

MCM Consulting Group, Inc.

# Monroe County 2016 Hazard Mitigation Plan

Monroe County Office of Emergency Management



**Monroe County, Pennsylvania**  
**2016 Hazard Mitigation Plan *DRAFT***

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**Certification of Annual Review Meetings**

<b>YEAR</b>	<b>DATE OF MEETING</b>	<b>PUBLIC OUTREACH ADDRESSED?*</b>	<b>SIGNATURE</b>
2017			
2018			
2019			
2020			
2021			

*\*Confirm yes here annually and describe on record of change page.*

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**Record of Changes**

<b>DATE</b>	<b>DESCRIPTION OF CHANGE MADE, MITIGATION ACTION COMPLETED, OR PUBLIC OUTREACH PERFORMED</b>	<b>CHANGE MADE BY (PRINT NAME)</b>	<b>CHANGE MADE BY (SIGNATURE)</b>

**REMINDER:** *Please attach all associated meeting agendas, sign-in sheets, handouts and minutes.*

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### **1. Introduction**

#### **1.1. Background**

The Monroe County Board of Commissioners, in response to the Disaster Mitigation Act of 2000 (DMA 2000), organized a countywide hazard mitigation planning effort to prepare, adopt and implement a multi-jurisdictional Hazard Mitigation Plan (HMP) for Monroe County and all of its twenty municipalities. The Monroe County Office of Emergency Management was charged by the County Board of Commissioners to prepare the 2016 plan. The 2011 HMP has been utilized and maintained during the 5 year life cycle.

The Monroe County Commissioners assigned the Monroe County Office of Emergency Management with the primary responsibility to update the hazard mitigation plan. MCM Consulting Group, Inc. was selected to complete the update of the HMP. A local hazard mitigation planning team was developed comprised of government leaders and citizens from Monroe County. This updated HMP will provide another solid foundation for the Monroe County Hazard Mitigation Program.

Hazard mitigation describes sustained actions taken to prevent or minimize long-term risks to life and property from hazards and to 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. 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 reestablish themselves in the wake of a disaster, getting the economy back on track sooner and with less interruption.

#### **1.2. Purpose**

The purpose of this All-Hazard Mitigation Plan 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 speed recovery and redevelopment following future disaster events;
- To demonstrate a firm local commitment to hazard mitigation principles; and

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

### **1.3. Scope**

This Monroe County Multi-Jurisdictional Hazard Mitigation Plan serves as a framework for saving lives, protecting assets and preserving the economic viability of the twenty municipalities in Monroe County. The HMP outlines actions designed to address and reduce the impact of a full range of natural hazards facing Monroe County, including drought, earthquakes, flooding, tornados, hurricanes/tropical storms and severe winter weather. Manmade hazards such as transportation accidents, hazardous materials spills and fires are also addressed.

A multi-jurisdictional planning approach was utilized for the Monroe County HMP update, thereby eliminating the need for each municipality to develop its own approach to hazard mitigation and its own planning document. Further, this type of planning effort results in a common understanding of the hazard vulnerabilities throughout the county, a comprehensive list of mitigation projects, common mitigation goals and objectives and an evaluation of a broad capabilities assessment examining policies and regulations throughout the county and its municipalities.

Updates will take place at a minimum of every five years, but updates will also take place following significant disaster events.

### **1.4. Authority and Reference**

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
- 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
- Pennsylvania Stormwater Management Act of October 4, 1978. P.L. 864, No. 167

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The following Federal Emergency Management Agency (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
- FEMA *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*. January 2013

The following Pennsylvania Emergency Management Agency (PEMA) guides and reference documents were used to prepare this document:

- PEMA: *Hazard Mitigation Planning Made Easy!*
- PEMA *Mitigation Ideas: Potential Mitigation Measures by Hazard Type: A Mitigation Planning Tool for Communities*. March 6, 2009
- PEMA: *Standard Operating Guide*. October 18, 2013

The following document produced by the National Fire Protection Association (NFPA) provided additional guidance for updating this plan:

- NFPA 1600: *Standard on Disaster/Emergency Management and Business Continuity Programs*. 2011

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## **2. Community Profile**

### **2.1. Geography and the Environment**

Monroe County is unique among the 67 counties in Pennsylvania. 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. Areas such as Camelback Mountain Resort and the Pocono Raceway draw a large contingent of seasonal visitors and the Mount Airy Resort and Casino draws visitors daily of the tristate region. At the time of the previous plan these factors created an appealing housing market for individuals and families that were willing to commute to the cities or were looking for a second home.

According to the 2011 HMP the growing housing market contributed to a 22.5 percent population increase between 2000 and 2010 and a projected 70 percent increase between 2000 and 2020. In reality according to the Census Bureau in a July 2014 estimate the population has actually decreased by 2.1% since the 2010 census. A major contributing factor was the collapse of the housing market. As sales prices decreased the number of foreclosures increased forcing many homeowners to abandon their homes and leaving them vacant. According to the Pocono Mountain Association of Realtors a slow recovery began in 2013 and sales increased by 24 percent.

The natural beauty which is the basis of Monroe County's tourist appeal is preserved though the mostly rural and undeveloped land. 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 Pike County to the east in Pennsylvania; and Warren and Sussex Counties in New Jersey to the east. A base map of the County is provided in *Figure 5 - Monroe County Base Map*. While most of the County is considered rural, East Stroudsburg was classified as an urban area by the 2010 US Census. Overall, the CDC classified as a "small metro" county in 2013, meaning that the County is in an "MSA of less than 250,000 population." This classification is a 4 on a scale from 1 to 6, with 6 being most rural and 1 being most urban (CDC, 2013).

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. In 1999, the County enacted a Comprehensive Plan intended to maintain the pristine environment of the County. This plan was updated in 2014. Monroe County contains part of the Delaware Water Gap National Recreation Area which averages four

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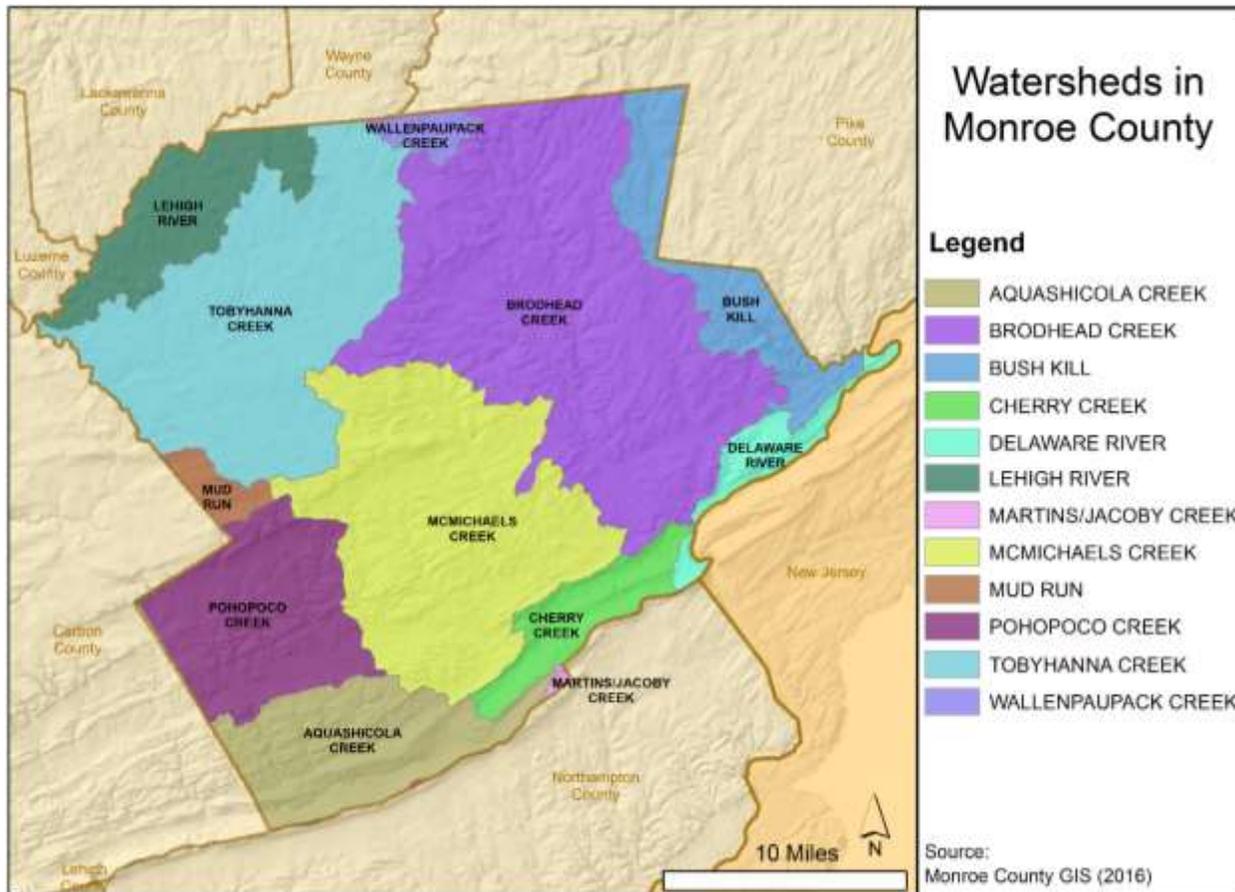
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million visitors a year. Big Pocono State Park and Tobyhanna State Park are also located in Monroe County.

There are twelve watersheds in Monroe County, including the watersheds for the Delaware and Lehigh Rivers. The largest watersheds are the Brodhead Creek, McMichael's Creek and the Tobyhanna Creek watersheds. See *Figure 1 - Monroe County Watersheds*.

*Figure 1 - Monroe County Watersheds*



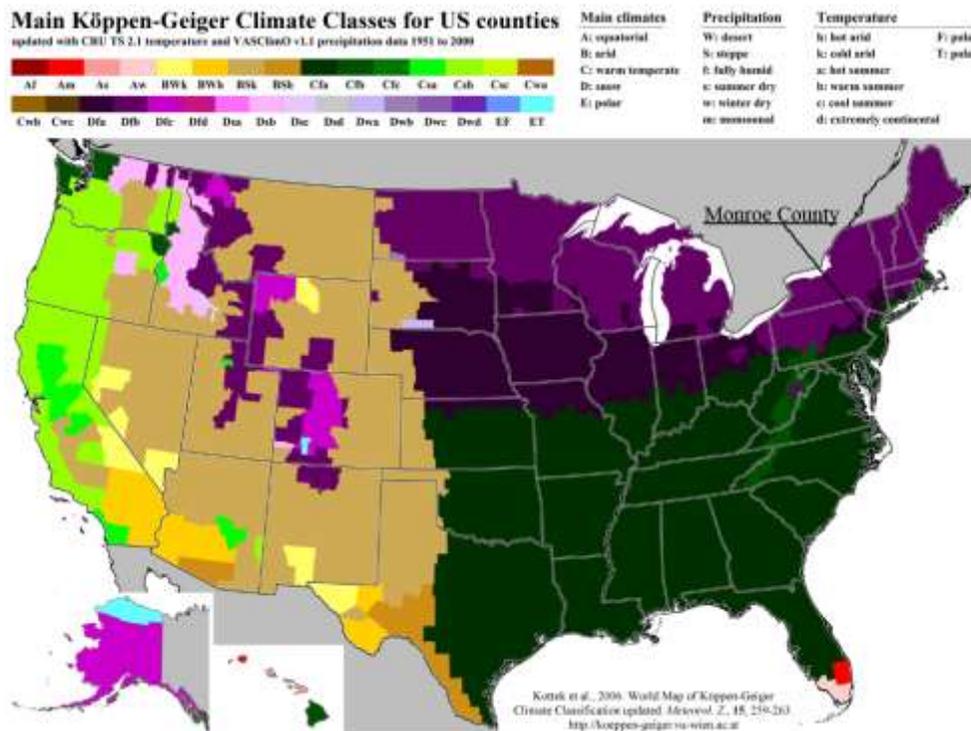
Monroe County on average receives 48 inches of rain per year. The US average is 37. Snowfall averages 52 inches in comparison to the average U.S. city receiving 25 inches of snow per year. The number of days with any measurable precipitation is 130. On average, there are 192 sunny days per year in Monroe County. The warmest month is July where the high is around 82 degrees and the coldest month is January with an average low of 16 degrees.

The Koppen-Geiger Climate Areas map classifies Monroe County and the rest of Pennsylvania, as Humid Continental (See *Figure 2 - Koppen-Geiger Climate Map*). While the counties of Pennsylvania share many weather similarities, there are also a few unique characteristics to certain regions.

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Figure 2 - Köppen-Geiger Climate Map



Monroe County is located in the northeastern region of Pennsylvania, sharing part of its eastern border with New Jersey. The weather patterns and climatic conditions of Monroe County are a major risk factor. The county’s weather extremes are the primary contributors to many of the county’s natural hazard events, including flash floods, winter storms, drought, high wind and lightning.

### 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 consists of a total of twenty municipalities, four boroughs and sixteen townships.

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 two 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. 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

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the second fastest growing in Pennsylvania into the 21<sup>st</sup> Century. 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, Delaware Water Gap National Recreation Area 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.

Monroe County is home to the Tobyhanna Army Depot. They are a military technology center and the largest employer in the county.

The following boroughs and townships are located in Monroe County:

### **Boroughs:**

- Delaware Water Gap
- East Stroudsburg
- Mount Pocono
- Stroudsburg (County seat)

### **Townships:**

- Barrett Township
- Chestnuthill Township
- Coolbaugh Township
- Eldred Township
- Hamilton Township
- Jackson Township
- Middle Smithfield Township
- Paradise Township
- Pocono Township
- Polk Township
- Price Township
- Ross Township

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- Smithfield Township
- Stroud Township
- Tobyhanna Township
- Tunkhannock Township

As of the first quarter of 2015, Monroe County has over 79,500 people in the civilian labor force, with 74,400 employed. There is an unemployment rate of 6.4% in Monroe County. The unemployment rate for the Commonwealth of Pennsylvania is 5.3%. Source: Pennsylvania Department of Labor and Industry.

*Table 1 - Top Employers*

<b>Monroe County Top 50 Employers (2014)</b>			
<b>Rank</b>	<b>Name Of Employer</b>	<b>Rank</b>	<b>Name Of Employer</b>
1	Federal Government (Tobyhanna Army Depot)	26	United Envelope LLC
2	Aventis Pasteur Inc.	27	Hayward Laboratories Inc.
3	Wal-Mart Associates Inc.	28	Lowes Home Centers Inc.
4	Pocono Medical Center	29	Ski Shawnee Inc.
5	Pocono Mountain School District	30	URS Federal Services Inc.
6	Mount Airy Casino Resort	31	Shoprite Of Mount Pocono
7	East Stroudsburg Area School Dist	32	Family Care Centers Inc.
8	Pleasant Valley School District	33	Shawnee Inn
9	Stroudsburg Area School District	34	Stroudsmoor Resort
10	Pa State System Of Higher Education	35	Pleasant Valley Manor Inc.
11	CBH2O LP	36	East Stroudsburg Savings Assn
12	Monroe County	37	YMCA of Monroe County
13	Weis Markets Inc.	38	Manpower International Inc.
14	Great Wolf Lodge	39	Pennsylvania CVS Pharmacy LLC
15	State Government	40	Northampton County Area Comm. College
16	Weiler Corporation	41	Colonial Intermediate Unit No 20
17	Kinsley's Market Of Tannersville	42	Pocono Profoods
18	JFBB Ski Areas Inc.	43	Iridium Industries Inc.
19	Genco I, Inc.	44	GMRI Inc.
20	Columbia Associates Management Lp	45	Target Corporation
21	Skytop Lodge Corporation	46	K-Mart Corporation
22	Fedex Freight Inc.	47	Compass Two Llc
23	Fitzmaurice Community Services Inc.	48	Under Armour Retail Inc.
24	Wyndham Vacation Ownership Inc.	49	Village Super Market Of Pa Inc.
25	Highgate Hotels	50	Giant Food Stores LLC

### 2.3. Population and Demographics

Monroe County is classified politically as a fourth class county. The 2010 population was 169,842 people. Monroe County is composed of four boroughs and sixteen townships. The populations per municipality are identified in *Table 2 - Municipal Population* below. Population density is 279 people per square mile.

In Monroe County 21.3% residents are under the age of 18, 63.6% are age 18-64 and 15.1% are age 65 or older. The median age is 40 within the county. In accordance with the 2010 census, 131,162 were white, 22,348 were black/African American and 16,332 were other race.

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There were an estimated 58,875 households in 2013. The average household size is 2.81 and the average family size is 3.17. Monroe County has a median household income of \$57,408 with a median per capita income of \$25,494. 12% of the residents live below the poverty level. These estimates are lower than the projections reported in the 2011 HMP.

*Table 2 - Municipal Population*

<b>Monroe County Municipality Populations</b>			
<b>Municipality</b>	<b>Population</b>	<b>Municipality</b>	<b>Population</b>
Barrett Township	4,225	Paradise Township	3,186
Chestnuthill Township	17,156	Pocono Township	11,065
Coolbaugh Township	20,564	Polk Township	7,874
Delaware Water Gap Borough	746	Price Township	3,573
East Stroudsburg Borough	9,840	Ross Township	5,940
Eldred Township	2,910	Smithfield Township	7,357
Hamilton Township	9,083	Stroud Township	19,213
Jackson Township	7,033	Stroudsburg Borough	5,567
Middle Smithfield Township	15,997	Tobyhanna Township	8,554
Mount Pocono Borough	3,170	Tunkhannock Township	6,789

Source: 2010 Census Bureau

There are five major transportation routes within the county that would be capable of handling a large amount of heavy truck traffic. The County is bisected by Interstates 80 and 380, with I-80 running east to west and I-380 running north from I-80. US 209 traverses the bottom half of the county running from Carbon County to Pike County. There are two major state highways, SR 33 and SR 611. SR 33 is a four lane expressway that connects Interstate 80 to Interstate 78 in Northampton County. SR 611 traverses the County from south to north ending just short of the county line in Tobyhanna. There are other state roads capable of large amounts of traffic, including but not limited to: State Routes 115, 191, 314, 390, 402, 423, 447, 534 and 715. These routes can be viewed on the county base map, *Figure 5 - Monroe County Base Map*.

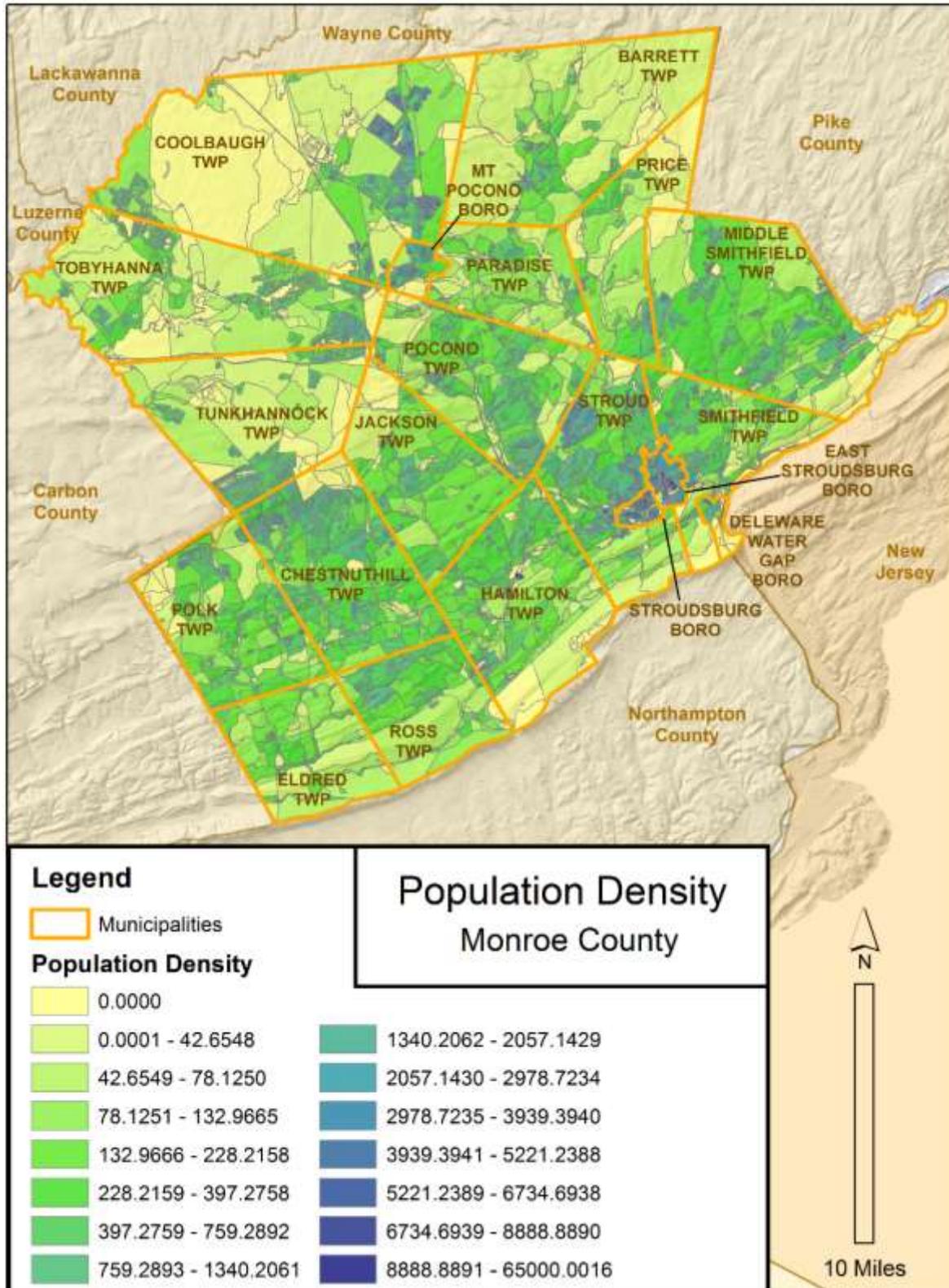
Pocono Medical Center in East Stroudsburg is the only hospital located in the County. In April of 2015 St. Luke's University Health Network broke ground for a new hospital in Bartonsville, near Route 33 and Interstate 80. It is anticipated to be opening in 2017. Pocono Medical Center and Geisinger Health Systems also operate walk-in Emergency Clinics in the county.

There are nineteen volunteer fire companies and five paid ambulance companies serving the county. There are three municipal and two regional police departments as well as three school and one university department. The Pennsylvania State Police also cover portions of the county that are not covered by a local or regional department.

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Figure 3 - Population Density Map



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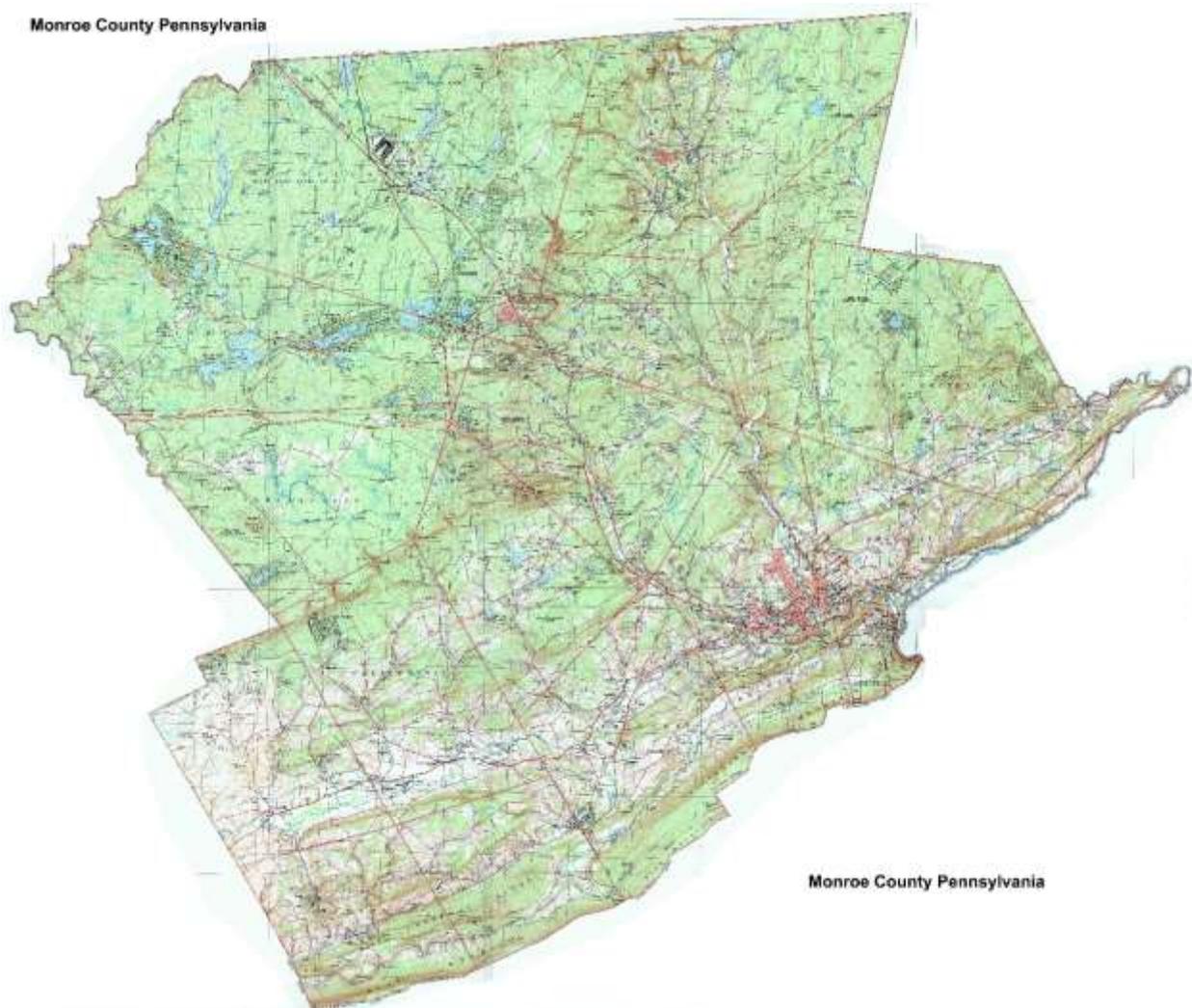
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### **2.4. Land Use and Development**

The topography of Monroe County is mountainous which lends to the county having some of the best ski areas, parks, hiking trails and other natural resources in the region. At 2214 feet the highest peak is Kistler Ledge in Tobyhanna State Park. It is located in Coolbaugh Township near the Pike and Wayne County borders. The park has activities open to the public year round including hunting, fishing, camping, swimming, biking and snowmobiling.

*Figure 4 - Monroe County Topography Map*



According to the U.S. Census bureau, Monroe County had a total of 80,685 housing units as of July 1, 2014. Of the available housing units, 80% are owner occupied. The

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majority of these housing units were built prior to 1940. From 2000 or later there was only an increase of 12.36% of housing units built.

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 2005-2016, 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 with the 2030 Comprehensive Plan.

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.

The total number of farms as of 2012 is 283. This is a 19% decrease from 2007 when there were 349 farms. In 2012 the total acres of farmland was 26,483, down from 29,165 in 2007. The average size of a Monroe County farm is 94 acres, up from 84 acres in 2007. The average market value of products sold per farm in Monroe County is \$38,777.

### **2.5. Data Sources and Limitations**

The county relied heavily on existing data sources developed by other Monroe County departments, including:

- Monroe County Hazard Vulnerability Analysis.
- Monroe County 2030 Comprehensive Plan.
- Monroe County Assessment Department data.
- Monroe County Subdivision and Land Development Ordinance.
- Monroe County Open Space, Greenway and Recreation Plan.
- Monroe County Digital Tax Assessment Data.
- Monroe County Knowledge Center™

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- Monroe County Commodity Flow Studies.

The following are additional data sources used during the update process:

- U.S. Census Bureau.
- National Climatic Data Center (NCDC).
- National Oceanic and Atmospheric Administration (NOAA).
- Pennsylvania Department of Conservation and Natural Resources.
- Pennsylvania Groundwater Information System.
- Pennsylvania Emergency Incident Reporting System.
- Pennsylvania Emergency Management Agency.

The countywide Digital Flood Insurance Rate Maps (DFIRM), were used for all flood risk analysis and estimation of loss. The Monroe DFIRMs were approved and effective in 2013. The DFIRM database provides flood frequency and elevation information used in the flood hazard risk assessment. Other Monroe County GIS datasets including road centerlines, parcels and structures were utilized in conjunction with the DFIRM. Potential losses were then analyzed by using existing county tax assessment data and DFIRM data.

### **Geographic Information Systems (GIS) Data**

GIS data was utilized in risk assessment, estimation of loss and the development of map products for the hazard mitigation plan update. A core foundation of data was available from the Monroe County Planning Commission. Some data was downloaded from the Pennsylvania Spatial Data Access (PASDA) and utilized. The following is a list of existing GIS data that was utilized in the plan update process and a list of new GIS data that was developed to complete the 2016 mitigation plan update.

#### **Existing Monroe County GIS Data Used:**

- Structures
- Road Centerlines
- Driveways
- Elevations of the county
- Tax Parcels
- Municipality Boundaries
- Digital Flood Insurance Rate Maps
- Watershed and Sub-sheds
- Lakes and Streams

#### **New GIS Data Developed and Used:**

- Critical Facilities
- Mobile Homes
- Mobile Home Parks

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- Utility Locations
- Tornado Paths

The Monroe County parcel dataset includes a value for the land in each parcel, as well as a combined value for all buildings on each parcel.

Mobile home parks depicted in the “Monroe County Tornado Risk” map were provided by Monroe County data as parcel polygons. The total building values in these parcels designated as mobile home parks were used to estimate the possible economic loss associated with a disaster.

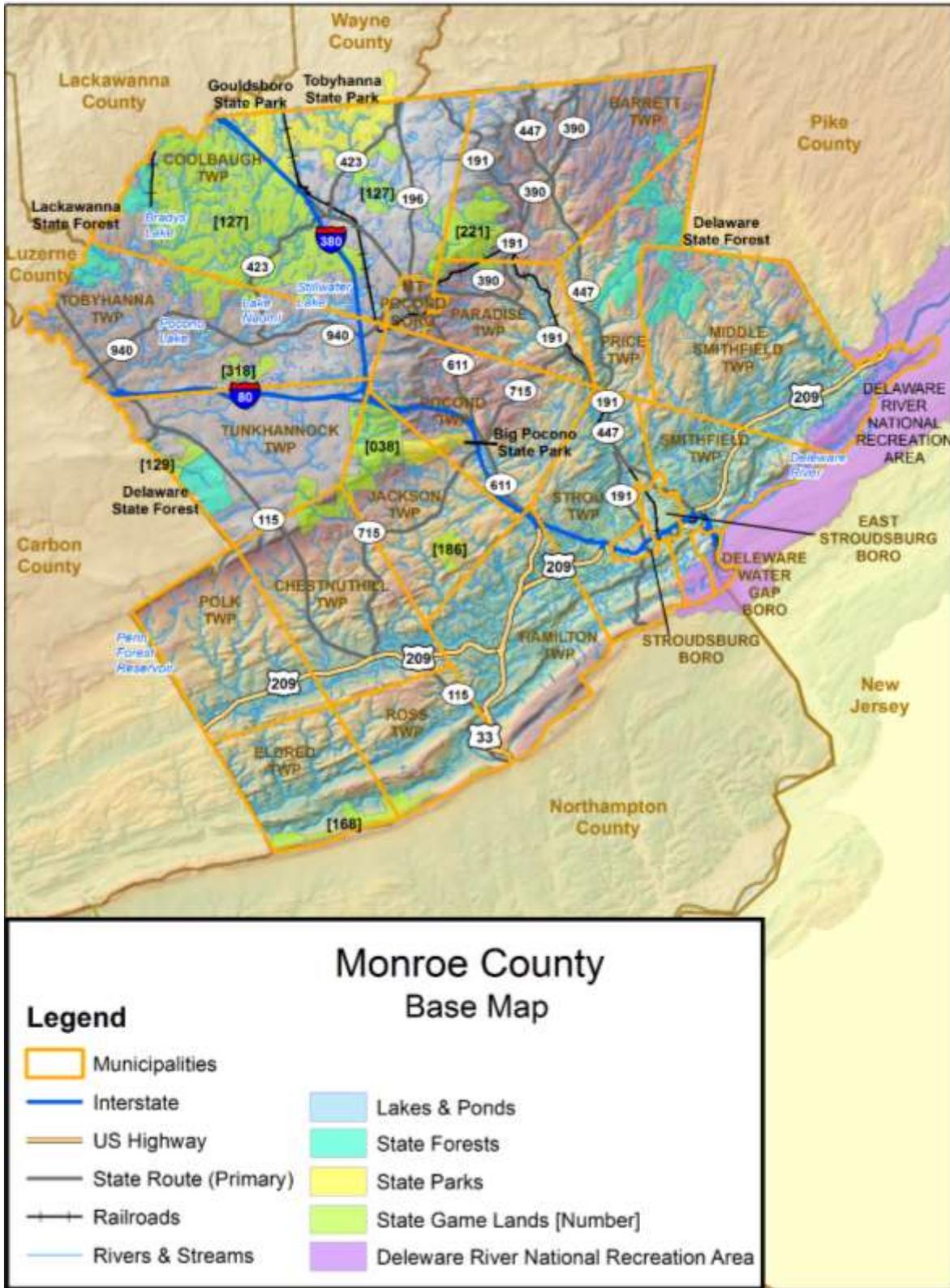
In order to assess the vulnerability of different jurisdictions to the hazards, data on past occurrences of damaging hazard events was gathered. For a number of historic natural-hazard events, the National Climatic Data Center (NCDC) database was utilized. NCDC is a division of the US Department of Commerce’s 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 from 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”.

The following maps provide an overview of Monroe County and other specific features of the county.

