/2002	Middle Smithfield Township	Unknown	Crude Oil Spill
9/16/2002	Snydersville	Unknown	Diesel Fuel Spill
10/24/2002	Middle Smithfield Township	Flammable Liquid	Chemical Release - A flammable liquid leaked from a tractor trailer on I-80.
10/27/2002	Tobyhanna Township	Diesel Fuel	Diesel Fuel Spill - Over 300 gallons of fuel spilled from a tractor trailer truck, some of which leaked into Swiftwater Creek.
11/14/2002	Delaware Water Gap Borough	Petroleum Distillates	Oil Spill - A 55 gallon drum of petroleum distillates was leaking in a tractor trailer.
1/11/2003	Pocono Township	Diesel Fuel	Diesel Fuel Spill - 125 gallons spilled from ruptured saddle tank on tractor trailer.
3/4/2003	Pocono Township	Petroleum	Oil Spill - Less than 55 gallons spilled on the ground.
5/22/2003	Delaware Water Gap Borough	Diesel Fuel	Diesel Fuel Spill - Fuel spilled onto roadway after a tractor trailer truck was in an accident.

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Table 4.3.10-1: Previous hazardous materials incidents in Monroe County between 2002 and 2009 (PEIRS, 2002-2009).

DATE	LOCATION	MATERIAL INVOLVED	TYPE OF INCIDENT/DETAILS
9/23/2003	Arrowhead Lake	Petroleum	Gasoline Spill - An unknown amount of petroleum spilled onto the ground.
10/6/2003	Tannersville	Cupric Sulfate	Chemical Spill - Twenty pounds of cupric sulfate spilled from bag when being unloaded from truck.
11/5/2003	Polk Township	Heating Oil	Oil Spill - About 250 gallons of heating oil spilled from truck, some of which entered into a tributary of Middle Creek.
11/5/2003	Ross Township	Roof Sealant	Chemical Spill - About 100 gallons of contaminated water from runoff off recently treated road ran into a retention pond.
11/6/2003	Hamilton Township	Gasoline	Gasoline Spill - Less than 55 gallons of gas was spilled onto the ground.
11/10/2003	Stroudsburg Borough	Asphalt Sealant	Chemical Spill - An unknown amount of asphalt sealer was spilled from a truck.
12/4/2003	Stroudsburg Borough	Diesel Fuel	Diesel Fuel Spill - About 150 gallons spilled from ruptured tank.
3/15/2004	Tannersville	Diesel Fuel	Diesel Fuel Spill - Over 250 gallons spilled from a ruptured tank.
4/14/2004	Tobyhanna Township	Lead Material	Chemical Release - An unknown amount of material was released from malfunctioning equipment.
4/16/2004	Delaware Water Gap Borough	Powdered Clay	Well Drilling Discharge - An undetermined amount of powdered clay was released into a pond during drilling.
4/19/2004	Smithfield Township	Bentonite	Chemical Spill - Two gallons of bentonite was spilled from a drill into Cherry Creek.
7/8/2004	Delaware Water Gap Borough	Acid	Chemical Spill - Acid spilled from a FedEx truck during transit. I-80 was closed and ten people were treated for exposure.
1/15/2005	Tunkhannock Township	Kerosene	Kerosene Spill - Over 200 gallons of kerosene was spilled from a storage tank.
1/21/2005	Delaware Water Gap Borough	Propionitrile	Chemical Spill - two gallons of propionitrile was spilled at a chemical plant causing one injury.
3/4/2005	Coolbaugh Township	Propane	Chemical Release - 1,800 gallons of propane were released during a fire at the Coca Cola plant.
4/7/2005	Coolbaugh Township	Diesel Fuel	Diesel Fuel Spill - An undetermined amount was released from an underground storage tank.

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Table 4.3.10-1: Previous hazardous materials incidents in Monroe County between 2002 and 2009 (PEIRS, 2002-2009).

DATE	LOCATION	MATERIAL INVOLVED	TYPE OF INCIDENT/DETAILS
6/3/2005	Coolbaugh Township	Undetermined	Chemical Release - An undetermined amount of an undetermined chemical was released into drinking water supply.
10/10/2005	Smithfield Township	Tar	Chemical Spill - Two hundred gallons of unknown tar were spilled on roadway.
6/6/2006	Tobyhanna Township	Diesel Fuel	Diesel Fuel Spill - Over 100 gallons of diesel fuel was spilled onto the roadway.
7/1/2006	Delaware Water Gap Borough	Oil	Oil Spill - An unknown amount of gear box oil was spilled from pumps into the Delaware River.
7/14/2006	Middle Smithfield Township	Propane	Propane Release - A 1,000 gallon propane truck ruptured after being struck in a motor vehicle accident and began to leak propane onto the ground.
9/4/2006	Delaware Water Gap Borough	Paint	Chemical Spill - An unknown amount of paint was reported spilled on I-80.
9/8/2006	Pocono Township	Diesel Fuel	Diesel Fuel Spill - Over 90 gallons of fuel was spilled from multiple tanks onto the roadway.
12/22/2006	Polk Township	Propane	Propane Release - The release occurred after a valve was ruptured.
1/5/2007	Tobyhanna Township	Ink	Chemical Spill - Approximately 300 gallons of ink spilled from ruptured tank when trailer overturned.
4/16/2007	Smithfield Township	Renalyn	Chemical Spill - Three gallons of renalyn were spilled at a dialyses center, 14 persons were taken in for treatment.
7/3/2007	Middle Smithfield Township	Propane	Propane Release - Propane was released from a tanker truck after it was struck during a motor vehicle accident.
8/3/2007	Delaware Water Gap Borough	Peroxide	Chemical Spill - A 55 gallon drum of peroxide exploded in a laboratory, one injury was reported.
8/23/2007	Stroudsburg Borough	Coal Tar	Chemical Release - An unknown amount of coal tar seeped out of the ground, some leaked into nearby creek.
10/9/2007	Hamilton Township	Diesel Fuel	Diesel Fuel Spill - About 100 gallons spilled from a tractor trailer truck.
11/9/2007	Hamilton Township	Diesel Fuel	Diesel Fuel Spill - About 300 gallons of diesel fuel was spilled as a result of a motor vehicle accident involving a tanker truck.

Table 4.3.10-1: Previous hazardous materials incidents in Monroe County between 2002 and 2009 (PEIRS, 2002-2009).

DATE	LOCATION	MATERIAL INVOLVED	TYPE OF INCIDENT/DETAILS
12/29/2007	Coolbaugh Township	Kerosene	Kerosene Spill - About 250 gallons of kerosene were released from a ruptured holding tank.
1/2/2008	Pocono Township	Propane	Propane Release - Propane was released when a tanker truck overturned.
1/12/2008	Delaware Water Gap Borough	Maleic Anhydride	Chemical Spill - 18,000 pounds of Maleic Anhydride were spilled from holding tank, 4 injuries were reported.
1/23/2008	Pocono Township	Fuel Oil	Oil Spill - 100 gallons of fuel oil was spilled from a damaged tanker truck.
2/20/2008	Delaware Water Gap Borough	Butly Acetate	Chemical Spill - An unknown amount of Butly Acetate was spilled from a tractor trailer onto I-80.
6/11/2008	Tobyhanna Township	Diesel Fuel	Diesel Fuel Spill - 150 gallons of diesel fuel spilled after accident involving a tanker truck, some fuel leaked toward Tobyhanna Creek.
9/10/2008	Pocono Township	Ammonium Nitrate	Chemical Spill - A truck carrying Ammonium Nitrate and dynamite was in an accident and overturned on I-80, and unknown amount of antifreeze and diesel fuel leaked after accident.
2/12/2009	Polk Township	Petroleum	Oil Spill - A petroleum product was spilled onto a roadway.

4.3.10.4. Future Occurrence

While many incidents involving hazardous materials releases have occurred in Monroe County in the past, they are generally difficult to predict. Any occurrence is largely dependent upon the accidental or intentional actions of a person or group. Population growth, especially in areas close to transportation routes, can expose more people to these hazards if a release incident occurs. However, based on past events, environmental hazards can be considered *likely* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1).

4.3.10.5. Vulnerability Assessment

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 Monroe County. Stroud Township has the most hazardous materials facilities with seven, followed by Coolbaugh Township and East Stroudsburg Borough which each host five facilities. Other jurisdictions hosting between one and four TRI sites include Barrett, Hamilton, Jackson, Pocono, Smithfield and Tobyhanna Townships and Delaware Water Gap and Stroudsburg Boroughs. Chestnuthill, Eldred, Middle Smithfield, Paradise, Polk, Price, Ross, and Tunkhannock Townships and Mount Pocono Borough have much 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 4.3.12-3 also shows the number of addressable structures and critical facilities within 1.5 miles of hazardous materials sites. Unsurprisingly, three of the municipalities with the most TRI facilities have the most structures and some of the most critical facilities within the buffer. Both Stroud and Coolbaugh Townships have over 5,000 structures within the buffer, and East Stroudsburg Borough has the most critical facilities within the buffer. Pocono, Smithfield, and Stroudsburg Townships also have over 2,000 structures within the 1.5 mile buffer of their TRI facilities. Other municipalities that are home to critical facilities vulnerable to fixed hazardous materials incidents include Barrett, Jackson, and Tobyhanna Townships and Delaware Water Gap Borough.

Jurisdictions without fixed hazardous materials facilities in general do not have vulnerable structures or critical facilities. However, 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. This is the case in Mount Pocono Borough and Paradise Township. There are 1,005 addressable structures and two critical facilities in Mount Pocono Borough within a 1.5 mile buffer of a facility in another municipality. Likewise, Paradise Township has 476 structures and seven critical facilities within a 1.5 mile buffer of a TRI facility in another municipality.

Table 4.3.10-2: 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
Barrett Township	1	499	4
Chestnuthill Township	0	0	0
Coolbaugh Township	5	5,996	12
Delaware Water Gap Borough	2	399	4
East Stroudsburg Borough	5	3,294	16
Eldred Township	0	0	0
Hamilton Township	1	570	0
Jackson Township	1	905	2
Middle Smithfield Township	0	3	0
Mount Pocono Borough	0	1,005	2
Paradise Township	0	476	7
Pocono Township	2	2,127	4
Polk Township	0	0	0
Price Township	0	9	0
Ross Township	0	30	0
Smithfield Township	3	2,421	9

Table 4.3.10-2: 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
Stroud Township	7	5,112	13
Stroudsburg Borough	4	3,381	14
Tobyhanna Township	1	419	1
Tunkhannock Township	0	0	0
TOTAL	32	26,646	88

In 2007 the Pennsylvania Emergency Management Agency rated Monroe County as having a moderate risk to fixed hazardous material releases and a significant risk from releases during transit (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 4.3.12.5.

4.3.11. Levee Failure

4.3.11.1. Location and Extent

Levee failures, like dam failures, have the potential to place large numbers of people and great amounts of property at risk. Unlike dams, levees are built parallel to a river or another body of water to protect the population and structures behind it from risks of casualty or damage during flooding events (FEMA, 2008). Levees do not serve a purpose beyond flood protection and, sometimes, as recreational space, unlike dams which can serve to store water or generate energy in addition to protect areas from flooding.

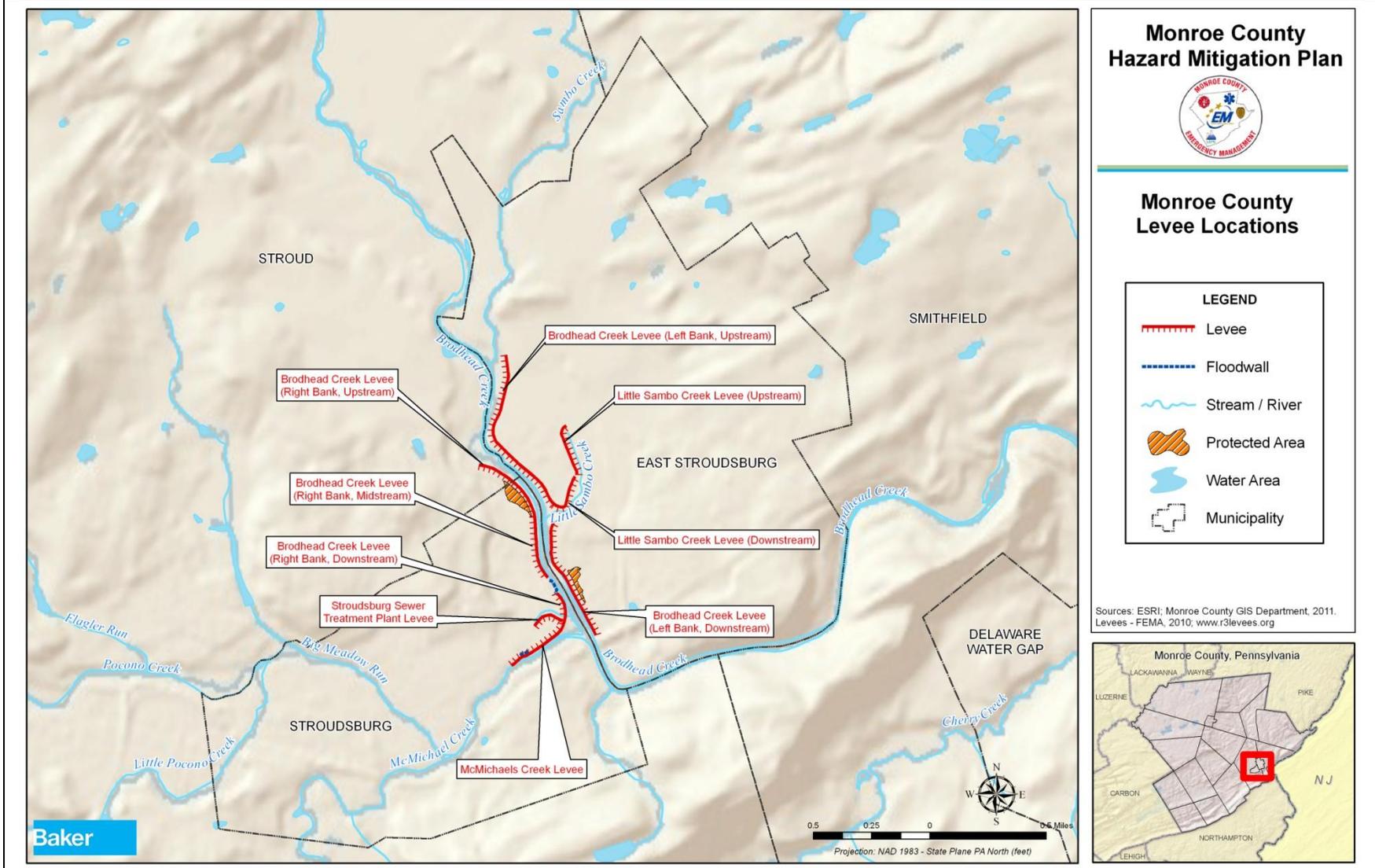
Levee failures can be caused by a number of factors, and they can cause catastrophic effects. Damage to the area beyond a levee if it fails could be more significant than if the levee was not present (FEMA, 2008). Levees are designed to provide a specific level of protection, so flooding events could overtop the levees if these events exceeded the levee specifications. Additionally, levees can also fail if they are allowed to decay or deteriorate, so regular maintenance of levees is critical.

As discussed in Section 4.3.3.5, the levee system in Monroe County was built in response to the 1955 flooding that caused widespread damage; Pennsylvania Department of Environmental Protection constructed the levee system, called the Stroudsburg/East Stroudsburg Joint Flood Control Project, in 1960-62 and turned it over to municipal control post-construction. The system was repaired and upgraded in 1982 (MCPC, 2005). The levee system is owned, operated, and maintained jointly by Stroudsburg and East Stroudsburg Boroughs and is composed of nine

individual levees. These levees were identified by compiling data taken from preliminary and final FIRMs and from the United States Army Corps of Engineers (FEMA R3, 2010). The Army Corps Philadelphia District has provided technical assistance for the maintenance and repair of the levees in the past. According to the FEMA Midterm Levee Inventory dated May 2010, none of the levees in the Joint Flood Control Project are certified to protect against the 1%-annual-chance flood hazard event. This may change as the county considers levee certification as a part of the DFIRM update process due in 2015. More details about the location of the levees are listed in Table 4.3.11-1. The levees can be seen in Figure 4.3.11-1.