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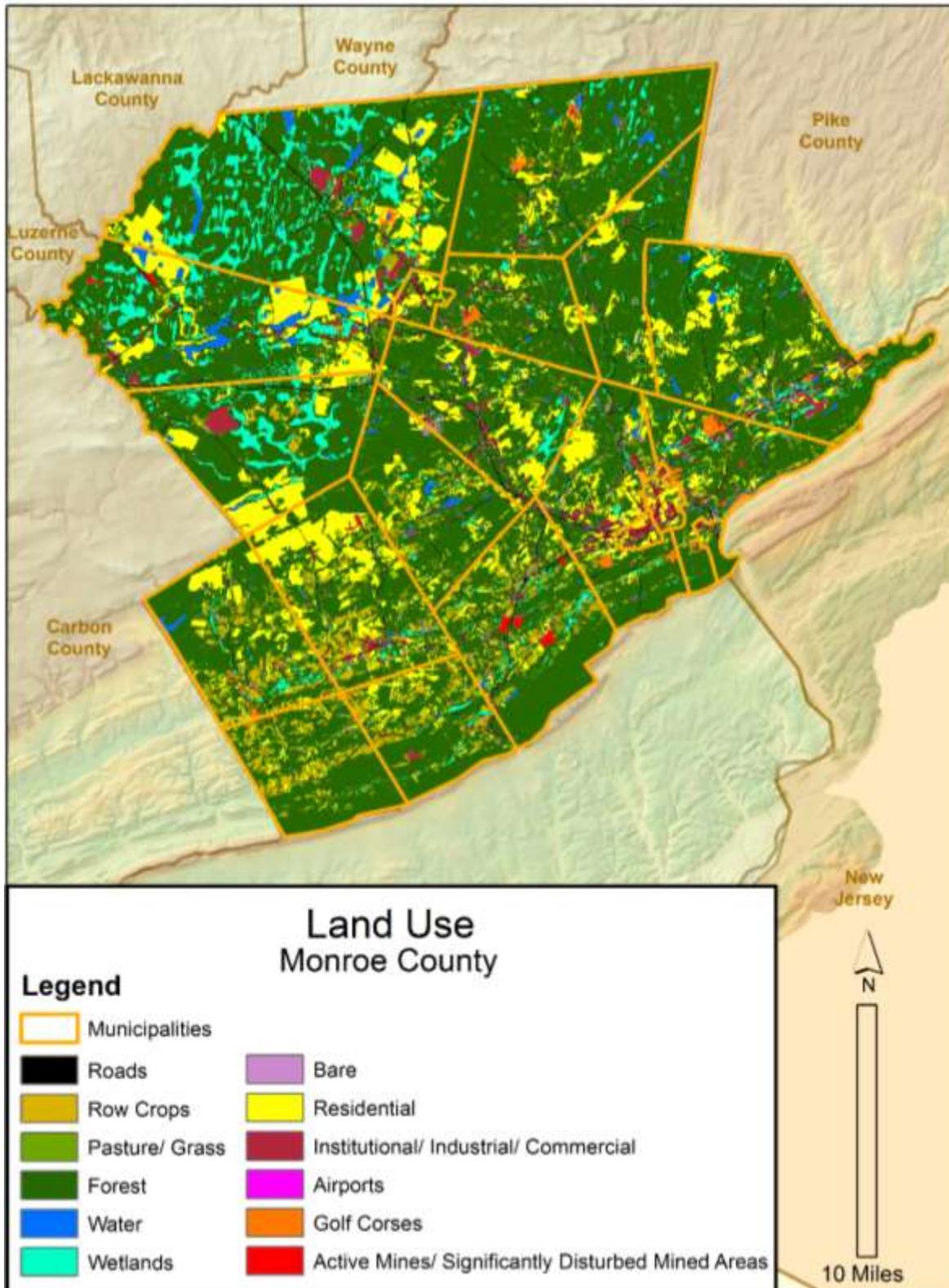
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Figure 5 - Monroe County Base Map



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Figure 6 - Land Use Map



### **3. Planning Process**

#### **3.1. Update Process and Participation Summary**

The Monroe County Hazard Mitigation Plan update began July 1, 2015. The Monroe County Office of Emergency Management was identified as the lead agency for the Monroe County Hazard Mitigation Plan update. The planning process involved a variety of key decision makers and stakeholders within Monroe County. Monroe County determined that the utilization of a contracted consulting agency would be necessary to assist with the plan update process. MCM Consulting Group, Inc. was selected as the contracted consulting agency to complete the update of the hazard mitigation plan. The core hazard mitigation team, which was referred to as the project team, included officials from the Monroe County Office of Emergency Management, Monroe County Planning Department, Pennsylvania Historical & Museum Commission and MCM Consulting Group, Inc. (MCM).

The process was developed around the requirements laid out in the Federal Emergency Management Agency (FEMA) Local Hazard Mitigation Plan Review Tool, referenced throughout this plan, as well as numerous other guidance documents including, but not limited to, Pennsylvania's All-Hazard Mitigation Standard Operating Guide, FEMA's State and Local Mitigation Planning How-to Guide series of documents (FEMA 386-series) and the National Fire Protection Association (NFPA) 1600 Standard on Disaster/Emergency Management and Business Continuity Programs.

MCM Consulting Group, Inc. assisted the Monroe County Office of Emergency Management in coordinating and leading public involvement meetings, local planning team meetings, analysis and the writing of the HMP. The Monroe County Local Planning Team worked closely with MCM in the writing and review of the HMP. MCM conducted project meetings and local planning team meetings throughout the process. Meeting agendas, meeting minutes and sign in sheets were developed and maintained for each meeting conducted by MCM. These documents are detailed in Appendix C of this plan.

Public meetings with local elected officials were held, as well as work sessions and in-progress review meetings with the Monroe County Local Planning Team and staff. At each of the public meetings, respecting the importance of local knowledge, municipal officials were strongly encouraged to submit hazard mitigation project opportunity forms, complete their respective portions of the capabilities assessment and review and eventually adopt the county hazard mitigation plan. Monroe County will continue to work with all local municipalities to collect local hazard mitigation project opportunities.

The HMP planning process consisted of:

- Applying for and receiving a hazard mitigation pre-disaster mitigation grant (PDM) to fund the planning project.
- Announcing the initiative via press releases and postings on the county website.

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- Involving elected and appointed county and municipal officials in a series of meetings, training sessions and workshops.
- Identifying capabilities and reviewed the information with the municipalities.
- Identifying hazards.
- Assessment of risk and analyzing vulnerabilities.
- Identifying mitigation strategies, goals and objectives.
- Developing an implementation plan.
- Announcing completion via press releases and postings on the county website.
- Plan adoption at a public meeting of the Monroe County Board of Commissioners.
- Plan submission to FEMA and PEMA.

The 2016 Monroe County HMP was completed March 9, 2016. The 2016 plan follows an outline developed by PEMA which provides a standardized format for all local HMPs in the Commonwealth of Pennsylvania. The 2016 HMP format is consistent with the PEMA recommended format. The Monroe County HMP has additional hazard profiles that were added to the HMP and these additional profiles increased the subsections in section 4.3 of the HMP.

### **3.2. The Planning Team**

The 2016 Monroe County Hazard Mitigation Plan update was led by the Monroe County Project Team. The Monroe County Project Team provided guidance and leadership for the overall project. The project team assisted MCM Consulting Group, Inc. with dissemination of information and administrative tasks. *Table 3 - Project Team* outlines the individuals that comprised this team.

*Table 3 - Project Team*

<b>Monroe County Hazard Mitigation Plan Update Project Team</b>		
<b>Name</b>	<b>Organization</b>	<b>Position</b>
Bruce Henry	Monroe County Office of Emergency Management	Director
Maryellen Keegan	Monroe County Office of Emergency Management	Deputy Director
Christine Meinhart	Monroe County Planning Commission	Director
Jeremy Young	Pennsylvania Historical and Museum Commission	Project Manager
Michael Rearick	MCM Consulting Group, Inc.	Senior Consultant
Robert Anderson	MCM Consulting Group, Inc.	Senior Consultant

In order to represent the county, the Monroe County Project Team developed a diversified list of potential Local Planning Team (LPT) members. Members that participated in the 2011 hazard mitigation plan were highly encouraged to join the 2016 team. The project team then provided invitations to the prospective members and provided a description of duties to serve on the LPT. The LPT worked throughout the process to plan and hold meetings, collect information and conduct public outreach.

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The stakeholders listed in *Table 4 - Local Planning Team* served on the 2016 Monroe County Hazard Mitigation Local Planning Team, actively participated in the planning process by attending meetings, completing assessments, surveys and worksheets and/or submitting comments.

*Table 4 - Local Planning Team*

<b>Monroe County Hazard Mitigation Plan Local Planning Team</b>		
Name	Organization	Position
Suzanne McCool	Monroe County Commissioner	Commissioner
Bruce Henry	Monroe County Office of Emergency Management	Director
Maryellen Keegan	Monroe County Office of Emergency Management	Deputy Director
Christine Meinhart	Monroe County Planning Commission	Director
Amy Leiser	Monroe County Historical Association	Executive Director
B.J. Bachman	Monroe County Archives Department	Archivist
Gary Hoffman	Monroe County 9-1-1	Director
Jeremy Young	Pennsylvania Historical and Museum Commission	Project Manager
Brick Linder	Barrett Township	Emergency Management Coordinator/ Fire Chief
David Albright	Chestnuthill Township	Twp. Manager
Bill Weimer	Coolbaugh Township	Chairman of Supervisors
Lisa Paulette	Delaware Water Gap Borough	Deputy Emergency Management Coordinator
Jim Phillips	East Stroudsburg Borough	Borough Manager
Christopher Marozzi	East Stroudsburg University	Director, EHS
Gary Hoffman	Eldred Township	Emergency Management Coordinator
Alan Everett	Hamilton Township	Supervisor
Dave Fenner	Hamilton Township	Chairman of Supervisors
Keith Elliott	Jackson Township	Emergency Management Coordinator
John Ferro	Middle Smithfield Township	Emergency Management Coordinator
Jeff Woehrle	Mount Pocono Borough	Emergency Management Coordinator
Reda Briglia	Paradise Township	Supervisor
Greg Schuster	Pocono Township	Twp. Manager
Brian Ahner	Polk Township	Supervisor
Barry Borger	Polk Township	Emergency Management Coordinator
Ruthanne Toner	Polk Township	Assistant & Recording Secretary
Don Cramer	Price Township	Chairman of Supervisors
John Brush	Price Township	Supervisor
Richard Marsilli	Ross Township	Emergency Management Coordinator

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<b>Monroe County Hazard Mitigation Plan Local Planning Team</b>		
<b>Name</b>	<b>Organization</b>	<b>Position</b>
Steve Carey	Smithfield Township	Emergency Management Coordinator
Daryl Eppley	Stroud Township	Supervisor
Cathie Thomas	Stroudsburg Borough	Borough Manager
Ed Tutrone	Tobyhanna Township	Emergency Management Coordinator
William T. Byron, Jr.	Tunkhannock Township	Emergency Management Coordinator
Nick Tylenda	Northampton County EMA	Deputy Director
Timothy Knapp	Pike County EMA	Director
Gail Toscano	American Red Cross	Disaster Program Manager
Mary Barlieb	Coolbaugh Township Historical Association	Member
Donna Kinsley	Coolbaugh Township Historical Association	Member
Phyllis Williams	Coolbaugh Township Historical Association	Member
Mike Roche	DCNR Bureau of Forestry	Forest Assistant Manager
Jeff Higbee	Dutot Museum & Gallery – DWG	
John Kloss	Eastern PA EMS Council	Director
Josh Kulp	Eastern PA EMS Council	EMS Specialist   Licensure Coordinator
Jessica Reitz	Heritage Center of Western Pocono	Member
Rachel Frick Cardelle	Northampton Community College - Monroe	Associate Dean, Administrative Services
Randy Snow	Delaware Water Gap Station Preservation Partnership	Treasurer
Kevin Crain	Pocono Medical Center	Director of Security
Janet Mishkin	Quiet Valley Living History Farm	Administrator Curator Grants Coordinator
Robert Shiner	Sanofi Pasteur	Director of Security of North America
Paul Gasper	Stroud Area Regional Police	Lieutenant
Chris Grim	PEMA	Operations Emergency Management Specialist
Tom Hughes	PEMA	State Hazard Mitigation Officer
Ernest Szabo	PEMA	PEMA State Hazard Mitigation Planner
Garrick Landsberg	AECOM	Historic Architect
Vanessa Zeoli	AECOM	Architectural Historian
Michael Rearick	MCM Consulting Group, Inc.	Senior Consultant
Robert Anderson	MCM Consulting Group, Inc.	Senior Consultant

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### 3.3. Meetings and Documentation

Monthly meetings with local elected officials and the local planning team were held. At each of the meetings, municipal officials were strongly encouraged to submit hazard mitigation project opportunity forms, complete their respective portions of the capability assessment and review and eventually adopt the multi-jurisdictional HMP. *Table 5 - HMP Process Timeline* lists the meetings held during the HMP planning process, which organizations and municipalities attended and the topic that was discussed at each meeting. All meeting agendas, sign-in sheets, presentation slides, any other documentation is located in Appendix C.

A final public meeting was held on March 9, 2016 to present the draft plan and invite public comments. The meeting was advertised in the local newspaper, posted in social media and also made available digitally on the Monroe County hazard mitigation web site.

The public comment period remained open until April 15, 2016. All public comments were submitted in writing to Maryellen Keegan at the Monroe County Office of Emergency Management. All public comments have been included in this plan in Appendix C.

*Table 5 - HMP Process Timeline*

<b>Monroe County HMP Process - Timeline</b>		
Date	Meeting	Description
07/01/15	Monroe County Hazard Mitigation Plan (HMP) Kick-Off Meeting	Identified challenges and opportunities as they relate to fulfilling the DMA 2000 requirements. Identified existing studies and information sources relevant to the Hazard Mitigation Plan. Identified stakeholders, including the need to involve local officials.
07/01/15	Local Planning Team Initial Meeting	Defined hazard mitigation planning and identified roles and responsibilities. Discussed the 2011 hazard mitigation plan and defined a timeline to complete the update.
01/13/16	Public Meeting	Conducted a public meeting to review the draft risk assessment section of the Monroe County Hazard Mitigation Plan update.
01/13/16 01/14/16 01/27/16 01/28/16	Meeting with Municipal Officials	Educated county and local elected officials on the hazard mitigation planning process. Presented the findings of the hazard vulnerability analysis and risk assessment. Sought input for mitigation projects throughout the county. Distributed Hazard Mitigation Project Opportunity Forms.
03/09/16	Monroe County Hazard Mitigation Plan – Draft Plan Review Public Meeting	An update of the hazard mitigation planning process was delivered. The Draft HMP was reviewed with the municipal representatives and public. Attendees were informed about the timeline and their opportunity to review the entire draft plan and provide written comments for inclusion into the plan.

### 3.4. Public and Stakeholder Participation

Monroe County engaged numerous stakeholders and encouraged public participation during the HMP update process. Advertisements for public meetings were completed

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utilizing the local newspaper, social media, public announcements and the Monroe County hazard mitigation website. Copies of the advertisements and outreach documents are located in Appendix C. Municipalities and other county entities were invited to participate in various meetings and encouraged to review and update various worksheets and surveys. Copies of all meeting agendas, meeting minutes and sign-in sheets are located in Appendix C. Overall results or worksheets and surveys completed by the municipalities, other stakeholders and the public are located in various sections and appendices of this plan update. Municipalities were also encouraged to review hazard mitigation related items with other constituents located in the municipality like businesses, academia, private and nonprofit interests.

The tools listed below were distributed with meeting invitations, provided directly to municipalities to complete and return to the Monroe County Office of Emergency Management or at meetings to solicit information, data and comments from both local municipalities and other key stakeholders. Responses to these worksheets and surveys are available for review at the Office of Emergency Management and the overall results are located in various sections and appendices of the plan update.

1. **Risk Assessment Hazard Identification and Risk Evaluation 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.
2. **Capability Assessment Survey:** Collects information on local planning, regulatory, administrative, technical, fiscal and political capabilities that can be included in the countywide mitigation strategy.
3. **Municipal Project Opportunity Forms and Mitigation Actions:** Copies of the 2011 actions/mitigation opportunity forms that were included in the current HMP were provided to the municipalities for review and amendment. Any of the previous mitigation actions/opportunities were added to individual mitigation opportunity forms for each municipality. The previous mitigation actions were provided and reviewed at update meetings. New 2016 municipal project opportunity forms are included in Appendix G.

A schedule that provided appropriate opportunities for public comment was utilized during the review and drafting process. Any public comment that was received during public meetings or during the draft review of the plan were documented and included in the plan. Copies of newspaper public meeting notices, website posted public notices and other correspondence are included in Appendix C of this plan.

Monroe County Office of Emergency Management utilized an online preparedness survey to seek input from the public in Monroe County. This online preparedness survey

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was advertised at the public meetings and public announcements were made throughout the entire hazard mitigation planning process to seek public participation in the survey. The survey was utilized to identify how prepared the public feels that they are in Monroe county and to identify mitigation capabilities, risks and mitigation strategies from the public's point of view. A total of 336 surveys were completed. This was a huge success for the hazard mitigation planning process. The overall results of the surveys are located in Appendix C of this hazard mitigation plan. Results of the surveys was taken into consideration during all planning phases of the hazard mitigation plan update.

### 3.5. Multi-Jurisdictional Planning

Monroe County used an open, public process to prepare this HMP. Meetings and letters to municipal officials were conducted to inform and educate them about hazard mitigation planning and its local requirements. Municipal officials provided information related to existing codes and ordinances, the risks and impacts of known hazards on local infrastructure and critical facilities and recommendations for related mitigation opportunities. The pinnacle to the municipal involvement process was the adoption of the final plan. *Table 6 - Worksheets, Surveys and Forms Participation* reflects the municipal participation by completing worksheets, surveys and forms.

*Table 6 - Worksheets, Surveys and Forms Participation*

<b>Municipality Participation in Worksheets, Surveys and Forms</b>			
Municipality	Capability Assessment Survey	Risk Assessment Hazard Identification and Risk Evaluation Worksheet	Hazard Mitigation Opportunity Form Review and Updates
Barrett Township	X	X	X
Chestnuthill Township	X	X	X
Coolbaugh Township	X	X	X
Delaware Water Gap Borough	X	X	X
East Stroudsburg Borough	X	X	X
Eldred Township	X	X	X
Hamilton Township	X	X	X
Jackson Township	X	X	X
Middle Smithfield Township	X	X	X
Mount Pocono Borough	X	X	X
Paradise Township	X	X	X
Pocono Township	X	X	X
Polk Township	X	X	X
Price Township	X	X	X
Ross Township	X	X	X
Smithfield Township	X	X	X
Stroud Township	X	X	X
Stroudsburg Borough	X	X	X
Tobyhanna Township	X	X	X
Tunkhannock Township	X	X	X

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All municipalities within Monroe County have adopted the 2011 Monroe County Hazard Mitigation Plan as the municipal hazard mitigation plan. The Monroe County Local Planning Team goal is 100% participation by municipalities in adopting the 2016 Monroe County Hazard Mitigation Plan.

### **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 2013 Commonwealth of Pennsylvania Standard All-Hazard Mitigation Plan, local floodplain management ordinances, the Monroe County Comprehensive Plan, Monroe County Emergency Operations Plan, local emergency operation plans, local zoning ordinances, local subdivision and land development ordinances and the Monroe County Stormwater Management Ordinance.

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. Floodplain management ordinance information was used to aid in the establishment of local capabilities in addition to participation in The National Flood Insurance Program (NFIP).

## **4. Risk Assessment**

### **4.1. Update Process Summary**

A key component to reducing future losses is to first have a clear understanding of what the current risks are and what steps may be taken to lessen their threat. The development of the risk assessment is the critical first step in the entire mitigation process, as it is an organized and coordinated way of assessing potential hazards and risks. The risk assessment identifies the effects of both natural and manmade hazards and describes each hazard in terms of its frequency, severity and county impact. Numerous hazards were identified as part of the process.

A risk assessment evaluates threats associated with a specific hazard and is defined by probability and frequency of occurrence, magnitude, severity, exposure and consequences. The Monroe County risk assessment provides in-depth knowledge of the hazards and vulnerabilities that affect Monroe County and its municipalities. This document uses an all-hazards approach when evaluating the hazards that affect the county and the associated risks and impacts each hazard presents.

This risk assessment provides the basic information necessary to develop effective hazard mitigation/prevention strategies. Moreover, this document provides the foundation for the Monroe County Emergency Operations Plan (EOP), local EOPs and other public and private emergency management plans.

The Monroe County risk assessment is not a static document, but rather, is a review requiring periodic updates. Potential future hazards include changing technology, new facilities and infrastructure, dynamic development patterns and demographic and socio-economic changes into or out of hazard areas.

Using the best information available and geographic information systems (GIS) technologies, the county can objectively analyze its hazards and vulnerabilities. Assessing past events is limited by the number of occurrences, scope and changing circumstances. For example, ever-changing development patterns in Pennsylvania have a dynamic impact on traffic patterns, population density and distribution, storm water runoff and other related factors. Therefore, limiting the risk assessment to past events is myopic and inadequate.

The Monroe County Local Planning Team reviewed and assessed the change in risk for all natural and manmade hazards identified in the 2011 hazard mitigation plan. The mitigation planning team then identified hazards that were outlined within the Pennsylvania Hazard Mitigation Plan but not included in the 2011 Monroe County Hazard Mitigation Plan that could impact Monroe County. The team utilized the hazard identification and risk evaluation worksheet that was provided by the Pennsylvania Emergency Management Agency.

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The Monroe County Project Team met with municipalities and provided guidance on how to complete the municipal hazard identification and risk evaluation worksheet. All twenty municipalities returned a completed worksheet. This information was combined with the county information to develop an overall list of hazards that would need to be profiled.

Once the natural and manmade hazards were identified and profiled, the local planning team then completed a vulnerability assessment for each hazard. An inventory of vulnerable assets was completed utilizing GIS data and local planning team knowledge. The team used the most recent Monroe County assessment data to estimate loss to particular hazards. Risk factor was then assessed to each profiled hazard utilizing the hazard prioritization matrix. 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.

### **4.2. Hazard Identification**

#### **4.2.1. Presidential and Gubernatorial Disaster Declarations**

*Table 7 - Presidential & Gubernatorial Disaster Declarations* presents a list of all Presidential and Governor's Disaster Declarations that have affected Monroe County from 1972 through 2014, according to the Pennsylvania Emergency Management Agency.

*Table 7 - Presidential & Gubernatorial Disaster Declarations*

<b>Presidential Disaster Declarations and Gubernatorial Declarations and Proclamations</b>		
Date	Hazard Event	Action
June 1972	Flood Hurricane Agnes	President's Declaration Of Major Disaster - Governor's Proclamation
January 1978	Heavy Snow	Governor's Proclamation
February 1978	Blizzard	Governor's Proclamation
March 1993	Blizzard	Governor's Proclamation & President's Declaration of Emergency
January 1994	Severe Winter Storm	Governor's Proclamation & President's Declaration Of Major Disaster
January 1996	Severe Winter Storm	Governor's Proclamation & President's Declaration Of Major Disaster for Individual Assistance
September 1999	Hurricane Floyd	Governor's Proclamation & President's Declaration Of Major Disaster
August 2003	High Winds and Heavy Rains	Presidential - Major Disaster
September 2003	Hurricane Isabel/Henri	Governor's Proclamation of Disaster Emergency; Presidential Declaration
September 2004	Tropical Depression Frances	Financial Assistance to Help Families and Communities Recover
September 2004	Tropical Depression Ivan	Financial Assistance to Help Families and Communities Recover

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<b>Presidential Disaster Declarations and Gubernatorial Declarations and Proclamations</b>		
<b>Date</b>	<b>Hazard Event</b>	<b>Action</b>
September 2005	Proclamation of Emergency – Hurricane Katrina	Emergency declaration. Proclamation of Emergency to render mutual aid and to receive and house evacuees
September 2006	Proclamation of Emergency – Tropical Depression Ernesto	Proclamation of Emergency to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation
February 2007	Proclamation of Emergency – Regulations	Proclamation of Emergency to waive the regulations regarding hours of service limitations for drivers of commercial vehicles
February 2007	Proclamation of Emergency – Severe Winter Storm	Proclamation of Emergency to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation
April 2007	Severe Storm	Proclamation of Emergency to utilize all available resources and personnel as is deemed necessary to supplement county and municipal efforts
February 2010	Proclamation of Emergency – Severe Winter Storm	Proclamation of Emergency to utilize all available resources and personnel as is deemed necessary to supplement county and municipal efforts
January 2011	Proclamation of Emergency – Severe Winter Storm	Proclamation of Emergency to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation
August 2011	Proclamation of Emergency – Severe Storms and Flooding (Lee/Irene)	Proclamation of Emergency to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation
April 2012	Proclamation of Emergency – Spring Winter Storms	Proclamation of Emergency to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation
October 2012	Proclamation of Emergency – Hurricane Sandy	Proclamation of Emergency to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation; to provide \$5 Million in funds to PEMA for disaster related expenses
January 2013	Hurricane Sandy	Presidential Disaster Declaration
October 2013	Severe Storms, Tornado and Flooding	Proclamation of Emergency to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation
January 2014	Severe Cold Weather	Proclamation of Propane and Heating Oil Emergency
February 2014	Severe Winter Storm	Proclamation of Emergency to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation

*Source: Pennsylvania Emergency Management Agency and Federal Emergency Management Agency*

### 4.2.2. Summary of Hazards

The Monroe County Local Planning Team (LPT) was provided the Pennsylvania Standard List of Hazards to be considered for evaluation in the 2016 HMP Update. Following a review of the hazards considered in the 2011 HMP and the standard list of hazards, the

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Local Planning Team decided that the 2016 plan should identify, profile and analyze nineteen (19) hazards. These 19 hazards include all of the hazards profiled in the 2011 plan. The list below contains the 19 hazards that have the potential to impact Monroe County as identified through previous risk assessments, the Monroe County Hazards Vulnerability Analysis and input from those that participated in the 2016 HMP update. Hazard profiles are included in Section 4.3 for each of these hazards.

### ***Identified 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).

#### **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).

#### **Extreme Temperatures**

Extreme cold temperatures drop well below what is considered normal for an area during the winter months and often accompany winter storm events. Combined with increases in wind speed, such temperatures in Pennsylvania can be life threatening to those exposed for extended periods of time. Extreme heat can be described as temperatures that hover 10°F or more above the average high temperature for a region during the summer months. Extreme heat is responsible for more deaths in Pennsylvania than all other natural disasters combined.

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### **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. 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.

### **Hurricanes, Tropical Storms**

Hurricanes and tropical storms 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 tornados. 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).

### **Invasive Species**

An invasive species is a species that is not indigenous to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. These species can be any type of organism: plant, fish, invertebrate, mammal, bird, disease, or pathogen. Infestations may not necessarily impact human health, but can create a nuisance or agricultural hardships by destroying crops, defoliating populations of native plant and tree species, or interfering with ecological systems (Governor's Invasive Species Council of Pennsylvania, 2009).

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### **Pandemic, Epidemic and Infectious Diseases**

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).

### **Tornado, Wind Storm**

A wind storm can occur during severe thunderstorms, winter storms, coastal storms, or tornados. 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. Tornados 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 tornados are a few dozen yards wide and touch down briefly, but even small, short-lived tornados 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 tornados that form over warm water and are relatively uncommon in Pennsylvania. Each year, an average of over 800 tornados 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 tornados 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).

### **Wildfire**

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

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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 (PA DCNR, 1999).

### **Winter Storm and Nor'easter**

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).

### ***Identified Manmade Hazards***

#### **Dam Failure**

A dam is a barrier across flowing water that obstructs, directs, or slows down water flow. Dams provide benefits such as flood protection, power generation, drinking water, irrigation and recreation. Failure of these structures results in an uncontrolled release of impounded water. Failures are relatively rare, but immense damage and loss of life is possible in downstream communities when such events occur. Aging infrastructure, hydrologic, hydraulic and geologic characteristics, population growth and design and maintenance practices should be considered when assessing dam failure hazards. The failure of the South Fork Dam, located in Johnstown, Pennsylvania, 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).

#### **Disorientation**

Large numbers of people are attracted to Pennsylvania's rural areas for recreational purposes such as hiking, camping, hunting and fishing. As a result, people can become lost or trapped in remote and rugged wilderness areas. Search and rescue may be required for people who suffer from medical problems or injuries and those who become accidentally or intentionally disoriented. Search and rescue efforts are focused in and around state forest and state park lands (DCNR, 2009).

#### **Drowning**

Drowning is death from suffocation, typically associated with swimming, fishing, boating or bridge accidents, or suicide. It can be a significant hazard in communities with numerous residential pools or water bodies (e.g. ponds, lakes, rivers, etc.) and extensive

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outdoor recreational activity. Drowning rates are particularly high for children ages 1-14. The Centers for Disease Control and Prevention estimates that drowning is the second leading cause of injury death (after motor vehicle crashes) among children ages 1-14. (CDC, 2008).

### **Hazardous Materials**

Environmental hazards are hazards that pose threats to the natural environment, the built environment and public safety through the diffusion of harmful substances, materials, or products. Environmental hazards include the following:

- Hazardous material releases; at fixed facilities or as such materials are in transit and including toxic chemicals, infectious substances, biohazardous waste and any materials that are explosive, corrosive, flammable, or radioactive (PL 1990-165, § 207(e)).
- Air or Water Pollution; the release of harmful chemical and waste materials into water bodies or the atmosphere, for example (National Institute of Health Sciences, July 2009; Environmental Protection Agency, Natural Disaster PSAs, 2009).
- Superfund Facilities; hazards originating from abandoned hazardous waste sites listed on the National Priorities List (Environmental Protection Agency, National Priorities List, 2009).
- Manure Spills; involving the release of stored or transported agricultural waste, for example (Environmental Protection Agency, Environmental Impacts of..., 1998).
- Product Defect or Contamination; highly flammable or otherwise unsafe consumer products and dangerous foods (Consumer Product Safety Commission, 2003).

### **Levee Failure**

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, 2013).

### **Nuclear Incidents**

Nuclear accidents 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

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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).

### **Terrorism**

Terrorism is use of force or violence against persons or property with the intent to intimidate or coerce. Acts of terrorism include threats of terrorism; assassinations; kidnappings; hijackings; bomb scares and bombings; cyber-attacks (computer-based); and the use of chemical, biological, nuclear and radiological weapons. (FEMA, 2009).

### **Transportation Accidents**

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. (Research and Innovative Technology Administration, 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).

### **Utility Interruption**

Utility interruption hazards are hazards that impair the functioning of important utilities in the energy, telecommunications and public works and information network sectors. Utility interruption hazards include the following:

- Geomagnetic Storms; including temporary disturbances of the Earth's magnetic field resulting in disruptions of communication, navigation and satellite systems (National Research Council et al., 1986).
- Fuel or Resource Shortage; resulting from supply chain breaks or secondary to other hazard events, for example (Mercer County, PA, 2005).
- 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).

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- Public Works Failure; damage to or failure of highways, flood control systems, deep-water ports and harbors, public buildings, bridges, dams, for example (United States Senate Committee on Environment and Public Works, 2009).
- Telecommunications System Failure; Damage to data transfer, communications and processing equipment, for example (FEMA, 1997)
- Transmission Facility or Linear Utility Accident; liquefied natural gas leakages, explosions, facility problems, for example (United States Department of Energy, 2005)
- Major Energy, Power, Utility Failure; interruptions of generation and distribution, power outages, for example (United States Department of Energy, 2000).

### **4.2.3. Climate Change**

#### **Impacts of Climate Change on Identified Hazards**

Humans have become the dominant species on Earth and our society and influence is globalized. Human activity such as the large scale consumption of fossil fuels and deforestation has caused atmospheric carbon dioxide concentrations to significantly increase and a notable diversity of species to go extinct. The result is rapid climate change unparalleled in Earth's history and an extinction event approaching the level of a mass extinction (Barnosky et al., 2011; Wake & Vredenburg, 2008). The corresponding rise of average atmospheric temperatures is intensifying many natural hazards, and further threatening biodiversity. The effects of climate change on these hazards is expected to intensify over time as temperatures continue to rise, so it is prudent to be aware of how climate change is impacting natural hazards.

The most obvious change is in regard to extreme temperature (Section 4.3.3). As average atmospheric temperatures rise, extreme high temperatures become more threatening, with record high temperatures outnumbering record low temperatures 2:1 in recent years (Meehl et al., 2009). As climate change intensifies, it is expected that the risk of extreme heat will be amplified whereas the risk of extreme cold will be attenuated. Less immediately apparent, climate change could increase the prevalence of the West Nile Virus (Section 4.3.7). Some studies show increased insect activities during a similar rapid warming event in Earth's history (Curano et al., 2008). Other studies make projections that with the warming temperatures and lower annual precipitation that are expected with climate change, there will be an expansion of the suitable climate for mosquitos and West Nile Virus, potentially increasing the risk that the disease poses (Harrigan et al., 2014).

Climate change is likely to increase the risk of droughts (Section 4.3.1). Higher average temperatures means that more precipitation will fall as rain rather than snow, snow will melt earlier in the spring, and evaporation and transpiration will increase. Along with the prospect of decreased annual precipitation, the risk of hydrological and agricultural

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drought is expected to increase (Sheffield & Wood, 2008). Correspondingly this will impact wildfires (Section 4.3.9). Drought is accompanied by drier soils and forests, resulting in an elongated wildfire season and more intense and long-burning wildfires (Pechony & Shindell, 2010). However, the Southwest United States is at a greater risk of this increased drought and wildfire activity than Monroe County in the Eastern United States.

While it may seem counterintuitive considering the increased risk of drought, there is also an increased risk of flooding associated with climate change (Section 4.3.4). As previously mentioned, warmer temperatures mean more precipitation will fall as rain rather than snow. Combined with the fact that warmer air holds more moisture, the result is heavier and more intense rainfalls, increasing the risk of flooding and dam and levee failures. Similarly, winter storms are expected to become more intense, if possibly less frequent (Section 4.3.10). Climate change is also expected to result in more intense hurricanes and tropical storms (Section 4.3.5). With the rise of atmospheric temperatures, ocean surface temperatures are rising, resulting in warmer and moister conditions where tropical storms develop (Stott et al., 2010). A warmer ocean stores more energy, and is capable of fueling stronger storms. It is projected that the Atlantic hurricane season is elongating, and there will be more category 4 and 5 hurricanes than before (Trenberth, 2010).