Table 4.3.11-1: Levees in Monroe County (FEMA R3, 2010).			
MUNICIPALITY	LEVEE	FLOOD SOURCE	RIVER BASIN
East Stroudsburg	Brodhead Creek Levee (Left Bank, Upstream)	Brodhead Creek	Upper Delaware
East Stroudsburg	Little Sambo Creek Levee (Downstream)	Little Sambo Creek	Upper Delaware
East Stroudsburg	Little Sambo Creek Levee (Upstream)	Little Sambo Creek	Upper Delaware
East Stroudsburg	Brodhead Creek Levee (Left Bank, Downstream)	Brodhead Creek	Upper Delaware
Stroudsburg/Stroud Township	Brodhead Creek Levee (Right Bank, Upstream)	Brodhead Creek	Upper Delaware
Stroudsburg	Brodhead Creek Levee (Right Bank, Midstream)	Brodhead Creek	Upper Delaware
Stroudsburg	Brodhead Creek Levee (Right Bank, Downstream)	Brodhead Creek	Upper Delaware
Stroudsburg	Stroudsburg Sewer Treatment Plant Levee	Brodhead Creek	Upper Delaware
Stroudsburg	McMichaels Creek Levee	McMichaels Creek	Upper Delaware

Figure 4.3.11-1: Location of Levees in Monroe County (FEMA, 2010).



4.3.11.2. *Range of Magnitude*

A levee failure or breach causes flooding in landward areas adjacent to the structure. The failure of a levee or other flood protection structure could be devastating depending on the level of flooding for which the structure is designed and the amount of landward development present. Large volumes of water may be moving at high velocities, potentially causing severe damage to buildings, infrastructure, trees and other large objects.

The environmental impacts of a levee failure result in significant water quality and debris disposal issues. Flood waters will back up sanitary sewer systems and inundate waste water treatment plants, causing raw sewage to contaminate residential and commercial buildings and the flooding waterway. The contents of unsecured containers of oil, fertilizers, pesticides and other chemicals get added to flood waters. Hazardous materials may be released and distributed widely across the floodplain. Water supplies and waste water treatment could be off-line for weeks. After the flood waters subside, contaminated and flood damaged building materials and contents must be properly disposed. Contaminated sediment must be removed from buildings, yards and properties. In addition, severe erosion is likely which can impact local ecosystems.

Levee failures are generally worse when they occur abruptly with little warning and result in deep, fast-moving water through highly developed areas. Since the only levees in Monroe County are located in the densest areas of the County, this concern is real for many residents of Stroudsburg, East Stroudsburg, and lower Stroud Township. The worst case scenario for levee failure in Monroe County would be if the Stroudsburg Sewer Treatment Plant levee were to fail. In this scenario, not only would there be flooding in the areas behind the levee, but there would also likely be a temporary shutdown of the sewer treatment facility and thus, access to clean water would be reduced.

4.3.11.3. *Past Occurrence*

There have been no known levee failures in Monroe County.

4.3.11.4. *Future Occurrence*

Similarly to dam failures, given certain circumstances, levee failures can occur at any time. However, the probability of future occurrence can be reduced through proper design, construction and maintenance measures. Most levees are designed to meet a specified level of flooding. While FEMA focuses on mapping levees that will reduce the risk of a 1%-annual-chance flood, other levees may be designed to protect against smaller or larger floods. Design specifications provide information on the percent-annual-chance flood a structure is expected to withstand, provided that it has been adequately constructed and maintained. If the levees in Monroe County are properly maintained the future occurrence of levee failure will continue to be considered *unlikely* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1).

4.3.11.5. *Vulnerability Assessment*

A levee typically protects the buildings and population within a 2,000 foot buffer. Table 4.3.11-2 displays the number of critical facilities and parcels within a 2,000 foot buffer of each levee. Please note that due to the physical proximity of these levees, the 2000-foot buffers of each

levee may overlap. Since it is unlikely that all the levees would fail simultaneously, vulnerable parcels and critical facilities are reported by levee rather than by jurisdiction. These facilities would be in danger from the effects of severe flooding if the levees in the area failed. If population grows in the areas protected by levees, the risk to the residents and structures in this area will also increase.

Table 4.3.14-2: Number of parcels and critical facilities falling within a 2,000-foot buffer of levees

LEVEE	FLOOD SOURCE	NUMBER OF CRITICAL FACILITIES WITHIN 2,000 FOOT LEVEE BUFFER	NUMBER OF PARCELS WITHIN 2,000 FOOT LEVEE BUFFER
Brodhead Creek Levee (Left Bank, Downstream)	Brodhead Creek	4	609
Brodhead Creek Levee (Left Bank, Upstream)	Brodhead Creek	5	914
Brodhead Creek Levee (Right Bank, Downstream)	Brodhead Creek	1	535
Brodhead Creek Levee (Right Bank, Midstream)	Brodhead Creek	2	752
Brodhead Creek Levee (Right Bank, Upstream)	Brodhead Creek	4	726
Little Sambo Creek Levee (Downstream)	Little Sambo Creek	5	717
Little Sambo Creek Levee (Upstream)	Little Sambo Creek	6	902
McMichaels Creek Levee	McMichaels Creek	6	1244
Stroudsburg Sewer Treatment Plant Levee	Brodhead Creek	3	742

4.3.12. Nuclear Incidents

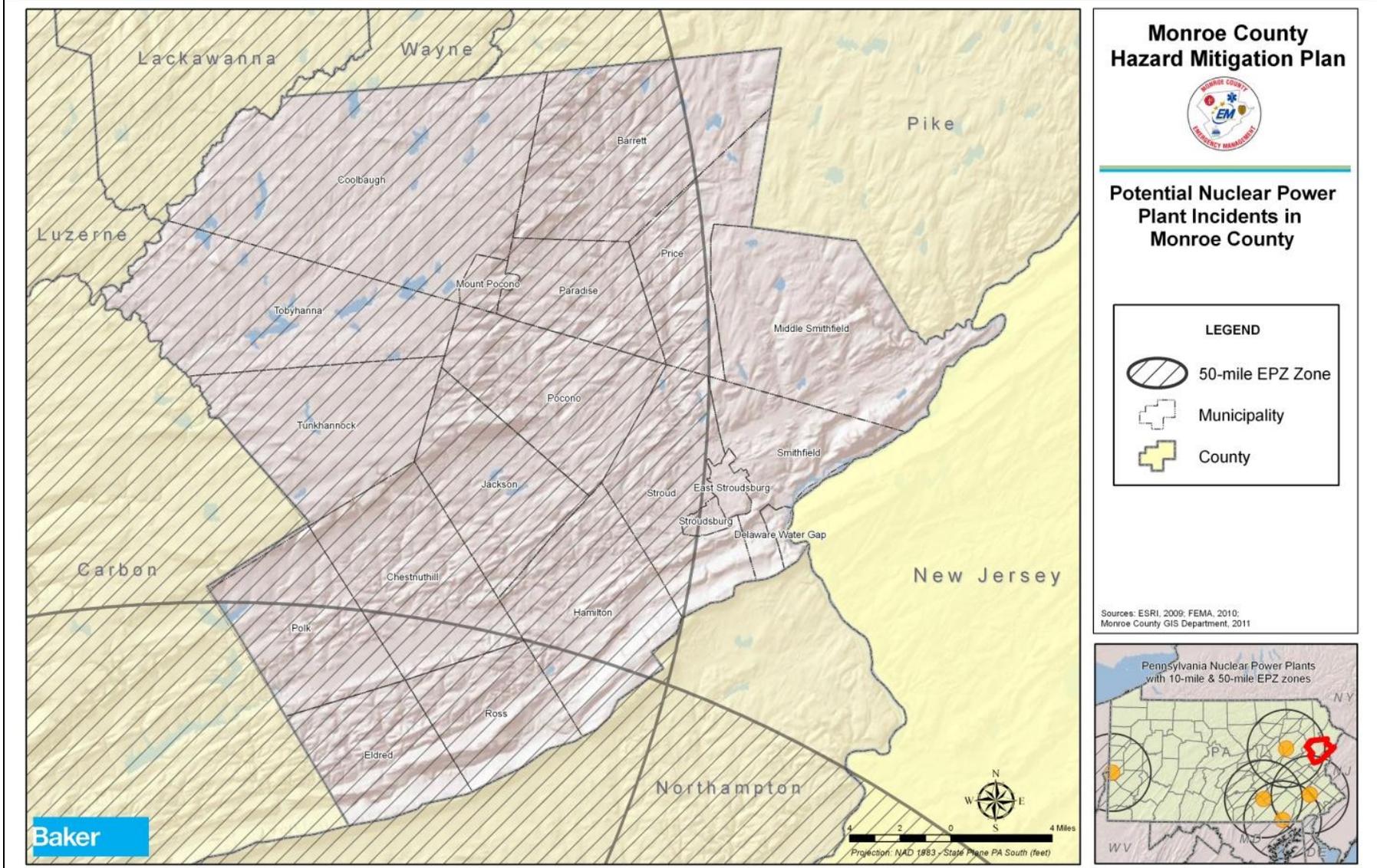
4.3.12.1. Location and Extent

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.

As seen in Figure 4.3.12-1, Monroe County is not located within the ten-mile Plume Exposure Pathway EPZ of any nuclear facility. However, it is almost completely within the fifty-mile Ingestion Exposure Pathway EPZ for the Susquehanna Steam Electric Station, located approximately twenty-eight miles west of the County border, in Salem Township, Luzerne

County, PA. In addition, Polk, Chestnuthill, Eldred, and Ross Townships are located within the fifty miles of the Limerick Generating Station, located approximately forty-one miles to the southwest in Limerick Township, Montgomery County, PA. The remaining three nuclear plants in Pennsylvania are more than fifty miles away from Monroe County. This distance exceeds the Plume Exposure and Ingestion Exposure Pathway EPZs for nuclear emergencies; therefore, these facilities are considered a minimal threat to the County. However, in the event of an emergency, evacuees from distant EPZs may seek shelter in Monroe County.

Figure 4.3.12-1: Portions of Monroe County covered by the 50-mile EPZ of nuclear facilities.



4.3.12.2. 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 Monroe County. The County instead focuses on the impact of the 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 (Nuclear Regulatory Commission, 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, and therefore of most concern to Monroe County, include the long-term effects of radioactive contamination in the environment and in agricultural products. Monroe County can expect some radioactive contamination in very small amounts in the case of a nuclear incident. This is not a significant concern in terms of external exposure and immediate health risks, but even a small amount of radiation will require the 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. Areas underlain by limestone and some types of glacial sediments are particularly susceptible to contamination.

The worst-case scenario for Monroe County would be if a General Emergency occurred at Susquehanna Steam Electric Station that leaked sufficient radiation to create longer-term damage in the form of contaminated water, soil, and food supplies.

4.3.12.3. *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.

4.3.12.4. *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. 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 County expects that the future occurrence of a nuclear incident will continue to be *unlikely* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1).

4.3.12.5. *Vulnerability Assessment*

Fifteen of Monroe County's 20 municipalities fall wholly or partially under the 50-mile EPZ of either the Susquehanna Steam Electric Station or the Limerick Generating Station. This represents a population of over 105,000 and covers the bulk of Monroe County's agricultural land cover. These jurisdictions include Barrett, Coolbaugh, Tobyhanna, Tunkhannock, Polk, Eldred, Ross, Chestnuthill, Hamilton, Jackson, Pocono, Paradise, Price and Stroud Townships and Mount Pocono Borough.

As stated in Section 4.3.12.2, the County's primary vulnerability to nuclear incidents comes in the form of food, soil, and water contamination. In terms of vulnerable land, the 9,165 acres of farmland held in Monroe County's 349 farms is vulnerable to radiological contamination in a nuclear incident. In 2007, the market value of all agricultural products of these farms exceeded \$7.8 million.

Water contamination is also a concern in nuclear incidents. There are two public water suppliers that operate in or provide water to the County: the Pocono Jackson Joint Water Authority and the Stroudsburg Municipal Authority. These water supplies, coupled with the County's 15,418 estimated domestic drinking water wells, are all vulnerable to the effects of a nuclear incident.

While unlikely that all agricultural products would be lost in the event of a nuclear incident, the County could expect some portion of that \$7.8 million to be lost. Time of year also impacts 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.

4.3.13. **Transportation Accident**

4.3.13.1. *Location and Extent*

For the purposes of this plan, transportation accidents are defined as incidents involving highway, air, and rail travel. Within Monroe County, there are a total of 1344.8 miles of developed roads. Interstate highways account for 40.4 miles of this total while 487.9 miles are state and US highways. The majority of roads are municipal routes (MCEMA, 2008). The County is home to significant transportation routes such as Interstate 380 and Interstate 80, US 209, PA 115, PA 447, PA 33, and PA 611.

There is one railroad line operating in the County which transport freight of all types, including hazardous materials. This rail line is owned by the Pennsylvania Northeast Regional Railroad Authority and runs generally northwest to southeast through the County (PennDOT 2010). Finally, there are two airports in the County - the Pocono Mountain Municipal Airport and the Stroudsburg-Pocono Airport. Figure 4.3.13-1 illustrates these major transportation systems in the County. Figure 4.3.13-2 shows the traffic volume on key roadways.

Figure 4.3.13-1: Monroe County transportation systems (Monroe County GIS Department, 2011).

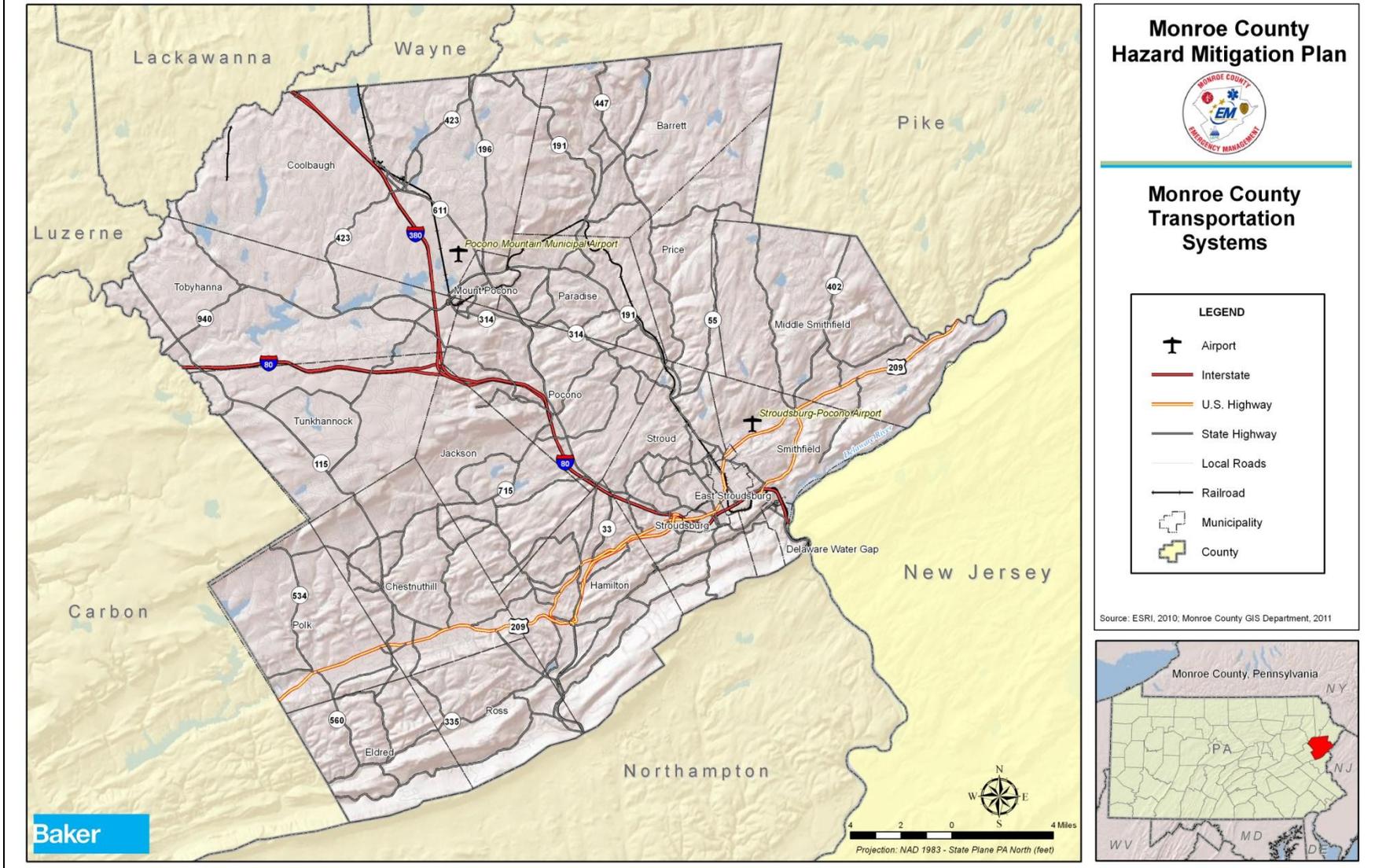
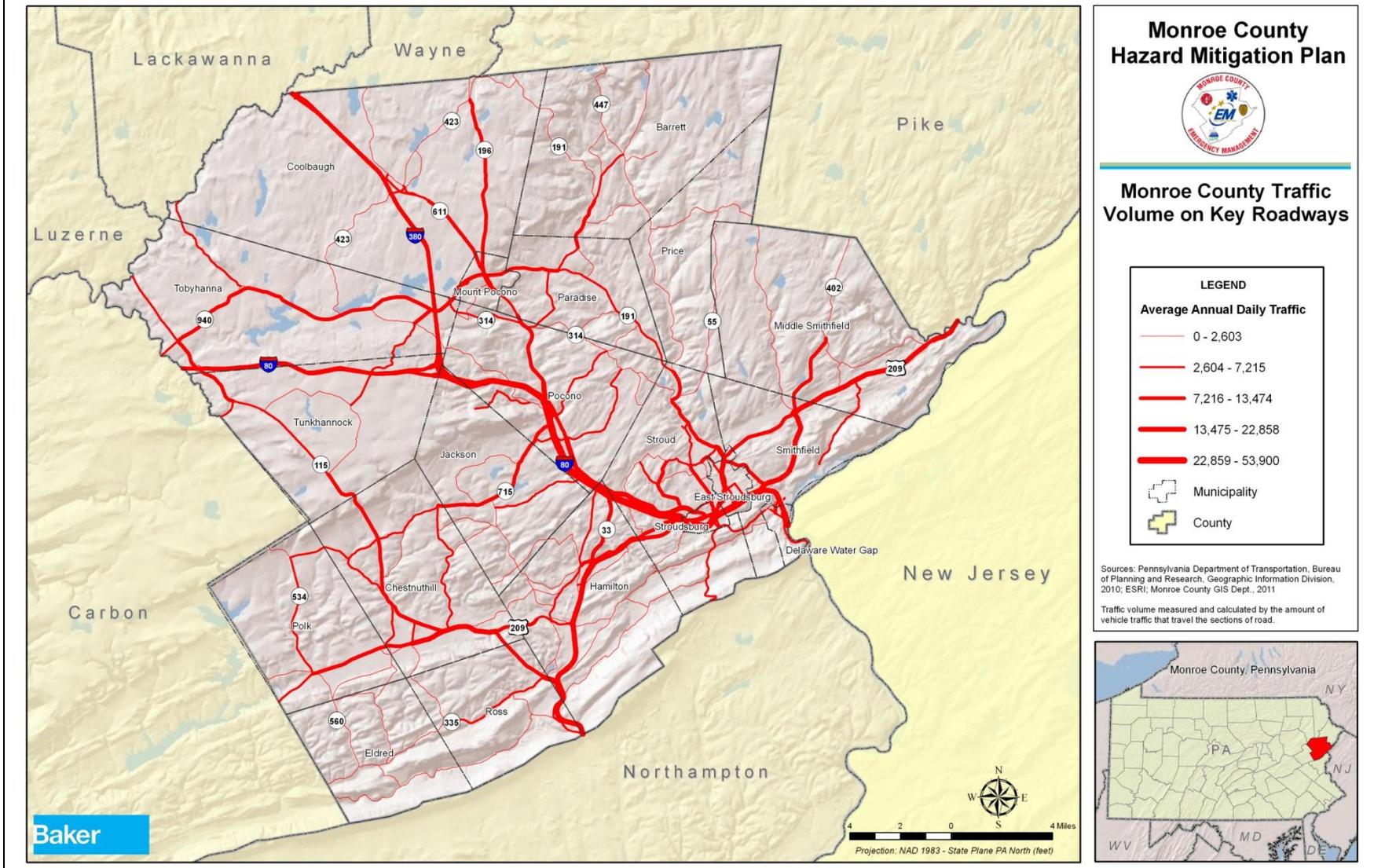


Figure 4.3.13-2: Monroe County traffic volume on key roadways (PennDOT, 2010).



4.3.13.2. 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 worst case scenario for transportation accidents focuses not just on the accident itself but the associated effects of a large-scale traffic accident. In this scenario, formulated by the HMPT, a westbound tanker truck hauling hazardous materials on Interstate 80 crashes at the curve before the Dresher Avenue exit. In this accident, traffic comes to a halt in both directions on I-80 and gridlock paralyzes Stroudsburg. In the middle of this transportation situation, a fire breaks out at the Westgate Apartments near Stroudsburg High School. Emergency responders cannot get to the elderly apartment dwellers, the vehicle in trouble on I-80, or the population located near the spreading chemical spill.

4.3.13.3. Past Occurrence

The most common transportation accidents in the County are highway accidents involving motor vehicles. The County’s most serious transportation concerns involve Interstate 80 and 380. 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.

Overall, though, over the five-year period from 2005-2009, highway accidents have decreased by over 700 crashes per year. Table 4.3.13-1 summarizes the overall vehicular crash data from 2005-2009 for Monroe County. The data was gathered through the PennDOT Crash Statistics Reports.

Table 4.3.13-1: Total number of crashes, traffic deaths, and pedestrian deaths for Monroe County from 2005-2009 (PennDOT, 2010).			
YEAR	TOTAL CRASHES	TOTAL TRAFFIC DEATHS	TOTAL PEDESTRIAN DEATHS
2005	2,887	40	3
2006	2,572	36	2
2007	2,241	33	3
2008	2,093	37	4
2009	2,113	30	4

In comparison to highway accidents, the past occurrences of rail and air accidents is quite small. PEIRS data was used to identify the number of rail and aircraft accidents in Monroe County from 2002-2009. This data indicates that there have been two aircraft incidents, both of which occurred in 2007, and three railroad incidents, one each in 2006, 2007, and 2009. There have been only minor injuries stemming from these incidents.

4.3.13.4. *Future Occurrence*

The County's population has increased significantly over the last decade, meaning it is likely that traffic volumes have also risen. New residents have limited knowledge of detour routes and alternate routes around accidents, contributing to the accident-related congestion experienced recently in the County. The trucking industry is expected to continue, maintaining and possibly increasing the number of tractor-trailers on the County's road system. Transportation accidents may increase slightly over the next five years without proper mitigation strategies in place. Therefore, based on this and past occurrences, the probability of transportation accidents is characterized as *highly likely* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1). However, the low number of rail and air traffic accidents in the County indicates that the bulk of future transportation accidents will be roadway accidents.

4.3.13.5. *Vulnerability Assessment*

A transportation-related incident can occur on any stretch of road or railway in Monroe County. However, severe accidents are more likely on the County's highways, such as Interstate 380 and Interstate 80, US 209, PA 196, and PA 611, 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. Like highway incidents, rail incidents can impact populations living near rail lines. These include populations in Coolbaugh Township, Mount Pocono Borough, Tobyhanna Township, Paradise Township, Barrett Township, Stroud Township, East Stroudsburg Borough, and Delaware Water Gap Borough. Monroe County is also susceptible to airplane accidents in Coolbaugh and Smithfield Townships due to the air traffic through the two airports.

Table 4.3.13-2 illustrates the vulnerability of addressable structures and critical facilities for each kind of transportation accident. For this analysis, vulnerability for highway accidents was defined as jurisdictions falling within a $\frac{1}{4}$ 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 $\frac{1}{4}$ 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 except Eldred Township have addressable structures located within $\frac{1}{4}$ mile of major highways, and Stroudsburg Borough has the most addressable structures within $\frac{1}{4}$ mile of major highways, an indication of the density of the Borough. Many jurisdictions also have critical facilities within $\frac{1}{4}$ mile of major highways; of the jurisdictions with vulnerable critical facilities, Chestnuthill Township, Stroud Township, and Stroudsburg Borough have the most with fourteen each. East Stroudsburg Borough has the highest number of addressable structures and critical facilities vulnerable to rail accidents. The other jurisdictions with comparatively higher numbers

of addressable structures vulnerable to rail accidents are Coolbaugh and Stroud Townships and Mount Pocono Borough; Coolbaugh and Eldred Townships have the next-highest number of critical facilities vulnerable to rail accidents. Vulnerability to air accidents is more concentrated because there are two airports in the County, but fifteen of the twenty jurisdictions have addressable structures and critical facilities vulnerable to aircraft accidents. Of these, Coolbaugh Township has the most addressable structures located in the 5-mile vulnerability zone; East Stroudsburg Borough, Stroud Township, and Smithfield Township have the most critical facilities within five miles of airports with sixteen each.

Table 4.3.13-2: 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
Barrett Township	2,587	74	1	1,138	10	133	1
Chestnuthill Township	6,874	0	0	1,582	14	0	0
Coolbaugh Township	10,998	729	4	2,161	11	7,227	13
Delaware Water Gap Borough	401	9	0	307	4	399	4
East Stroudsburg Borough	3,294	1,611	7	1,967	10	3,294	16
Eldred Township	1,217	93	5	0	0	0	0
Hamilton Township	3,890	0	0	1,069	2	0	0
Jackson Township	3,577	0	0	482	2	4	0
Middle Smithfield Township	8,363	0	0	1,188	6	3,723	5
Mount Pocono Borough	1,405	323	1	843	4	1,405	4
Paradise Township	1,560	182	0	639	4	832	9
Pocono Township	5,852	1	0	1,775	7	1,433	2
Polk Township	3,521	0	0	744	4	0	0
Price Township	1,766	0	0	124	0	746	1
Ross Township	2,315	0	0	49	0	0	0
Smithfield Township	4,215	118	0	1,187	7	4,212	16
Stroud Township	8,178	227	1	2,902	14	5,918	16
Stroudsburg Borough	3,381	0	0	3,224	14	3,380	14
Tobyhanna Township	7,409	36	0	2,252	13	3,459	5
Tunkhannock Township	3,642	0	0	744	0	331	0
TOTAL	84,445	3,403	19	24,377	126	36496	106

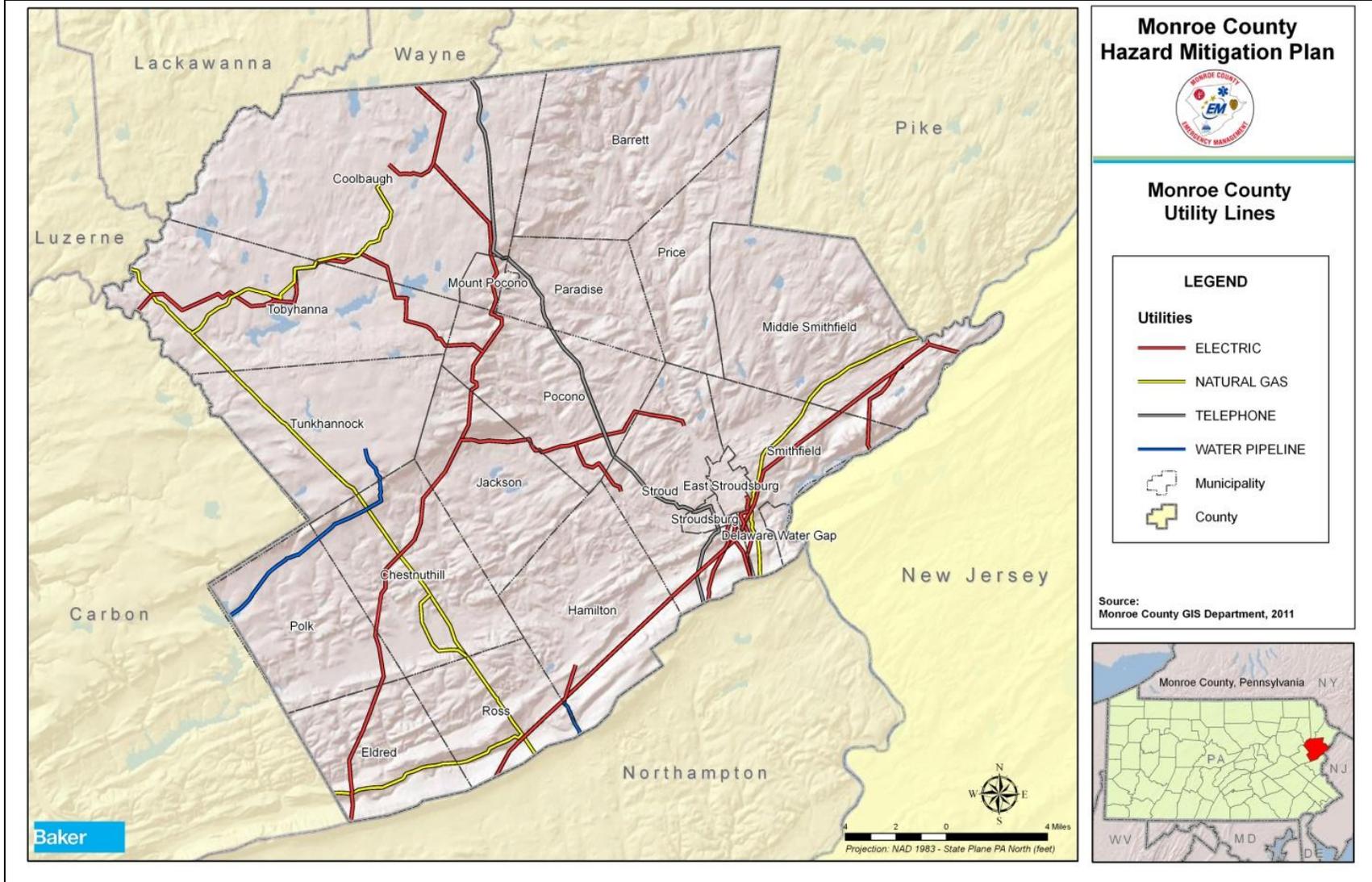
*Major Highways include Interstates, US Highways and State Highways.

4.3.14. Utility Interruption

4.3.14.1. Location and Extent

Utility interruptions in Monroe County include disruptions in fuel, water, electric and telecommunications capabilities in the County, but the primary focus is on electric power failures. Utility interruptions are often a secondary impact of another hazard; for example, many of the windstorm events previously experienced in Monroe County have led to widespread power outages. Severe thunderstorms, 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 the County; Figure 4.3.14-1 shows the locations of utility lines throughout the County.

Figure 4.3.14-1: Monroe County utility line locations (Monroe County GIS Department, 2011).



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. 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 to maintain a safe temperature.

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. The January 2005 ice storm, one of the worst on record in the Poconos, led to the worst case scenario for utility interruptions. During this event, nearly 46,000 homes and businesses in Monroe County alone lost power; system-wide, 238,000 Pennsylvania Power and Light customers lost power with an overall estimated repair cost of \$25 million. It took eleven days for power to be fully restored in the Poconos.

4.3.14.3. Past Occurrence

In Monroe County, minor utility interruptions occur annually, most often in conjunction with winter storms and wind storms. There is no complete or comprehensive list of utility interruption events for the County, but PEIRS data on utility interruptions, shown in Table 4.3.14-1, illustrates known past occurrences.

Table 4.3.14-1: Utility interruptions reported to PEIRS (PEIRS, 2010).							
INCIDENT TYPE	2002	2004	2006	2007	2008	2009	TOTAL BY TYPE
Phone Outage	1	1	2	2	2	1	9
Power Outage	1	2	6	1	2	1	13
Water Main Break					1		1
TOTAL BY YEAR	2	3	8	3	5	2	23

4.3.14.4. Future Occurrence

Minor, short-term utility interruptions may occur several times a year for any given area in the County, while major, long-term events may take place once every few years, but utility interruptions are difficult to predict. However, because utility interruptions are frequent by-products of severe weather events, citizens should prepare for them during severe storms. Therefore, the future occurrence of utility interruptions should be considered *likely* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1).

4.3.14.5. Vulnerability Assessment

Hospitals and emergency medical facilities as well as retirement homes and senior centers are particularly vulnerable to power outages. While back-up power generators are often used at these facilities, loss of electricity may result in hot or cold temperatures for which elderly

populations are particularly vulnerable. Additionally, staff members at the Pocono Medical Center indicated that even with back-up power sources, it very difficult to keep the Center's computer systems running during a power outage. While this does not affect their ability to care for critical patients, it does slow the process and functioning of medical services.

Monroe County is in the service area of Pennsylvania Power and Light. In 2009, Pennsylvania Power and Light announced plans to improve electrical facilities and make service more reliable in the Appenzell and Effort/Jonas/Sun Valley areas of Monroe County. This investment, if fully implemented, should reduce the County's vulnerability to power outages.