Climate change is contributing to the introduction of new invasive species (Section 4.3.6). As maximum and minimum seasonal temperatures change, non-native species are able to establish themselves in previously inhospitable climates where they have a competitive advantage. This may shift the dominance of ecosystems in the favor of non-native species, contributing to species loss and the risk of extinction.

This type of sudden global change is novel to humanity. Despite the myriad of well thought out research, there is still much uncertainty surrounding the future of the Earth. All signs point to the intensification of the hazards mentioned above, especially if human society and individuals do not make swift and significant changes to reduce emissions and species losses.

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### 4.3. Hazard Profiles

#### 4.3.1. Drought

##### 4.3.1.1 Location and Extent

While Pennsylvania is generally more water-rich than many U.S. states, the Commonwealth may be subject to drought conditions. A drought is broadly defined as a time period of prolonged dryness that contributes to the depletion of ground and surface water. Droughts are regional climatic events, so when such an event occurs in Monroe County, impacts are not restricted to the county and are often more widespread. The spatial extent of the impacted area can range from localized areas in Pennsylvania to the entire Mid-Atlantic region.

There are three types of drought:

**Meteorological Drought** – A deficiency of moisture in the atmosphere compared to average conditions. Meteorological drought is defined by the duration of the deficit and degree of dryness, and is often associated with below average rainfall. Depending on the severity of the drought, it may or may not have a significant impact on agriculture and the water supply.

**Agricultural Drought** – A drought inhibiting the growth of crops, due to a moisture deficiency in the soil. Agricultural drought is linked to meteorological and hydrologic drought.

**Hydrologic Drought** – A prolonged period of time without rainfall that has an adverse effect on streams, lakes, and groundwater levels, potentially impacting agriculture.

##### 4.3.1.2 Range of Magnitude

The Commonwealth uses five parameters to assess drought conditions:

- Stream flows (compared to benchmark records);
- Precipitation (measured as the departure from normal, 30 year average precipitation);
- Reservoir storage levels in a variety of locations (especially three New York City reservoirs in Upper Delaware River Basin);
- Groundwater elevations in a number of counties (comparing to past month, past year and historic record); and
- Soil moisture via the Palmer Drought Index (See *Table 8 - Palmer Drought Severity Index*) - a soil moisture algorithm calibrated for relatively homogeneous regions which measures dryness based on recent precipitation and temperature. As of October 2015, the PDSI for Monroe County is between -1.9 and 1.9, “near normal” conditions (*Figure 8 - Recent Drought Severity Index*)

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Table 8 - Palmer Drought Severity Index

Palmer Drought Severity Index (PDSI) Classifications	
SEVERITY CATEGORY	
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

Table 9 - Drought Preparation Phases

Drought Preparation Phases				
	General Activity	Actions	Request	Goal
<b>Drought Watch</b>	Early stages of planning and alert for drought possibility	Increased water monitoring, awareness and preparation for response among government agencies, public water suppliers, water users and the public	Voluntary water conservation	Reduce water use by 5%
<b>Drought Warning</b>	Coordinate a response to imminent drought conditions and potential water shortages	Reduce shortages, relieve stressed sources, develop new sources if needed	Continue voluntary water conservation, impose mandatory water use restrictions if needed	Reduce water use by 10-15%
<b>Drought Emergency</b>	Management of operations to regulate all available resources and respond to emergency	Support essential and high priority water uses and avoid unnecessary uses	Possible restrictions on all nonessential water uses	Reduce water use by 15%

Source: PA Department of Environmental Protection

**Local Water Rationing:** With the approval of the PA Emergency Management Council, local municipalities may 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 4 PA Code Chapter 120,

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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. [Source: PEMA, 409 Plan]

### 4.3.1.3 Past Occurrence

Declared drought status for Monroe County from November 1980 to October 2015 as reported by the PA DEP can be found in *Table 10 – Past drought events in Monroe County. Figure 7 - Palmer Drought Severity Index History* shows that Monroe County has experienced severe drought (PDSI  $\leq$  -3) between five and ten percent of time from 1895-1995, which gives a good idea of how often Monroe County has been affected by drought events.

*Table 10 – Past drought events in Monroe County*

<b>Past drought events in Monroe County (PA DEP 2015)</b>			
DATE	DROUGHT STATUS	DATE	DROUGHT STATUS
Nov 18, 1980 - Apr 20, 1982	Emergency	Nov 10, 1982 - Feb 8, 1983	Warning
Feb 8, 1983 - March 28, 1983	Warning	Jan 23, 1985 - Apr 26, 1985	Warning
Apr 26, 1985 - Jul 29, 1985	Emergency	Jul 29, 1985 - Oct 22, 1985	Emergency
Oct 22, 1985 - Oct 29, 1985	Emergency	Oct 29, 1985 - Dec 19, 1985	Emergency
Jul 7, 1988 - Aug 24, 1988	Watch	Aug 24, 1988 - Dec 12, 1988	Watch
Mar 3, 1989 - May 15, 1989	Warning	Jun 28, 1991 - Jul 24, 1991	Watch
Jul 24, 1991 - Aug 16, 1991	Emergency	Aug 16, 1991 - Sep 13, 1991	Emergency
Sep 13, 1991 - Oct 21, 1991	Emergency	Oct 21, 1991 - Jan 16, 1992	Emergency

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<b>Past drought events in Monroe County (PA DEP 2015)</b>			
<b>DATE</b>	<b>DROUGHT STATUS</b>	<b>DATE</b>	<b>DROUGHT STATUS</b>
Jan 17, 1992 - Apr 20, 1992	Emergency	Apr 20, 1992 - Jun 23, 1992	Warning
Sep 1, 1995 - Sep 20, 1995	Warning	Sep 20, 1995 - Nov 8, 1995	Emergency
Nov 8, 1995 - Dec 18, 1995	Emergency	Oct 27, 1997 - Nov 13, 1997	Warning
Nov 13, 1997 - Jan 16, 1998	Warning	Dec 3, 1998 - Dec 8, 1998	Watch
Dec 8, 1998 - Dec 14, 1998	Watch	Dec 14, 1998 - Dec 16, 1998	Warning
Dec 16, 1998 - Jan 15, 1999	Warning	Jan 15, 1999 - Mar 15, 1999	Warning
Mar 15, 1999 - Jun 10, 1999	Watch	Jun 10, 1999 - Jun 18, 1999	Warning
Jun 18, 1999 - Jul 20, 1999	Warning	Jul 20, 1999 - Sep 30, 1999	Emergency
Sep 30, 1999 - Dec 16, 1999	Watch	Dec 16, 1999 - Feb 25, 2000	Watch
Feb 25, 2000 - May 5, 2000	Watch	Nov 6, 2001 - Dec 5, 2001	Watch
Dec 5, 2001 - Feb 12, 2002	Warning	Feb 12, 2002 - May 13, 2002	Emergency
May 13, 2002 - Jun 14, 2002	Watch	Jun 14, 2002 - Aug 9, 2002	Watch
Aug 9, 2002 - Sep 5, 2002	Watch	Sep 5, 2002 - Nov 7, 2002	Watch
Apr 11, 2006 - Jun 30, 2006	Watch	Aug 8, 2007 - Sep 5, 2007	Watch

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Past drought events in Monroe County (PA DEP 2015)			
DATE	DROUGHT STATUS	DATE	DROUGHT STATUS
Sep 5, 2007 - Oct 5, 2007	Watch	Oct 5, 2007 - Jan 11, 2008	Watch
Sep 16, 2010 – Nov 10, 2010	Warning	March 24, 2015 – July 10 2015	Watch

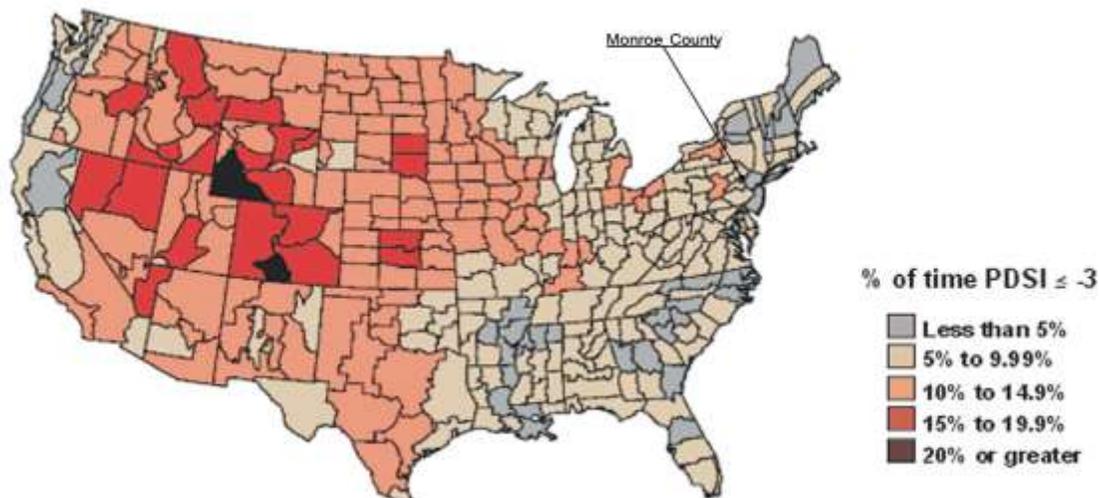
### 4.3.1.4 Future Occurrence

It is difficult to forecast the exact severity and frequency of future drought events, and the future of climate change will lead to increased uncertainty and extremity of climate events, suggesting that it is best to be prepared for potentially adverse conditions. Monroe County has experienced severe drought between five and ten percent of the time between 1895 and 1995 (*Figure 7 - Palmer Drought Severity Index History*), which can be used to make a rough estimate of the future probability of drought in Monroe County, although it does not account for uncertainty introduced by climate change. *Figure 8 - Recent Drought Severity Index* shows a recent Palmer Drought Severity Index reading for the continental United States and as of October 17, 2015, Monroe County and the surrounding region are considered in “Near Normal” conditions, with a PDSI between -1.9 and 1.9.

*Figure 7 - Palmer Drought Severity Index History*

### Palmer Drought Severity Index History

1895–1995

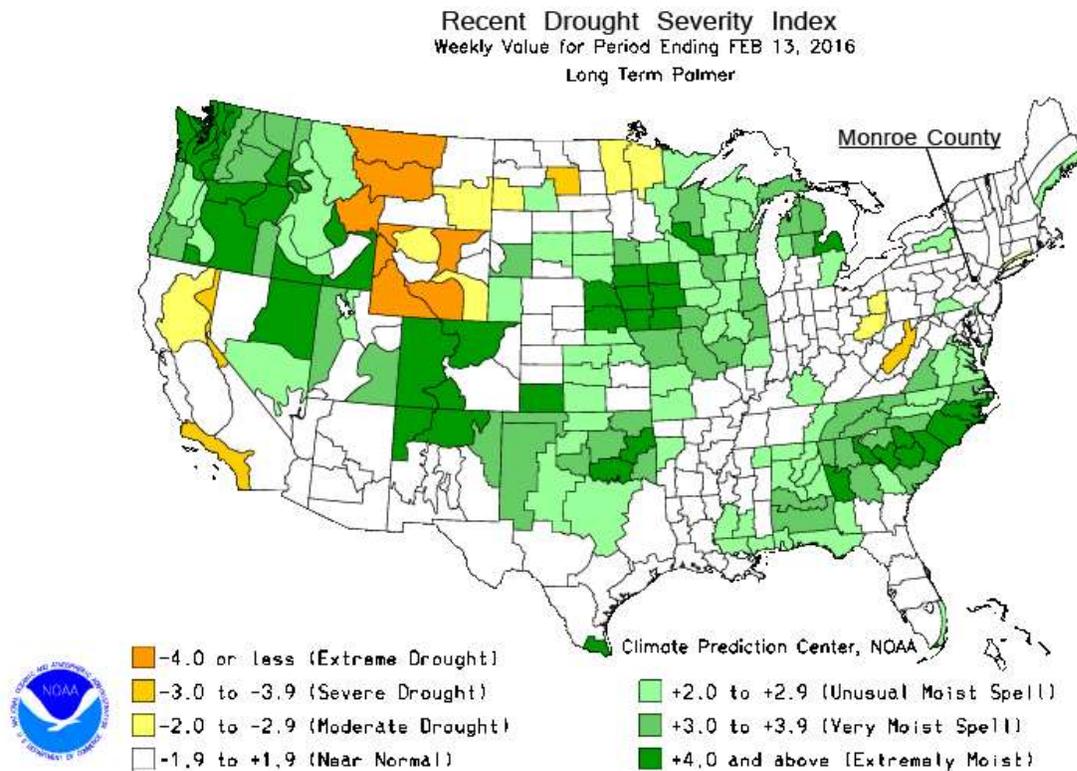


Source: McKee et al. (1993); NOAA (1990); High Plains Regional Climate Center (1996)  
Albers Equal Area Projection; Map prepared at the National Drought Mitigation Center

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Figure 8 - Recent Drought Severity Index



Source: [http://www.cpc.ncep.noaa.gov/products/MD\\_index.shtml](http://www.cpc.ncep.noaa.gov/products/MD_index.shtml)

### 4.3.1.5 Vulnerability Assessment

The most significant losses resulting from drought events are typically found in the agriculture sector. The 1999 Gubernatorial Proclamation was issued in part due to significant crop damage. Preliminary estimates by the Department of Agriculture indicated possible crop losses across the Commonwealth in excess of \$500 million. This estimate did not include a 20 percent decrease in dairy milk production which also resulted in million dollar losses (NCDC, 2009).

While these were statewide impacts, they illustrate the potential for droughts to severely impair the local economy in more agricultural communities. Monroe County ranks 57<sup>th</sup> of the 67 counties with agricultural production totaling \$11 million (USDA, 2012). The majority of this production comes from crops, including nursery and greenhouse crops (\$7.3 million); the remaining agricultural production is made up of livestock, poultry, and their products (\$3.6 million).

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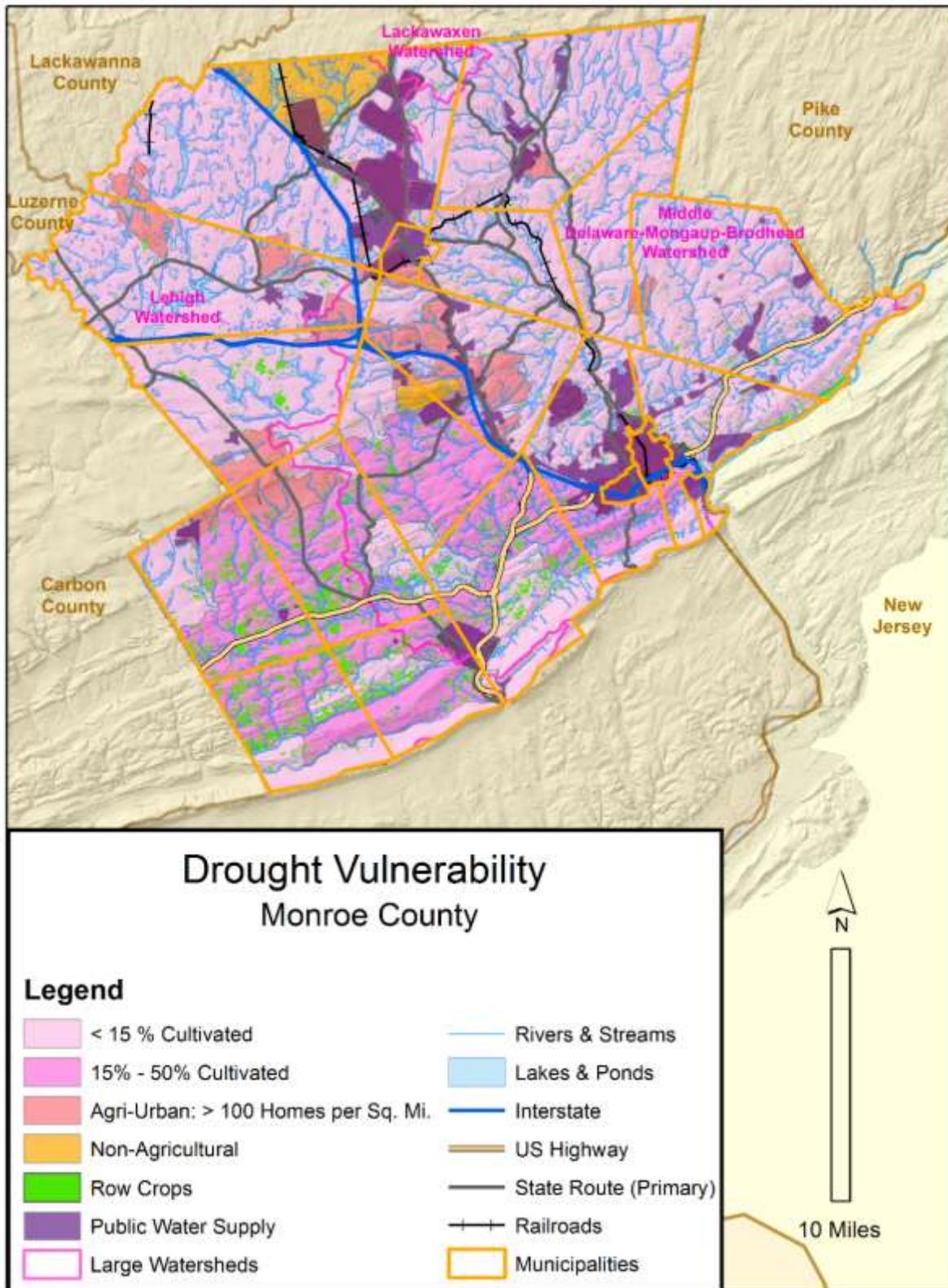
Water supplies are also vulnerable to the effects of drought. Public Water Service Areas cover only 8.5% of the county, including the entirety of Stroudsburg and East Stroudsburg boroughs (See *Figure 9 - Drought Vulnerability*), however the majority of the county relies on wells for their fresh drinking water. Droughts will quickly affect systems that rely on surface supplies, whereas systems with wells are more capable of handling short-term droughts without issue. Longer-term droughts inhibit the recharging of groundwater aquifers which has an impact on well owners. Depending on the severity of the drought, this could cause the well to dry up, rendering the well owner at a loss for useable water, meaning Monroe County residents who use private domestic wells are vulnerable to drought events. *Table 11 - Domestic Wells* shows the number of wells in each municipality in Monroe County. Well data was gathered from the Pennsylvania Groundwater Information System (PaGWIS), which relies on voluntary submissions by well drillers. While this is the best dataset of domestic wells available for Monroe County, it is not a complete due to the voluntary nature of the data submission.

*Table 11 - Domestic Wells*

<b>Domestic Wells in Monroe County by Municipality (PaGWIS 2015)</b>			
<b>Municipality</b>	<b>Number of reported domestic wells</b>	<b>Municipality</b>	<b>Number of reported domestic wells</b>
Barrett Township	362	Chestnuthill Township	2397
Coolbaugh Township	1408	Delaware Water Gap Boro	13
East Stroudsburg Boro	17	Eldred Township	363
Hamilton Township	846	Jackson Township	732
Middle Smithfield Township	1656	Mount Pocono Borough	37
Paradise Township	474	Pocono Township	1809
Polk Township	932	Price Township	720
Ross Township	593	Smithfield Township	631
Stroud Township	621	Stroudsburg Borough	7
Tobyhanna Township	3369	Tunkhannock Township	1754
		<b>Total</b>	<b>18540</b>

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Figure 9 - Drought Vulnerability



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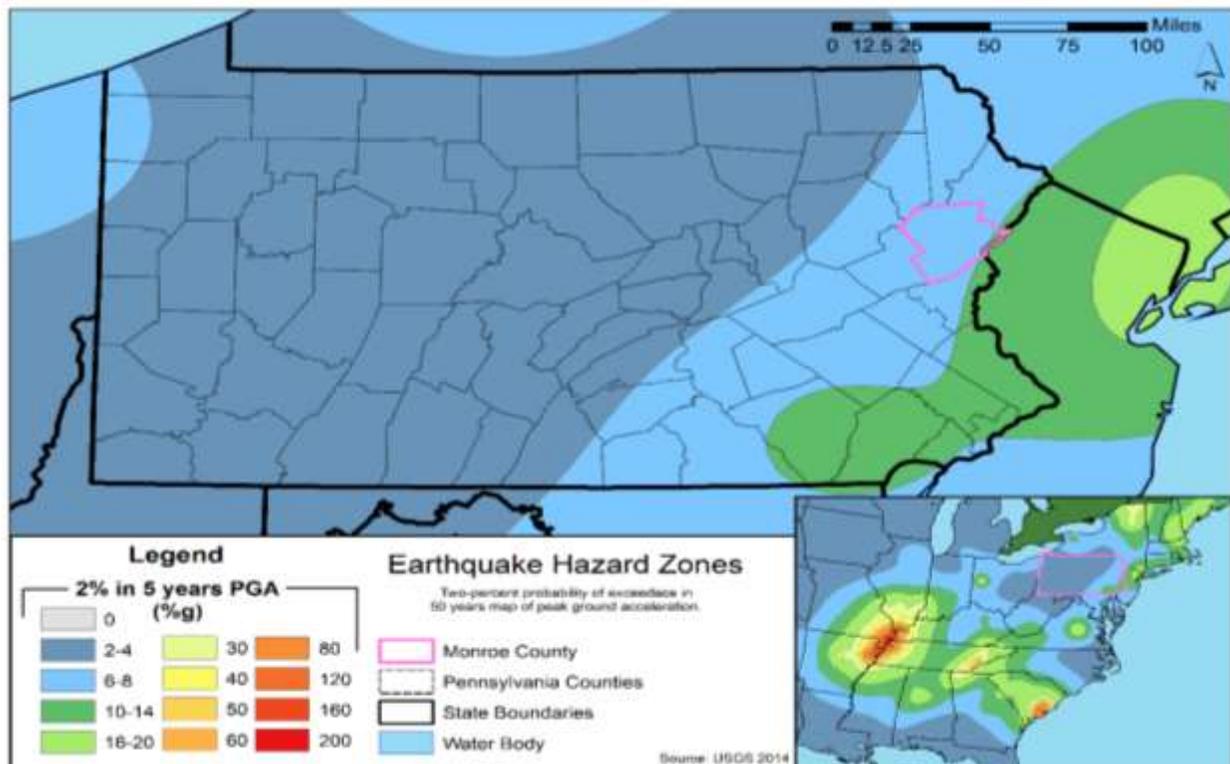
### 4.3.2. Earthquake

#### 4.3.2.1 Location and Extent

An earthquake is sudden movement of the earth's surface caused by the release of stress accumulated within or along the edge of the earth's tectonic plates, a volcanic eruption, or by a manmade explosion (DCNR, 2007). Earthquake events in Pennsylvania, including Monroe County are usually mild events; impacting areas no greater than 100 km in diameter from the epicenter. A majority of earthquakes occur along boundaries between tectonic plates. Today, Eastern North America, including Monroe County, Pennsylvania, is far from the nearest plate boundary. That plate boundary is the Mid-Atlantic Ridge, and is approximately 2,000 miles to the east.

When the supercontinent of Pangaea broke up about 200 million years ago, the Atlantic Ocean began to form. This event produced many faults. Locating all of the faults would be an idealistic approach to identifying the region's earthquake hazard; however, many of the fault lines in this region have no seismicity associated with them. The best way to determine earthquake history for Monroe County is to conduct a probabilistic earthquake-hazard analysis, with the earthquakes that have already happened in and around the county, to include neighboring counties in New Jersey.

Figure 10 - Earthquake Hazard Zones



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### 4.3.2.2 Range of Magnitude

Earthquakes result in the propagation of seismic waves, which are detected using seismographs. These seismograph results are measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake. *Table 12 - Richter Scale* summarizes Richter Scale Magnitudes as they relate to the spatial extent of impacted areas. The Modified Mercalli Intensity scale (*Table 13 - Modified Mercalli Intensity Scale*) is an alternative measure of earthquake intensity that is broken down by the impacts of the earthquake event.

*Table 12 - Richter Scale*

<b>Richter Scale Magnitudes and Associated Earthquake Size Effects</b>	
<b>RICHTER MAGNITUDES</b>	<b>EARTHQUAKE EFFECTS</b>
<b>Less than 3.5</b>	Generally not felt, but recorded.
<b>3.5-5.4</b>	Often felt, but rarely causes damage.
<b>Under 6.0</b>	At most, slight damage to well-designed buildings; can cause major damage to poorly constructed buildings over small regions.
<b>6.1-6.9</b>	Can be destructive in areas where people live up to about 100 kilometers across.
<b>7.0-7.9</b>	Major earthquake; can cause serious damage over large areas.
<b>8.0 or greater</b>	Great earthquake; can cause serious damage in areas several hundred kilometers across.

*Table 13 - Modified Mercalli Intensity Scale*

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

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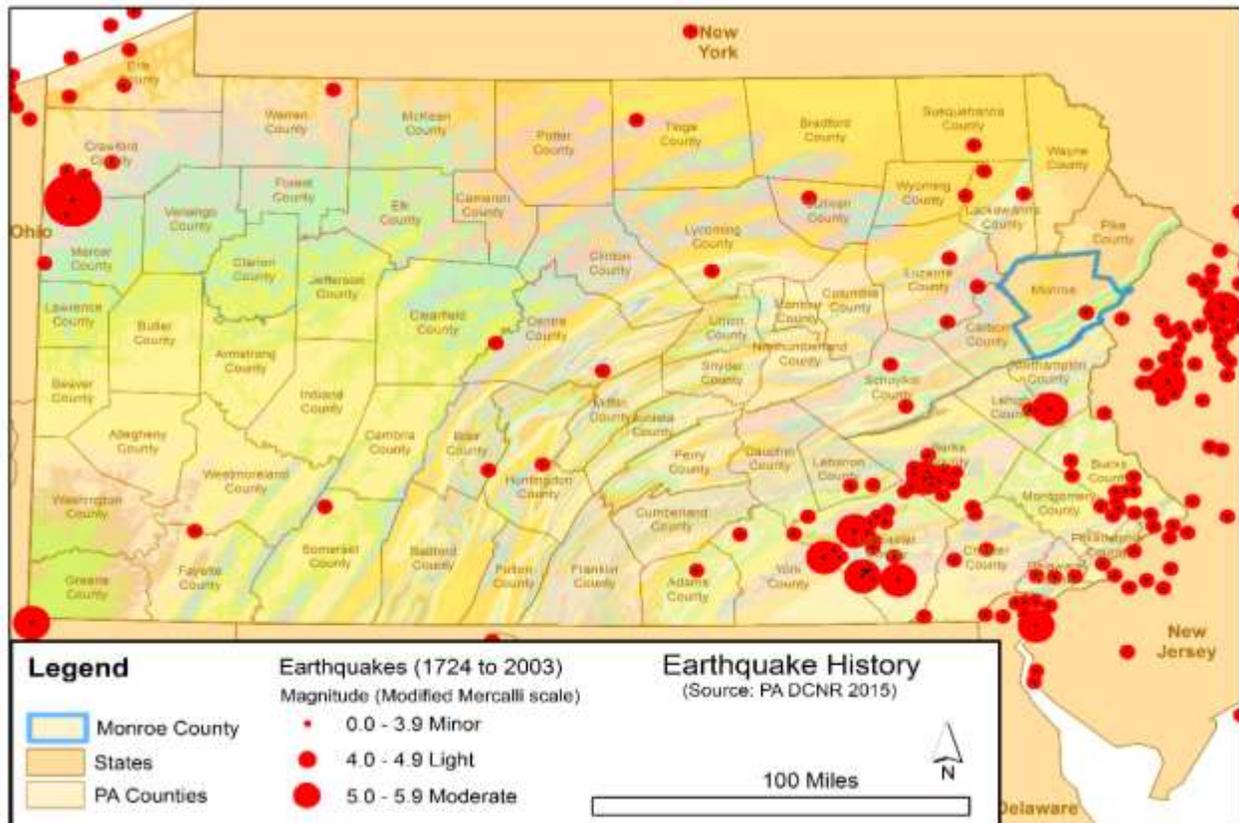
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The strongest recorded earthquake in Pennsylvania was a magnitude 5.1 on the Richter Scale, so it could be expected that strong intensity effects could be felt in Monroe County from earthquake events that happen in and around the county.

### 4.3.2.3 Past Occurrence

The only earthquake that originated in Monroe County occurred on October 24, 1942, with a magnitude of 3.4; according to the Pennsylvania DCNR. A total of 107 events located within 100 km of Monroe County is shown in *Figure 11 - Earthquake Past Occurrences*. Effects from these events may have been felt in Monroe County. The strongest recorded earthquake with an epicenter in Pennsylvania occurred on September 25<sup>th</sup> 1998 and was in the Mercer County at a magnitude 5.2 (USGS, 2012).

Figure 11 - Earthquake Past Occurrences



### 4.3.2.4 Future Occurrence

Earthquake activity and intensities are difficult to predict; but a probabilistic analysis of prior earthquakes can assist determining future occurrence. Even with only one

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recorded past event, Monroe County has a low to moderate probability of an earthquake, according to the earthquake hazard zones map *Figure 10 - Earthquake Hazard Zones*.

### **4.3.2.5 Vulnerability Assessment**

According to the U.S. Geological Society (USGS) Earthquake Hazards Program, an earthquake hazard is anything associated with an earthquake that may affect a resident's normal activities. For Monroe County this could include: surface faulting, ground shaking, landslides, liquefaction, tectonic deformation, and seiches (sloshing of a closed body of water from earthquake shaking).

Earthquakes usually occur without warning, and can impact areas a great distance from their point of origin (epicenter). Ground shaking is the greatest risk to building damage within Monroe County. Risk to public safety and loss of life from an earthquake is dependent upon the severity of the event. Injury or death to those inside buildings, or people walking below building ornamentation and chimneys is a higher risk to Monroe County's general public during an earthquake.

### **4.3.3. Extreme Temperatures (Hot or Cold)**

#### **4.3.3.1 Location and Extent**

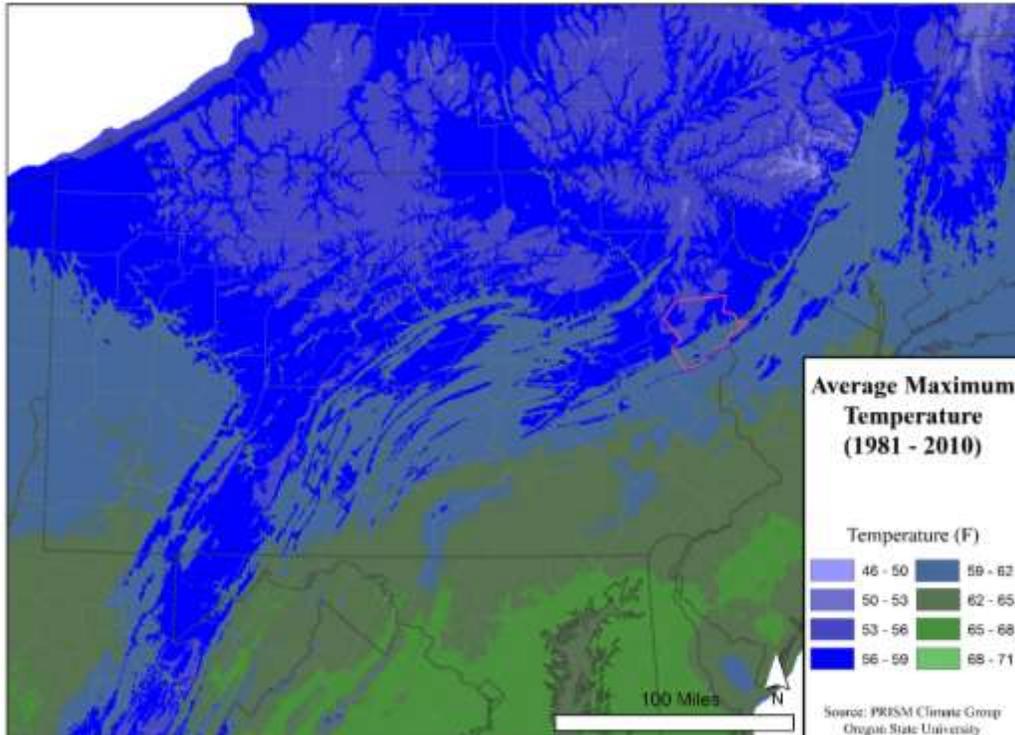
Extreme temperatures can be devastating: extreme heat can cause sunburn, heat cramps, heat exhaustion, heat stroke, and dehydration while extreme cold can cause hypothermia and frostbite. *Figure 12 - Average Maximum Temperature* and *Figure 13 - Average Minimum Temperature* show annual mean maximum and minimum temperatures for Pennsylvania. July is typically the warmest month for Monroe County, with normal temperatures ranging from upper 70s to mid 80s. January is typically the coldest month for Monroe, with normal temperatures ranging from low teens to high 20s. Temperatures can vary across Monroe County due to elevation changes in topography.