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 thirteen hazards profiled in the 2011 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:

$$\text{Risk Factor Value} = [(Probability \times .30) + (Impact \times .30) + (Spatial \text{ Extent} \times .20) + (Warning \text{ Time} \times .10) + (Duration \times .10)]$$

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 <i>What is the likelihood of a hazard event occurring in a given year?</i>	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 PROBABILITY	4	
IMPACT <i>In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?</i>	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 <i>How large of an area could be impacted by a hazard event? Are impacts localized or regional?</i>	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 <i>Is there usually some lead time associated with the hazard event? Have warning measures been implemented?</i>	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 <i>How long does the hazard event usually last?</i>	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	

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 thirteen potential hazards identified in the 2011 HMP. 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	Flood, Flash Flood, Ice Jam (N)	4	3	3	2	3	3.2
	Winter Storm (N)	4	2	4	1	3	3.0
	Environmental Hazards (M)	3	3	3	4	1	2.9
	Wildfire (N)	4	2	2	4	2	2.8
	Transportation Accidents (M)	4	2	2	4	2	2.8
MODERATE	Utility Interruption (M)	3	1	3	4	2	2.4
	Dam Failure (M)	1	3	2	4	4	2.4
	Nuclear Incidents (M)	1	2	3	4	4	2.3
	Drought (N)	2	1	4	1	4	2.2
	Tornado, Windstorm (N)	3	2	1	4	1	2.2
LOW	Hurricane, Tropical Storm, Nor'easter (N)	2	2	2	1	2	1.9
	Pandemic (M)	2	1	2	1	4	1.8
	Levee Failure (M)	1	2	1	4	2	1.7
	Earthquake (N)	1	1	2	4	1	1.5

Based on these results, there are five *high* risk hazards, five *moderate* risk hazards and four *low* risk hazards in Monroe County. Mitigation actions were developed for all high, moderate, and low risk hazards (see Section 6.4). 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 Monroe County and whether their risk is greater than (>), less than (<), or equal to (=) the risk factor assigned to the County as a whole. This table was developed by the consultant team based on the findings in the hazard profiles of Section 4.3. Municipal officials had the opportunity to review the findings and make changes at the Risk Assessment Workshop. Those changes are reflected in the table.

Monroe County 2011 Hazard Mitigation Plan

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

JURISDICTION	IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR													
	Flood, Flash Flood, Ice Jam (N)	Winter Storm (N)	Environmental Hazards (M)	Wildfire (N)	Transportation Accidents (M)	Utility Interruption (M)	Dam Failure (M)	Nuclear Incidents (M)	Drought (N)	Tornado, Windstorm (N)	Hurricane, Tropical Storm, Nor'easter (N)	Pandemic (M)	Levee Failure (M)	Earthquake (N)
	3.2	3.0	2.9	2.8	2.8	2.4	2.4	2.3	2.2	2.2	1.9	1.8	1.7	1.5
Barrett Twp.	=	=	=	>	>	=	>	<	=	=	=	=	<	=
Chestnuthill Twp.	=	=	=	=	=	=	=	=	=	>	=	=	<	=
Coolbaugh Twp.	=	=	=	=	=	=	>	=	=	>	=	=	<	=
Del. Water Gap Borough	=	=	=	=	=	=	<	<	=	=	=	>	<	=
East Stroudsburg Borough	=	=	=	<	=	=	=	<	=	=	=	>	=	=
Eldred Twp.	=	=	<	=	=	=	<	=	=	>	=	=	<	=
Hamilton Twp.	=	=	=	=	=	=	=	=	=	=	=	=	<	=
Jackson Twp.	=	=	>	>	<	=	>	=	=	=	=	=	<	=
Middle Smithfield Twp.	=	=	=	=	=	=	>	<	=	=	=	=	<	=
Mount Pocono Borough	=	=	=	=	=	=	=	=	=	=	=	>	<	=
Paradise Twp.	=	=	=	=	>	=	>	=	=	=	=	=	<	=
Pocono Twp.	=	=	=	=	=	=	=	=	=	=	=	=	<	=
Polk Twp.	=	=	=	=	=	=	=	=	=	>	=	=	<	=
Price Twp.	=	=	<	=	=	=	=	=	=	=	=	=	<	=
Ross Twp.	=	=	<	=	=	=	=	=	=	>	=	=	<	=
Smithfield Twp.	=	=	=	=	=	=	>	<	=	=	=	=	<	=
Stroud Twp.	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Stroudsburg Borough	=	=	=	<	=	=	=	=	=	=	=	>	=	=
Tobyhanna Twp.	=	=	=	=	=	=	>	=	=	>	=	=	<	=
Tunkhannock Twp.	=	>	=	>	=	=	=	=	=	=	=	=	<	=

4.4.3. Potential Loss Estimates

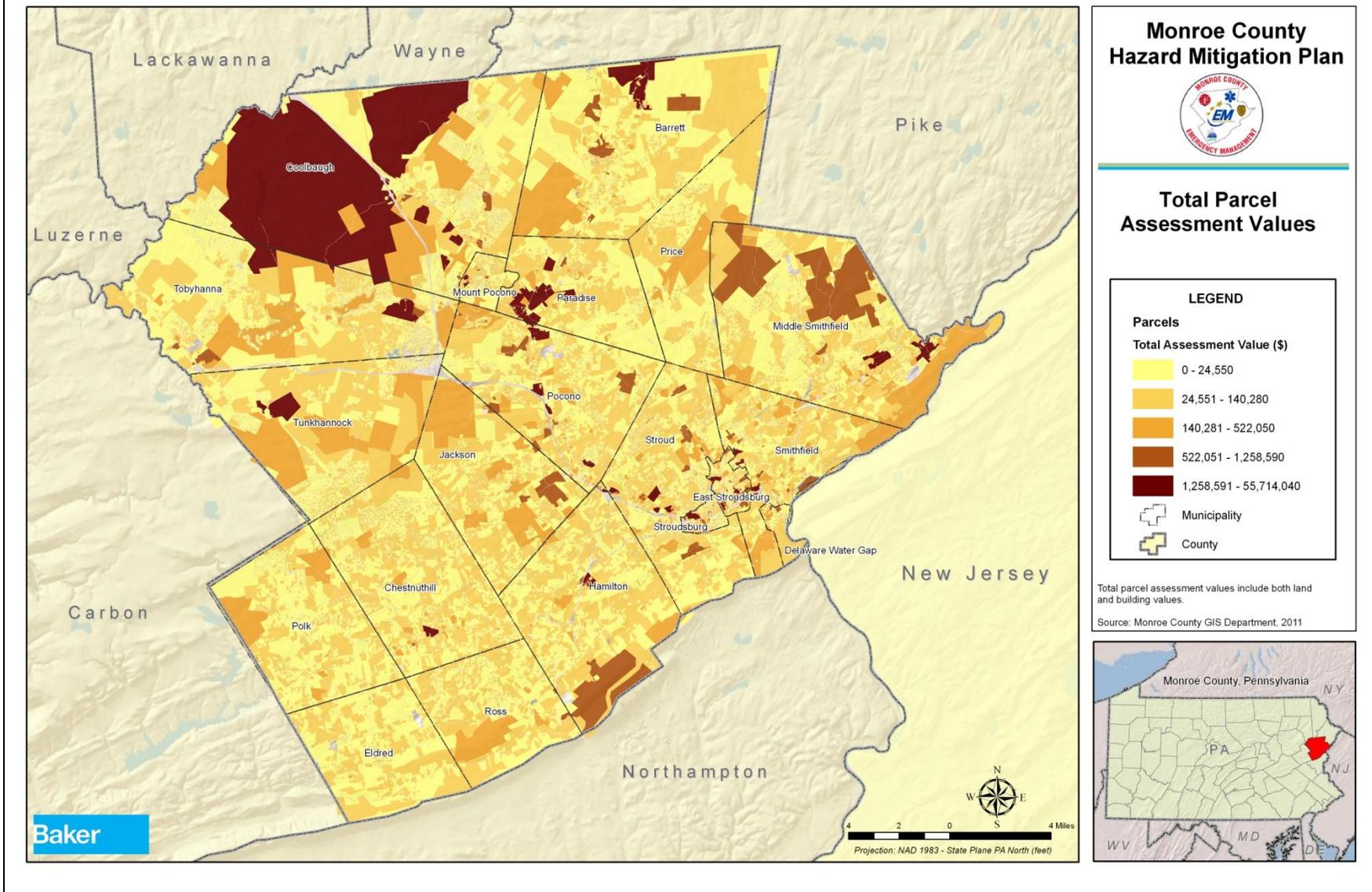
Based on various kinds of available data, potential loss estimates were established for flood, flash flood, and ice jam, tornado and windstorms, drought, nuclear incident, and winter storms. Estimates provided in this section are based on HAZUS-MH, version MR4, geospatial analysis, and previous events. 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 Monroe County. The 99,847 parcels in Monroe County have a cumulative assessed value of over \$2.5 billion. The average assessed value of these parcels is \$25,476. Coolbaugh and Stroud Townships have the potential to experience the most loss, with assessed values exceeding \$349.9 million and \$269.3 million, respectively. At the other end of the spectrum, Delaware Water Gap has the lowest cumulative assessed value of all parcels with \$8.5 million in assessed value. This is not unexpected given the Borough's small size.

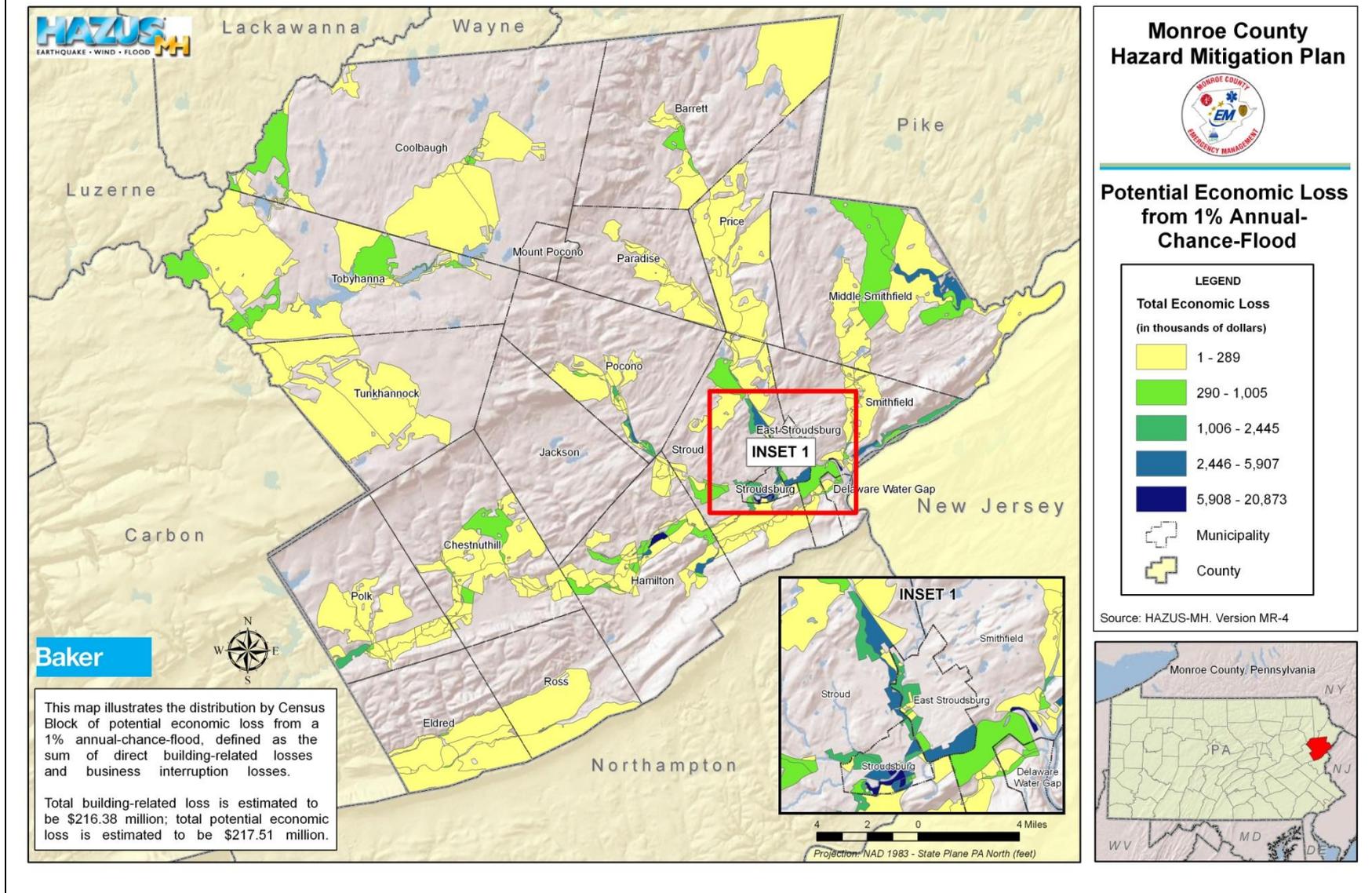
Figure 4.4-1: Monroe County parcel assessed values (Monroe County GIS Department, 2011).



The full suite of potential losses was able to be calculated for flood events 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 flood response and mitigation planning activity.

Using HAZUS-MH, total building-related losses for the 1% annual-chance flood event were estimated to be \$216.4 million. Just over half of these building-related losses were incurred by residential occupancies; a further 28% of building-related losses were incurred by commercial properties. Approximately 16% of the building-related losses were incurred by industrial occupancies. In addition to simply building-related losses, HAZUS calculated the total economic losses. These total economic losses incorporate both building-related losses and business interruption losses. Figure 4.4-2 shows the spatial distribution of total economic losses at the Census block level. Some of the highest economic losses are expected in East Stroudsburg and Stroudsburg Boroughs. Total economic loss, including replacement value, content loss, functional loss, and displacement cost was estimated at \$217.51 million for the entire County. The full HAZUS results report can be found in **Appendix F**.

Figure 4.4-2: Monroe County potential economic loss 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 Monroe County's \$7.8 million in agricultural production, depending on the magnitude of the event. Losses associated with particular natural hazard events are sometimes reported to the NCDRC 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 NCDRC total \$114.31 million and for any single event, range from \$8 million to \$42.3 million. Tornado and windstorm events have had losses ranging from \$5,000 to \$32.2 million depending on the magnitude of the events. These events have also led to two deaths and ten injuries. For winter storm events, only three of the past events have losses reported with the event, but those that do had losses ranging \$100,000-\$15 million per event; over the reporting period for the NCDRC, there were also seven deaths and 52 injuries associated with winter storms.

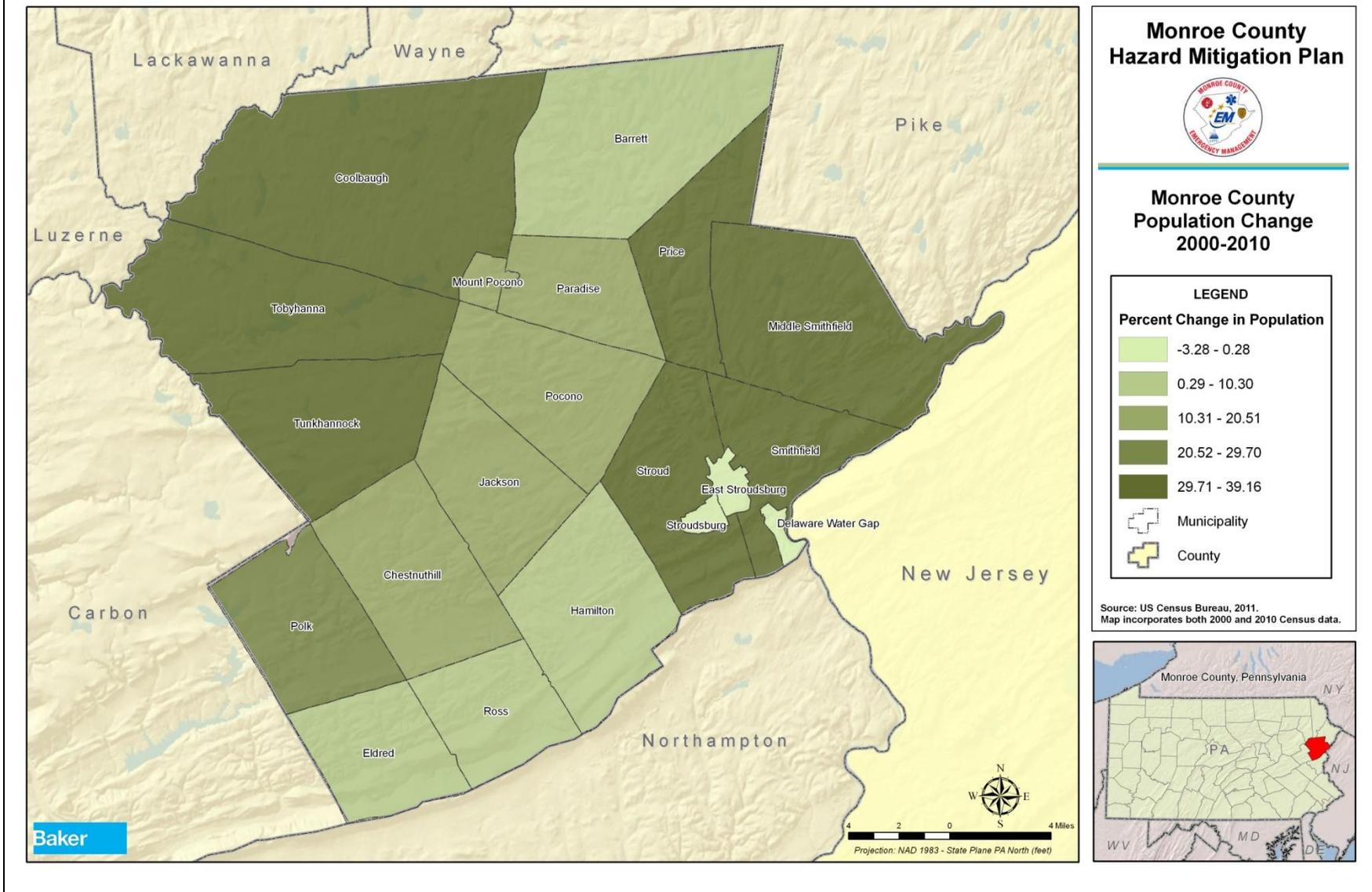
4.4.4. Future Development and Vulnerability

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. Monroe 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 is perhaps the most significant indicator of changes in vulnerability in the future. As discussed in Section 2.3, the total population of Monroe County has grown by more than 22 percent from 2000 to 2010. The population change can be seen in Figure 4.4-3. This growth has largely been due to development pressure from New York and New Jersey to the west. Population growth has not been evenly distributed throughout the County, though. East Stroudsburg and Stroudsburg Boroughs both lost a small portion of their population between 2000 and 2010. The highest growth happened in the four townships on the eastern edge and the three townships on the western edge of Monroe County; Coolbaugh, Tobyhanna, Tunkhannock, Price, Middle Smithfield, Stroud, and Smithfield Townships all experienced over 29 percent growth in the previous decade. In addition to these high growth rates, most municipalities also have a large weekender population, so the population totals of these townships have the potential to increase significantly from Thursday to Sunday year-round.

While Monroe County has grown significantly in the last ten years, there are still few places with high density. Hazard vulnerability and loss potential will be higher in the places of higher density (namely the boroughs) throughout the County. However, the population growth and associated development will likely create increases in loss potential, as more people may be living in areas prone to hazards, especially flooding, winter storms, and wildfires.

Figure 4.4-3: Municipal population change in Monroe County (US Census 2000 and 2011).



Increased development pressures in Monroe County are related to the population growth experienced in the last decade. As discussed in Section 2.4, almost 86 percent of Monroe County's land can be considered forestland or limited agricultural land, and 6.8 percent can be considered developed. However, the amount of developed land almost doubled between 1992 and 2005. The County has identified preservation of the natural environment as a key goal in their comprehensive plan, Monroe 2020. Preservation of these open and natural areas, as well as implementation of responsible development patterns, will address the County's concerns of threats to the fiscal and natural environments. Additionally, these natural areas can help maintain or reduce risk and vulnerability in the County.

Monroe 2020 laid out objectives to increase the amount of publically held open space from 20 percent in 1998. The Open Space Preservation program, which uses \$25 million in bonds to preserve open space across the County, was one of the strategies implemented from these objectives (MCPC, 1999). The Monroe 2020 plan also included a number of recommendations and goals for municipalities to limit the effects of population growth. These include implementing changes in subdivision regulations to emphasize clustering houses in new developments, adopting resource protection ordinances, promoting development in areas that are currently served by existing infrastructure to limit sprawling building patterns, and protecting water resources from contamination or depletion.

In 2002 the Monroe County Planning Commission outlined the actions that the County had taken to meet the objectives in Monroe 2020. These actions include:

- A project with the Department of Environmental Protection to establish watershed-wide sanitary disposal techniques in the Pocono Creek Watershed.
- Implementation of the Open Space Preservation program with the Department of Conservation and Natural Resources, including acquiring land and writing six regional open space plans.
- Proposed allocation of financing for municipalities to establish resource protection ordinances.
- Review of municipality ordinances and plans through Growing Greener audits in partnership with Natural Land Trusts and the Department of Community and Economic Development (MCPC, 2002).

The population growth and intensified development increases the risks and vulnerabilities to specific hazards. New houses are being built in areas surrounded by forestland are vulnerable to wildfires. Additionally, the flammable elements in the structures lead to an increased risk of spreading or intensifying wildfires in the area. These houses are in areas with limited access points, increasing the chance that emergency responders will not be able to fully respond to a fire within a short time period.

The risk of severe weather events like winter storms or events leading to flooding will not increase due to population growth. However, there are areas of increased vulnerability to these storms stemming from the increased development and population growth. An influx of people into the area that are not used to the severity of winter storms could increase the amount of residents or tourists who are stranded during a severe winter storm. In the case of flooding

risks, the FIRM maps for Monroe County are outdated, and some maps have not been updated in as many as thirty years. Areas of flooding risk could be different than the current maps suggest, and areas of new development areas could have be at higher risk of flooding events than is shown on these maps.

The increased permanent and weekender population, as well as an increase in the amount of tourists in the area, can also amplify the risks of transportation accidents and environmental hazards during transit. More residents and travelers are using I-80 and other major routes in Monroe County, increasing the chances of motor vehicle accidents. Additionally, the trucking industry is transporting more hazardous materials on these major roadways. These two factors combined increase the risk of a hazardous material being released while it is transported through Monroe County.

5. Capability Assessment

5.1. Update Process Summary

Monroe 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 2005 HMP identified the most commonly used resources available in Monroe County to support hazard mitigation with a focus on planning and regulatory tools. It indicated the presence of local plans, ordinances, and codes in each municipality. Finally, the 2005 Capability Assessment specified local, state, and non-profit resources available for mitigation efforts including the Monroe County Planning Commission, Pennsylvania State Association of Township Supervisors, Pennsylvania State Association of Boroughs, DCED, DCNR, and DEP. Through responses to the *Capability Assessment Survey* distributed to all 20 municipalities and input from the HMSC and the HMPT, the 2011 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. All twenty municipalities in Monroe County completed the Capability Assessment Survey, allowing for a comprehensive look at the capabilities in the County.

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 Monroe County Emergency Management Agency coordinates countywide emergency management efforts. 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, eighteen of the jurisdictions in the County have or are in the process of developing an EOP. A countywide EOP also exists. Municipalities are not required to sign on to the County EOP, because County staff prefers to keep municipal emergency management coordinators actively engaged at a more local level.

Communities in Monroe County also have additional emergency management capabilities. Fourteen jurisdictions have an evacuation plan in place or under development either as a part of

the EOP or as a separate plan. Eight 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 Emergency Management Agency provides major training exercised and instructional workshops to emergency personnel in order to ensure that personnel are properly trained.

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

All jurisdictions in Monroe County 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 while the Monroe County Planning Commission provides an oversight and coordination role. 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.

Monroe County also has its own model floodplain ordinance that is more restrictive than the PA model ordinance in that it prohibits the following types of development in the floodplain:

- All walled or roofed buildings;
- All structures or development that will in any manner retard, divert, or alter the natural flow of flood waters except activities permitted by the DEP under Title 25, Chapter 105 (Dam Safety and Encroachments Act);
- The placement of fill that is not associated with a permitted activity;
- On-lot or community subsurface sewage disposal systems;
- The new construction, enlargement, or expansion of any structure used as a hospital, nursing home, jail or prison; and
- The development of any facility which will be used for the production or storage of dangerous materials and substances.

The County model ordinance also establishes standard buffers for streams, wetlands, vernal ponds, and lakes.

According to the Monroe County Conservation District, the restrictiveness of floodplain ordinances is mixed across the County, and no comprehensive list of which communities use which model ordinance exists. Many ordinances were adopted when the first FIRMs were released in the 1970s and 1980s; this generation of floodplain ordinances follows the federal FEMA guidelines closely. Other jurisdictions that were mapped more recently used the PA model ordinance that was in place when their FIRMs were released. The Conservation District identified four jurisdictions whose floodplain regulations were more restrictive than the PA model ordinance: Tobyhanna Township, Mount Pocono Borough, Middle Smithfield Township, and Hamilton Township. Middle Smithfield uses the County model ordinance almost exactly while the other more restrictive jurisdictions use a variation of it.

Monroe County municipalities currently use paper FIRM maps with current effective map dates ranging from 1976-2000; 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 and its communities are eagerly awaiting DFIRM databases but do not expect to receive digital maps, even in preliminary form, until 2015. In the meantime, communities will continue to regulate development in the SFHAs as best they can. When they become 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. In addition, DCED provides guidance and technical support through Community Assistance and Community Assistance Visits.

There are no communities in Monroe 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 Monroe County (HMP Capability Assessment Surveys, 2011)					
COMMUNITY	COMPRE-HENSIVE PLAN	BUILDING CODE	FLOODPLAIN ORDINANCE - NFIP PARTICIPANT	SUBDIVISION & LAND DEVELOPMENT ORDINANCE	ZONING ORDINANCE
Barrett Township	Yes	Yes	Yes	Yes	Yes
Chestnuthill Township	Yes, part of regional comp plan	Yes	Yes	Yes	Yes
Coolbaugh Township	Yes, part of regional comp plan	Yes	Yes	Yes	Yes
Delaware Water Gap Borough	Yes	Yes	Yes	Yes	Yes
East Stroudsburg Borough	Yes	Yes	Yes	Yes	Yes
Eldred Township	Yes, part of regional comp plan	Yes	Yes	Yes	Yes
Hamilton Township	Yes, part of regional comp plan	Yes	Yes	Yes	Yes
Jackson Township	Yes, part of regional comp plan	Yes	Yes	Yes	Yes
Middle Smithfield Township	Yes	Yes	Yes	Yes	Yes
Mount Pocono Borough	Yes, part of regional comp plan	Yes	Yes	Yes	Yes
Paradise Township	Yes	Yes	Yes	Yes	Yes
Pocono Township	Yes, part of regional comp plan	Yes	Yes	Yes	Yes
Polk Township	No	Yes	Yes	Yes	Yes
Price Township	Yes	Yes	Yes	Yes	Yes
Ross Township	Yes, part of regional comp plan	Yes	Yes	Yes	Yes
Smithfield Township	Yes	Yes	Yes	Yes	Yes

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

COMMUNITY	COMPRE-HENSIVE PLAN	BUILDING CODE	FLOODPLAIN ORDINANCE - NFIP PARTICIPANT	SUBDIVISION & LAND DEVELOPMENT ORDINANCE	ZONING ORDINANCE
Stroud Township	Yes, part of regional comp plan	Yes	Yes	Yes	Yes
Stroudsburg Borough	Yes, part of regional comp plan	Yes	Yes	Yes	Yes
Tobyhanna Township	Yes, part of regional comp plan	Yes	Yes	Yes	Yes
Tunkhannock Township	Yes, part of regional comp 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 Monroe County was developed in 1999. This plan encouraged development in existing centers and along corridors in order to avert sprawl and contain the natural landscape of the County even as it grows. There are also three multi-municipal regional comprehensive plans in Monroe County:

- The CJER Plan covers Chestnuthill, Jackson, Eldred, and Ross Townships;
- The HSPS Plan covers Hamilton, Pocono, and Stroud Townships and Stroudsburg Borough; and
- The Top of the Mountain Plan covers Coolbaugh, Tobyhanna, and Tunkhannock Townships and Mount Pocono Borough.

Except for Polk Township, which has no comprehensive plan, the remaining communities conduct individual comprehensive plans. 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 2011 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 20 municipalities in Monroe

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 Monroe County are required to abide by the UCC they will be 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, all 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. All jurisdictions within Monroe County have adopted and enforce a subdivision and land development ordinance.

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. All municipalities in Monroe County have zoning regulations.

The Pennsylvania legislature enacted the Stormwater Management Act (Act 167 of 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. There are two watershed-based Act 167 Plans in Monroe County: the Brodhead-McMichaels Creek Act 167 Plan, updated in 2006, and the Tobyhanna Creek Act 167 Plan, adopted in 1996. In conjunction with these Act 167 Plans, which together cover every jurisdiction in the County, each municipality must adopt and implement ordinances and regulations needed to regulate development in a manner consistent with the Act 167 Plan. All jurisdictions in the County have

stormwater management ordinances adopted except for Delaware Water Gap Borough, Coolbaugh Township, Polk Township, and Ross Township, whose ordinances are under development as of February 2011.

A final, unique planning and regulatory capability in Monroe County is the Municipal Partnership Program; this program encourages municipalities to develop and adopt resource protection ordinances by providing a partial reimbursement to a municipality that develops and adopts resource protection ordinances. The County keeps model ordinances for many of these resource protection initiatives, including conservation zoning, agricultural zoning, open space protection, the management of sensitive land, and maintaining denser centers (DCED, 2005).

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 Monroe County have moderate-to-high 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. A majority of municipalities have engineering capabilities, though they tend to be 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. While all jurisdictions have access to the County's spatial data through ArcView or ArcExplorer, many communities do not feel they have personnel skilled in GIS.

The Monroe County Conservation District and County Planning Commission 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 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. Of the eighteen municipalities providing a political capability rating, scores ranged from 3-5 with an average score of 4.1.

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 fifteen responses received. For example, 67% of communities who responded indicated their community had moderate community resilience 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	11%	50%	39%

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

CAPABILITY CATEGORY	LIMITED	MODERATE	HIGH
Administrative & Technical	5%	50%	44%
Fiscal	22%	50%	22%
Political	0%	56%	44%
Community Resiliency	6%	72%	22%

5.2.8. Existing Limitations

As discussed in Section 5.2.2, the communities in Monroe 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. If communities were to use the County’s model floodplain ordinance, awareness of flood risk and NFIP capability would rise. 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 least eleven 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 2015-2016. Having new DFIRM data and the associated new floodplain ordinances that follow the County model ordinance could have a significant impact on enhancing NFIP capabilities. Actions 12 and 26 in the 2011 Mitigation Action Plan are intended to help remedy these limitations.

As mentioned, there are no communities in Monroe County participating in the NFIP Community Rating System. However, all 20 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 27 in the 2011 Action Plan will encourage participation in CRS.

The fact that the Tobyhanna Creek Act 167 plan has not been updated since 1996 is another limitation and opportunity to increase the County’s capability to conduct mitigation activities. This plan has not been updated due to a lack of funding from DEP, but having this plan updated will assist with reducing stormwater runoff during severe precipitation events, thus having an impact on the volume of floodwaters in the County.

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 five goals and fourteen objectives identified in the 2005 HMP. The five goals were focused on the hazards identified as being significant in the HMP, and the objectives read more like actions – detailed, specific descriptions of mitigation-related tasks. When beginning the 2011 HMP update process, the HMSC examined the Pennsylvania State Plan goals and re-evaluated the 2005 Monroe 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 overall spirit of the old goals has been embodied in the new HMP goals, and many of the very specific 2005 objectives have been moved to the 2011 Mitigation Action Plan. 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 2005 Mitigation Strategy Goals and Objectives.	
Goal 1: Reduce flooding losses.	
Objective: Continue updates of stormwater management plans.	Review: This goal has been discontinued as 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 1 (see Table 6.2-1). Each objective is captured in the 2011 Action Plan in actions 13, 14, and 7.
Objective: Remove debris from streams.	
Objective: Adopt floodplain ordinance in Brodhead-McMichaels Stormwater Plan update.	
Goal 2: Lessen impacts of winter storms.	
Objective: Maintain/upgrade equipment.	Review: This goal has been discontinued as 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 1 (see Table 6.2-1). Each objective is captured in the 2011 Action Plan in actions 1, 2 and 21.
Objective: Develop public education program for household safety measures/preparedness.	
Objective: Support the PennDOT Winter Storm education program for road maintenance.	
Goal 3: Reduce potential of fires.	
Objective: Secure “Firewise” designation in appropriate areas.	Review: This goal has been discontinued as written because of a desire to create a long-term vision for hazard reduction and enhancement of mitigation capability. The goal
Objective: Develop public information program on personal mitigation measures	

Table 6.1-1: List of 2005 Mitigation Strategy Goals and Objectives.	
	has been incorporated into the new Goal 1 (see Table 6.2-1). Each objective is captured in the 2011 Action Plan in actions 10 and 21.
Goal 4: Lessen impacts of droughts.	
Objective: Expand public education programs for homeowner conservation measures.	Review: This goal has been discontinued as 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 1 (see Table 6.2-1). Each objective is captured in the 2011 Action Plan in actions 3 and 4.
Objective: Continue watershed assessments and build-out analyses	
Objective: Continue environmental education center programs for school students.	
Goal 5: Lessen impacts of tornadoes and straight line winds.	
Objective: Adopt and enforce the UCC.	Review: This goal has been discontinued as 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 1 (see Table 6.2-1). Each objective is captured in the 2011 Action Plan in actions 5, 21, and 6.
Objective: Develop public education program.	
Objective: Improve Emergency Broadcast System to provide additional time for evasive action.	