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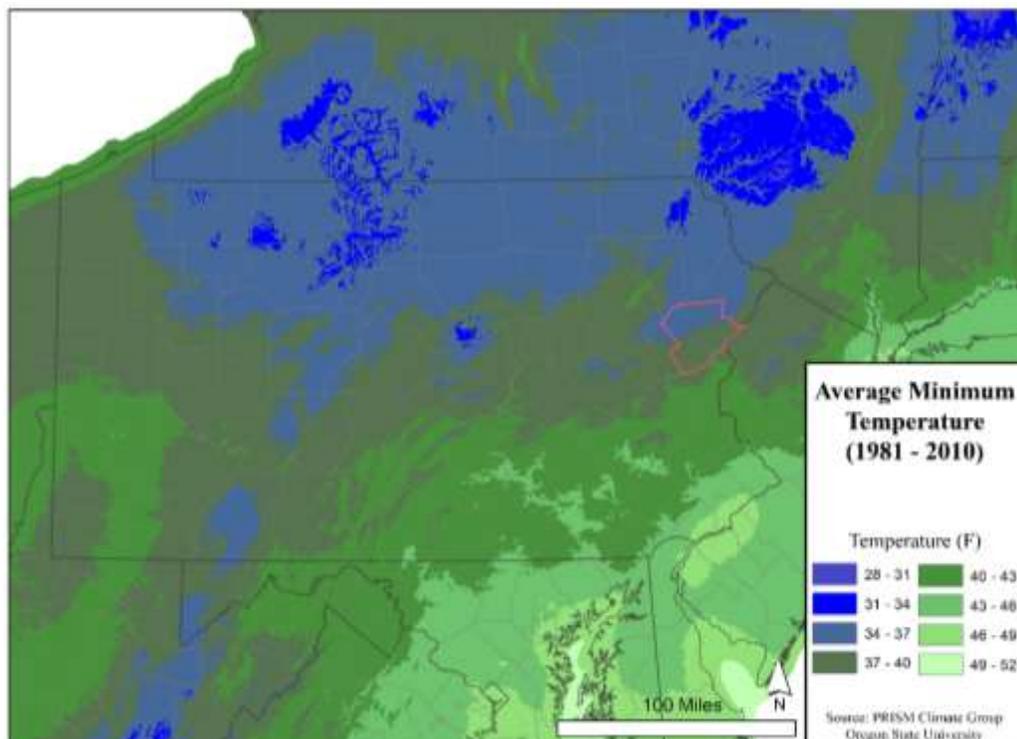
Figure 12 - Average Maximum Temperature



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Figure 13 - Average Minimum Temperature



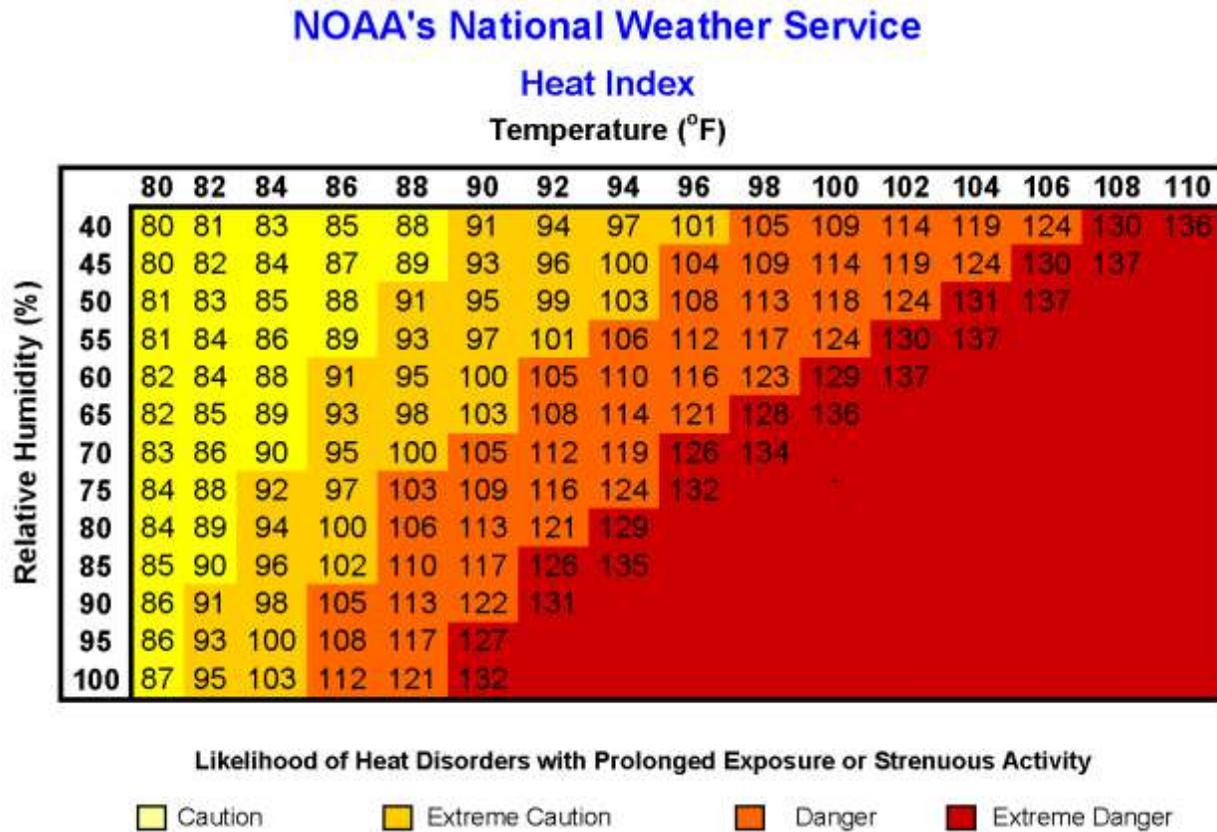
### 4.3.3.2 Range of Magnitude

When extreme temperature events occur, they typically impact the entirety of Monroe County, including the surrounding region. Extreme heat is described as temperatures that hover at least 10°F above the average high temperature for a region during the summer months. Extreme heat is responsible for more deaths in Pennsylvania than all other natural disasters combined. The apparent temperature of the air increases as relative humidity increases, and the National Weather Service created a Heat Index chart (*Figure 14 - National Weather Service Heat Index* (NOAA 2016)) which shows the likelihood of heat disorders relative to the temperature and relative humidity. *Heat Advisories* are issued when the heat index will be equal to or greater than 100°F, but less than 105°F, *Excessive Heat Warnings* are issued when heat indices will attain or exceed 105°F, and *Excessive Heat Watches*, are issued when there is a possibility that excessive heat warning criteria may be experienced within twelve to forty-eight hours (NOAA NWS, 2010). A potential worst-case extreme temperature scenario would be if widespread areas of the Commonwealth experienced 90°F or higher temperatures for an extended number of days. The heat could overwhelm the power grid and cause widespread blackouts, cutting off vital HVAC services for residents.

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Figure 14 - National Weather Service Heat Index (NOAA 2016)

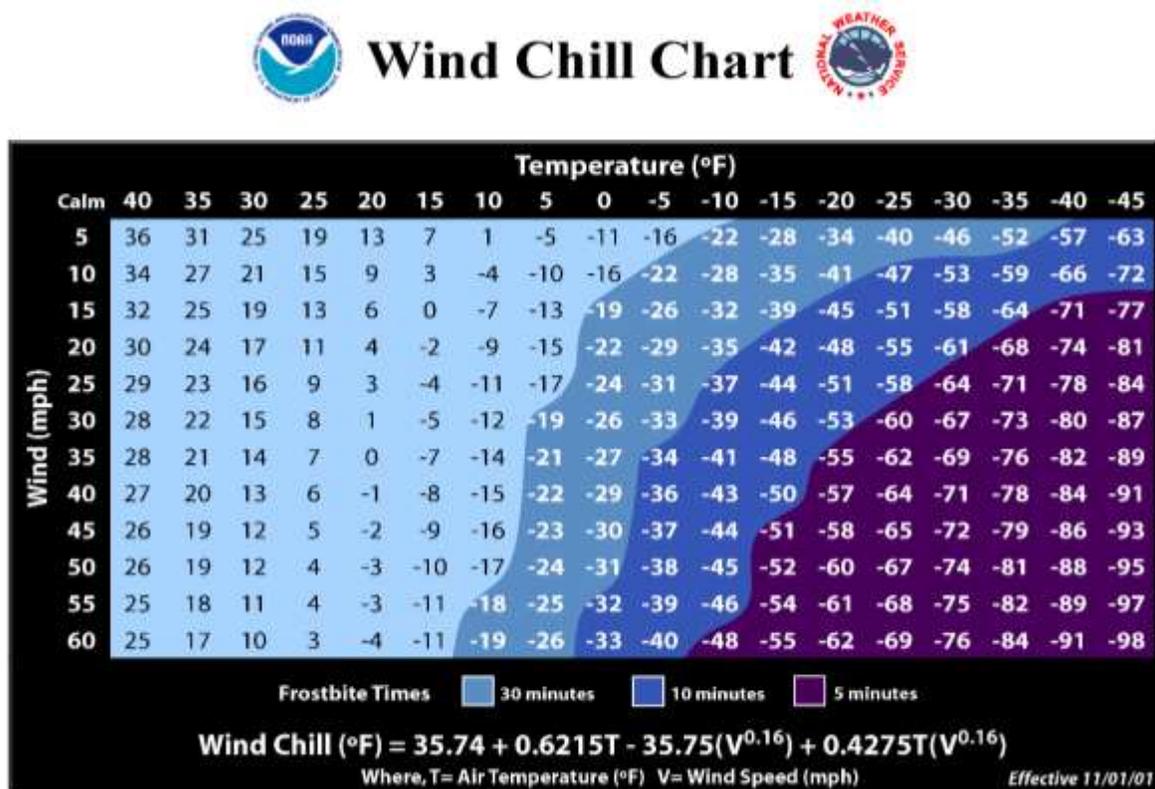


Extreme cold temperatures drop well below typical temperatures, and are often associated with winter storm events. Wind can make the apparent temperature drop further, and exposure to such extreme cold temperatures can cause hypothermia, frost bite and death. The National Weather Service created a Wind Chill chart (*Figure 15 - National Weather Service Wind Chill* (NOAA 2016)) which shows the time frostbite takes to set in depending on temperature and wind speed. *Wind Chill Warnings* are issued when wind chills drop to -25°F or lower. Wind Chill Advisories are issued in the south-east and western sections of Pennsylvania when wind chill values drop to -10°F to -24°F. South-central to northern sections of the Commonwealth when wind chills drop to -15°F to -24°F (NOAA NWS, 2010).

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Figure 15 - National Weather Service Wind Chill (NOAA 2016)



### Past Occurrence

Monroe County has had more occurrences of extreme cold incidents than extreme heat due to the geographic location of the county. In the state of Pennsylvania, there have been 315 extreme temperature events between 1950 and 2013, resulting in 587 deaths and 530 injuries (NCDC, 2013). Of those events, 71 were extreme cold (27 deaths, 129 injuries), and 205 were extreme heat (560 deaths, 401 injuries) (NCDC, 2013). Although exact data for Monroe County is limited below (*Table 14 - Extreme Temperature History*), it is the assumption that the county experienced the effects of extreme temperatures more in the past.

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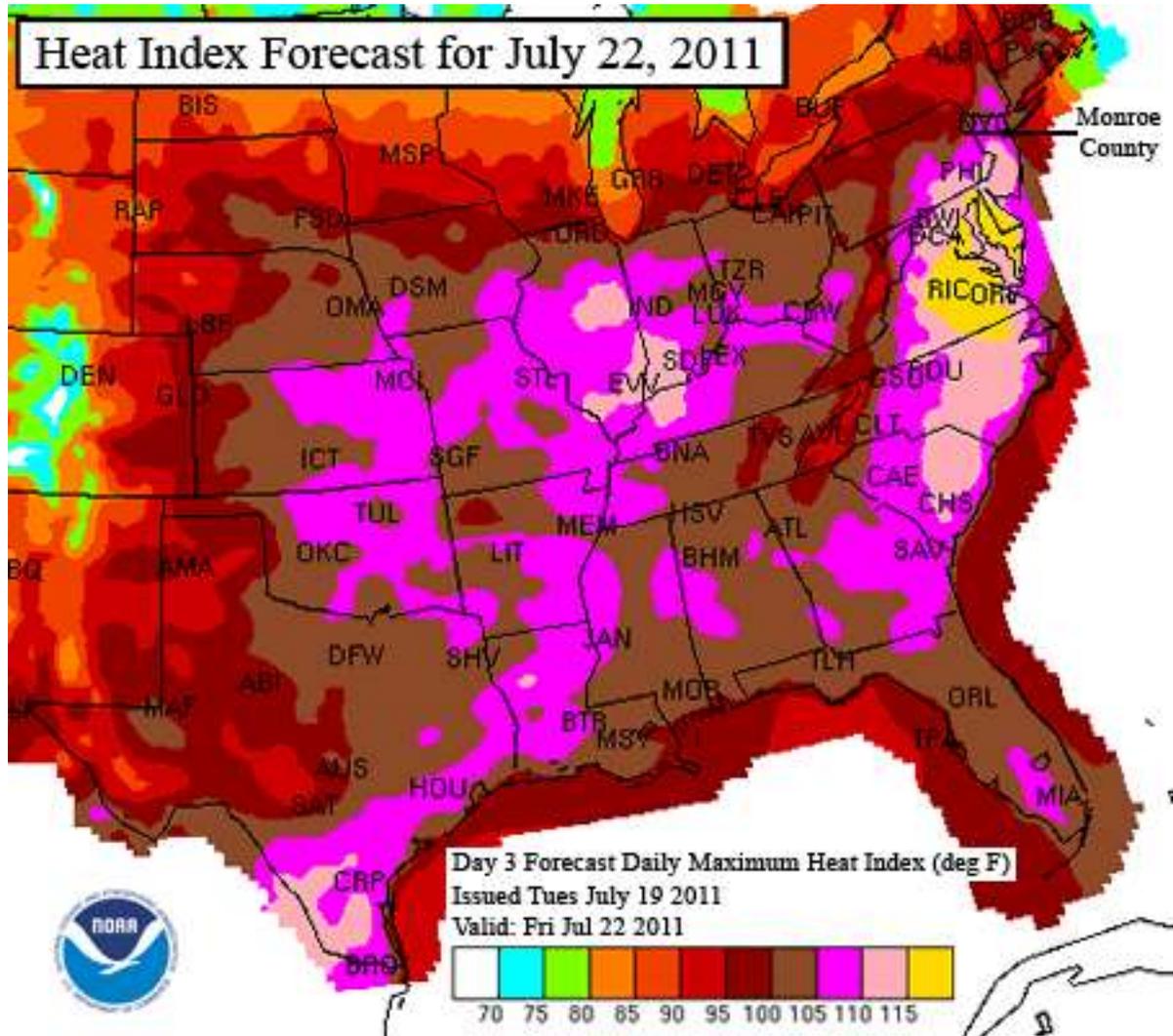
Table 14 - Extreme Temperature History

<b>Monroe County Extreme Temperature History (1950 - 2015)</b>			
<b>Date</b>	<b>Type</b>	<b>Deaths</b>	<b>Injuries</b>
5/2/2001	Excessive Heat	0	0
1/26/2007	Extreme Cold/Wind Chill	0	0
2/5/2007	Extreme Cold/Wind Chill	0	0
2/6/2007	Extreme Cold/Wind Chill	0	0
6/7/2008	Excessive Heat	0	0
7/16/2008	Excessive Heat	0	0
7/6/2010	Excessive Heat	0	0
7/21/2011	Excessive Heat	0	0
1/4/2014	Extreme Cold/Wind Chill	0	0
1/7/2014	Extreme Cold/Wind Chill	0	0
1/22/2014	Extreme Cold/Wind Chill	0	0
1/7/2015	Extreme Cold/Wind Chill	0	0
2/13/2015	Extreme Cold/Wind Chill	0	0
2/15/2015	Extreme Cold/Wind Chill	0	0
2/19/2015	Extreme Cold/Wind Chill	0	0
2/24/2015	Extreme Cold/Wind Chill	0	0
Source: NOAA National Climatic Data Center			

In 2011, Pennsylvania experienced record-breaking heat in 19 counties and a total of 45 broken heat records. *Figure 16 - Heat Index Forecast for July 22, 2011* shows the temperatures for July 22, 2011. Pennsylvania was again hit with record breaking temperatures on July 9, 2012 when daily record highs were broken in several cities in eastern Pennsylvania, including Harrisburg, Lancaster, and Chambersburg, which each reached 101 °F (38.3 °C).

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Figure 16 - Heat Index Forecast for July 22, 2011



## Future Occurrence

Extreme temperature has a risk factor of 2.4 as determined by the Pennsylvania Emergency Management Agency, and extreme temperatures will continue to impact Monroe County. Anthropogenic climate change is causing extreme climatic events to occur more frequently, suggesting that extreme temperatures are becoming a more threatening hazard as the impacts of climate change intensify. In recent years, record high temperatures have outnumbered record low temperatures 2:1 (Meehl et al., 2009) so it is expected that the risk of extreme heat will be amplified whereas the risk of extreme cold will be attenuated.

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### **Vulnerability Assessment**

Extreme temperatures are usually a regional hazard when they occur. The elderly and young people are most vulnerable to extreme temperatures due to mobility challenges and disabilities. Extreme temperatures can increase the demand for utility services, often resulting in an increased cost to consumers. The increased expense can make it difficult for the consumer to afford the service. The increased demand for services may cause a decrease in availability of these services or failure of the system. A decrease or failure of the utility system during extreme temperature events puts a large population at great risk.

#### **4.3.4. Flood, Flash Flood and Ice Jams**

##### **4.3.4.1 Location and Extent**

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. 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.

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.

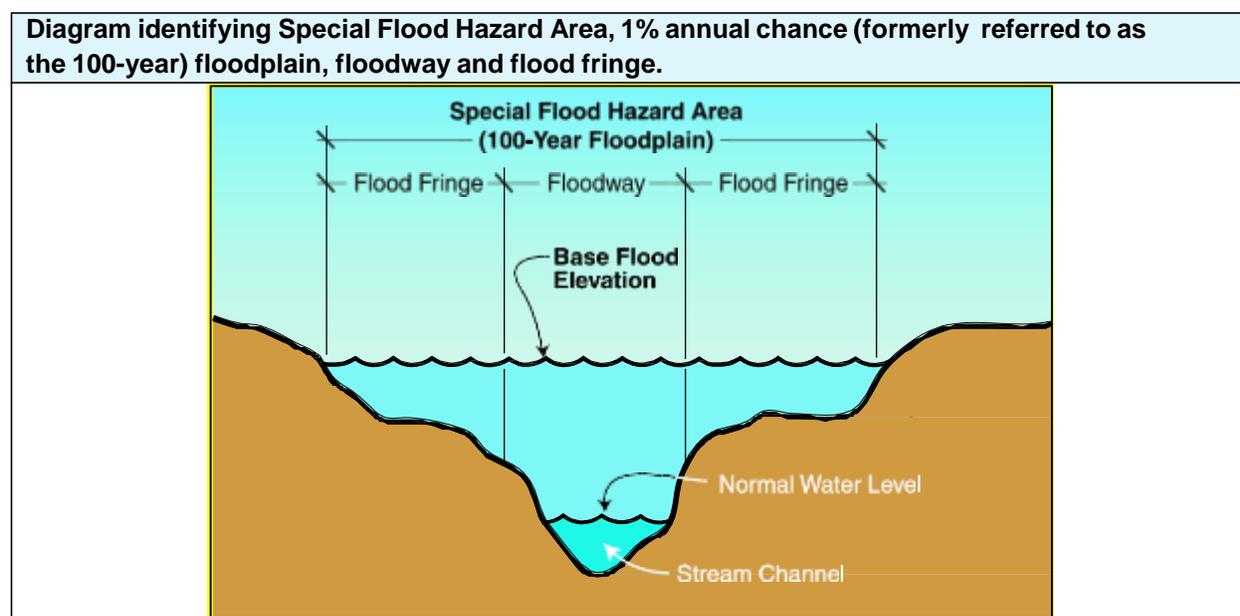
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Floodplains are lowlands adjacent to rivers, streams and creeks that are subject to recurring floods. The size of the floodplain is described by the recurrence interval of a given flood. Flood recurrence intervals are explained in more detail in Section 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 digital flood insurance rate maps (DFIRMs) 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 17 - Flooding and Floodplain Diagram* illustrates these terms. The SFHA serves as the primary regulatory boundary used by FEMA, the Commonwealth of Pennsylvania and Monroe County local governments.

*Figure 17 - Flooding and Floodplain Diagram*



The National Flood Insurance Program (NFIP) publishes flood insurance rate maps. These maps identify the 1% annual chance of flood area. Special Flood Hazard Area (SFHA) and Base Flood Elevations (BFE) are developed from the 1% annual chance flood event. Structures located in the SFHA have a 26% chance of flooding in a 30 year period. The SFHA serves as the primary regulatory boundary used by county and municipal governments. Federal floodplain management regulations and mandatory flood insurance purchase requirements apply to the following high risk special flood hazard areas in

*Table 15 - Flood Hazard High Risk Zones.*

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Table 15 - Flood Hazard High Risk Zones

<b>Special Flood Hazard Area High Risk Zones</b>	
<b>Zone</b>	<b>Description</b>
<b>A</b>	Areas subject to inundation by the 1% annual chance flood event. Because detailed hydraulic analysis have not been performed, no base flood elevations or flood depths are shown
<b>AE</b>	Areas subject to inundation by the 1% annual chance flood event determined by detailed methods. BFEs are shown within these zones.
<b>AH</b>	Areas subject to inundation by the 1% annual chance shallow flooding (usually areas of ponding) where average depths are 1-3 feet. BFEs derived from detailed hydraulic analysis are shown in this zone.
<b>AO</b>	Areas subject to inundation by the 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are 1-3 feet. Average flood depths derived from detailed hydraulic analysis are shown within this zone.
<b>AR</b>	Areas that result from the decertification of a previously accredited flood protection system that is determined to be in the process of being restored to provide base flood protection.
<i>Source: Federal Emergency Management Agency</i>	

In the past, heavy rains have caused most of Monroe County’s flood problems. Heavy rains cause small creeks and streams to overflow their banks, which leads to road closures. Flooding poses the biggest threat to those who reside or conduct business in the floodplain. The most significant hazard exists for businesses in the floodplain that process, use and/or store hazardous materials. A flood could potentially allow for hazardous materials to leak out of these areas. As the water recedes it would spread the hazardous materials throughout the area. Also threatened are the agricultural areas in the floodplain. Most flood damage to property and structures located in the floodplain is caused by water exposure to the interior, high velocity water and debris flow.

#### **4.3.4.2 Range of Magnitude**

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

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

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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.

Potential flooding impacts range from very low to catastrophic depending on the type and location of flooding. The maximum threat of flooding in Monroe County is estimated by looking at potential loss data and repetitive loss data, both analyzed in the risk assessment portion of the hazard mitigation plan.

The potential for loss of life and injuries to occur in these areas is high. Additionally, the long-term impact severe flooding could have on the health and safety of the citizens is high. Depending on the scope and magnitude of the flooding, the likelihood of long-term economic disruption is possible. Flooding may have a moderate impact on property, facilities and infrastructure with varying levels of damage to structures in the affected area. Mobile homes are especially threatened by high water levels. Basic services may experience moderate impacts, as disruptions for short periods of time could occur. Government operations are expected to continue without disruption. The environmental impact should be minimal, unless hazardous materials are released as a result of the flooding.

Power failures are the most common secondary effect associated with flooding. Coupled with a shortage of critical services and supplies, power failures could cause a public

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health emergency. Disruption in traffic flow may cause a transportation accident. Flooding also has the potential to cause other hazards, such as landslides, hazardous material spills and dam failures.

Industrial, commercial and public infrastructure facilities can become inundated with flood waters, threatening the continuity of government and business. The special needs population must be tracked and identified in flooding situations, as they are often home-bound.

Severe flooding can have long-term secondary effects on the population, economy and infrastructure of Monroe County. Escalating costs of damage to private structures and the frequency of flooding can cause permanent population displacement. Small businesses that contribute to the local economy may close if they are unable to recover from the disaster. Disruption to the commerce and/or transportation modes can have an adverse effect on municipal economies in affected areas. Critical infrastructure, such as sewage and water treatment facilities, can be severely damaged. This can have a significant effect on public health. High flood waters can cause sewage systems to fail, overflow and contaminate groundwater and drinking water.

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.

#### **4.3.4.3 Past Occurrence**

Monroe County has experienced numerous flooding, flash flooding and ice jam flooding events in the past. The flooding and flash flooding was caused by a variety of storms, tropical storms, ice jams and other issues. The most significant occurrence of flooding is due to heavy storms with rain. A summary of the flood history of Monroe County is noted below in *Table 16 – Recent Flood Event History*.

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Table 16 – Recent Flood Event History

<b>Monroe County Flood Event History 2011-2016</b>			
Date	Location	Type	Deaths
03/07/2011	Shoemakers	Flooding on the Bush Kill due to heavy rain and snow melt	0
03/11/2011	Shoemakers	Flooding on the Bush Kill due to heavy rain and snow melt	0
05/19/2011	Marshalls Creek	Flash Flooding in Hamilton, Middle Smithfield and Stroud Townships	0
08/28/2011	Blakeslee	Flash Flooding due to heavy rain from Tropical Storm Irene	0
08/28/2011	Shoemakers	Flooding on the Bush Kill due to heavy rain from Tropical Storm Irene	0
09/07/2011	East Stroudsburg	Flooding due to remnants of Tropical Storm Lee	0
09/08/2011	Minisink Hills	Flooding due to remnants of Tropical Storm Lee	0
09/28/2011	McMichaels	Flash flooding in south central Monroe County	0
05/26/2012	East Stroudsburg, Barton and Pocono Manor	Flash flooding throughout Monroe County. Pocono Township and Hamilton Township	0
09/04/2012	Brodheads ville and Stroudsburg	Flash flooding in Chestnuthill, Hamilton, Jackson, Middle Smithfield, Stroud Townships and Stroudsburg Borough	0
09/18/2012	Kresgeville	Flash flooding from heavy downpours during thunderstorms in Tobyhanna and Pocono Townships	0
07/01/2013	Shoemakers	Flash flooding due to heavy rain and poor drainage in eastern Monroe County	0
07/02/2013	Kunkletown	Poor drainage flooding in Polk, Jackson and Chestnuthill Townships	0
07/28/2013	Kunkletown	Flash flooding due to heavy rainfall in Hamilton, Stroud, Smithfield and Middle Smithfield Townships and Stroudsburg and East Stroudsburg Boroughs	0
08/09/2013	Long Pond	Flash flooding from torrential down pours in Chestnuthill and Tunkhannock Townships	0
01/11/2014	Stroudsburg	Flooding due to light to moderate rain over and snow melt over 24 hours	0
06/14/2015	Snydersville	Heavy rains and poor drainage flooding	0
06/30/2015	Misertown and Henryville	Flash flooding from heavy rain in Chestnuthill and Pocono Townships. Brodhead Creek near Anamolink area. An estimation of over \$100,000 in property damage	0
07/01/2015	Misertown	Residual flash flooding from previous day storms	0

The following *Table 17 - Flood Event History 1993-2010* identifies flooding events that were identified in the 2011 Monroe County Hazard Mitigation Plan.

Table 17 - Flood Event History 1993-2010

<b>Monroe County Flood Event History 1993-2010</b>	
Date	Location and 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.

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<b>Monroe County Flood Event History 1993-2010</b>	
<b>Date</b>	<b>Location and Description</b>
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 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.

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<b>Monroe County Flood Event History 1993-2010</b>	
<b>Date</b>	<b>Location and Description</b>
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.
9/30/10	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 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).

In addition to the aforementioned past flood events, the National Flood Insurance Program identifies properties that frequently experience flooding. *Repetitive loss properties* are structures insured under the NFIP which have had at least two paid flood losses of more than \$1,000 over any ten year period since 1978. A property is considered a *severe repetitive loss property* either when there are at least four losses each exceeding \$5,000 or when there are two or more losses where the building payments exceed the property value. As of June 30, 2015, there are 41 repetitive loss and 2 severe repetitive loss properties in Monroe County.

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Table 18 - Municipal NFIP Policies and Repetitive Loss Properties

<b>Summary of NFIP Policies, Severe Repetitive Loss and Repetitive Loss properties by municipality</b>					
<b>MUNICIPALITY</b>	<b>NFIP POLICIES</b>	<b>SEVERE REPETITIVE LOSS</b>	<b>REPETITIVE LOSS 2-4 FAMILY</b>	<b>REPETITIVE LOSS SINGLE FAMILY</b>	<b>SUM OF REPETITIVE LOSS PROPERTIES</b>
Barrett Township	29	0	0	0	0
Chestnut Hill Township	47	0	0	2	0
Coolbaugh Township	85	0	0	0	0
Delaware Water Gap Borough	14	0	0	2	0
East Stroudsburg Borough	9	0	0	0	0
Eldred Township	12	0	0	1	1
Hamilton Township	33	0	0	3	3
Jackson Township	7	0	0	0	0
Middle Smithfield Township	45	0	0	2	2
Mount Pocono Borough	4	0	0	0	0
Paradise Township	19	0	0	0	0
Pocono Township	41	0	0	0	0
Polk Township	39	0	0	0	0
Price Township	2	0	0	0	0
Ross Township	13	0	0	1	1
Smithfield Township	61	2	0	22	22
Stroud Township	68	0	0	6	6
Stroudsburg Borough	29	0	0	1	1
Tobyhanna Township	67	0	0	1	1
Tunkhannock Township	5	0	0	0	0
<b>TOTAL</b>	<b>629</b>	<b>2</b>	<b>0</b>	<b>41</b>	<b>41</b>

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### 4.3.4.4 Future Occurrence

Table 19 - Flood Probability Summary

Flood Probability Summary	
Flood Recurrence Intervals	Chance of Occurrence
10-year	10.00%
50-year	2.00%
100-year	1.00%
500-year	0.20%

Source: Federal Emergency Management Agency

Flooding is a frequent problem throughout Pennsylvania. The probability of a flooding event impacting Monroe County is highly likely. Monroe County experiences some degree of flooding annually. The threat of flooding is compounded in the late winter and early spring months, as melting snow can overflow streams, creeks and

tributaries, increasing the amount of groundwater, clogging stormwater culverts and bridge openings. The NFIP recognizes the 1%-annual-chance flood, also known as the *base flood*, as the standard for identifying properties subject to federal flood insurance purchase requirements. A 1%-annual-chance flood is a flood which has a 1% chance of occurring over a given year. The digital flood insurance rate maps (DFIRMs) are used to identify areas subject to the 1% annual-chance flooding. A property's vulnerability to a flood is dependent upon its location in the floodplain. The properties that reside along the banks of a waterway are the most vulnerable. The property within the floodplain is broken into sections depending on its distance from the waterway. The 10-year flood zone is the area that has a 10 percent chance of being flooded every year. However, this label does not mean that this area cannot flood more than once every 10 years. It just designates the probability of a flood of this magnitude every year. Further away from this area is the 50-year floodplain. This area includes all of the 10-year floodplain plus additional property. The probability of a flood of this magnitude occurring during a one-year period is two percent. A summary of flood probability is shown in *Table 19 - Flood Probability Summary*.

### 4.3.4.5 Vulnerability Assessment

#### River and Stream Flooding:

Monroe County is vulnerable to flooding events. Flooding puts the entire population at some level of risk, whether through the flooding of homes, businesses, places of employment, or the road, sewer and water infrastructure. High floodwaters can devastate homeowners with both property damage and property loss. Monroe County's population is also vulnerable to the secondary effects of flooding. Power loss can leave citizens without heat for extended periods of time. The transportation infrastructure of the county can be severely crippled by flooding events which can endanger citizens attempting to travel or evacuate the area, as well as leave those remaining without goods and services.

Monroe County's economy is vulnerable to flooding events. The potential impacts on the economy presented by this hazard can lead to long-term economic disruption, especially

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among small businesses. Flooding can destroy the physical structures, merchandise and equipment essential for business operation. Secondary effects of flooding include power outages and transportation accidents. Power outages can stop a business from operating while transportation accidents can hinder the supply of essential goods, services and supplies.

Minor flooding events in Monroe County present a moderate vulnerability to the environment. For the most part, flooding is a natural occurrence and alone cannot do much harm to the environment. However, the environment is vulnerable to the secondary effects of flooding such as hazardous material spills. For example, flooding can result in contamination when raw sewage, animal waste, chemicals, pesticides, or other hazardous materials are suspended and transported through flood waters to sensitive habitats, neighborhoods, or business settings. Events such as these require major clean-up and remediation efforts.

*Table 20 – Critical Facilities Vulnerable to Flooding* identifies the critical facilities within Monroe County that are located within the special flood hazard area and the assessed value of the building. *Table 21 - Addressable Structures Vulnerable to Flooding* identifies the quantity of residential and commercial structures that are located in the special flood hazard area. The structures were identified using county GIS data. Critical facilities are facilities that if damaged would present an immediate threat to life, public health and safety.

*Table 20 – Critical Facilities Vulnerable to Flooding*

<b>Monroe County Critical Facilities in the Special Hazard Flood Area</b>		
<b>Name</b>	<b>Facility Type</b>	<b>Building Assessed Value</b>
Pocono Township Volunteer Fire Company, Pocono Township	Fire Department	\$95,140
St. Johns Lutheran Church, Stroudsburg Borough	Daycare	\$92,720
BF Morey Elementary School/ Stroudsburg School District, Stroudsburg Borough	School	\$2,127,800
PSP Fern Ridge, Tobyhanna Township	Police Station	\$32,800
Gilbert Medical Center & Podiatry Associates, Chestnuthill Township	Physician & Outpatient Lab	\$131,490
Brookmont Healthcare Center LLC, Chestnuthill Township	Skilled Nursing Facility	\$390,690
Pleasant Valley Manor, Hamilton Township	Assisted Living	\$979,850
<b>Total</b>		<b>\$3,850,490</b>
<i>Source: Monroe County GIS</i>		

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Monroe County is vulnerable to flooding that causes loss of lives, property damage and road closures. 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 county GIS data and the FEMA countywide digital flood data.