Actions provide more detailed descriptions of specific work tasks to help the County and its municipalities achieve prescribed goals and objectives. There were 12 actions identified in the 2005 Mitigation Strategy; seven of these actions have been partially or entirely completed while another three are continual actions that reduce risk, vulnerability, and losses. 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 or continuous but still viable for the next five years.

Table 6.1-2: List and review summary of 2005 mitigation actions.	
ACTION	REVIEW
1. Debris removal in streambeds.	This action is continuous and is included in the 2011 HMPU. See Action 16.
2. Re-addressing	This action is in progress and is included in the 2011 HMPU. See Action 8.
3. Adopt the updated Stormwater Management Plan and Ordinance for the Brodhead and McMichaels Creeks	This action has been completed in nearly all municipalities but is in progress for two jurisdictions. See Action 3.
4. Implement the Statewide Building Code	This action has been completed. However, the Action Plan includes provisions for enforcement of the building code. See Action 5.
5. Web server and software to link GIS to municipalities	This action has been completed.
6. Complete the activities to secure “Storm Ready” designation	Storm Ready status is a continual, 3-year cycle, so this action is considered continuous. See Action 6.
7. Complete the activities to secure “Firewise” designation	This action is in progress and is included in the 2011 HMPU. See Action 7.

Table 6.1-2: List and review summary of 2005 mitigation actions.	
ACTION	REVIEW
8. Implement outdoor burning ban	This action has been changed to reflect the fact that the County cannot enforce a burn ban; it can only encourage them and provide technical assistance. See Action 11.
9. Make FEMA updated digital floodplain maps available	There has been no progress on this action and will likely not see progress until 2015, but the County feels the action is very important and must be continued. See Action 12.
10. Public Education Programs	This action is continuous, but the 2011 HMPU is more specific about the types of education programs conducted. See Action 3 and 21.
11. Stormwater Management Plan Updates	This action has been completed for the Brodhead-McMichaels Creek Watershed Stormwater Plan but not the Tobyhanna-Tunkhannock Creek Watershed Stormwater Plan. The action has been changed to reflect this fact. See Action 13.
12. Correction of identified stormwater problems	This action is in progress and has not been completed. See Action 14.

6.2. Mitigation Goals and Objectives

Based on results of the goals and objectives evaluation exercise and input from the HMSC, a list of five goals and fourteen corresponding objectives was developed. Table 6.2-1 details the mitigation goals and objectives established for the 2011 HMPU.

Table 6.2-1: List of Mitigation Strategy Goals and Objectives.	
GOAL 1	<i>Reduce potential injury, death, and damage to existing community assets due to natural hazards, especially flooding.</i>
Objective 1A	<i>Continue to use stormwater management planning as a means to reduce flood losses.</i>
Objective 1B	<i>Recommend that flood insurance policies remain affordable through government programs, especially through the NFIP's CRS.</i>
Objective 1C	<i>Ensure adequate and consistent enforcement of ordinances and codes within and between jurisdictions.</i>
GOAL 2	<i>Reduce the potential impact and losses stemming from natural and human-made disasters on public and private property.</i>
Objective 2A	<i>Reduce wildfire potential through planning and outreach.</i>
Objective 2B	<i>Ensure that existing streams and drainage systems are adequate and functioning properly, when funding and technical assistance is available.</i>
Objective 2C	<i>Reduce the number of repetitive loss and severe repetitive loss properties in the County.</i>

Table 6.2-1: List of Mitigation Strategy Goals and Objectives.

GOAL 3	<i>Increase public education awareness regarding natural and man-made hazard risk and vulnerability, preparedness, and mitigation.</i>
Objective 3A	<i>Support public education programs for business, household and individual mitigation, safety measures and preparedness.</i>
Objective 3B	<i>Advise the public on small-scale conservation measures.</i>
GOAL 4	<i>Improve emergency preparedness, warning and response procedures and capabilities.</i>
Objective 4A	<i>Maintain and upgrade emergency services equipment, especially snow and ice removal equipment.</i>
Objective 4B	<i>Provide residents with adequate warning of potential floods and other weather-related events.</i>
Objective 4C	<i>Continue increasing 911 response capabilities in the county, especially by encouraging volunteers and regionalization.</i>
GOAL 5	<i>Reduce or redirect the impact of natural disaster away from at-risk environmental and population areas.</i>
Objective 5A	<i>Research possible structural mitigation projects to redirect or reduce the impact of disasters.</i>
Objective 5B	<i>Encourage and facilitate the development of comprehensive plan, zoning, land use, and, most importantly, floodplain management ordinances to appropriately direct development away from high-hazard areas.</i>

6.3. Identification and Analysis of Mitigation Techniques

Appendix 7 of the SOG developed by PEMA provides a comprehensive list of hazard mitigation ideas. Monroe County used this guide to identify mitigation techniques and develop mitigation actions. There are six categories of mitigation actions which Monroe 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 moderate and high risk 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 moderate and high risk hazards in Monroe County.						
HAZARD	MITIGATION TECHNIQUE					
	PREVENTION	PROPERTY PROTECTION	PUBLIC EDUCATION AND AWARENESS	NATURAL RESOURCE PROTECTION	STRUCTURAL PROJECT IMPLEMENTATION	EMERGENCY SERVICES
Drought	X		X			X
Flood, Flash Flood, Ice Jam	X	X	X	X	X	X
Tornado, Windstorm	X		X			X
Winter Storm	X		X			X
Wildfire	X		X			X
Dam Failure	X		X	X		X
Environmental Hazards	X		X			X
Nuclear Incidents	X		X			X
Transportation Accidents	X	X	X		X	X

Table 6.3-1: Mitigation techniques used for moderate and high risk hazards in Monroe County.

HAZARD	MITIGATION TECHNIQUE					
	PREVENTION	PROPERTY PROTECTION	PUBLIC EDUCATION AND AWARENESS	NATURAL RESOURCE PROTECTION	STRUCTURAL PROJECT IMPLEMENTATION	EMERGENCY SERVICES
Utility Interruption	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 7, 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 2011 HMPU. It is important to note that many of the actions collected during the planning process were consolidated if they were similar and generalized to remove location-specific information (i.e. Eliminate flooding at 123 Main Street) per FEMA guidance. However, all location-specific information on individual projects can be found in **Appendix C** (under “Mitigation Action Forms”).

The Mitigation Action Form was not the only avenue available to municipalities to identify mitigation priorities. In total, all municipalities selected actions by using one of the following methods: submission of a Mitigation Action Form; comment provided on other worksheets completed throughout the process (i.e., the Goal and Objective Evaluation, the Evaluation of Identified Hazards and Risk Form, or Plan Comment Form); or actions located in the 2005 Mitigation Action Plan that the HMSC evaluated and determined to be in progress or incomplete but still viable.

The final list of 42 mitigation actions for the 2011 HMPU is located in Table 6.4-1. At least one mitigation action was established for each moderate and high-risk hazard in Monroe 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 12, 26, and 27 will contribute to continued compliance with and participation in the NFIP.

Monroe County 2011 Hazard Mitigation Plan

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.

COMMUNITY: Monroe County	ACTION: Upgrade snow removal equipment when funding is available.
ACTION NO: 1	
Category:	Emergency Services
Hazard(s) Addressed:	Winter Storm
Lead Agency/Department:	Monroe County Emergency Management Agency
Implementation Schedule:	As funds become available
Funding Source:	FEMA
COMMUNITY: Monroe County	ACTION: Support the PennDOT Winter Storm education Program for road maintenance.
ACTION NO: 2	
Category:	Public Education and Awareness
Hazard(s) Addressed:	Winter Storm, Transportation Accident
Lead Agency/Department:	Monroe County Emergency Management Agency
Implementation Schedule:	Continuous
Funding Source:	PennDOT
COMMUNITY: Monroe County	ACTION: Expand public education programs for homeowner conservation measures to deal with drought events.
ACTION NO: 3	
Category:	Public Education and Awareness
Hazard(s) Addressed:	Drought
Lead Agency/Department:	Monroe County Conservation District, Monroe County Cooperative Extension
Implementation Schedule:	Within 5 years
Funding Source:	Staff time
COMMUNITY: Monroe County	ACTION: Continue environmental education center programs for school students.
ACTION NO: 4	

Monroe County 2011 Hazard Mitigation Plan

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.

Category:	Public Education and Awareness
Hazard(s) Addressed:	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Hurricane, Tropical Storm, Nor'easter; Pandemic; Tornado, Windstorm; Wildfire; Winter Storm; Dam Failure; Environmental Hazards; Nuclear Incidents; Transportation Accidents; Utility Interruption
Lead Agency/Department:	Monroe County Conservation District
Implementation Schedule:	Continuous
Funding Source:	Staff time
COMMUNITY: Monroe County	ACTION: Enforce UCC and promote the establishment of best practices on implementation.
ACTION NO: 5	
Category:	Prevention
Hazard(s) Addressed:	Earthquake; Flood, Flash Flood, Ice Jam; Hurricane, Tropical Storm, Nor'easter; Tornado, Windstorm; Wildfire; Winter Storm; Utility Interruption
Lead Agency/Department:	Monroe County Planning Commission
Implementation Schedule:	Continuous
Funding Source:	Staff time
COMMUNITY: Monroe County	ACTION: Improve emergency broadcast system by implementing an early warning system to provide additional time for evasive action.
ACTION NO: 6	
Category:	Emergency Services
Hazard(s) Addressed:	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Hurricane, Tropical Storm, Nor'easter; Pandemic; Tornado, Windstorm; Wildfire; Winter Storm; Dam Failure; Environmental Hazards; Nuclear Incidents; Transportation Accidents; Utility Interruption
Lead Agency/Department:	Monroe County Emergency Management Agency
Implementation Schedule:	Within 1 years
Funding Source:	Homeland Security Grant Funding
COMMUNITY: Coolbaugh Township, Ross Township	ACTION: Adopt the updated Stormwater Management Plan and Ordinance for the Brodhead and McMichaels Creeks, which includes an updated floodplain ordinance.
ACTION NO: 7	

Monroe County 2011 Hazard Mitigation Plan

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.	
Category:	Prevention
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Monroe County Conservation District
Implementation Schedule:	Within 1 year
Funding Source:	Staff time
COMMUNITY: Chestnuthill Township, Coolbaugh Township, East Stroudsburg Borough, Hamilton Township, Jackson Township, Middle Smithfield Township, Mount Pocono Borough, Pocono Township, Polk Township, Ross Township, Smithfield Township, Stroud Township, Tobyhanna Township, Tunkhannock Township	ACTION: Complete 911 re-addressing project.
ACTION NO: 8	
Category:	Emergency Services
Hazard(s) Addressed:	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Hurricane, Tropical Storm, Nor'easter; Pandemic; Tornado, Windstorm; Wildfire; Winter Storm; Dam Failure; Environmental Hazards; Nuclear Incidents; Transportation Accidents; Utility Interruption
Lead Agency/Department:	Monroe County Emergency Management Agency
Implementation Schedule:	By December 2011
Funding Source:	County funds (project already being funded)
COMMUNITY: Hamilton Township, Tunkhannock Township	ACTION: Complete the activities to secure "Storm Ready" designation.
ACTION NO: 9	

Monroe County 2011 Hazard Mitigation Plan

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.

Category:	Prevention, Public Education and Awareness
Hazard(s) Addressed:	Flood, Flash Flood, and Ice Jam; Winter Storm; Wildfire; Tornado, Windstorm; Hurricane, Tropical Storm, Nor'easter
Lead Agency/Department:	Township Emergency Management Coordinators
Implementation Schedule:	Within 5 years
Funding Source:	NOAA
COMMUNITY: Jackson Township, Tunkhannock Township	ACTION: Complete the activities to secure "Firewise" designation.
ACTION NO: 10	
Category:	Prevention, Public Education and Awareness
Hazard(s) Addressed:	Wildfire
Lead Agency/Department:	Township Emergency Management Coordinators
Implementation Schedule:	Within 5 years
Funding Source:	National Fire Protection Agency, DCNR Bureau of Forestry
COMMUNITY: Monroe County	ACTION: Encourage wildfire-prone municipalities to implement outdoor burning bans, providing ordinance-writing assistance where necessary.
ACTION NO: 11	
Category:	Prevention
Hazard(s) Addressed:	Wildfire
Lead Agency/Department:	Monroe County Planning Commission, Monroe County Emergency Management Agency
Implementation Schedule:	Within 5 years
Funding Source:	Staff time

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.	
COMMUNITY: Barrett Twp, Chestnuthill Twp, Coolbaugh Two, Delaware Water Gap Borough, East Stroudsburg Borough, Eldred Township, Hamilton Township, Jackson Township, Middle Smithfield Township, Mount Pocono Borough, Paradise Township, Pocono Township, Polk Township, Price Township, Ross Township, Smithfield Township, Stroud Township, Stroudsburg Borough, Tobyhanna Township, Tunkhannock Township	ACTION: Get updated FEMA digital floodplain maps and make them available to communities.
ACTION NO: 12	
Category:	Prevention, Property Protection
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	FEMA
Implementation Schedule:	By 2015
Funding Source:	FEMA, DCED
COMMUNITY: Coolbaugh Township, Mount Pocono Borough, Tobyhanna Township, Tunkhannock Township	ACTION: Update Tobyhanna/Tunkhannock Creek Watershed 167 Plan.
ACTION NO: 13	
Category:	Prevention
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam

Monroe County 2011 Hazard Mitigation Plan

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.	
Lead Agency/Department:	Monroe County Planning Commission, Monroe County Conservation District
Implementation Schedule:	As funds become available
Funding Source:	DEP
COMMUNITY: Chestnuthill Township, Coolbaugh Township, East Stroudsburg Borough, Jackson Township, Middle Smithfield Township, Mount Pocono Borough, Paradise Township, Stroud Township, Stroudsburg Township, Tobyhanna Township, Tunkhannock Township	ACTION: Correct drainage problems as identified in Brodhead/McMichaels and Tobyhanna Creek Watershed Act 167 Plans.
ACTION NO: 14	
Category:	Property Protection, Structural Projects
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Monroe County Conservation District
Implementation Schedule:	As funds become available
Funding Source:	FEMA/HMGP
COMMUNITY: All communities surrounding Route 611: Coolbaugh Township, Mount Pocono Borough, Paradise Township, Stroud Township, Hamilton Township, Delaware Water Gap Borough, Smithfield Township	ACTION: Conduct Commodity Flow Study to evaluate the transportation of hazardous materials on Route 611 and enable the selection of priority mitigation activities.
ACTION NO: 15	
Category:	Prevention

Monroe County 2011 Hazard Mitigation Plan

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.	
Hazard(s) Addressed:	Environmental Hazards
Lead Agency/Department:	Monroe County Emergency Management Agency
Implementation Schedule:	1 year
Funding Source:	USDOT, PEMA
COMMUNITY: Barrett Township, Delaware Water Gap Borough, Eldred Township, Price Township Stroudsburg Borough, Stroud Township	ACTION: Clean up brush and debris in waterways in identified locations and jurisdictions to alleviate flooding.
ACTION NO: 16	
Category:	Natural Resource Protection
Hazard(s) Addressed:	Flood, Flash Flood, and Ice Jam
Lead Agency/Department:	Township Supervisors
Implementation Schedule:	As funds become available
Funding Source:	FEMA/HMGP, DEP
COMMUNITY: Barrett Township	ACTION: Conduct homeowner and business owner outreach to the public on the importance of clearing brush and grass away from buildings, making them less susceptible to wildfires.
ACTION NO: 17	
Category:	Public Education and Awareness
Hazard(s) Addressed:	Wildfire
Lead Agency/Department:	Township Emergency Management Coordinator
Implementation Schedule:	2 years
Funding Source:	FEMA, DCNR
COMMUNITY: Chestnuthill Township	ACTION: Conduct emergency planning for transportation routes to reduce business interruption from transportation accidents.
ACTION NO: 18	

Monroe County 2011 Hazard Mitigation Plan

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.