*Table 21 - Addressable Structures Vulnerable to Flooding*

<b>MUNICIPALITY</b>	<b>Commercial</b>	<b>Residential</b>	<b>Total</b>
Barrett Township	9	76	85
Chestnut Hill Township	19	146	165
Coolbaugh Township	11	318	329
Delaware Water Gap Borough	11	15	26
East Stroudsburg Borough	25	41	66
Eldred Township	5	39	44
Hamilton Township	23	133	156
Jackson Township	1	16	17
Middle Smithfield Township	3	69	72
Mount Pocono Borough	0	1	1
Paradise Township	1	23	24
Pocono Township	94	103	197
Polk Township	14	142	156
Price Township	5	7	12
Ross Township	2	66	68
Smithfield Township	39	191	230
Stroud Township	42	85	127
Stroudsburg Borough	9	121	130
Tobyhanna Township	0	117	117
Tunkhannock Township	1	0	1
<b>Total</b>	<b>314</b>	<b>1,709</b>	<b>2,023</b>

A risk factor was determined for each municipality in Monroe County utilizing the summary of risk factor approach document for flooding. The results for each municipality are identified in *Table 22 - Flooding Risk Factor by Municipality*. Risk Factors identified as high risk have risk factors greater than or equal to 2.5. Risk Factors 2.0 to 2.4 are considered moderate risk hazards. Risk Factors less than 2.0 are considered low risk.

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According to the default weighting scheme applied, the highest possible risk factor value is 4.0.

Table 22 - Flooding Risk Factor by Municipality

<b>Flooding Risk Factor Results per Municipality</b>						
<b>FLOODING HAZARD PER MUNICIPALITY</b>	<b>RISK ASSESSMENT CATEGORY</b>					<b>RISK FACTOR (RF)</b>
	<b>PROBABILITY</b>	<b>IMPACT</b>	<b>SPATIAL EXTENT</b>	<b>WARNING TIME</b>	<b>DURATION</b>	
Barrett Township	3	2	2	1	3	2.3
Chestnut Hill Township	2	2	3	1	3	2.2
Coolbaugh Township	2	1	2	1	3	1.7
Delaware Water Gap Borough	3	4	4	1	4	3.4
East Stroudsburg Borough	2	2	3	1	3	2.2
Eldred Township	2	2	3	1	3	2.2
Hamilton Township	4	3	3	1	4	3.2
Jackson Township	2	2	3	1	3	2.2
Middle Smithfield Township	3	3	1	3	4	2.7
Mount Pocono Borough	2	1	2	4	2	1.9
Paradise Township	2	3	2	1	3	2.3
Pocono Township	2	2	2	1	3	2
Polk Township	2	2	3	1	3	2.2
Price Township	2	1	1	1	3	1.5
Ross Township	2	2	3	1	3	2.2
Smithfield Township	3	3	2	3	4	2.9
Stroud Township	2	2	2	1	3	2
Stroudsburg Borough	2	2	3	1	3	2.2
Tobyhanna Township	2	2	2	1	3	2
Tunkhannock Township	1	1	1	4	1	1.3

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### **Flash Flooding:**

Flash flooding can occur anywhere within Monroe County when the conditions are right. Locations that are more populated and have more impervious ground have a higher vulnerability to flash flooding. During the risk assessment process numerous resources were utilized to determine flash flooding locations. Municipalities were asked to identify locations within the municipality that are prone to frequent flash flooding. The National Climatic Data Center was also queried to determine flash flood vulnerable areas. This data is reflected in *Table 16 – Recent Flood Event History* and *Table 17 - Flood Event History 1993-2010* above.

Locations that are identified as vulnerable to flash flooding in Monroe County are as follows:

Bartonsville	Long Pond
Blakeslee	McMichaels
Brodheads ville	Misertown
Henryville	Pocono Manor
Kunkletown	Shoemakers

Municipalities that have experienced flash flooding in accordance with National Climatic Data Center information are as follows:

Chestnuthill Township	Middle Smithfield Township
East Stroudsburg Borough	Pocono Township
Hamilton Township	Stroud Township
Jackson Township	Stroudsburg Borough

Although the above locations were identified as vulnerable areas within Monroe County, they are not the only locations that are vulnerable to flash flooding. The Monroe County Hazard Mitigation Team will continue to work with municipalities to identify vulnerable flash flooding locations and identify vulnerable special needs population and critical facilities.

### **Ice Jam Flooding:**

There are only two recorded incidents of ice jam flooding in Monroe County. The first occurred on January 20 1996 when a rapid thaw resulted in ice jam flooding of the Delaware River. Three hundred full and part time residents of the Shawnee village were evacuated. While no people were injured or killed, twenty six horses housed in the Shawnee Stables tragically drowned. The Delaware Water Gap National Recreation Area was shut down for two days and several roads were forced to close. Buildings at Smithfield and Milford Beaches sustained significant damage, and the flood caused damage to two boat launches.

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The second ice jam flood took place in 2002 at Appenzell in Jackson Township. The Monroe County Local Planning Team was not aware of any other incidents or vulnerable areas in the county. The Monroe County Hazard Mitigation Team will continue to work with municipalities to identify vulnerable ice jam flooding locations and identify vulnerable special needs population and critical facilities.

### **4.3.5. Hurricane, Tropical Storm**

#### **4.3.5.1 Location and Extent**

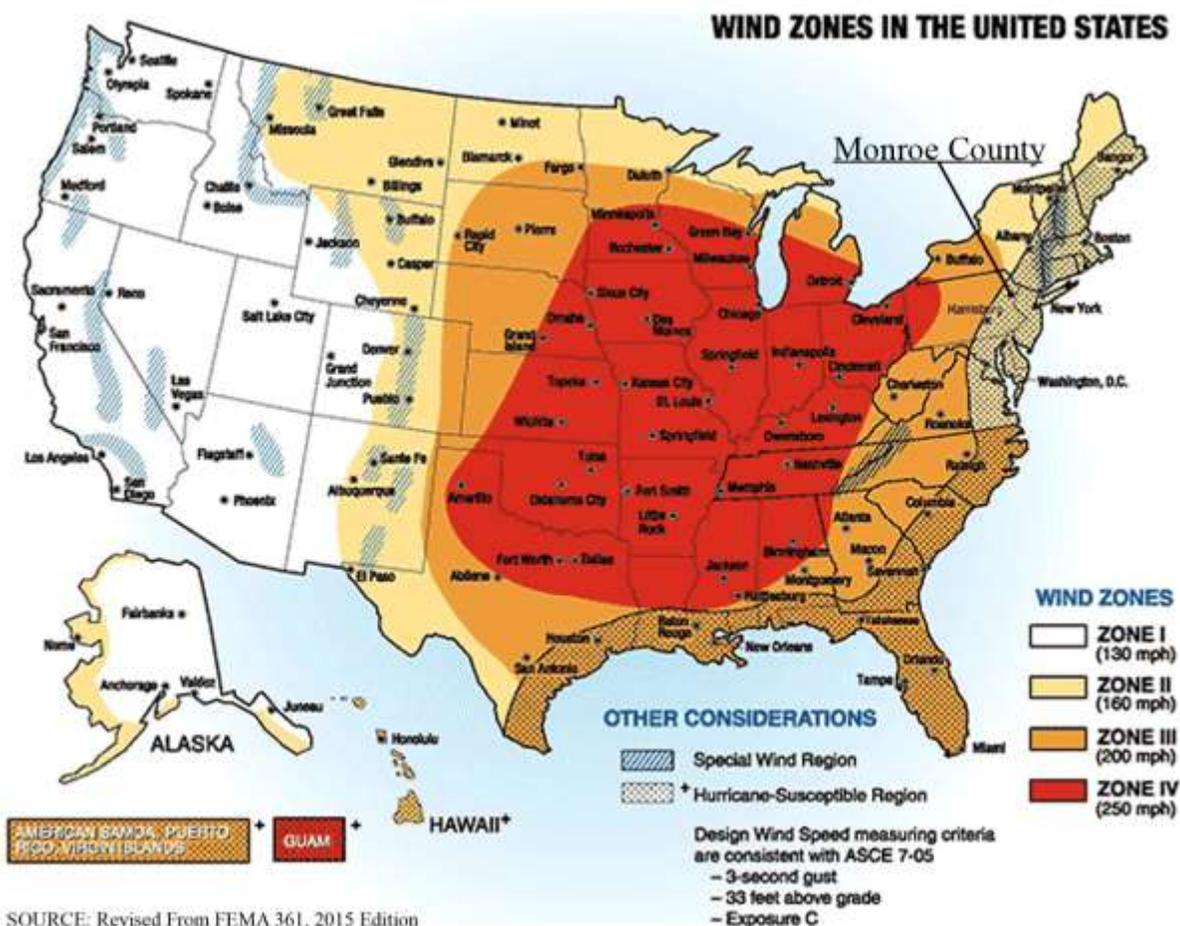
Tropical storms impacting Monroe County develop in tropical or sub-tropical waters found in the Atlantic Ocean, Gulf of Mexico, or Caribbean Sea. Tropical depressions are cyclones with maximum sustained winds of less than 39 miles per hour (mph). The system becomes a tropical storm when the maximum sustained winds reach between 39-74 mph. When wind speeds in exceed 74 mph, the system is considered a hurricane.

While Monroe County is located about 75 miles from the Atlantic Coast, tropical storms can track inland causing heavy rainfall and strong winds. *Figure 18 - Wind Zones* shows that Monroe County falls within the hurricane susceptible region. Monroe County falls within Zone II, meaning it is suggested that shelters and critical facilities should be able to withstand a 3-second gust of wind of up to 160 mph. Tropical Storms and Hurricanes are regional and seasonal events that can impact very large areas hundreds to thousands of miles across over the life the storm. Hurricane season is typically June to November. All communities within Monroe County are equally subject to the impacts of hurricanes and tropical storms that track through or near the county. Areas in Monroe County which are subject to flooding, wind, and winter storm damage are particularly vulnerable.

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Figure 18 - Wind Zones



### 4.3.5.2 Range of Magnitude

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 (*Table 23 - 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). 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.

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Table 23 - Saffir-Simpson Scale

<b>Saffir-Simpson Hurricane Scale</b>		
<b>Category</b>	<b>Wind Speed</b>	
	<b>mph</b>	<b>knots</b>
5	≥156	≥135
4	131-155	114-134
3	111-130	96-113
2	96-110	84-95
1	74-95	65-83
<b>Non-Hurricane Classifications</b>		
Tropical Storm	39-73	34-64
Tropical Depression	0-38	0-33

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 4.3.4. 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.

#### 4.3.4.3 Past Occurrence

Table 24 - History of coastal storms lists all coastal storms that have impacted Monroe County from the 1850s until November 2015.

Table 24 - History of coastal storms

<b>History of coastal storms impacting Monroe County</b>		
<b>Year</b>	<b>Event</b>	<b>Strength in/near Monroe</b>
1878	Unnamed	Hurricane
1888	Unnamed	Tropical Storm
1893	Unnamed	Tropical Storm
1899	Unnamed	Extra-tropical Storm
1903	Unnamed	Tropical Storm
1929	Unnamed	Extra-tropical Storm
1939	Unnamed	Tropical Depression
1945	Unnamed	Extra-tropical Storm
1949	Unnamed	Tropical Storm
1952	Able	Tropical Storm
1955	Connie	Hurricane
1955	Diane	Hurricane
1972	Agnes	Tropical Storm
1994	Beryl	Tropical Depression
1999	Floyd	Hurricane
2003	Isabel/Henri	Tropical Storm
2004	Frances	Tropical Depression
2004	Ivan	Tropical Depression
2011	Irene	Hurricane
2011	Lee	Hurricane
2012	Sandy	Hurricane

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In the last five years, Monroe County was impacted by three coastal storms– Irene, Lee and Sandy. Irene caused moderate flooding and there were utility interruptions for 5 to 8 days. Sandy caused significant wind damage and utility interruptions for 8 to 10 days. Although hurricane Lee caused significant flooding in the surrounding counties, Monroe County primarily experienced high winds causing minor utility outages for 1 to 2 days.

### 4.3.5.4 Future Occurrence

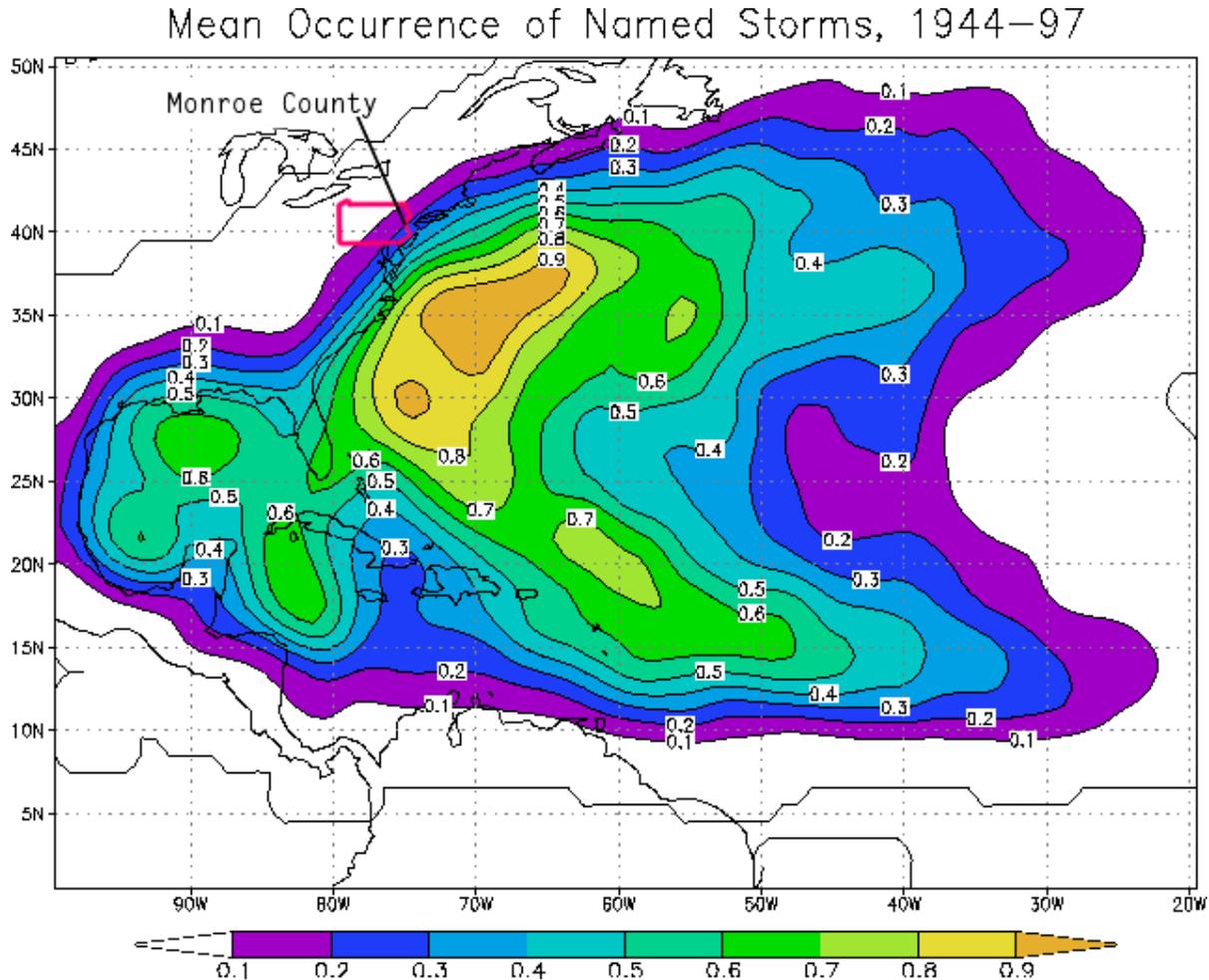
*Table 25 - Annual Probability of Wind Speeds* shows the annual probability of winds that reach the strength of tropical storms and hurricanes in Monroe County based on a sample period of 46 years.

*Table 25 - Annual Probability of Wind Speeds*

<b>Annual probability of wind speeds for Monroe County (FEMA, 2000)</b>		
Wind Speed (mph)	Saffir-Simpson Scale	Annual Probability of Occurrence (%)
45-77	Tropical Storms// Category 1 Hurricane	91.59
78-118	Category 1 to 2 Hurricanes	8.32
119-138	Category 3 to 4 Hurricanes	.0766
139-163	Category 4 to 5 Hurricanes	.0086
164-194	Category 5 Hurricanes	.00054
195+	Category 5 Hurricanes	.00001

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Figure 19 - Mean Occurrence of Named Storms



Source: NOAA Hurricane Research Division 2015

NOAA’s Hurricane Research Division estimates that on average, Monroe County will experience impacts from a tropical storm or hurricane approximately once every five years, or 20% chance annually (*Figure 19 - Mean Occurrence of Named Storms*). However according to FEMA (*Table 25 - Annual Probability of Wind Speeds*), there is high probability each year that Monroe County will experience winds from coastal storms that could cause minimal to moderate damages. The probability of winds exceeding 118 mph is less than .1% annually.

Climate change is causing atmospheric temperatures to rise, and correspondingly ocean surface temperatures to rise resulting in warmer and moister conditions where tropical storms develop (Stott et al., 2010). Warmer oceans store more energy, and are

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capable of fueling stronger storms and it is projected that Atlantic hurricanes will become more intense and produce more precipitation as surface temperatures rise (Trenberth, 2010). There are expected to be more category 4 and 5 hurricanes in the Atlantic, and the hurricane season may be elongating. Monroe County is affected by Atlantic coastal storms, so the county should be prepared to deal with impacts of coastal storms more frequently in the future.

### **4.3.5.5 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 4.3.4.5 and vulnerability to wind damage is addressed in Section 4.3.8.5.

### **4.3.6. Invasive Species**

#### **4.3.6.1 Location and Extent**

An invasive species is a species that is not indigenous to a given ecosystem and that, when introduced to a non-native environment, tends to thrive. The spread of an invasive species often alters ecosystems, which can cause environmental and economic harm and pose a threat to human health. The phenomena of invasive species is due to human activity. Human society is globalized, and people have the capability to traverse the globe at rates unparalleled in the history of the Earth. Either intentionally or unintentionally, other species may accompany people when they travel, introducing the stowaway to a novel ecosystem. In a foreign ecosystem, a transported species may thrive, potentially restructuring the ecosystem and threatening its health. Common pathways for invasive species introduction to Pennsylvania include (PA DOA, 2010):

- Contamination of internationally traded products
- Hull fouling
- Ship ballast water release
- Discarded live fish bait
- Intentional release
- Escape from cultivation
- Movement of soil, compost, wood, vehicles or other materials and equipment
- Unregulated sale of organisms
- Smuggling activities
- Hobby trading or specimen trading

Invasive species threats are typically divided into two main subsets:

**Aquatic Invasive Species (AIS)** are nonnative, invertebrates, fish, aquatic plants and viruses that threaten the diversity or abundance of native species, the ecological stability

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of the infested waters, human health and safety, or commercial, agriculture, or recreational activities dependent on such waters.

**Terrestrial Invasive Species (TIS)** are nonnative vascular plants, vertebrates, arthropods, or pathogens that complete their lifecycle on land whose introduction does or is likely to cause economic or environmental harm or harm to human health.

The location and extent of invasive threats is dependent on the preferred habitat of the species, as well as the species' ease of movement and establishment. *Table 26 - Invasive Species Threats Monroe Invasive Threats* lists invasive species that have been found in Monroe County as well as invasives that were found near Monroe County and could spread into the county.

*Table 26 - Invasive Species Threats (PA DCNR, 2016) (Nature Serve, 2014) (EDDMapS, 2016) (USDA Forest Service, 2016)*

Invasive Threats Found in Monroe County	
Common Name	Scientific Name
Insects and other Invertebrates	
Asiatic Oak Weevil	<i>Cyrtopistomus castaneus</i>
European Bark Beetle	<i>Ips typographus</i>
Gypsy Moth	<i>Lymantria dispar dispar</i>
Hemlock Woolly Adelgid	<i>Adelges tsugae</i>
Japanese Beetle	<i>Popillia japonica</i>
Pine Shoot Beetle	<i>Tomicus piniperda</i>
Sirex Woodwasp	<i>Sirex noctilio</i>
Chinese Mysterysnail	<i>Bellamyia chinensis synonym Cipangopaludina chinensis</i>
Plants	
Japanese Barberry	<i>Berberis thunbergii</i>
Japanese Stiltgrass, Nepalese Browntop	<i>Microstegium vimineum</i>
Mile-a-Minute	<i>Persicaria perfoliata</i>
Oriental Bittersweet	<i>Celastrus orbiculatus</i>
Phragmites	<i>Phragmites australis</i>
Bush Honeysuckle	<i>Diervilla</i>
Japanese Knotweed	<i>Fallopia japonica</i>
Plant (Aquatic)	
Carolina Fanwort, Fanwort	<i>Cabomba caroliniana</i>
Watercress	<i>Nasturtium officinale</i>
Marshopper Knotweed, Smartweed	<i>Polygonum pensylvanicum L.</i>
Curly-leaf Pondweed	<i>Potamogeton crispus</i>
Plant Pathogens	
Beech Bark Disease	<i>Cryptococcus fagisula &amp; Nectria coccinea var. faginata</i>
Butternut Canker	<i>Sirococcus clavigignenti-juglandacearum</i>
Chestnut Blight	<i>Cryphonectria parasitica</i>
Dogwood Anthracnose	<i>Discula destructiva</i>

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Dothichiza canker of poplar	<i>Dothichiza populea</i>
Oak Pit Scale	<i>Asterolecanium sp.</i>
Red Pine Scale	<i>Matsucoccus resinosa</i>
White Pine Blister Rust	<i>Cronartium ribicola</i>
Fabrella needle blight of hemlock	<i>Fabrella tsugae</i>
Vulnerable (Found Near Monroe County)	
Animal	
Emerald Ash Borer	<i>Agilus planipennis</i>
Lycorma (Spotted Lanternfly)	<i>Lycorma delicatula</i>
Asian Longhorned Beetle	<i>Anoplophora glabripennis</i>
Pathogen	
Thousand cankers disease	<i>Geosmithia morbida &amp; Pityophthorus juglandis</i>
(Sources: PA DCNR, iMapinvasives.org, EDDMapS.org, USDA Alien Forest Pest Explorer, 2015)	

### 4.3.6.2 Range of Magnitude

Some invasive species like the Brown Marmorated Stink Bugs are not considered an agricultural pest and do not harm humans. Other invasive species can cause significant changes in the composition of ecosystems. For example, the Emerald Ash Borer has a 99% mortality rate for any ash tree it infects. Didymo, an aggressive form of algae, can clog waterways and smother native aquatic plants and animals.

The aggressive nature of many invasive species can cause significant reductions in biodiversity by crowding out native species. This can affect the health of individual host organisms as well as the overall well-being of the affected ecosystem. An example of a possible worst-case scenario for invasive species is if the Emerald Ash Borer becomes widespread in the County. With the high mortality rate associated with the ash borer, hardwood forests in the County would be devastated. Degradation of forest health cascades into other problems. Among other benefits, forests prevent soil degradation and erosion, protect watersheds, and sequester carbon from the atmosphere. Forests have a key role in hydrologic systems, so losing a forest amplifies the effects of erosion and flooding. Forest degradation also has adverse economic effects, impacting such activities as logging, tourism, and other production activities dependent on lumber.

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

### 4.3.6.3 Past Occurrence

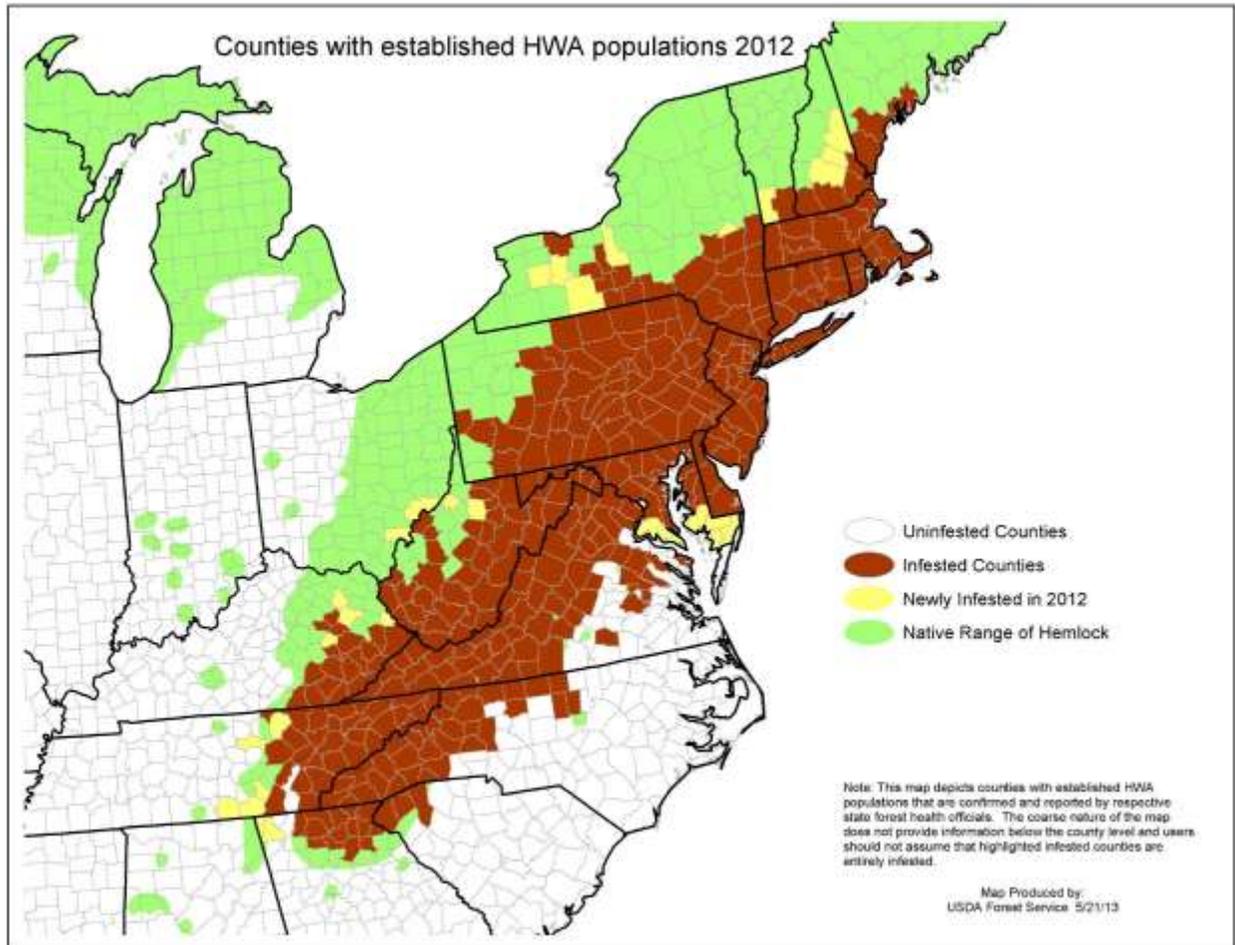
Invasive species have been entering Pennsylvania since the arrival of European settlers. *Table 26 - Invasive Species Threats* lists all invasive species that are established in Monroe County that pose a threat. Some invasive species such as the hemlock woolly adelgid (*Figure 20 - Hemlock Woolly Adelgid Range* (USDA Forest Service, 2013)) and the gypsy moth (*Figure 21 - Gypsy Moth Egg Mass Survey* (PA DCNR, 2015)) are widespread in the region surrounding Monroe County. While Monroe County can work towards mitigating

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the negative impacts of such widespread species, controlling the spread of the species is more difficult. For some species, such as the red pine scale (*Figure 22 - Red Pine Scale Range* (US Forest Service, 2013)), Monroe County is on the edge of the species range, meaning control efforts taken by Monroe County can help limit the spread of the threat.

Figure 20 - Hemlock Woolly Adelgid Range (USDA Forest Service, 2013)



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Figure 21 - Gypsy Moth Egg Mass Survey (PA DCNR, 2015)

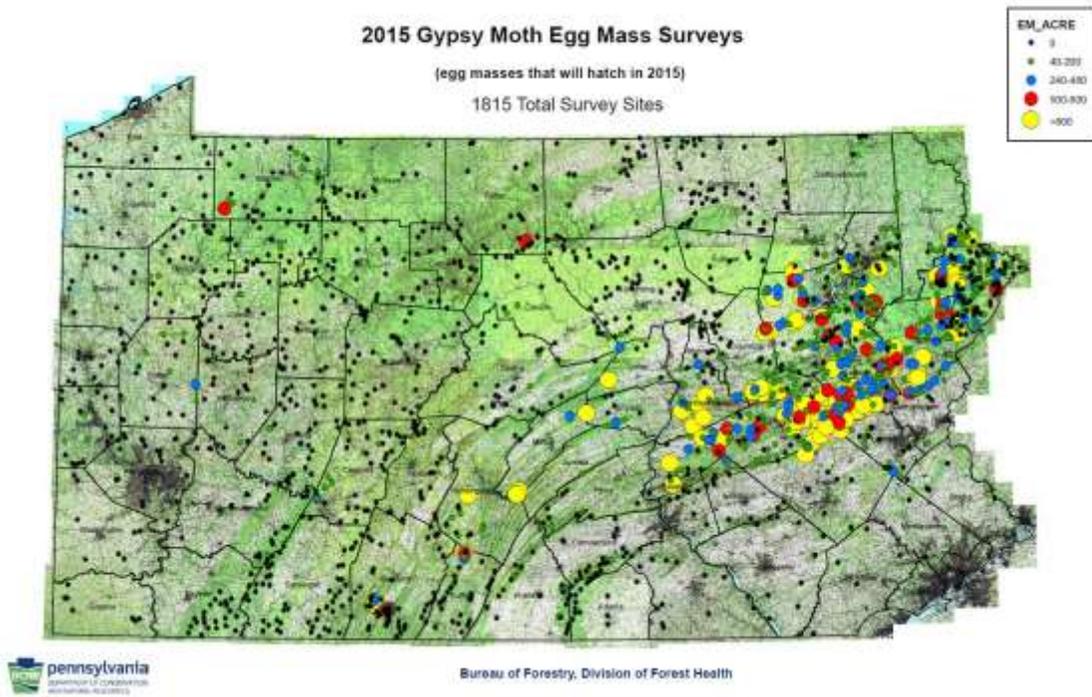
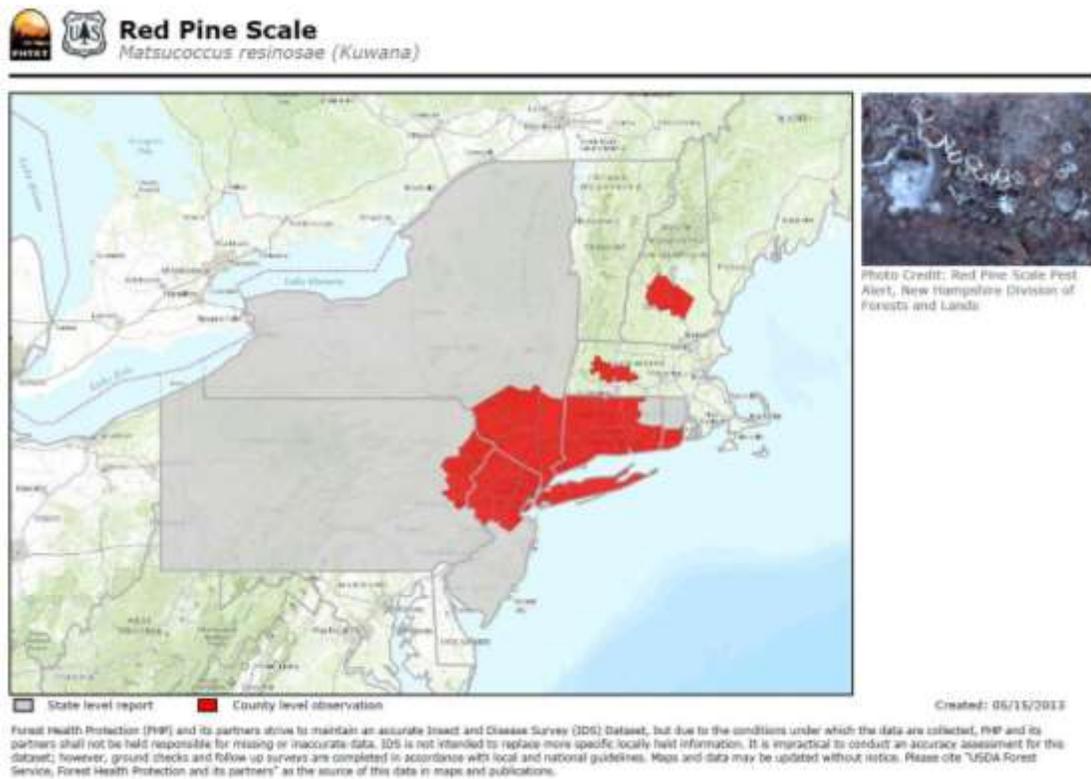


Figure 22 - Red Pine Scale Range (US Forest Service, 2013)



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### **4.3.6.4 Future Occurrence**

According to PISC (the Pennsylvania Invasive Species Council), the probability of future occurrence for invasive species threats is growing due to the increasing volume of transported goods, increasing efficiency and speed of transportation, and expanding international trade agreements. Expanded global trade has created opportunities for many organisms to be transported to and establish themselves in new counties and regions. Climate change is contributing to the introduction of new invasive species. As maximum and minimum seasonal temperatures change, pests are able to establish themselves in previously inhospitable climates. This also gives introduced species an earlier start and increases the magnitude of their growth, possibly shifting the dominance of ecosystems in the favor of nonnative species.

In order to combat the increase in future occurrences, the PISC (a collaboration of state agencies, public organizations and federal agencies) released the Invasive Species Management Plan in April of 2010. The plan outlines the Commonwealth's goals for managing the spread of nonnative invasive species and creates a framework for responding to threats through research, action, and public outreach and communication. More information can be found at [invasivespeciescouncil.com](http://invasivespeciescouncil.com).