Category:	Prevention, Emergency Services
Hazard(s) Addressed:	Transportation Accidents
Lead Agency/Department:	Township Supervisors
Implementation Schedule:	3 years
Funding Source:	PennDOT, Monroe County, Chestnuthill Township
COMMUNITY: Hamilton Township, Smithfield Township	ACTION: Upgrade municipal radio system for identified jurisdictions.
ACTION NO: 19	
Category:	Emergency Services
Hazard(s) Addressed:	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Hurricane, Tropical Storm, Nor'easter; Pandemic; Tornado, Windstorm; Wildfire; Winter Storm; Dam Failure; Environmental Hazards; Nuclear Incidents; Transportation Accidents; Utility Interruption
Lead Agency/Department:	Township Emergency Management Coordinators
Implementation Schedule:	As funds become available
Funding Source:	Homeland Security Grant Funding, Regional Counter-Terrorism Task Force, and Township funds for the local match
COMMUNITY: Middle Smithfield Township	ACTION: Conduct two public outreach campaigns to private communities in the Township around the emergency operations plan and opportunities for mitigation assistance.
ACTION NO: 20	
Category:	Public Education and Awareness
Hazard(s) Addressed:	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Hurricane, Tropical Storm, Nor'easter; Pandemic; Tornado, Windstorm; Wildfire; Winter Storm; Dam Failure; Environmental Hazards; Nuclear Incidents; Transportation Accidents; Utility Interruption
Lead Agency/Department:	Township Emergency Management Coordinator
Implementation Schedule:	2 years
Funding Source:	FEMA/HMGP; PEMA
COMMUNITY: Monroe County	ACTION: Conduct community outreach and public education materials for all hazards, including household safety, preparedness and personal

Monroe County 2011 Hazard Mitigation Plan

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.	
ACTION NO: 21	mitigation measures, especially flooding and wildfire.
Category:	Public Education and Awareness
Hazard(s) Addressed:	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Hurricane, Tropical Storm, Nor'easter; Pandemic; Tornado, Windstorm; Wildfire; Winter Storm; Dam Failure; Environmental Hazards; Nuclear Incidents; Transportation Accidents; Utility Interruption with emphasis on Flooding and Wildfires
Lead Agency/Department:	Monroe County Emergency Management Agency
Implementation Schedule:	Continuous
Funding Source:	FEMA/HMGP
COMMUNITY: Polk Township	ACTION: Restore road shoulders with Gabion Baskets at identified locations throughout the Township.
ACTION NO: 22	
Category:	Property Protection; Structural Projects
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Polk Township
Implementation Schedule:	By summer 2012
Funding Source:	Taxes; FEMA/HMGP; DEP
COMMUNITY: Coolbaugh Township, Paradise Township, Polk Township	ACTION: Maintain, repair, and/or replace roadway drainage systems at identified locations to alleviate flooding and prevent transportation incidents.
ACTION NO: 23	
Category:	Property Protection; Structural Projects
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam; Transportation Accidents
Lead Agency/Department:	Polk Township Roads Department
Implementation Schedule:	By fall 2012
Funding Source:	Taxes; FEMA/HMGP; DEP
COMMUNITY: Smithfield Township	ACTION: Purchase an emergency generator for the new municipal center.

Monroe County 2011 Hazard Mitigation Plan

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.

ACTION NO: 24	
Category:	Emergency Services
Hazard(s) Addressed:	Utility Interruption
Lead Agency/Department:	Township Supervisors
Implementation Schedule:	As funds become available
Funding Source:	FEMA; PEMA
COMMUNITY: Tunkhannock Township	ACTION: Distribute NOAA weather alert radios to public facilities municipality-wide.
ACTION NO: 25	
Category:	Emergency Services
Hazard(s) Addressed:	Drought; Flood, Flash Flood, Ice Jam; Hurricane, Tropical Storm, Nor'easter; Tornado, Windstorm; Wildfire; Winter Storm
Lead Agency/Department:	Local Emergency Management Coordinator
Implementation Schedule:	Continuous
Funding Source:	County; PEMA

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.

COMMUNITY: Barrett Twp, Chestnuthill Twp, Coolbaugh Two, Delaware Water Gap Borough, East Stroudsburg Borough, Eldred Township, Hamilton Township, Jackson Township, Middle Smithfield Township, Mount Pocono Borough, Paradise Township, Pocono Township, Polk Township, Price Township, Ross Township, Smithfield Township, Stroud Township, Stroudsburg Borough, Tobyhanna Township, Tunkhannock Township	ACTION: Adopt floodplain ordinances which exceed the minimum FEMA requirements which protect the floodplain and its functions to stop or slow floodwaters to support continued strong participation in the NFIP.
ACTION NO: 26	
Category:	Prevention
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Monroe County Conservation District
Implementation Schedule:	Within 2 years
Funding Source:	DCED
COMMUNITY: Monroe County	ACTION: Encourage participation in the NFIP-CRS program through outreach and education to municipal officials.
ACTION NO: 27	
Category:	Public Education and Awareness
Hazard(s) Addressed:	Flood, Flash Flood, and Ice Jam
Lead Agency/Department:	Monroe County Planning Commission, Monroe County Conservation District
Implementation Schedule:	1 year

Monroe County 2011 Hazard Mitigation Plan

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.

Funding Source:	Staff time
COMMUNITY: Chestnuthill Township, Stroudsburg Borough	ACTION: Upgrade traffic control and detour routes to include non-highway surface roads to help improve circulation and prevent overload on small roads during transportation accidents.
ACTION NO: 28	
Category:	Emergency Services
Hazard(s) Addressed:	Transportation Accidents, Environmental Hazards
Lead Agency/Department:	PennDOT local district
Implementation Schedule:	5 years
Funding Source:	PennDOT
COMMUNITY: Pocono Township	ACTION: Replace and/or elevate (as appropriate) bridges at identified locations to prevent flood-related circulation issues and prevent business interruption.
ACTION NO: 29	
Category:	Structural Projects
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Township Public Works
Implementation Schedule:	Within 1 year
Funding Source:	FEMA/HMGP
COMMUNITY: Pocono Township	ACTION: Mitigate roadway flooding and conduct stream stabilization at identified locations.
ACTION NO: 30	
Category:	Property Protection, Natural Resource Protection
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Township Public Works
Implementation Schedule:	As soon as permits are approved
Funding Source:	FEMA/HMGP

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.

COMMUNITY: Monroe County, Barrett Twp, Chestnuthill Twp, Coolbaugh Two, Delaware Water Gap Borough, East Stroudsburg Borough, Eldred Township, Hamilton Township, Jackson Township, Middle Smithfield Township, Mount Pocono Borough, Paradise Township, Pocono Township, Polk Township, Price Township, Ross Township, Smithfield Township, Stroud Township, Stroudsburg Borough, Tobyhanna Township, Tunkhannock Township	ACTION: Continue to target and prioritize at-risk structures for acquisition, relocation, and elevation countywide, completing Hazard Mitigation Opportunity Forms when applicable, and meet with homeowners on the benefits of mitigation.
ACTION NO: 31	
Category:	Property Protection
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Monroe County Emergency Management Agency
Implementation Schedule:	Continuous
Funding Source:	FEMA/HMGP, RFC, PDM
COMMUNITY: Monroe County	ACTION: Conduct outreach to private owners of high-hazard dams on the importance of dam safety planning and on mitigation opportunities for dam failure hazards.
ACTION NO: 32	
Category:	Public Education and Awareness
Hazard(s) Addressed:	Dam Failure
Lead Agency/Department:	Monroe County Emergency Management Agency

Monroe County 2011 Hazard Mitigation Plan

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.	
Implementation Schedule:	1 year
Funding Source:	Staff Time; DEP
COMMUNITY: Delaware Water Gap Borough	ACTION: Implement traffic calming measures on key roadways.
ACTION NO: 33	
Category:	Prevention, Structural Projects
Hazard(s) Addressed:	Transportation Accidents
Lead Agency/Department:	Borough Engineer
Implementation Schedule:	Within 5 years
Funding Source:	Toll bridge grants
COMMUNITY: Monroe County	ACTION: Disseminate updated Farmers Emergency Information pamphlet titled "What You Should Know about Nuclear Power Plant Incidents" to agricultural facilities located within the 50-mile EPZ of nuclear facilities.
ACTION NO: 34	
Category:	Public Education and Awareness
Hazard(s) Addressed:	Nuclear Incident
Lead Agency/Department:	Monroe County Emergency Management Agency
Implementation Schedule:	When new pamphlet is completed by State Agencies.
Funding Source:	Department of Agriculture, PEMA
COMMUNITY: Paradise Township	ACTION: Conduct stream bank restoration to prevent flooding.
ACTION NO: 35	
Category:	Natural Resource Protection
Hazard(s) Addressed:	Flood, Flash Flood, and Ice Jam
Lead Agency/Department:	Township Zoning Officer
Implementation Schedule:	3 years
Funding Source:	Growing Greener

Monroe County 2011 Hazard Mitigation Plan

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.

COMMUNITY: Paradise Township	ACTION: Enact wildfire protection plan and any appropriate ordinances.
ACTION NO: 36	
Category:	Prevention
Hazard(s) Addressed:	Wildfire
Lead Agency/Department:	Township Zoning Officer
Implementation Schedule:	1 year
Funding Source:	Municipal funds
COMMUNITY: Paradise Township	ACTION: Enact best management plan for flood-related natural resources protection.
ACTION NO: 37	
Category:	Prevention; Natural Resource Protection
Hazard(s) Addressed:	Flood, Flash Flood, and Ice Jam
Lead Agency/Department:	Township Zoning Officer
Implementation Schedule:	2 years
Funding Source:	DEP
COMMUNITY: Paradise Township	ACTION: Enact local airport zoning protection.
ACTION NO: 38	
Category:	Prevention; Property Protection
Hazard(s) Addressed:	Transportation Incidents
Lead Agency/Department:	Township Zoning Officer
Implementation Schedule:	1 year
Funding Source:	Municipal funds
COMMUNITY: Paradise Township	ACTION: Use forest management to protect open space and prevent wildfire events.
ACTION NO: 39	

Monroe County 2011 Hazard Mitigation Plan

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.	
Category:	Prevention; Natural Resource Protection
Hazard(s) Addressed:	Wildfire
Lead Agency/Department:	Township Zoning Officer
Implementation Schedule:	1 year
Funding Source:	Municipal funds
COMMUNITY: Tobyhanna Township	ACTION: Maintain and/or reconstruct identified bridges to prevent transportation accidents and improve the transportation network.
ACTION NO: 40	
Category:	Structural Projects
Hazard(s) Addressed:	Transportation
Lead Agency/Department:	Tobyhanna Township
Implementation Schedule:	3 years
Funding Source:	PennDOT; Federal Highway Administration
COMMUNITY: Tobyhanna Township	ACTION: Remove excess sediment and install channel stabilization at specified locations.
ACTION NO: 41	
Category:	Property Protection
Hazard(s) Addressed:	Flood, Flash Flood, and Ice Jam
Lead Agency/Department:	Tobyhanna Township
Implementation Schedule:	2 years
Funding Source:	FEMA/HMGP
COMMUNITY: Stroudsburg Borough, East Stroudsburg Borough	ACTION: Develop and implement an Emergency Action Plan for the East Stroudsburg/Stroudsburg Joint Flood Control Project.
ACTION NO: 42	
Category:	Prevention

Table 6.4-1: List of 2011 mitigation actions with information including the community or communities affected, action category, hazard addressed, action description, lead agency/department, and general implementation schedule.	
Hazard(s) Addressed:	Flood, Flash Flood, and Ice Jam; Levee Failure
Lead Agency/Department:	Borough Emergency Management Coordinators
Implementation Schedule:	1 year
Funding Source:	DEP, Boroughs

Table 6.4-1 lists 42 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 2011 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 2011 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.

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

MITIGATION ACTIONS		PA STEEL CRITERIA CONSIDERATIONS																					SUMMARY (EQUAL WEIGHTING)	SUMMARY (BENEFITS & COSTS PRIORITIZED)		
		(+) 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		
1	Upgrade snow removal equipment when funding is available.	+	+	+	-	-	-	+	+	+	-	N	+	-	N	-	N	N	N	N	N	+	+	N	9 (+) 6 (-) 8 (N)	11 (+) 8 (-) 8 (N)
2	Support the PennDOT Winter Storm education Program for road maintenance.	+	+	+	-	-	-	N	N	N	-	N	+	+	+	-	N	N	N	N	N	+	+	N	8 (+) 5 (-) 10 (N)	12 (+) 5 (-) 10 (N)
3	Expand public education programs for homeowner conservation measures to deal with drought events.	N	N	N	-	+	N	+	+	N	+	N	+	+	N	N	+	N	N	+	N	N	N	N	8 (+) 1 (-) 14 (N)	12 (+) 1 (-) 14 (N)
4	Continue environmental education center programs for school students.	N	+	+	+	-	N	+	+	N	+	+	+	+	N	-	+	N	N	+	N	N	+	N	12 (+) 2 (-) 9 (N)	16 (+) 2 (-) 9 (N)
5	Enforce UCC and promote the establishment of best practices on implementation.	+	N	N	-	-	+	+	+	+	+	+	+	-	+	-	N	N	N	N	N	+	N	N	10 (+) 4 (-) 9 (N)	12 (+) 6 (-) 9 (N)
6	Improve emergency broadcast system by implementing an early warning system to provide additional time for evasive action	+	+	+	N	-	-	+	+	+	+	+	+	-	N	-	N	N	+	+	N	N	+	N	12 (+) 4 (-) 7 (N)	14 (+) 6 (-) 7 (N)

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

MITIGATION ACTIONS		PA STEEL CRITERIA CONSIDERATIONS																				SUMMARY (EQUAL WEIGHTING)	SUMMARY (BENEFITS & COSTS PRIORITIZED)			
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		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		
7	Adopt the updated Stormwater Management Plan and Ordinance for the Brodhead and McMichaels Creeks, which includes an updated floodplain ordinance.	-	+	N	N	N	N	+	+	+	+	+	+	+	N	-	+	N	N	+	+	+	+	N	13 (+) 2 (-) 8 (N)	17 (+) 2 (-) 8 (N)
8	Complete 911 re-addressing project.	+	+	+	+	+	+	+	+	+	+	N	+	-	N	-	N	N	N	+	N	N	+	N	13 (+) 2 (-) 8 (N)	15 (+) 4 (-) 8 (N)
9	Complete the activities to secure "Storm Ready" designation	N	+	N	N	+	N	+	+	N	N	+	+	+	N	N	N	N	N	N	N	N	N	N	7 (+) 0 (-) 16 (N)	11 (+) 0 (-) 16 (N)
10	Complete the activities to secure "Firewise" designation	N	+	N	N	+	N	+	+	N	N	+	+	+	N	N	N	N	N	N	N	N	N	N	7 (+) 0 (-) 16 (N)	14 (+) 4 (-) 9 (N)
11	Encourage wildfire-prone municipalities to implement outdoor burning bans, providing ordinance-writing assistance where necessary.	-	-	+	N	N	N	-	+	+	N	+	+	+	N	N	+	N	N	+	N	+	+	-	10 (+) 4 (-) 9 (N)	16 (+) 4 (-) 9 (N)
12	Get updated FEMA digital floodplain maps and make them available to communities.	+	+	+	N	N	N	+	+	+	+	+	+	-	N	-	+	N	N	+	+	+	+	N	14 (+) 2 (-) 7 (N)	16 (+) 4 (-) 7 (N)

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

MITIGATION ACTIONS		PA STEEL CRITERIA CONSIDERATIONS																				SUMMARY (EQUAL WEIGHTING)	SUMMARY (BENEFITS & COSTS PRIORITIZED)			
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		P Political			A Administrative			S Social		T Technical			E Economic			E Environmental					L Legal					
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13	Update Tobyhanna/Tunkhannock Creek Watershed 167 Plan.	N	+	N	N	-	-	+	+	+	N	+	+	+	N	-	+	N	N	+	N	+	+	N	11 (+) 3 (-) 9 (N)	15 (+) 3 (-) 9 (N)
14	Correct drainage problems as identified in Brodhead/McMichaels and Tobyhanna Creek Watershed Act 167 Plans.	N	-	N	N	-	-	+	+	+	+	N	+	-	N	-	N	N	N	N	N	N	N	N	5 (+) 5 (-) 13 (N)	7 (+) 7 (-) 13 (N)
15	Conduct Commodity Flow Study to evaluate the transportation of hazardous materials on Route 611 and enable the selection of priority mitigation activities.	+	N	+	+	-	N	+	+	+	N	N	+	+	+	-	+	N	+	N	N	N	N	N	11 (+) 2 (-) 10 (N)	15 (+) 2 (-) 10 (N)
16	Clean up brush and debris in waterways in identified locations and jurisdictions to alleviate flooding.	N	+	N	-	-	N	+	+	+	-	+	+	-	N	-	+	N	N	N	N	-	+	N	8 (+) 6 (-) 9 (N)	10 (+) 8 (-) 9 (N)
17	Conduct homeowner and business owner outreach to the public on the importance of clearing brush and grass away from buildings, making them less susceptible to wildfires.	-	+	N	-	N	N	+	+	+	N	N	+	+	N	N	N	N	N	+	N	N	+	N	8 (+) 2 (-) 13 (N)	12 (+) 2 (-) 13 (N)