There are several invasive species that are found nearby Monroe County but have not yet been detected inside the County (see *Table 26 - Invasive Species Threats*). In these cases, control efforts can help prevent an invasive from becoming established. A quarantine can be enacted to prevent the spread of particularly threatening invasives. While the Emerald Ash Borer has not yet been found in the County, Monroe is inside the widespread quarantine. As of May 2015, the Emerald Ash Borer has been found in 57 of the 67 counties in Pennsylvania, 18 of those being infected between 2013 and 2015 (*Figure 23 - Emerald Ash Borer in Pennsylvania* (PA DCNR, 2015)). The data suggests that the Emerald Ash Borer will soon become established in Monroe if enhanced detection and control efforts are not taken. Other species found near Monroe County include Lycroma – Lanternfly (*Figure 25 - Spotted Lanternfly (Lycroma) Detection* (USDA, 2015)), and Thousand Canker Disease (*Figure 26 - Thousand Canker Disease Range* (PA DCNR, 2014)).

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Figure 23 - Emerald Ash Borer in Pennsylvania (PA DCNR, 2015)

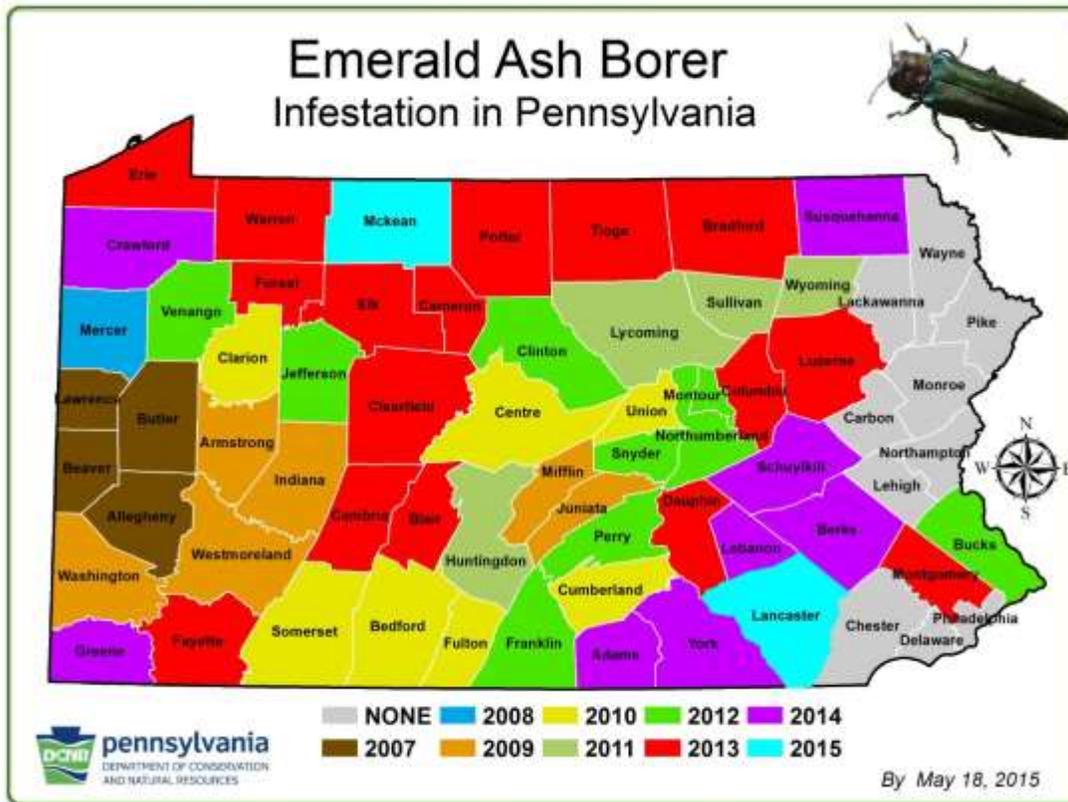


Figure 24 - Emerald Ash Borer Quarantine (USDA, 2015)



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Figure 25 - Spotted Lanternfly (*Lycroma*) Detection (USDA, 2015)

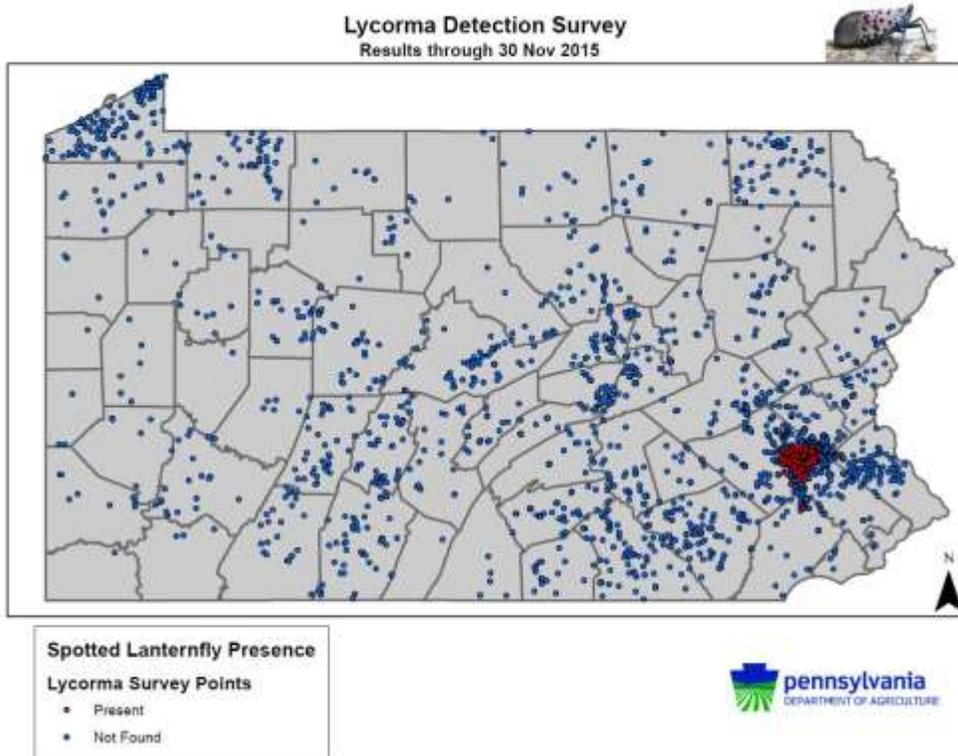
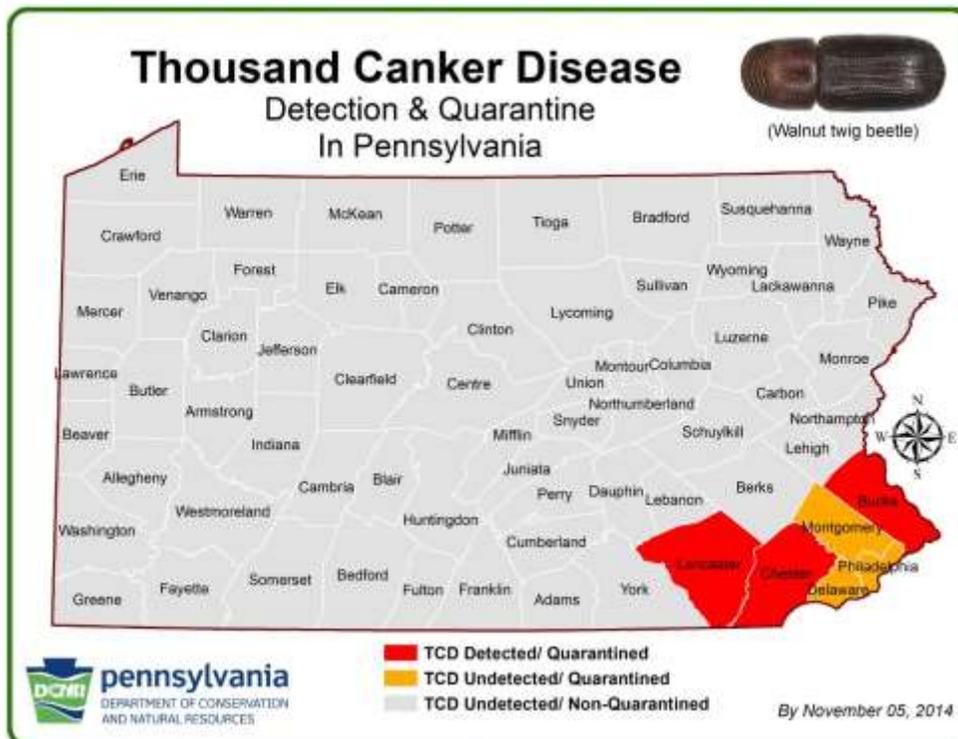


Figure 26 - Thousand Canker Disease Range (PA DCNR, 2014)



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### **4.3.6.5 Vulnerability Assessment**

Monroe County's vulnerability to invasion depends on the species in question. Human activity and mobility are ever increasing, and combined with the prospects of climate change, invasive species are becoming increasingly threatening. Invasive species can have adverse economic effects by impacting agriculture and logging activities. Natural forest ecosystems provide clean water, recreational opportunities, habitat for native wildlife, and places to enjoy the tranquility and transcendence of nature. The balance of forest ecosystems and forest health are vulnerable to invasive species threats.

### **4.3.7. Pandemic and Infectious Disease**

#### **4.3.7.1 Location and Extent**

##### **Pandemic & Epidemic**

Pandemic is a widespread outbreak of infectious disease that impacts an extensive region, potentially spanning continents and having global impacts. An epidemic also refers to an outbreak of a rapidly spreading infectious disease, but is more regional and less widespread than a pandemic. The spread of a disease depends on the mode of transmission of the disease, how contagious it is, and the amount of contact between infected and non-infected persons. In the event of a pandemic occurring in the eastern United States, the entirety of Monroe County would likely be affected. Strains of influenza, or the flu have caused epidemics and pandemics, and they commonly attack the respiratory tract in humans. Influenza pandemic 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. Avian flu did not reach pandemic proportions in the United States, but the County began planning for flu outbreaks. The PA Department of Health Influenza Pandemic Response Plan states that "an influenza pandemic is inevitable and will probably give little warning" (PA Department of Health, 2005). For this reason, influenza is a primary concern regarding pandemic and infectious disease in Monroe County. Norovirus, sometimes referred to as the "stomach bug," can outbreak in a community and spread very rapidly, causing an epidemic.

##### **Infectious Disease**

West Nile Virus has been detected in all 67 counties in the Commonwealth at least once in the past 10 years, making it a hazard to Monroe County. The disease is commonly spread by ticks or insects such as the mosquito. West Nile causes headaches, high fever, neck stiffness, disorientation, tremors, convulsions, muscle weakness, paralysis, and death in its most serious form.

#### **4.3.7.2 Range of Magnitude**

##### **Pandemic**

Advancements in medical technologies have greatly reduced the number of deaths caused by influenza over time. For example, the 1918 Spanish Flu caused approximately 50 million deaths worldwide (the worst influenza pandemic event on record), while the

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2009 Swine Flu only caused less than 20,000 deaths worldwide. Most people infected with Swine Flu in 2009 have recovered without needing medical treatment. However, the virus caused many deaths, including 78 in Pennsylvania by the end of the pandemic event. About 70 percent 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). High risk populations for influenza include children, the elderly, pregnant women, and patients with reduced immune system capability. Such high risk populations are discussed in more detail in Section 4.3.9.5.

### **Epidemic**

Norovirus rarely results in death, but symptoms include nausea, vomiting, watery diarrhea, and abdominal pain. The disease incubates in the infected individual for 12-48 hours, and generally runs its course in 24-72 hours. Norovirus infection is typically due to fecal contaminated food or water.

### **Infectious Disease**

West Nile Virus originated in regions of East Africa around 1937 but spread globally. In 2012, West Nile Virus caused 286 deaths in the United States. Most West Nile infections in humans are subclinical, causing no symptoms. Approximately 20% of infections cause symptoms and less than 1% of cases result in severe neurological disease or death. Symptoms typically appear between 2 and 15 days after infection and there is currently no vaccine for West Nile Virus. Person to person transmission of West Nile is less prevalent than person to person transmission of influenza.

#### **4.3.7.3 Past Occurrence**

### **Pandemic**

*Table 27- Past Outbreaks*

<b>Past Outbreaks and Pandemics of Influenza</b>			
Year/Time Frame	Common Name	Virus Type	Geographic Origin
1889	Russian flu	H2N2 or H3N8	Russia
1918-1920	Spanish flu	H1N1	Germany, Britain, France and the United States
1957-1958	Asian flu	H2N2	China
1968-1969	Hong Kong flu	H3N2	Hong Kong
1976	Swine flu fiasco	H1N1	Fort Dix, United States
2006-2008	Avian (Bird) Flu	H5N1	India
2007	Equine flu	H3N8	Australia
2009	Swine Flu	H1N1	Mexico

Influenza outbreaks of Spanish Flu, Asian flu, Hong Kong Flu and Swine Flu caused deaths in the United States and are considered pandemics. The 1918-1920 Spanish

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Flu claimed 50 million lives worldwide and 500,000 in the United States with 350,000 cases in Pennsylvania. The Asian flu caused about 1.5-2 million deaths worldwide with 70,000 deaths in the United States, peaking between September 1957 and March 1958. Approximately 15% of the population of Pennsylvania was affected by Asian flu. 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). The most recent flu outbreak to impact Monroe County was the 2009 outbreak of Swine flu. There were 10,940 cases reported in Pennsylvania resulting in 78 deaths. Monroe County had 167 cases confirmed and no reported deaths (Pennsylvania Department of Health, 2010), however the outbreak did cause one school in the County to temporarily close for cleaning and decontamination.

### **Epidemic**

Between February 10 and 13 of 2015, East Stroudsburg University experienced an outbreak of Norovirus. Approximately 154 students were effected, and several were hospitalized.

### **Infectious Disease**

West Nile Virus was first detected in Pennsylvania in the year 2000. In 2003, there were the most reported cases of West Nile, with 237 infected Pennsylvanians (including one in Monroe County) resulting in 9 deaths. Since then, a comprehensive network has been developed in Pennsylvania to detect West Nile Virus, including trapping mosquitoes, collecting dead birds and monitoring horses, people, and in past years, sentinel chickens. West Nile Virus was detected in 56 of 67 counties in the Commonwealth in 2015, including Monroe County (PA West Nile Virus Control Program, 2016). West Nile Virus has been detected in Monroe County in 9 out of the last 15 years. Fourteen counties in the Commonwealth reported cases where West Nile infected humans in 2015, none of which occurred in Monroe County. The last reported human West Nile infection in Monroe County was in 2012 (PA West Nile Virus Control Program, 2016).

#### **4.3.7.4 Future Occurrence**

### **Pandemic**

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. The emergence of a novel virus is the first step towards pandemic, and based on historical events, is expected every 11 to 41 years.

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### **Epidemic**

Norovirus is transmitted via stool and vomit, so proper hand washing and sanitation is suggested to attenuate the spread of Norovirus. Those experiencing vomiting and or diarrhea should not visit or work in crowded places.

### **Infectious Disease**

Instances of West Nile Virus have been decreasing due to extensive planning and eradication efforts, however the prospect of climate change could increase the prevalence of the virus. Some studies show increased insect activities during a similar rapid warming event in Earth's history (Curano et al., 2008). Other studies make projections that with the warming temperatures and lower annual precipitation that are expected with climate change, there will be an expansion of the suitable climate for mosquitos and West Nile Virus, increasing the risk that the disease poses (Harrigan et al., 2014).

#### **4.3.7.5 Vulnerability Assessment**

Certain groups are at higher risk of infectious disease infection, including people 65 years and older, children younger than 5 years, pregnant women, and people with certain chronic medical conditions. Such conditions include but are not limited to diabetes, heart disease, asthma, kidney disease. Schools, convalescent centers, and other institutions serving those younger than 5 years old and older than 65 are locations conducive to faster transmission of influenza. More generally, areas with higher population densities and places where people gather can be hotspots where influenza can spread more rapidly.

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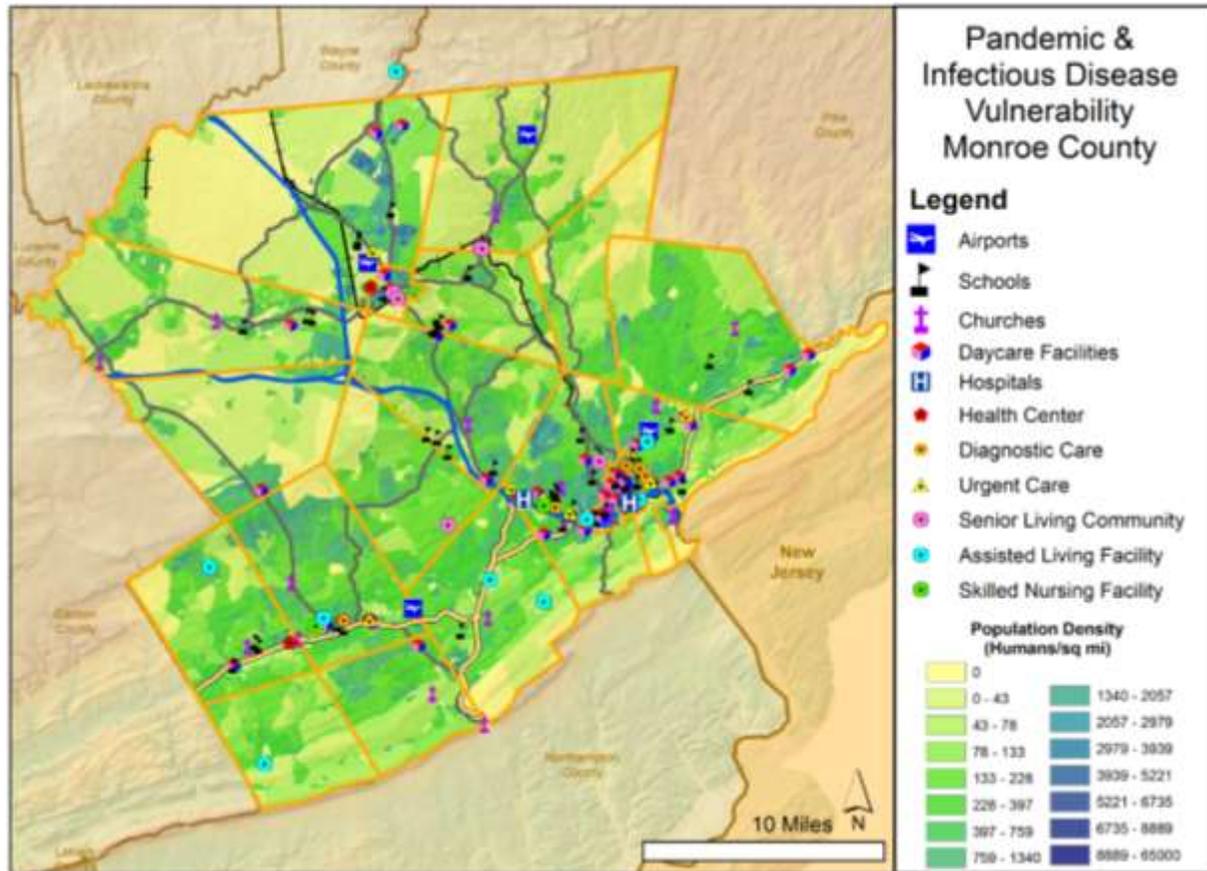
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*Figure 27 - Pandemic & Infectious Disease Vulnerability* shows the population density according to 2010 census data and locations of schools, daycares and churches, shedding light on areas where the disease may more readily spread. The highest concentration of elevated transmission risk locations in the county is found in the Stroudsburg/East Stroudsburg area.

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Figure 27 - Pandemic & Infectious Disease Vulnerability



### 4.3.8. Tornados and Windstorms

#### 4.3.8.1 Location and Extent

##### **Tornados**

Tornados may occur in the Commonwealth during the spring and summer months. In the past 65 years, records show that 415 tornados have been reported in all 67 counties in Pennsylvania during the period of 1950-2015. The National Weather Service estimates the Commonwealth will experience ten tornados annually.

According to the National Climatic Data Center (NCDC), wind speeds in tornados range from values below that of hurricane speeds to more than 300 miles per hour. The NCDC continues by reporting that, “the maximum winds in tornados are often confined to extremely small areas and vary tremendously over short distances.” This is the reason that one house will be completely demolished by a tornado and the house next to it might be untouched. Additionally, the forward motion of tornados can range from speeds between 0 and 50 miles per hour.

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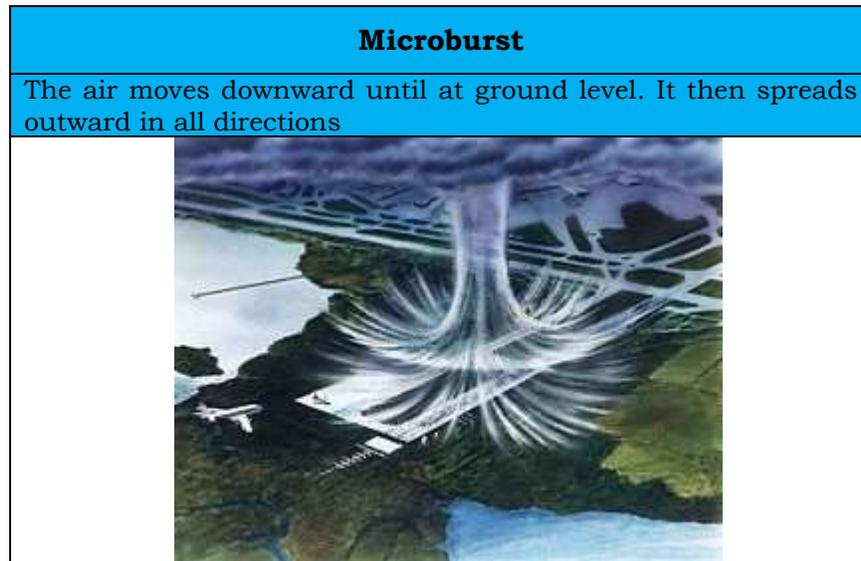
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### Windstorms

Windstorms are more frequent with thunderstorms than with hurricanes or tornados in Northeastern Pennsylvania. A microburst is a very-localized column of sinking air, capable of producing damaging opposing and straight-line winds at the surface.

Figure 28 - Microburst Illustration



A Wind Sheer is usually found when a violent weather front is moving through; wind speeds have been recorded up to 100 mph. Wind Sheer is defined as a difference in wind speed and direction over a relatively short distance in the atmosphere.

#### 4.3.8.2 Range of Magnitude

Each year, tornados account for \$1.1 billion in damages and cause over 80 deaths nationally. 2011 was the second worst year on record for deadly tornados. The worst year was 1936. The number of tornado reports has increased by 14% since 1950. 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 tornados 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 tornados 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.

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Damages and deaths can be especially significant when tornados move through populated, developed areas. The destruction caused by tornados ranges from light to inconceivable depending on the intensity, size and duration of the storm. Typically, tornados 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 tornados into six intensity categories, as shown in *Table 28 - Enhanced Fujita Scale*, 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 tornados based upon damage to buildings and structures. F-Scale categories with corresponding EF-Scale wind speeds are provided in *Table 28 - Enhanced Fujita Scale* since the magnitude of previous tornado occurrences is based on the F-Scale.

Section 4.3.5.1 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 (NCEI, 2016).

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.

While it is difficult to pinpoint the exact locations at the greatest risk of a tornado, the southeast, southwest and northwest sectors of the Commonwealth are more prone to tornados. Monroe County lies in the Northeast part of Pennsylvania. Tornados can have varying secondary effects. The most common is power failure. The severe wind strength can dismantle power sources. Structural damage can also be significant. Hazardous material spills can occur if a tornado comes near a holding tank, or the spill stems from a traffic accident caused by high winds.

Windstorms of all types have caused the following problems within Monroe County:

- Power failures lasting 4 hours or longer
- Loss of communications networks lasting 4 hours or more

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- Residents requiring evacuation or provision of supplies or temporary shelter
- Severe crop loss and or damage

Table 28 - Enhanced Fujita Scale

<b>Enhanced Fujita Scale (EF-Scale) Categories with Associated Wind Speeds and Description of Damages.</b>			
<b>EF-SCALE NUMBER</b>	<b>WIND SPEED (mph)</b>	<b>F-SCALE NUMBER</b>	<b>TYPE OF DAMAGE POSSIBLE</b>
<b>EF0</b>	65–85	F0-F1	<b>Minor damage:</b> Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornados with no reported damage (i.e., those that remain in open fields) are always rated EF0.
<b>EF1</b>	86-110	F1	<b>Moderate damage:</b> Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
<b>EF2</b>	111–135	F1-F2	<b>Considerable damage:</b> 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.
<b>EF3</b>	136–165	F2-F3	<b>Severe damage:</b> 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.
<b>EF4</b>	166–200	F3	<b>Devastating damage:</b> Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
<b>EF5</b>	>200	F3-F6	<b>Extreme damage:</b> 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.

### 4.3.8.3 Past Occurrence

Monroe County has thirteen tornados since 1952, the last one occurred in 2009.

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*Table 29 - Tornado History and Figure 29 - Monroe County Tornado History* outline previous tornados in Monroe County.

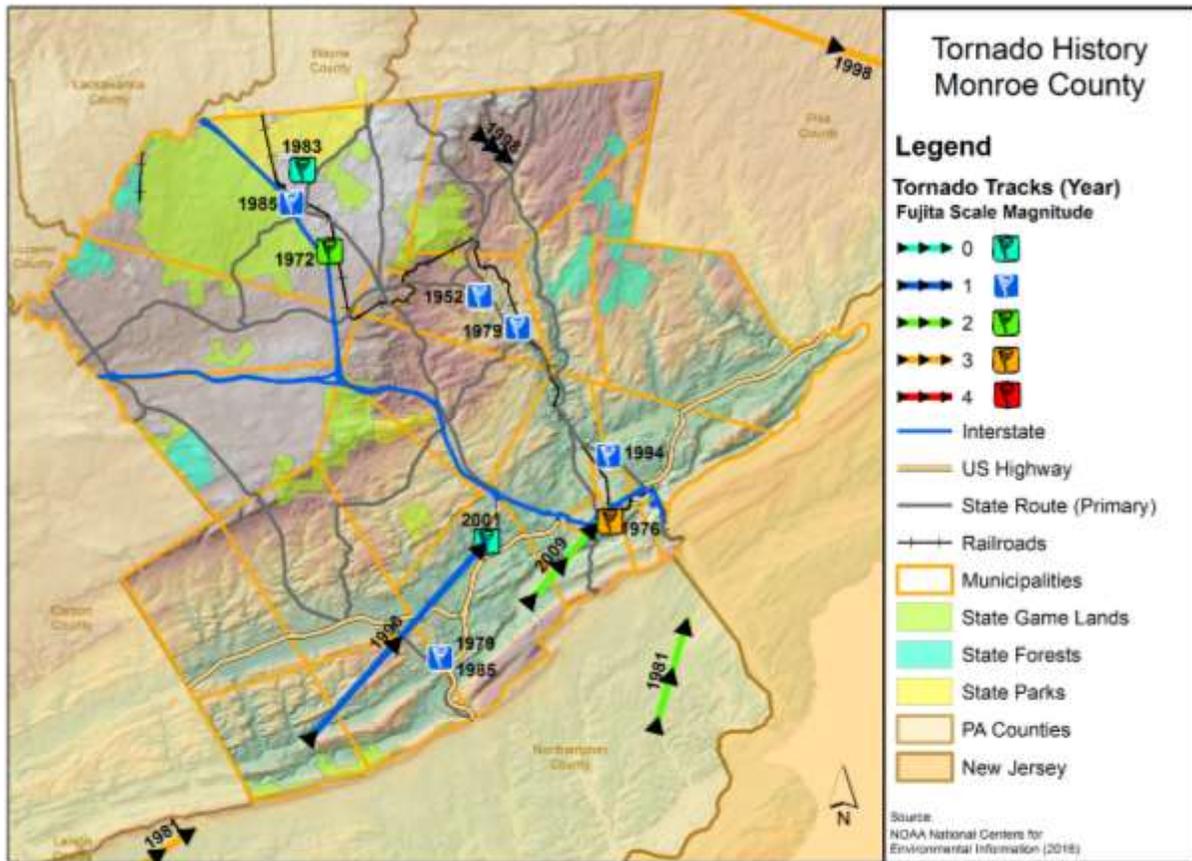
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Table 29 - Tornado History

<b>Previous Tornado Events Between 1950 and 2016 in Monroe County (NCDC, 2016).</b>					
<b>LOCATION</b>	<b>DATE</b>	<b>ESTIMATED LENGTH</b>	<b>ESTIMATED WIDTH</b>	<b>MAGNITUDE</b>	<b>ESTIMATED PROPERTY DAMAGE (\$)</b>
Monroe County	04/05/52	1.0 mi	33 yards	F1	3000
Monroe County	09/13/72	0.1 mi	100 yards	F2	3000
Monroe County	03/21/76	0.5 mi	100 yards	F3	2,500,000
Monroe County	10/05/79	0.3 mi	20 yards	F0	3000
Monroe County	10/05/79	0.3 mi	100 yards	F2	25,000
Monroe County	10/05/79	0.3 mi	80 yards	F1	3000
Monroe County	08/29/83	1.0 mi	10 yards	F0	0
Monroe County	05/31/85	0.2 mi	17 yards	F1	3000
Monroe County	06/03/85	0.2 mi	17 yards	F1	25,000
Kunkletown	11/08/96	10.0 mi	67 yards	F1	400,000
Buck Hill Falls	09/07/98	3.0 mi	30 yards	F1	0
Snydersville	07/01/01	0.2 mi	50 yards	F0	0
Bossardsville	07/29/09	5.0 mi	100 yards	F2	1,000,000

Figure 29 - Monroe County Tornado History



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### Windstorms

Windstorm events may be the result of thunderstorms, hurricanes, tropical storms, winter storms, or nor'easters. Since 1950 there have been 85 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. *Table 30 - Windstorm History* outlines the history of the windstorm events with winds greater than 50 knots in Monroe County from 1950-2016.

*Table 30 - Windstorm History (NCEI, 2016)*

<b>Previous Windstorm Events Greater Than 50 Knots Monroe County 1950-2016</b>					
<b>LOCATION</b>	<b>DATE</b>	<b>ESTIMATED WIND SPEED</b>	<b>DEATHS</b>	<b>INJURIES</b>	<b>ESTIMATED PROPERTY DAMAGE (\$)</b>
Countywide	06/23/61	50 kts.	0	0	0
Eastern PA (Regional Event)	03/19/96	52 kts.	0	0	0
Skytop	05/19/97	50 kts.	0	0	0
Kresgeville	08/16/97	74 kts.	0	3	0
Stroudsburg	06/16/98	55 kts.	0	0	0
Countywide	06/30/98	50 kts.	0	0	0
Snydersville	09/02/98	50 kts.	0	0	0
Countywide	08/13/99	56 kts.	0	0	0
Snydersville	09/09/99	57 kts.	0	0	0
Eastern PA (Regional Event)	09/16/99	50 kts.	0	0	\$ 2,800,000
Eastern PA (Regional Event)	11/02/99	58 kts.	0	1	0
Blakeslee	05/10/00	50 kts.	0	0	0
Kunkletown	05/13/00	50 kts.	0	0	0
Pocono Lake	05/18/00	50 kts.	0	0	0
East Stroudsburg	05/18/00	57 kts.	0	0	0
Tannersville	05/24/00	50 kts.	0	0	0
Gilbert	06/02/00	52 kts.	0	0	0
Tannersville	06/11/00	52 kts.	0	0	0
Eastern PA (Regional Event)	12/12/00	51 kts.	1	1	\$ 360,000
Long Pond	04/09/01	52 kts.	0	0	0
Tannersville	06/11/01	50 kts.	0	0	0
Long Pond	07/1/01	50 kts.	0	0	0
Snydersville	07/10/01	52 kts.	0	0	0
Effort	07/11/01	56 kts.	0	0	0
Marshalls Creek	07/25/01	52 kts.	0	0	0
Countywide	03/10/02	50 kts.	0	0	0

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<b>Previous Windstorm Events Greater Than 50 Knots Monroe County 1950-2016</b>					
<b>LOCATION</b>	<b>DATE</b>	<b>ESTIMATED WIND SPEED</b>	<b>DEATHS</b>	<b>INJURIES</b>	<b>ESTIMATED PROPERTY DAMAGE (\$)</b>
Long Pond	06/26/02	52 kts.	0	0	0
Mt Pocono	06/26/02	52 kts.	0	0	0
Tobyhanna	06/26/02	52 kts.	0	0	0
Mt Pocono Airport	07/23/02	52 kts.	0	0	0
Pocono Pines	07/23/02	52 kts.	0	0	0
Blakeslee	07/23/02	52 kts.	0	0	0
Tobyhanna	08/02/02	52 kts.	0	0	0
Blakeslee	08/05/02	52 kts.	0	0	0
Countywide	07/21/03	56 kts.	0	0	0
Kresgeville	08/16/03	56 kts.	0	0	0
Brodheads ville	08/16/03	56 kts.	0	0	0
Eastern PA (Regional Event)	09/18/03	52 kts.	0	0	\$ 32,200,000
Eastern PA (Regional Event)	11/13/03	52 kts.	1	3	\$ 2,200,000
Snydersville	08/12/04	52 kts.	0	0	0
Tannersville	06/06/05	52 kts.	0	0	0
Snydersville	06/09/05	56 kts.	0	0	0
Stroudsburg	07/27/05	52 kts.	0	0	0
Long Pond	08/12/05	50 kts.	0	0	0
Paradise Valley	08/14/05	52 kts.	0	0	0
Tobyhanna	08/14/05	50 kts.	0	0	0
Delaware Water Gap	08/14/05	50 kts.	0	0	0
Eastern PA (Regional Event)	01/14/06	53 kts.	0	0	\$ 600,000
Eastern PA (Regional Event)	02/17/06	50 kts.	0	0	\$ 250,000
Shawnee On Delaware	05/30/06	56 kts.	0	0	0
Long Pond	06/30/06	50 kts.	0	0	0
Pocono Pines	07/18/06	52 kts.	0	0	0
Countywide	07/27/06	50 kts.	0	0	0
Blakeslee	12/01/06	52 kts.	0	0	0
Echo Lake	06/01/07	50 kts.	0	0	0
Marshalls Creek	06/01/07	52 kts.	0	0	0
Shawnee On Delaware	06/01/07	52 kts.	0	0	0
Mt Pocono	06/19/07	52 kts.	0	0	0
Effort	06/19/07	52 kts.	0	0	0
Stroudsburg	06/19/07	52 kts.	0	0	0
Stroudsburg	06/27/07	52 kts.	0	0	0
Analomink	07/10/07	52 kts.	0	0	0
Tobyhanna	07/27/07	52 kts.	0	0	0
Marshalls Creek	08/03/07	50 kts.	0	0	0
Brodheads ville	08/25/07	50 kts.	0	0	0
Brodheads ville	08/25/07	50 kts.	0	0	0
Mountainhome	04/01/08	52 kts.	0	0	0
Swiftwater	05/31/08	52 kts.	0	0	0
Skytop	06/04/08	50 kts.	0	0	0
Tobyhanna	06/10/08	52 kts.	0	0	0
Saylorsburg	06/10/08	52 kts.	0	0	\$ 25,000

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<b>Previous Windstorm Events Greater Than 50 Knots Monroe County 1950-2016</b>					
<b>LOCATION</b>	<b>DATE</b>	<b>ESTIMATED WIND SPEED</b>	<b>DEATHS</b>	<b>INJURIES</b>	<b>ESTIMATED PROPERTY DAMAGE (\$)</b>
Stroudsburg	06/16/08	52 kts.	0	0	\$ 25,000
Paradise Valley	09/09/08	52 kts.	0	0	0
Deleware Water Gap	05/24/09	50 kts.	0	0	0
Tobyhanna	06/26/09	50 kts.	0	0	0
Kresgeville	06/26/09	50 kts.	0	0	0
Bossardsville	07/29/09	61 kts.	0	0	\$ 50,000
Tobyhanna	08/21/09	50 kts.	0	0	0
Rossland	08/21/09	52 kts.	0	0	0
Mt Pocono Airport	12/03/09	52 kts.	0	0	0
Countywide	01/03/10	51 kts.	0	0	\$ 10,000
Countywide	05/08/10	50 kts.	0	0	0
Marshalls Creek	06/06/10	52 kts.	0	0	0
Countywide	12/27/10	52 kts.	0	0	\$5,000
Countywide	10/29/12	57 kts.	0	0	\$930,000
Countywide	02/15/15	50 kts.	0	0	\$25,000
<b>TOTAL</b>			<b>2</b>	<b>8</b>	<b>\$ 39,485,000</b>

#### **4.3.8.4 Future Occurrence**

The probability of a disastrous tornado hitting Monroe County is ranked as possible. A risk factor of 1.9 has been assessed to this hazard utilizing the risk factor assessment tool. 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 2016, most of Monroe County lies within an area that has experienced one to five F3, F4, or F5 tornadoes per 3,700 square miles. A small portion in the southwestern portion of the county has experienced up to fifteen F3, F4, or F5 tornados 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. Over all tornado and windstorm events can be considered likely, as defined by the Risk Factor Methodology probability criteria. Additionally, based on historic patterns, tornados are unlikely to remain on the ground for long distances, especially in areas of the county with hilly terrain.