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

MITIGATION ACTIONS		PA STEEL CRITERIA CONSIDERATIONS																				SUMMARY (EQUAL WEIGHTING)	SUMMARY (BENEFITS & COSTS PRIORITIZED)			
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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		
18	Conduct emergency planning for transportation routes to reduce business interruption from transportation accidents.	+	+	+	N	-	N	+	+	+	N	N	+	-	+	-	N	N	N	N	N	-	+	N	9 (+) 4 (-) 10 (N)	11 (+) 6 (-) 10 (N)
19	Upgrade municipal radio system for identified jurisdictions.	+	+	N	+	-	-	N	+	+	+	N	+	-	N	-	N	N	N	+	N	N	+	N	9 (+) 4 (-) 10 (N)	11 (+) 6 (-) 10 (N)
20	Conduct two public outreach campaigns to private communities in the Township around the emergency operations plan and opportunities for mitigation assistance.	N	+	N	N	N	N	-	+	N	N	+	+	+	N	-	N	N	N	N	N	N	N	N	5 (+) 2 (-) 16 (N)	9 (+) 2 (-) 16 (N)
21	Conduct community outreach and public education materials for all hazards, including household safety, preparedness and personal mitigation measures, especially flooding and wildfire.	+	+	+	-	N	N	+	N	N	N	+	+	+	N	-	+	N	N	+	N	+	+	N	11 (+) 2 (-) 10 (N)	15 (+) 2 (-) 10 (N)

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

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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		
22	Restore road shoulders with Gabion Baskets at identified locations throughout the Township.	+	+	N	-	-	-	+	+	+	-	-	+	-	N	-	-	N	N	N	N	N	N	N	6 (+) 8 (-) 9 (N)	8 (+) 10 (-) 9 (N)
23	Maintain, repair, and/or replace roadway drainage systems at identified locations to alleviate flooding and prevent transportation incidents.	+	+	+	N	-	-	+	N	+	+	N	+	-	N	-	+	N	N	N	N	-	+	N	9 (+) 5 (-) 9 (N)	11 (+) 7 (-) 9 (N)
24	Purchase an emergency generator for the new municipal center.	+	+	N	N	N	+	+	+	N	+	N	+	-	+	-	N	N	N	N	N	N	N	N	8 (+) 2 (-) 13 (N)	10 (+) 4 (-) 13 (N)
25	Distribute NOAA weather alert radios to public facilities municipality-wide	N	N	+	N	N	N	+	-	N	+	N	+	-	N	-	N	N	N	N	N	N	+	N	5 (+) 3 (-) 15 (N)	7 (+) 5 (-) 15 (N)
26	Adopt floodplain ordinances which exceed the minimum FEMA requirements which protect the floodplain and its functions to stop or slow floodwaters to support continued strong participation in the NFIP.	-	+	N	-	N	N	-	+	N	N	N	+	+	N	N	+	N	N	+	+	+	+	N	9 (+) 3 (-) 11 (N)	13 (+) 3 (-) 11 (N)

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

MITIGATION ACTIONS		PA STEEL CRITERIA CONSIDERATIONS																				SUMMARY (EQUAL WEIGHTING)	SUMMARY (BENEFITS & COSTS PRIORITIZED)			
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27	Encourage participation in the NFIP-CRS program through outreach and education to municipal officials.	-	-	N	N	-	N	+	+	N	+	N	+	+	+	-	N	N	N	+	+	N	N	N	8 (+) 4 (-) 11 (N)	12 (+) 4 (-) 11 (N)
28	Upgrade traffic control and detour routes to include non-highway surface roads to help improve circulation and prevent overload on small roads during transportation accidents	+	+	+	-	-	+	+	N	N	N	N	+	-	+	-	N	N	N	N	N	-	N	N	7 (+) 5 (-) 11 (N)	9 (+) 7 (-) 11 (N)
29	Replace and/or elevate (as appropriate) bridges at identified locations to prevent flood-related circulation issues and prevent business interruption.	+	+	N	N	-	+	N	N	+	N	N	+	-	N	-	N	N	N	N	N	-	N	N	5 (+) 4 (-) 14 (N)	7 (+) 6 (-) 14 (N)
30	Mitigate roadway flooding and conduct stream stabilization at identified locations.	N	+	+	-	-	+	+	+	+	N	N	+	-	+	-	+	N	N	+	N	N	+	N	11 (+) 4 (-) 8 (N)	13 (+) 6 (-) 8 (N)

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

MITIGATION ACTIONS		PA STEEL CRITERIA CONSIDERATIONS																				SUMMARY (EQUAL WEIGHTING)	SUMMARY (BENEFITS & COSTS PRIORITIZED)			
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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		
31	Continue to target and prioritize at-risk structures for acquisition, relocation, and elevation countywide, completing Hazard Mitigation Opportunity Forms when applicable, and meet with homeowners on the benefits of mitigation.	+	+	+	+	-	+	+	+	+	+	+	+	-	N	-	+	N	N	+	+	+	+	N	16 (+) 3 (-) 4 (N)	18 (+) 5 (-) 4 (N)
32	Conduct outreach to private owners of high-hazard dams on the importance of dam safety planning and on mitigation opportunities for dam failure hazards.	N	N	N	N	N	+	+	+	+	+	+	+	+	N	N	+	N	+	+	N	N	+	N	12 (+) 0 (-) 11 (N)	16 (+) 0 (-) 11 (N)
33	Implement traffic calming measures on key roadways.	+	+	+	N	N	+	N	N	+	+	+	+	-	N	-	N	N	N	N	N	N	N	N	8 (+) 2 (-) 13 (N)	10 (+) 4 (-) 13 (N)

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

MITIGATION ACTIONS		PA STEEL CRITERIA CONSIDERATIONS																				SUMMARY (EQUAL WEIGHTING)	SUMMARY (BENEFITS & COSTS PRIORITIZED)			
		(+) 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		
34	Disseminate updated Farmers Emergency Information pamphlet titled "What You Should Know about Nuclear Power Plant Incidents" to agricultural facilities located within the 50-mile EPZ of nuclear facilities.	N	N	N	N	N	N	+	+	N	N	+	+	+	N	N	N	N	N	N	N	N	+	N	6 (+) 0 (-) 17 (N)	10 (+) 0 (-) 17 (N)
35	Conduct stream bank restoration to prevent flooding.	N	N	+	N	-	+	+	+	+	+	+	+	-	N	-	+	N	N	+	N	N	N	N	10 (+) 3 (-) 10 (N)	12 (+) 5 (-) 10 (N)
36	Enact wildfire protection plan and any appropriate ordinances.	+	N	N	N	N	+	+	+	+	+	+	+	+	N	N	N	N	N	+	N	N	+	N	11 (+) 0 (-) 12 (N)	15 (+) 0 (-) 12 (N)
37	Enact best management plan for flood-related natural resources protection.	N	N	N	N	N	+	+	+	+	+	+	+	+	N	N	N	N	N	+	N	N	N	N	9 (+) 0 (-) 14 (N)	13 (+) 0 (-) 14 (N)
38	Enact local airport zoning protection.	-	+	N	N	N	+	+	+	+	+	+	+	+	N	N	N	N	N	N	N	N	N	N	9 (+) 1 (-) 13 (N)	13 (+) 1 (-) 13 (N)
39	Use forest management to protect open space and prevent wildfire events.	+	+	+	N	-	+	+	+	N	N	+	+	+	N	N	+	N	N	+	N	N	N	N	11 (+) 1 (-) 11 (N)	13 (+) 1 (-) 11 (N)

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

MITIGATION ACTIONS		PA STEEL CRITERIA CONSIDERATIONS																				SUMMARY (EQUAL WEIGHTING)	SUMMARY (BENEFITS & COSTS PRIORITIZED)			
		(+) 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		
40	Maintain and/or reconstruct identified bridges to prevent transportation accidents and improve the transportation network.	+	+	+	-	-	-	+	N	N	N	N	+	-	N	N	N	N	N	N	N	N	N	N	5 (+) 4 (-) 14 (N)	7 (+) 6 (-) 14 (N)
41	Remove excess sediment and install channel stabilization at specified locations.	N	+	N	-	-	-	+	N	+	N	-	+	-	N	-	+	N	N	+	N	N	N	N	6 (+) 6 (-) 11 (N)	8 (+) 8 (-) 11 (N)
42	Develop and implement an Emergency Action Plan for the East Stroudsburg/Stroudsburg Joint Flood Emergency Project.	+	+	N	N	N	+	+	+	+	N	+	+	+	N	-	+	N	+	+	N	+	N	N	13 (+) 1 (-) 9 (N)	17 (+) 1 (-) 9 (N)

Using cost-benefit weighted prioritization, one action received more unfavorable ratings than favorable ratings: Action 22. This action has to do with restoring road shoulders with Gabion Baskets throughout the Township. Additionally, two actions tied on unfavorable and favorable ratings: Actions 14 and 41. Action 14 seeks to identify and correct drainage problems throughout the County while Action 41 involves installing channel stabilization in streams. The ratings do not mean that these actions should not be considered. Rather, barriers to implementation may increase their costs (i.e. political, financial, time, etc...) and therefore reduce overall benefits.

7. Plan Maintenance

7.1. Update Process Summary

Monitoring, evaluating and updating this plan, is critical to maintaining its value and success in Monroe 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 2005 maintenance procedures. The 2005 plan monitoring stated that the Monroe County EMA would prepare a "State of the Plan" report every five years coupled with a public meeting to solicit input. This procedure has been supplanted by PEMA's new plan update standards as found in the Standard Operating Guidance. The 2005 plan maintenance also established an annual meeting to review progress and implementation and to develop plan revisions, as needed. To the best knowledge of the HMSC, no plan maintenance was conducted from 2005-2011, though the public had continual access to the HMP through the County's website.

The HMSC recognizes the importance of monitoring, evaluating, and updating the plan and decided to alter the 2005 maintenance procedures to establish yearly evaluations with each municipality providing information as needed; the proposed maintenance schedule was presented at the public meeting and there were no comments received about it. The 2011 HMPU builds on the spirit of the 2005 plan maintenance procedures, stating that the County will conduct both an annual review and a review of the plan within 30 days of a disaster event to help identify mitigation opportunities. This HMPU also defines the municipalities' role in updating and evaluating the plan. Finally, the 2011 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 2011 HMPU is designated to administer the plan maintenance processes of monitoring, evaluation and updating with support and representation from all 21 participating municipalities. Maryellen Keegan, Hazard Preparedness Planner at the Monroe County Emergency Management Agency, in coordination with and cooperation of John Woodling, the Director of the Monroe County Planning Commission, 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 2011 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 HMPU.

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. 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 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 2011 HMPU into them.

The 2011 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 Monroe 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

In the past five years, Monroe County has worked diligently to implement this plan, the Monroe 2020 Comprehensive Plan, Open Space Plan, and Act 167 plans. However, not many new plans have been written in this time period, so there have been few opportunities to incorporate the 2005 findings into other planning mechanisms. The exception to this is the regional comprehensive plans. For example, the Chestnuthill-Jackson-Eldred-Ross Comprehensive Plan establishes goals of protecting water resources, especially the floodplain, for the protection of both property and the environment. Similarly, the Coolbaugh-Mount Pocono-Tobyhanna-Tunkhannock Comprehensive Plan includes the objective of minimizing flood damage and protecting the floodplain; the Hamilton-Pocono-Stroud-Stroudsburg Comprehensive Plan discusses the importance of acquiring key tracts of land that can absorb flood waters. The 2005 HMP played a key role in identifying the at-risk areas for each of these plans.

Moving forward, based on the comprehensive nature of this plan, the HMSC believes that this document will be highly useful when updating and developing other planning mechanisms in the County. Specific documents that the HMSC will actively incorporate information from the 2011 HMPU into include:

- Monroe 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 Comprehensive Plans: The 2011 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.
- Monroe County Emergency Operations Plan: The 2011 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 2011 HMPU will provide information on risk and vulnerability that will assist municipalities in developing their EOPs.
- Monroe County Hazard Vulnerability Analysis: The County's most recent HVA is from 1984; the 2011 HMPU will be used to aid in goal and objective development, hazard identification, and risk assessment in the next County HVA. These two documents are used together to better understand risk and vulnerability.
- Municipality Local Land Use Regulations: The Hazard Mitigation Plan provides an opportunity to contribute to local land use regulations to steer development away from hazard-prone areas.
- Act 167 Stormwater Management Plans: The Tobyhanna Creek Act 167 Plan is overdue for an update and the Brodhead-McMichaels Creek Act 167 Plan will likely need to be updated before the next HMP update. The results of the 2011 HMPU vulnerability analysis, particularly for flooding, will be taken into consideration when updating these stormwater management plans.

7.4. Continued Public Involvement

As was done during the development of the 2011 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, Monroe County Emergency Management Agency or the Monroe County Planning Commission. The EMA will also keep a paper copy of the plan should a citizen not have ready electronic access. 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://www.co.monroe.pa.us>). 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 April 26, 2011. It was forwarded to FEMA for final review and approval-pending-adoption on April 27, 2011. FEMA granted approval-pending-adoption on October 25, 2011. Full approval from FEMA was received on *<Month Day, Year>*.

This section of the plan includes copies of the local adoption resolutions passed by Monroe 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.

Monroe County 2011 Hazard Mitigation Plan
County Adoption Resolution

Resolution No. _____
Monroe County, Pennsylvania

WHEREAS, the municipalities of Monroe County, Pennsylvania are most vulnerable to natural and human-made hazards which may result in loss of life and property, economic hardship, and threats to public health and safety, and

WHEREAS, Section 322 of the Disaster Mitigation Act of 2000 (DMA 2000) requires state and local governments to develop and submit for approval to the President a mitigation plan that outlines processes for identifying their respective natural hazards, risks, and vulnerabilities, and

WHEREAS, Monroe County acknowledges the requirements of Section 322 of DMA 2000 to have an approved Hazard Mitigation Plan as a prerequisite to receiving post-disaster Hazard Mitigation Grant Program funds, and

WHEREAS, the Monroe County 2011 Hazard Mitigation Plan has been developed by the Monroe County Emergency Management Agency and the Monroe County Planning Commission in cooperation with other county departments, local municipal officials, and the citizens of Monroe County, and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the Monroe County 2011 Hazard Mitigation Plan, and

WHEREAS, the Monroe County 2011 Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural and human-made hazards that face the County and its municipal governments,

NOW THEREFORE BE IT RESOLVED by the governing body for the County of Monroe that:

- The Monroe County 2011 Hazard Mitigation Plan is hereby adopted as the official Hazard Mitigation Plan of the County, and
The respective officials and agencies identified in the implementation strategy of the Monroe County 2011 Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

ADOPTED, this _____ day of _____, 2011

ATTEST:

MONROE COUNTY COMMISSIONERS

By _____

By _____

By _____

Monroe County 2011 Hazard Mitigation Plan
Municipal Adoption Resolution

Resolution No. _____

<Borough/Township of Municipality Name>, Monroe County, Pennsylvania

WHEREAS, the <Borough/Township of Municipality Name>, Monroe County, Pennsylvania is most vulnerable to natural and human-made hazards which may result in loss of life and property, economic hardship, and threats to public health and safety, and

WHEREAS, Section 322 of the Disaster Mitigation Act of 2000 (DMA 2000) requires state and local governments to develop and submit for approval to the President a mitigation plan that outlines processes for identifying their respective natural hazards, risks, and vulnerabilities, and

WHEREAS, the <Borough/Township of Municipality Name> acknowledges the requirements of Section 322 of DMA 2000 to have an approved Hazard Mitigation Plan as a prerequisite to receiving post-disaster Hazard Mitigation Grant Program funds, and

WHEREAS, the Monroe County 2011 Hazard Mitigation Plan has been developed by the Monroe County Emergency Management Agency and the Monroe County Planning Commission in cooperation with other county departments, and officials and citizens of <Borough/Township of Municipality Name>, and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the Monroe County 2011 Hazard Mitigation Plan, and

WHEREAS, the Monroe County 2011 Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural and human-made hazards that face the County and its municipal governments,

NOW THEREFORE BE IT RESOLVED by the governing body for the <Borough/Township of Municipality Name>:

- The Monroe County 2011 Hazard Mitigation Plan is hereby adopted as the official Hazard Mitigation Plan of the <Borough/Township>, and
The respective officials and agencies identified in the implementation strategy of the Monroe County 2011 Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

ADOPTED, this _____ day of _____, 2011

ATTEST: <BOROUGH/TOWNSHIP OF MUNICIPALITY NAME>

By _____

By _____

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)*
- Appendix H – Inventory of EPA TRI Hazardous Materials Facilities*

** Appendices are available for viewing at:

Monroe County Planning Office
Office of Emergency Management