Windstorms, straight line winds and winds associated with a severe thunderstorm occur on a more frequent basis. The local planning team ranked this hazard separate from tornados since the wind events occur more often in Monroe County. The local planning

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team identified the probability of a windstorm event as highly likely. A risk factor of 2.3 has been assigned to this hazard utilizing the risk factor assessment tool.

### **4.3.8.5 Vulnerability Assessment**

Tornados can occur at any time of the year, with peak months in the northern part of the United States during the summer. Tornados are most likely to occur between 3 P.M. and 9 P.M. but have been known to occur at all hours of the day or night.

Other factors that impact the amount of damage caused by a tornado are the strength of the tornado, the time of day and the area of impact. Usually these distinct funnel clouds are localized phenomena impacting a small area. However, the high winds of tornados make them one of the most destructive natural hazards.

Other associated dangers that accompany thunderstorms that can produce tornados are:

- Flash floods – with 146 deaths annually nationwide
- Lightning – 75 to 100 deaths annually nationwide
- Damaging straight-line winds – reaching 140 mph wind speed
- Large hail – can reach the size of a grapefruit and causes several hundred million dollars in damages annually to property and crops.

The critical facilities of Monroe County are highly vulnerable to tornados. While many severe storms can cause exterior damage to structures, tornados can completely destroy structures, along with surrounding infrastructure and abruptly halt operations. Severe storms often accompany tornados and can be just as threatening to the critical facilities within the county. Many secondary effects from these disasters can jeopardize the operation of these critical facilities as well. Power outages can leave facilities functionless, which can have a crippling effect on the infrastructure supporting the population of the county.

Tornados present a high social vulnerability in Monroe County. With a storm's ability to destroy structures, citizens and their possessions are often left at the will of the storm. Numerous secondary effects can also spawn from tornados; among these, power outages, transportation accidents, hazardous material spills and flooding can be the most frequent. The special needs population is vitally at risk when faced with tornados. Without assistance to evacuate, they may be unable to prepare themselves or their homes and other possessions to safely weather the storm.

The economy of Monroe County is highly vulnerable to tornados. While there may be limited impact on the financial and commercial systems of the economy, these storms and the damage they cause can disrupt business for the long term. The local economy can be crippled if buildings or supporting infrastructure are destroyed in the storm. The secondary effects of tornados can also take a toll on business. Power outages can create

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work stoppages while transportation accidents and road closings can limit the transportation of goods and services. Also, flooding cannot be discounted as it can destroy the physical structures, merchandise and equipment essential for business operation.

Monroe County's environment is moderately vulnerable to tornados. Like many natural disasters, tornados alone will have little impact on the local ecosystems. However, similar to other hazards, secondary effects can impact the environment. Most notably, hazardous material spills can pollute ground water systems and vegetation. These situations often require extensive clean-up and mitigation efforts.

A proper warning system is vital for the public to be informed of what to do and where to go. Monroe County is a rural county and with that comes tourism. Numerous hikers and hunters visit Monroe County annually. In the event of a tornado or severe storm, these tourists have limited emergency notification measures.

Monroe County is also highly vulnerable to windstorms. Power outages and blown down trees are the most likely secondary effect of these storms. The local planning team has identified windstorms to be more frequent than tornados. Windstorms have impacted critical infrastructure and closed vital state highways in the past.

Monroe County is also more vulnerable economically to windstorms. Windstorms can impact tracts of hardwood and softwood lumber. At times, the storms can blow down large pockets of trees in a specific geographic area. The loss of these trees can be considered a financial loss to landowners and the lumber industry due to their value.

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 31 - Mobile Home Parcels* 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, and *Figure 30 - Monroe County Tornado Risk* shows the location of mobile home parcels. 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

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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.

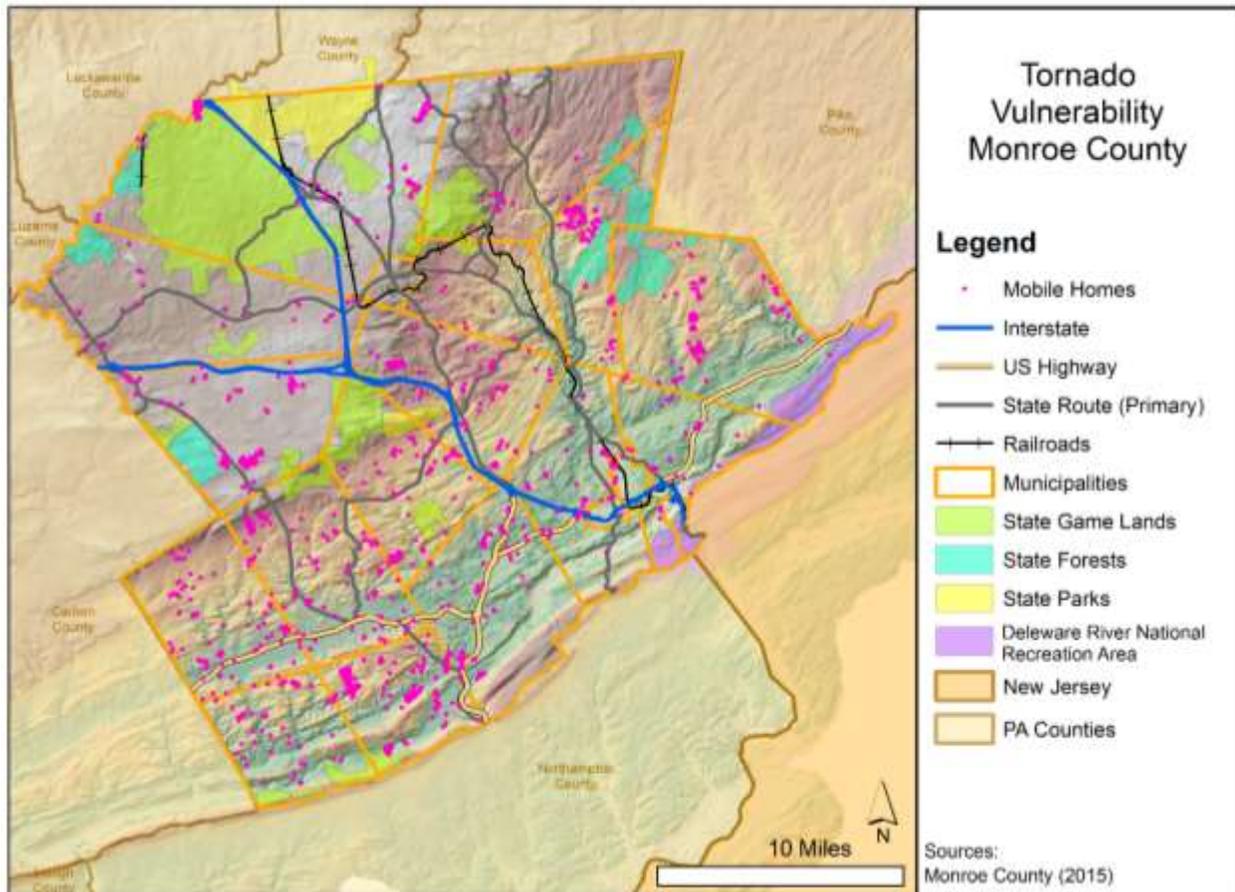
Table 31 - Mobile Home Parcels

<b>Mobile Home Parcels and Addressable Structures</b>		
<b>MUNICIPALITY</b>	<b># OF MOBILE HOME PARCELS</b>	<b># OF ADDRESSABLE STRUCTURES IN MOBILE HOME PARCELS</b>
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
<b>TOTAL</b>	<b>1,647</b>	<b>2,524</b>
<b>Source: Monroe County GIS, 2016</b>		

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Figure 30 - Monroe County Tornado Risk



### 4.3.9. Wildfire

#### 4.3.9.1 Location and Extent

The most frequent causes of devastating wildfires are droughts, arson and human carelessness. Wildfires occur throughout wooded and open vegetation areas in Monroe County. Small fires can rapidly escalate to large fires if undetected. These large wooded areas could be impacted with wildfires.

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. Ninety-eight percent of wildfires in Pennsylvania are caused by people, often by debris

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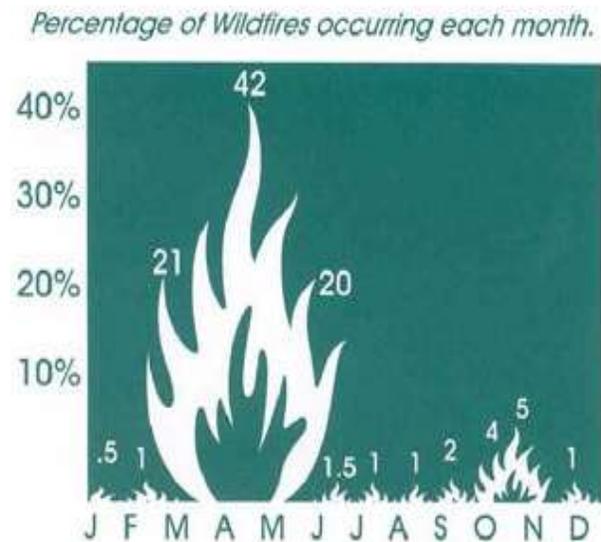
burns. In some cases fires have started in a person's backyard and traveled through dead grasses and weeds into bordering woodlands.

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 felled 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.

*Figure 31 - Seasonal Wildfire Percentage* shows the wildfire percentage occurrence during each month occurring in Pennsylvania.

*Figure 31 - Seasonal Wildfire Percentage (PA DCNR, 2016)*



### 4.3.9.2 Range of Magnitude

The forested areas of the county are at the greatest risk for wildfires. Monroe County must be watchful of wildfires that could severely hinder farming, recreation, or industry. Wildfires usually occur following prolonged periods of dry weather; and with Monroe County covered in forests, State Parks and game lands, a wildfire could prove to be costly.

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If an urban fire or wildfire is not contained, certain secondary hazards may affect Monroe County. Power outages may be the most prevalent of these hazards. Environmental hazards could also result from a wildfire or urban fire.

The United States Forest Service utilizes the Forest Fire Assessment System to classify the dangers of wildfire. *Table 32 - Wildland Fire Assessment System* identifies each threat classification and provides a description of the level.

*Table 32 - Wildland Fire Assessment System*

<b>U.S. Forest Service – Wildland Fire Assessment System</b>	
<b>Low (L)</b>	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.
<b>Moderate (M)</b>	Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
<b>High (H)</b>	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High-intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
<b>Very High (VH)</b>	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
<b>Extreme (E)</b>	Fires start quickly, spread furiously and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions the only effective and safe control action is on the flanks until the weather changes or the fuel supply lessens.

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### 4.3.9.3 Past Occurrences



The Pennsylvania Department of Conservation of Natural Resources (DCNR) Bureau of Forestry tracks forest fires by Forest Districts. The Monroe County portion of the Delaware State Forest is located in the 19<sup>th</sup> Forest District (D-19).

Monroe County now uses Knowledge Center™ for statistical record keeping. Information on fire statistics recorded in the PEIRS system can be found in the 2011 HMP.

NOTE: DCNR no longer has current records and NOAA/NCDC records only two wildfires in the given period. Therefore all information contained in this report relies on that which is provided in Knowledge Center™.

Table 33 - Wildfire History Summary

<b>Wildfire Events in Monroe County 2012-2016 (Knowledge Center™)</b>		
Event	Location	Date
Brush Fire	Chestnuthill Township	03/14/12
Brush Fire	Chestnuthill Township	03/14/12
Brush Fire	Chestnuthill Township	03/14/12
Brush Fire	Smithfield Township	03/14/12
Brush Fire	Hamilton Township	03/15/12
Brush Fire	Tunkhannock Township	03/19/12
Brush Fire	Hamilton Township	03/21/12
Brush Fire	Pocono Township	03/22/12
Brush Fire	Tobyhanna Township	03/24/12
Brush Fire	Pocono Township	03/24/12
Brush Fire	Hamilton Township	03/24/12
Brush Fire	Tunkhannock Township	03/24/12
Brush Fire	Barrett Township	03/26/12
Brush Fire	Middle Smithfield Township	03/26/12
Brush Fire	Tobyhanna Township	03/26/12
Brush Fire	Tobyhanna Township	03/27/12
Brush Fire	Stroudsburg Borough	03/30/12
Brush Fire	Stroud Township	04/04/12
Brush Fire	Smithfield Township	04/04/12
Brush Fire	Middle Smithfield Township	04/04/12
Brush Fire	Ross Township	04/05/12
Brush Fire	Stroud Township	04/05/12
Brush Fire	Jackson Township	04/06/12
Brush Fire	Hamilton Township	04/06/12
Brush Fire	Ross Township	04/06/12

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<b>Wildfire Events in Monroe County 2012-2016 (Knowledge Center <sup>TM</sup>)</b>		
<b>Event</b>	<b>Location</b>	<b>Date</b>
Brush Fire	Hamilton Township	04/07/12
Brush Fire	Eldred Township	04/07/12
Brush Fire	Mt Pocono Borough	04/07/12
Brush Fire	Price Township	04/07/12
Brush Fire	Hamilton Township	04/07/12
Brush Fire	Ross Township	04/08/12
Brush Fire	Stroud Township	04/08/12
Brush Fire	Middle Smithfield Township	04/08/12
Brush Fire	Barrett Township	04/08/12
Brush Fire	Barrett Township	04/08/12
Brush Fire	Polk Township	04/08/12
Brush Fire	Paradise Township	04/08/12
Brush Fire	Chestnuthill Township	04/08/12
Brush Fire	Smithfield Township	04/09/12
Brush Fire	Pocono Township	04/10/12
Brush Fire	East Stroudsburg Borough	04/10/12
Brush Fire	Pocono Township	04/12/12
Brush Fire	Hamilton Township	04/12/12
Brush Fire	Smithfield Township	04/12/12
Brush Fire	Chestnuthill Township	04/13/12
Brush Fire	Pocono Township	04/14/12
Brush Fire	Polk Township	04/14/12
Brush Fire	Jackson Township	04/14/12
Brush Fire	Pocono Township	04/15/12
Brush Fire	Chestnuthill Township	04/15/12
Brush Fire	Smithfield Township	04/16/12
Brush Fire	Pocono Township	04/16/12
Brush Fire	Tobyhanna Township	04/16/12
Brush Fire	Price Township	04/16/12
Brush Fire	Tunkhannock Township	04/17/12
Brush Fire	Pocono Township	04/20/12
Brush Fire	Tobyhanna Township	04/20/12
Brush Fire	Mt Pocono Borough	04/20/12
Brush Fire	Chestnuthill Township	04/21/12
Brush Fire	Ross Township	04/25/12
Brush Fire	Middle Smithfield Township	04/29/12
Brush Fire	Jackson Township	04/29/12
Brush Fire	Polk Township	07/06/12
Brush Fire w/Structure	Smithfield Township	04/02/13
Brush Fire	Jackson Township	04/03/13
Brush Fire	Pocono Township	04/03/13
Brush Fire	Jackson Township	04/04/13
Brush Fire	Tunkhannock Township	04/05/13

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<b>Wildfire Events in Monroe County 2012-2016 (Knowledge Center <sup>TM</sup>)</b>		
<b>Event</b>	<b>Location</b>	<b>Date</b>
Brush Fire	Tobyhanna Township	04/05/13
Brush Fire	Jackson Township	04/05/13
Brush Fire	Price Township	04/06/13
Brush Fire	Ross Township	04/06/13
Brush Fire	Coolbaugh Township	04/06/13
Brush Fire	Pocono Township	04/06/13
Brush Fire	Pocono Township	04/06/13
Brush Fire	Ross Township	04/06/13
Brush Fire	Barrett Township	04/06/13
Brush Fire	Smithfield Township	04/06/13
Brush Fire	Price Township	04/07/13
Brush Fire	East Stroudsburg Borough	04/07/13
Brush Fire	Chestnuthill Township	04/08/13
Brush Fire	Coolbaugh Township	04/08/13
Brush Fire	Jackson Township	04/09/13
Brush Fire	Pocono Township	04/10/13
Brush Fire	Pocono Township	04/10/13
Brush Fire	Eldred Township	04/10/13
Brush Fire	Chestnuthill Township	04/13/13
Brush Fire	Barrett Township	04/14/13
Brush Fire	Jackson Township	04/17/13
Brush Fire	Middle Smithfield Township	04/17/13
Brush Fire	Middle Smithfield Township	04/17/13
Brush Fire	Pocono Township	04/17/13
Brush Fire	Pocono Township	04/21/13
Brush Fire	Jackson Township	04/21/13
Brush Fire	Barrett Township	04/23/13
Brush Fire	Middle Smithfield Township	04/23/13
Brush Fire	Stroud Township	04/24/13
Brush Fire	Hamilton Township	05/01/13
Brush Fire	Smithfield Township	10/26/13
Brush Fire	Chestnuthill Township	04/10/14
Brush Fire	Middle Smithfield Township	04/10/14
Brush Fire	Middle Smithfield Township	04/10/14
Brush Fire	Middle Smithfield Township	04/10/14
Brush Fire	Pocono Township	04/10/14
Brush Fire	Middle Smithfield Township	04/13/14
Brush Fire	Ross Township	04/14/14
Brush Fire	Middle Smithfield Township	04/14/14
Brush Fire	Eldred Township	04/19/14
Brush Fire	Price Township	04/19/14
Brush Fire	Barrett Township	04/19/14
Brush Fire	Paradise Township	04/20/14

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<b>Wildfire Events in Monroe County 2012-2016 (Knowledge Center <sup>TM</sup>)</b>		
<b>Event</b>	<b>Location</b>	<b>Date</b>
Brush Fire	Ross Township	04/20/14
Brush Fire	Hamilton Township	04/21/14
Brush Fire	Hamilton Township	04/21/14
Brush Fire	Tunkhannock Township	04/21/14
Brush Fire	Middle Smithfield Township	04/21/14
Brush Fire	Eldred Township	04/23/14
Brush Fire	Jackson Township	04/24/14
Brush Fire	Stroudsburg Borough	04/24/14
Brush Fire	Ross Township	04/24/14
Brush Fire	Hamilton Township	04/24/14
Brush Fire	Eldred Township	04/24/14
Brush Fire	Barrett Township	04/25/14
Brush Fire	Paradise Township	04/25/14
Brush Fire	Polk Township	04/25/14
Brush Fire	Pocono Township	04/25/14
Brush Fire	Jackson Township	04/25/14
Brush Fire	Chestnuthill Township	04/26/14
Brush Fire	Hamilton Township	04/28/14
Brush Fire	Tobyhanna Township	04/28/14
Brush Fire	Chestnuthill Township	11/25/14
Brush Fire	Chestnuthill Township	03/29/15
Brush Fire	Polk Township	03/29/15
Brush Fire	Stroud Township	04/04/15
Brush Fire	Jackson Township	04/06/15
Brush Fire	Paradise Township	04/06/15
Brush Fire	Coolbaugh Township	04/06/15
Brush Fire	Middle Smithfield Township	04/06/15
Brush Fire	Tunkhannock Township	04/06/15
Brush Fire	Barrett Township	04/06/15
Brush Fire	Stroud Township	04/06/15
Brush Fire	Polk Township	04/11/15
Brush Fire	Price Township	04/12/15
Brush Fire	Hamilton Township	04/12/15
Brush Fire	Jackson Township	04/13/15
Brush Fire	Pocono Township	04/13/15
Brush Fire	Jackson Township	04/13/15
Brush Fire	Eldred Township	04/13/15
Brush Fire	Chestnuthill Township	04/14/15
Brush Fire	Pocono Township	04/15/15
Brush Fire	Polk Township	04/16/15
Brush Fire	Hamilton Township	04/16/15
Brush Fire	Jackson Township	04/16/15
Brush Fire	Middle Smithfield Township	04/18/15

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<b>Wildfire Events in Monroe County 2012-2016 (Knowledge Center <sup>TM</sup>)</b>		
<b>Event</b>	<b>Location</b>	<b>Date</b>
Brush Fire	Chestnuthill Township	04/18/15
Brush Fire	Eldred Township	04/18/15
Brush Fire	Middle Smithfield Township	04/19/15
Brush Fire	Tobyhanna Township	04/25/15
Brush Fire	Coolbaugh Township	04/25/15
Brush Fire	Tunkhannock Township	04/25/15
Brush Fire	Middle Smithfield Township	04/25/15
Brush Fire	Jackson Township	04/26/15
Brush Fire	Jackson Township	04/26/15
Brush Fire	Chestnuthill Township	04/26/15
Brush Fire	Barrett Township	04/27/15
Brush Fire	Chestnuthill Township	04/27/15
Brush Fire	Smithfield Township	04/28/15
Brush Fire	Tunkhannock Township	04/28/15
Brush Fire	Tobyhanna Township	04/28/15
Brush Fire	Jackson Township	04/29/15
Brush Fire	Jackson Township	04/29/15
Brush Fire	Tunkhannock Township	04/29/15
MVA w/injuries / Brush Fire	Pocono Township	04/29/15
Brush Fire	Chestnuthill Township	04/29/15
Brush Fire	Hamilton Township	04/29/15
Brush Fire	Hamilton Township	04/29/15
Brush Fire	Coolbaugh Township	05/02/15
Brush Fire	Jackson Township	05/02/15
Brush Fire	Ross Township	05/03/15
Brush Fire	Coolbaugh Township	05/03/15
Brush Fire	Polk Township	05/04/15
Brush Fire	Polk Township	05/04/15
Brush Fire	Polk Township	05/04/15
Brush Fire	Hamilton Township	05/04/15
Brush Fire	Tobyhanna Township	05/04/15
Brush Fire	Pocono Township	05/04/15
Brush Fire	Tunkhannock Township	05/04/15
Brush Fire	Stroud Township	05/04/15
Brush Fire	Coolbaugh Township	05/04/15
Brush Fire	Middle Smithfield Township	05/09/15
Brush Fire	Chestnuthill Township	05/10/15
Brush Fire	Paradise Township	05/14/15
Brush Fire	Tunkhannock Township	05/15/15
Brush Fire	Middle Smithfield Township	05/16/15
Brush Fire	Coolbaugh Township	05/22/15
Brush Fire	Barrett Township	05/24/15
Brush fire involving a shed	Polk Township	10/21/15

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<b>Wildfire Events in Monroe County 2012-2016 (Knowledge Center™)</b>		
<b>Event</b>	<b>Location</b>	<b>Date</b>
Brush Fire	Coolbaugh Township	10/21/15
Brush Fire	Middle Smithfield Township	10/22/15
Brush Fire	Smithfield Township	10/22/15
Brush Fire	Jackson Township	10/22/15
Brush Fire	Tobyhanna Township	10/24/15

*\* Data from 2009 to 2013 was obtained from the Monroe County Knowledge Center™ log.*

There have been 204 wildfire events reported in Knowledge Center™ from 2012-2015. As noted in the previous HMP the figures provided were probably a low estimate of wildfire events, as it did 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 was the most comprehensive list of wildfire occurrences available for Monroe County at that time. Table 4.3.7-1 of the 2011 HMP 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. With the change to Knowledge Center™ the statistics are more accurate as they have been provided directly by the County.

Of all of Monroe County’s jurisdictions, Chestnuthill Township, Jackson Township, Middle Smithfield, and Pocono Township had the most wildfires between 2012 and 2015 according to Knowledge Center.

Overall, the county is at a moderate to high risk for wildland fires.

#### **4.3.9.4 Future Occurrence**

Wildfires have a probability of occurring on an annual basis. A risk factor of 3.1 has been assigned to the wildfire hazard utilizing the risk factor assessment tool provided by the Pennsylvania Emergency Management Agency.

Weather conditions play a major role in the occurrence of wildfires. Dry conditions with decreased humidity are an ideal scenario for a wild fire.

No significant wildfires have occurred in Monroe County’s recorded history. The probability of a wildfire occurring in the county is highly likely in any given year as defined by the Risk Factor Methodology probability criteria. 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 4.3.9.1. The storm caused many trees to fall in the forestland in this area, as well as knocked off the branches and

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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.

### **4.3.9.5 Vulnerability**

Although no significant wildfires have been recorded by the Pennsylvania Department of Conservation and Natural Resources – Bureau of Forestry (PA DCNR-BOF) and the National Centers for Environmental Information (formerly the National Climatic Data Center) for Monroe County, all areas of the county can be prone to wildfires. The size and impact of a wildfire depends on its location, climate conditions and the response of firefighters. If the right conditions exist, these factors can usually mitigate the effects of wildfires. During a drought, wildfires can be devastating. Lightning strikes are another cause of wildfires. However, human carelessness and negligence remain as the leading factor.

Wildfires are most common in the spring (March–May) and fall (October–November) months. During spring months the lack of leaves on the trees allows the sunlight to heat the existing leaves on the ground from the previous fall. The same theory applies for the fall; however, the dryer conditions are a more crucial factor.

Firefighters and other first responders are vulnerable to forest fires. Traffic accidents during a response and then the impacts of fighting the fire once on scene are examples of the first responder vulnerabilities.

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 *Table 34 - Addressable Structures Vulnerable to Wildfires*. 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 34 - Addressable Structures Vulnerable to Wildfires* 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.

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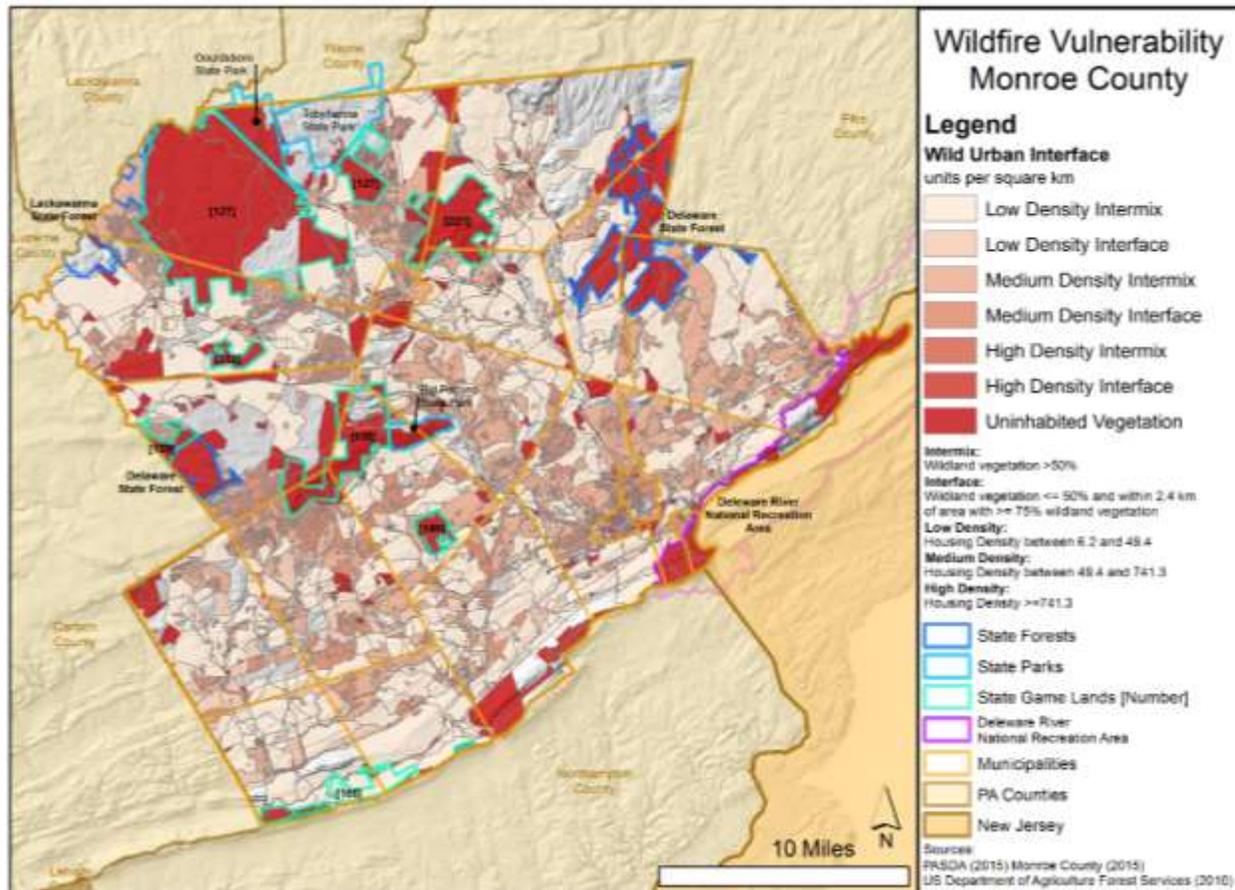
Table 34 - Addressable Structures Vulnerable to Wildfires

<b>Addressable Structures and Critical Facilities in Wildfire High Hazard Areas.</b>			
<b>MUNICIPALITY</b>	<b>TOTAL ADDRESSABLE STRUCTURES</b>	<b>TOTAL ADDRESSABLE STRUCTURES IN HIGH WILDFIRE HAZARD AREAS</b>	<b>TOTAL CRITICAL FACILITIES IN HIGH WILDFIRE HAZARD AREAS</b>
Barrett Township	2,587	81	12
Chestnuthill Township	6,874	0	0
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
<b>TOTAL</b>	<b>84,445</b>	<b>1,069</b>	<b>118</b>

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Figure 32 - Wildfire Vulnerability Map



### 4.3.10. Winter Storms, Nor'easter

#### 4.3.10.1 Location and Extent

Winter storms with excessive snow and ice and frigid temperatures can occur on average three times a year in Monroe County. There are an average of 20 winter weather events each year. Every county in Pennsylvania shares these hazards. However, the northern tier, western counties and mountainous regions seem to experience storms more frequently and with a greater severity due to lake effects. *Figure 33 - PA Annual Snowfall* shows the annual snowfall amounts for locations in Pennsylvania. (NOTE: This chart is the latest available from NWS.)

Winter storms are regional events. 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.

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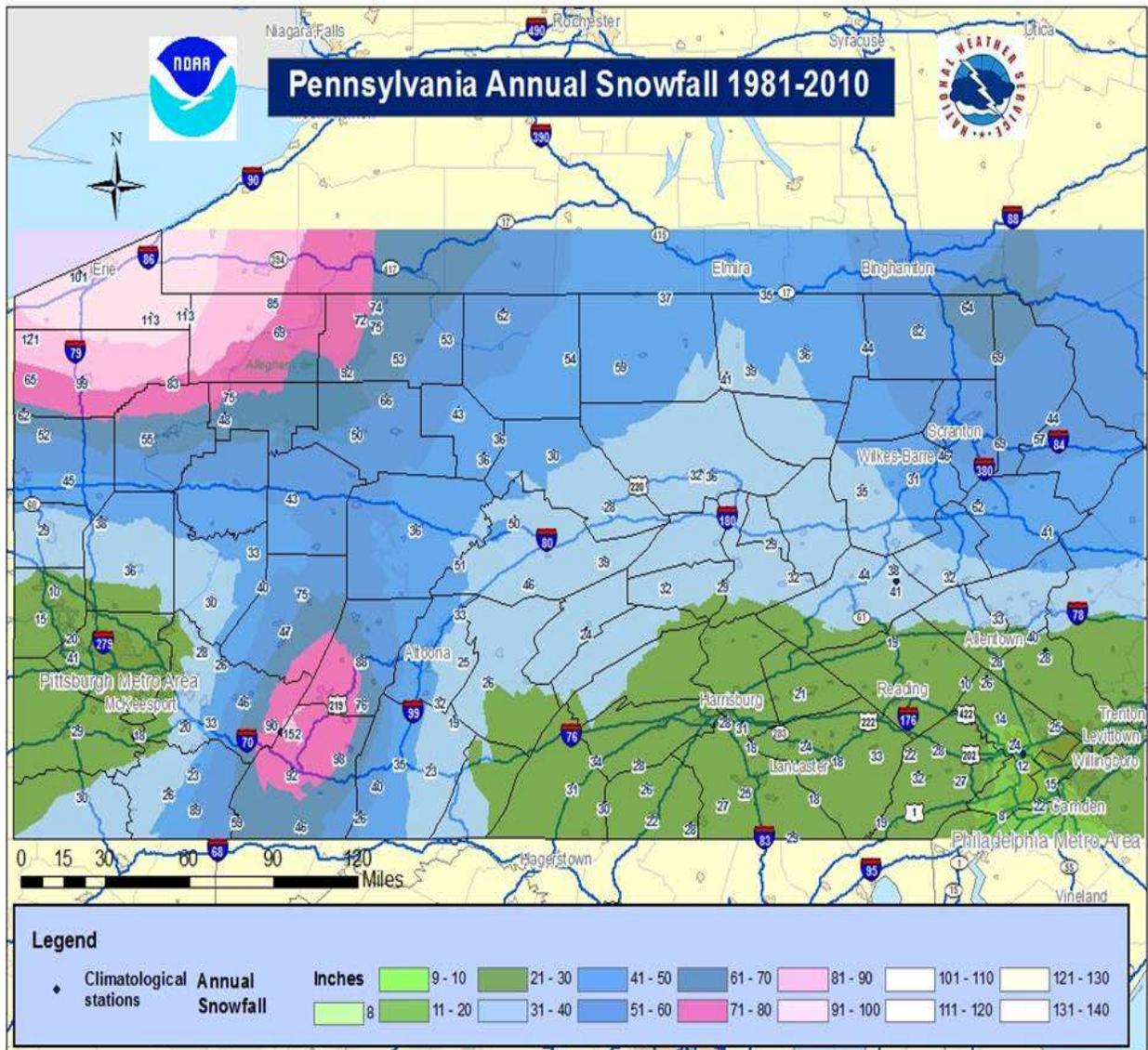
On occasion Monroe County can be affected by a Nor'easter, depending on its track. A Nor'easter is a storm characterized by a central low pressure area that deepens dramatically as it moves northward along the U.S. East Coast. The name came from the strong northeast winds that precede and accompany the storm as it passes over New England. Nor'easters are notorious for producing heavy snow in the Central and Northeastern Mountains (including the Poconos), but typically make lighter snow (or even no snow) for counties in the west. Nor'easters will ordinarily produce a heavy, wet snow. There is usually a fairly consistent demarcation between rain, mixed precipitation, and snow which moves along with the storm and generally parallel to the track of the surface low. The demarcation typically pivots with the storm as the track changes direction. The mixed precipitation and rainfall are generated when warmer marine air is pulled into the storm. The heaviest snow in a Nor'easter falls to the north and west of the track of the surface low.

A significant Nor'easter impacted Monroe County in November of 2012, just a few days after Hurricane Sandy causing additional utility outage issues as well as wind damage.

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Figure 33 - PA Annual Snowfall (NWS, 2016)



### 4.3.10.2 Range of Magnitude

Winter storms and Nor'easters are usually a countywide hazard. Winter storms consist of cold temperatures, heavy snow or ice, sleet and sometimes strong winds. Due to their regular occurrence, these storms are considered hazards only when they result in damage to specific structures or cause disruption to traffic, communications, electric power, or other utilities.

During the winter months about a fourth of the precipitation occurs in Monroe County as snow; with about a chance of precipitation on any day. The snow fall is generally

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from late November to early April, with the greatest monthly amounts occurring in December and January. The month of March usually records the greatest individual storm amounts, as the moisture in the air increases.

Flooding and power outages are major secondary effects of winter storms and winter weather. Melting snow can lead to large amounts of ground water that cannot be contained by streams and creeks. Power outages can be caused by large amounts of snow or ice that weighs on power lines.

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 outlined in *Table 35 - Winter Weather Events*.

*Table 35 - Winter Weather Events*

<b>Winter Weather Events</b>	
<b>Weather Event</b>	<b>Classification</b>
<b><u>Heavy Snowstorm</u></b>	Accumulations of four inches or more in a six-hour period, or six inches or more in a twelve-hour period.
<b><u>Sleet Storm</u></b>	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.
<b><u>Ice Storm</u></b>	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.
<b><u>Blizzard</u></b>	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.
<b><u>Severe Blizzard</u></b>	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.

Monroe County and its twenty municipalities are susceptible to the entire range of severe weather, from heavy snow storm to severe blizzard. The worst case scenario would be a series of multiple, severe blizzards causing major disruptions to utilities and transportation and limiting the effectiveness of emergency response activities.

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 33 - PA Annual Snowfall* 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 36 - Severe Winter Weather Occurrences*). Other reported winter storm

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events, including those associated with Disaster Declarations, are also listed in *Table 36 - Severe Winter Weather Occurrences*.

### **4.3.10.3 Past Occurrence**

Winter storms occur on the average of three times a year in Monroe County.

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 since 2010 are listed in *Table 36 - Severe Winter Weather Occurrences*. 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.

In the winter of 1993-94, the state 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.

The first of these devastating winter storms occurred in early January with record snowfall depths (in excess of 33 inches in the southwest and south-central portions of the Commonwealth), strong winds and sleet/freezing rain. 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.

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 PennDOT storage sites.

During January and February 1994, Pennsylvania experienced at least 17 regional or statewide winter storms. The consequences of these disasters resulted in the need for intervention by the President in an effort to alleviate the severity of the hardship and to aid the recovery of the hardest-hit counties.

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In January 1996, another series of severe winter storms with 27 and 24 inch accumulated snow depths was followed by 50 to 60 degree temperatures resulting in rapid melting and flooding.

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 turned to freezing rain later that day accumulating ½ to ¾ of an inch of ice 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 (NCEI, 2016).

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.

The “Blizzard of 2016” hit the northeast on January 22 & 23, 2016. Although Lehigh County and points south were hit with record snowfall, Monroe County was spared the brunt of the storm receiving heavier amounts to the south at 26½ inches to 10 inches in the north. There was only small power outage and a few minor accidents.

Monroe County is vulnerable to an array of winter weather. This weather has the ability to close businesses, close schools and block and damage roadways throughout the county. The average snowfall is 60-80 inches per year depending upon location within the county. The history of major winter storms in Monroe County since 2010 is outlined in *Table 36 - Severe Winter Weather Occurrences*. Information on prior events can be found in the 2011 HMP.

*Table 36 - Severe Winter Weather Occurrences*

<b>Severe Winter Weather Occurrences in Monroe County</b>					
<b>DATE</b>	<b>EVENT TYPE</b>	<b>DATE</b>	<b>EVENT TYPE</b>	<b>DATE</b>	<b>EVENT TYPE</b>
01/01/10	Winter Weather	02/29/12	Winter Weather	02/12/14	Winter Storm
01/24/10	Winter Weather	03/01/12	Winter Weather	02/15/14	Winter Weather
01/28/10	Winter Weather	11/27/12	Winter Weather	02/18/14	Winter Weather
02/02/10	Winter Weather	12/07/12	Winter Weather	02/19/14	Winter Weather
02/05/10	Winter Weather	12/20/12	Winter Weather	03/12/14	Winter Weather
02/09/10	Winter Storm	12/24/12	Winter Weather	03/30/14	Winter Weather
02/22/10	Winter Storm	12/26/12	Winter Storm	04/15/14	Winter Weather
02/25/10	Winter Storm	12/29/12	Winter Weather	11/13/14	Winter Weather

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Severe Winter Weather Occurrences in Monroe County					
DATE	EVENT TYPE	DATE	EVENT TYPE	DATE	EVENT TYPE
03/30/10	Winter Weather	01/15/13	Winter Weather	11/17/14	Winter Weather
11/25/10	Winter Weather	01/25/13	Winter Weather	11/26/14	Winter Storm
12/02/10	Winter Weather	01/28/13	Winter Weather	11/27/14	Winter Weather
12/11/10	Winter Weather	02/03/13	Winter Weather	12/02/14	Winter Weather
12/26/10	Winter Weather	02/08/13	Winter Storm	12/05/14	Winter Weather
01/06/11	Winter Weather	02/11/13	Winter Weather	12/09/14	Winter Weather
01/08/11	Winter Weather	02/13/13	Winter Weather	12/10/14	Winter Weather
01/11/11	Winter Weather	02/15/13	Winter Weather	12/12/14	Winter Weather
01/17/11	Winter Storm	02/19/13	Winter Weather	12/22/14	Winter Weather
01/20/11	Winter Weather	02/23/13	Winter Weather	01/03/15	Winter Weather
01/25/11	Winter Weather	02/26/13	Winter Weather	01/23/15	Heavy Snow
01/26/11	Heavy Snow	03/07/13	Winter Weather	01/26/15	Winter Weather
01/29/11	Winter Weather	03/16/13	Winter Weather	01/29/15	Winter Weather
02/01/11	Winter Storm	03/18/13	Winter Storm	02/01/15	Winter Storm
02/05/11	Winter Weather	03/25/13	Winter Weather	02/08/15	Winter Weather
02/07/11	Winter Weather	11/26/13	Winter Weather	02/14/15	Winter Weather
02/20/11	Heavy Snow	12/06/13	Winter Weather	02/21/15	Winter Weather
02/24/11	Winter Weather	12/08/13	Winter Weather	03/01/15	Winter Weather
03/06/11	Winter Weather	12/10/13	Winter Weather	03/03/15	Winter Weather
03/09/11	Winter Weather	12/14/13	Winter Storm	03/04/15	Winter Weather
03/21/11	Winter Weather	12/17/13	Winter Weather	03/14/15	Winter Weather
03/22/11	Winter Storm	12/24/13	Winter Weather	03/20/15	Winter Weather
03/30/11	Winter Weather	12/26/13	Winter Weather	03/25/15	Winter Weather
04/01/11	Winter Weather	01/02/14	Heavy Snow	03/31/15	Winter Weather
10/29/11	Heavy Snow	01/05/14	Winter Weather	01/23/16	Heavy Snow
12/07/11	Winter Weather	01/10/14	Winter Weather		
01/16/12	Winter Weather	01/11/14	Winter Weather		
01/21/12	Winter Weather	01/18/14	Winter Weather		
01/22/12	Winter Weather	01/21/14	Winter Weather		
01/26/12	Winter Weather	01/25/14	Winter Weather		
02/12/12	Winter Weather	02/03/14	Winter Weather		
02/14/12	Winter Weather	02/05/14	Winter Storm		
02/16/12	Winter Weather	02/09/14	Winter Weather		
02/18/12	Winter Weather	01/12/15	Winter Weather		
02/23/12	Winter Weather	01/18/15	Winter Weather		

#### 4.3.10.4 Future Occurrence

There is a likely probability of winter weather and winter storms occurring in Monroe County, with expected annual events. The county is located in an area with the chance of equaling or exceeding total snow depths of 31 to 50 inches. An analysis of the past occurrences indicates that this trend will continue annually in the future. A risk factor of 3.3 is associated with this natural hazard. Approximately thirty-six winter storms occur across Pennsylvania every year, with Monroe County experiencing approximately three annually.

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### **4.3.10.5 Vulnerability Assessment**

Since winter storms are a regular occurrence in Monroe County, as well as other counties throughout the Commonwealth, 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 specific structures. Locations 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, interrupt power supply and communications and cause the failure of inadequately designed and/or maintained roof systems.

Similar to the vulnerability assessment discussion for tornados and severe wind, vulnerability to the effects of winter storms on buildings is dependent on the age of the building type, construction material used and condition of the structure. Additional information on construction type and building codes enforced at time of construction would allow a more thorough assessment of the vulnerability of structures to winter storm impacts such as severe wind and heavy snow loading.

Based on the information available, all twenty communities within Monroe County are 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 37 - Housing Units Age* 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 37 - Housing Units Age

<b>Age of Housing Units in Monroe County (US Census, ACS, 2005-2009).</b>		
<b>MUNICIPALITY</b>	<b>NUMBER OF HOUSING UNITS BUILT PRIOR TO 1940</b>	<b>PERCENT OF TOTAL HOUSING UNITS</b>
Barrett Township	697	28.84%
Chestnuthill 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%
<b>Total</b>	<b>9,646</b>	<b>12.36%</b>

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).

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### **4.3.11. Dam Failure**

*For Dam Failure profile, see Appendix F.*

### **4.3.12. Disorientation**

#### **4.3.12.1 Location and Extent**

Large numbers of people are attracted to Pennsylvania's rural areas for recreational purposes such as hiking, camping, hunting, and fishing. As a result, people can become lost or trapped in remote and rugged wilderness areas. Search and rescue may be required for people who suffer from medical problems or injuries and those who become accidentally or intentionally disoriented. Search and rescue efforts are focused in and around state forest and state park lands.

Most municipalities in Monroe County have experienced lost and missing persons however disorientation is most likely to occur in areas of vast, open wilderness. Monroe County has great tourist appeal due to the natural beauty of the county seeing approximately 17 million tourists per year. A majority of Monroe County's land area is rural and undeveloped, the majority being forested. There are numerous miles of hiking and biking trails in the Monroe County and each year several people become lost or disoriented in wilderness areas throughout the county. The Delaware Water Gap National Recreation Area, Big Pocono State Park and Tobyhanna State Park are just some of the areas visited annually by tourists.

#### **4.3.12.2 Range of Magnitude**

A wide variety of factors can contribute to the outcome of a search and rescue mission but the most common dangers associated with disorientation are lack of food, water and shelter. Monroe County generally has an abundance of water and during the warmer summer months shelter is less of a necessity than during winter months when extreme temperatures can pose a huge threat. Age, physical fitness, and familiarity with the area can also have a bearing on the outcome.

#### **4.3.12.3 Past Occurrence**

Each year several people become lost or go missing in Monroe County's wilderness areas. Wilderness search and rescue has required considerable resources, sometimes resulting in the expenditure of hundreds of man-hours. *Table 38 - Disorientations 2009-2016* identifies the disoriented and missing person incidents for Monroe County from 2009 -2016.

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Table 38 - Disorientations 2009-2016

<b>Disorientation Events (Knowledge Center™)</b>		
Date	Event	Location
07/13/2009	Missing Person Search	Middle Smithfield Township
07/20/2010	Missing Person Search	Coolbaugh Township
10/23/2010	Missing Person Search	Hamilton Township
06/08/2011	Missing Person Search	Stroud Township
06/17/2011	Lost Hikers	Tobyhanna Township
10/18/2011	Missing Person Search	Monroe County
04/23/2012	Missing Person Search	Jackson Township
09/24/2012	Lost Hikers	Stroud Township
02/26/2013	Missing Person Search	Middle Smithfield Township
07/12/2013	Missing Person Search	Stroud Township
11/23/2013	Lost Hikers	Coolbaugh Township
06/08/2014	Search and Rescue, unspecified	Pocono Township
07/09/2014	Missing Person Search	Stroud Township
04/18/2015	Missing Person Search	Chestnuthill Township
05/21/2015	Missing Person Search	Tunkhannock Township
06/02/2015	Missing Person Search	Stroud Township
06/13/2015	Missing Person Search	Polk Township
07/05/2015	Missing Person Search	Barrett Township

#### 4.3.12.4 Future Occurrence

It is impossible to predict when and where disorientation may occur. During the warm summer months, as activities such as hiking, biking and camping increase, so does the likelihood of individuals becoming disoriented. Search and rescue operations throughout the county are predicted to continue but can be mitigated with appropriate actions.

#### 4.3.12.5 Vulnerability Assessment

Individuals are most likely to become disorientated in areas of vast, open wilderness. Children and the elderly are more vulnerable to the exposure of elements. The most dangerous period to become lost outdoors is during the winter months when heat and shelter are vital. Monroe County regularly experiences winter storms and temperatures below freezing. Fortunately, most outdoor recreational activities take place during the warmer months of spring and summer.

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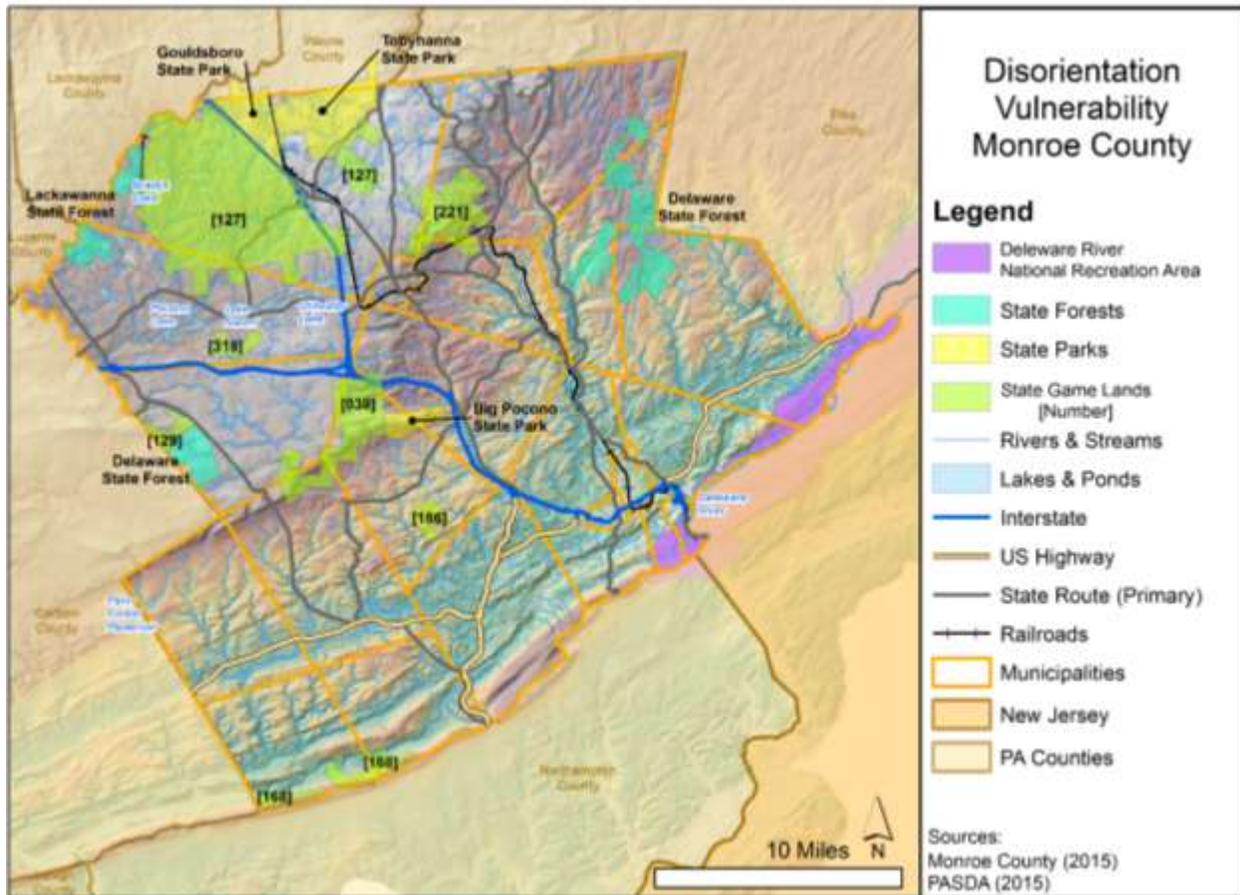
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*Figure 34 - Disorientation Vulnerability* identifies areas within the county that are vulnerable to disorientation.

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Figure 34 - Disorientation Vulnerability



### 4.3.13. Drowning

#### 4.3.13.1 Location and Extent

Drowning can be a significant hazard in communities with numerous water bodies (e.g. ponds, lakes, rivers, etc.) and extensive outdoor recreational activity. Monroe County has been and continues to grow in popularity as a tourist destination. Water related recreational opportunities such as fishing, boating and swimming are popular among visitors. Some of the most popular tourist destinations in the county is the Stillwater Lake, Lake Naomi, Pocono Lake, Bradys Lake, Beltzville Lake and the Delaware River specifically in the Delaware Water Gap area. Additional rivers, lakes and ponds are spread throughout the county. In addition to natural bodies of water, swimming pools are another location where drownings occur. Many swimming pools are located at residences and hotel/lodges throughout the county.

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### 4.3.13.2 Range of Magnitude

By definition, drowning results in death due to the lungs filling with water and not allowing the transfer of oxygen to the body. Drowning rates are particularly high for children ages 1- 19. According to the Center for Disease Control (CDC), drowning is the third leading cause of death from unintentional injury worldwide. In the United States, children under the age of 5 and adults over the age of 85 had the highest risk to drowning.

### 4.3.13.3 Past Occurrence

Records of past occurrences of drowning were difficult to identify. The Monroe County Knowledge Center identified one incident of drowning in the county. Additional research was completed to quantify the number of deaths due to drowning. *Table 39 - Drowning Events* identifies incidents of drowning and near drowning in Monroe County from 2013-2015.

*Table 39 - Drowning Events (Knowledge Center™)*

<b>Drownings identified in Monroe County 2013-2015</b>		
<b>Date</b>	<b>Event</b>	<b>Location</b>
07/04/2013	Drowning in a pool	East Stroudsburg
07/23/2013	Drowning in Broadhead Creek	Monroe County
07/16/2014	Personal Care Home resident drowning in nearby lake	Stroud Township
07/23/2014	Drowning in a pool at Days Inn	Smithfield Township
05/29/2015	Near drowning at lodge	Great Wolf Lodge, Scotrun
08/18/2015	Drowning in the Delaware River	Delaware Water Gap

### 4.3.13.4 Future Occurrence

It is impossible to predict when and where drowning may occur. During the warm summer months, as activities such as swimming, boating and fishing increase so does the likelihood of drowning. Based on past occurrence, Monroe County can expect to experience numerous drownings each year.

### 4.3.13.5 Vulnerability Assessment

As tourism continues to increase in the county and number of visitors grows, drowning is likely to continue without mitigation actions in place. Natural water sources like rivers, streams, lakes and ponds are identified as vulnerable locations. In addition to natural water sources, man-made water sources such as pools pose a high vulnerability to visitors and residents of the county.

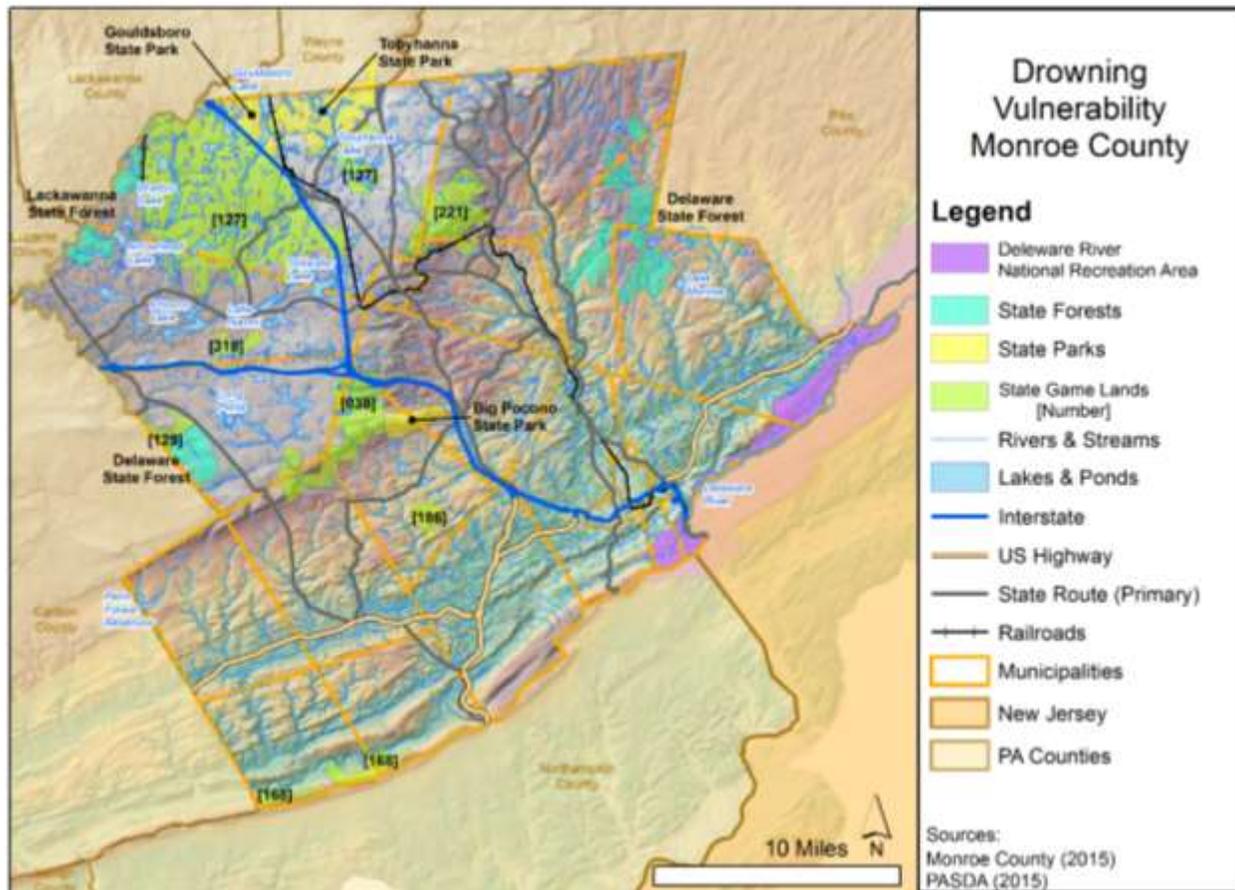
With tourism extremely high in Monroe County, it is anticipated that drownings will continue at pools and natural water sources. Pools with no supervision or life guards create a higher vulnerability than ones that are supervised. Children and the elderly

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are at a higher vulnerability than all other age groups. It should be noted that the number of indoor and outdoor water parks have increased in Monroe County over the past 5 years. Natural water sources located in federal and state parks are more vulnerable than natural water sources located in remote areas. In general, all natural water sources and pools in Monroe County create some level of vulnerability to the residents and visitors of the county. *Figure 35 - Drowning Vulnerability* reflects the vulnerability for drowning in Monroe County.

*Figure 35 - Drowning Vulnerability*



### 4.3.14. Hazardous Materials

#### 4.3.14.1 Location and Extent

Hazardous materials incidents in Monroe County are broken down into the subcategories of Transportation and Fixed Facility. Most hazardous materials incidents are unintentional, however hazardous materials could also be released in a criminal or terrorist act. A release, whether it is intentional or accidental, can result in injury or death and may contaminate air, water and/or soils.



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Emergency Planning Committees (LEPCs) are designed by EPCRA to ensure that state and local communities are prepared to respond to potential chemical accidents.

Fixed facilities are also monitored by the Environmental Protection Agency (EPA). The EPA has identified hazardous materials sites, not regulated by SARA Title III, and are known as Toxic Release Inventory (TRI) sites.

### **4.3.14.2 Range of Magnitude**

Dispersion of hazardous materials can take place rapidly when transported by water and wind. Hazardous material incidents caused by natural hazards are known as secondary events.

Hazardous materials fall into nine hazard classes: explosives; gases (flammable, non-flammable, non-toxic, and toxic); flammable and combustible liquids; flammable solids (spontaneously combustible materials, and dangerous when wet materials/water-reactive substances); oxidizing substance and organic peroxides; toxic substances and infectious substances; radioactive materials; corrosive substances; and miscellaneous hazardous materials/products, substances or organisms. All nine hazard classes can be found being transported and at fixed facilities. By conducting commodity flow studies, Monroe County can predict the increase or decrease of hazardous materials along the roadways and railways within the county. In 2011 and 2014 commodity flow studies were conducted, which are discussed further in section 4.3.14.3.

The circumstances described below, the type of material released, and the response time for emergency response teams are all factors that dictate the severity of any given incident. Most often areas within close proximity to a release is considered at a greater risk, however, a release can travel great distances through the air and in/on water or could remain in the environment for a long period of time (e.g. radioactive materials with centuries to millennia half-lives), thus resulting in wide-ranging effects on people and the environment.

### **Transportation**

Weather conditions can affect how a hazardous materials incident caused by a transportation accident develops. A hazardous substance can be carried great lengths by the wind; liquids can be dispersed widely by rain; while other substances can react with rain or extreme temperatures.

### **Fixed Facility**

Conditions or characteristics that can aggravate a hazardous materials incident at a fixed facility could be:

- Micro-meteorological effects of buildings and terrain – alters dispersion of hazardous materials.

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- Non-compliance with applicable codes (e.g. building or fire codes) and maintenance failures (e.g. fire protection and containment features) – increase the damage to the facility itself and to surrounding buildings.

Flood waters that compromise the production or storage of hazardous chemicals should be a concern for fixed facilities. Flood waters could swiftly move toxic chemicals throughout a water supply and across great distances.

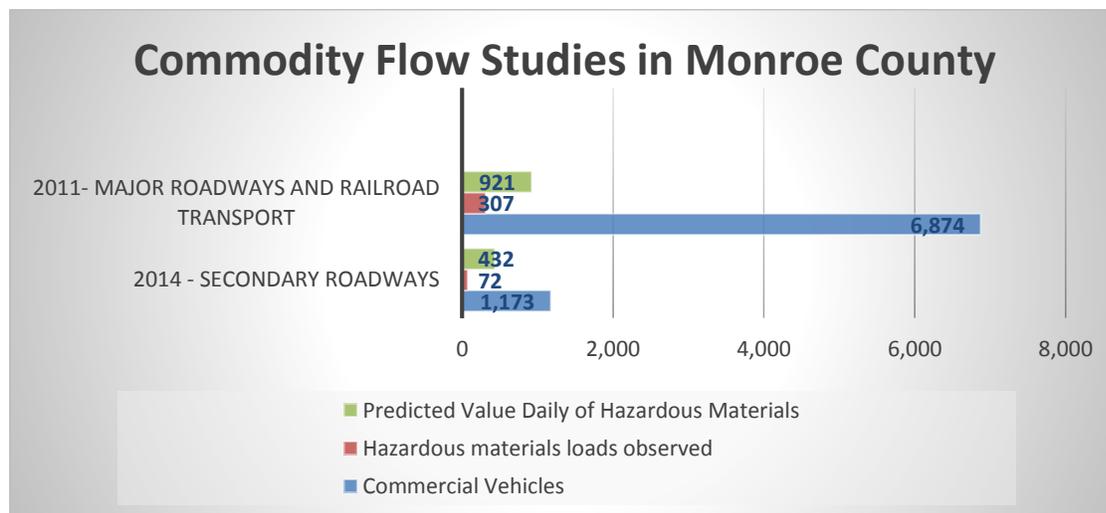
### 4.3.14.3 Past Occurrence

#### Transportation

A commodity flow study was conducted in July 2014 focusing on secondary roadways. A total of 1,173 commercial vehicles were observed from June 23, 2014 through July 14, 2014. From this total number of commercial vehicles 72 were observed hauling hazardous materials. The 2014 Monroe County Commodity Flow Study applied a predicted value of 432 motor vehicle movements of hazardous materials daily.

An earlier study in 2011 examined highway, other major roadways and railroad transport of hazardous materials. Monroe County has approximately 36 miles of active freight rail systems, and 129 miles of major motor vehicle traffic routes. The 2011 Commodity Flow Study identified 6,874 commercial vehicles from July 11, 2011 through July 15, 2011. Of this total 307 were hazardous materials vehicles. The study applied a predicted value of 921 motor vehicle movements of hazardous materials daily. Information provided by the rail carriers in Monroe County showed that Gases (Flammable) – Hazard Class 2, and Liquids (Flammable, Combustible – Hazard Class 3) were transported along the rail lines. *Figure 37 - Commodity Flow Studies* compares the two commodity flow studies. *Table 40- Hazardous Materials Transportation Incidents* lists previous transportation related incidents involving hazardous materials that occurred in Monroe County.

*Figure 37 - Commodity Flow Studies*



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Table 40- Hazardous Materials Transportation Incidents

<b>Date</b>	<b>Location</b>	<b>Material Involved</b>	<b>Type of Incident/Details</b>
01/23/2002	Hamilton Township	Unknown	Chemical release
02/19/2002	Bartonsville	Unknown	Chemical release
02/20/2002	Mount Pocono Borough	Kerosene	Kerosene spill
04/06/2002	Stroud Township	Unknown	Hazardous waste materials
04/09/2002	Delaware Water Gap Borough	Diesel fuel	Diesel fuel spill – tank on tanker truck ruptured
05/02/2002	East Stroudsburg Borough	Unknown	Chemical spill
05/03/2002	Delaware Water Gap Borough	Unknown	Chemical release
05/09/2002	Delaware Water Gap Borough	Unknown	Gasoline spill
08/09/2002	Middle Smithfield Township	Unknown	Crude oil spill
09/16/2002	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.
01/11/2003	Pocono Township	Diesel fuel	Diesel fuel spill – 125 gallons spilled from ruptured saddle tank on tractor trailer.
03/04/2003	Pocono Township	Petroleum	Oil spill – less than 55 gallons spilled on the ground.
05/22/2003	Delaware Water Gap Borough	Diesel fuel	Diesel fuel spill – fuel spilled onto roadway after a tractor trailer truck was in an accident.
09/23/2003	Arrowhead Lake	Petroleum	Gasoline spill – an unknown amount of petroleum spilled onto the ground.
11/05/2003	Polk Township	Heating oil	Oil spill – about 250 gallons of heating oil spilled from truck, some heating oil entered into a tributary of Middle Creek.
11/06/2003	Hamilton Township	Gasoline	Gasoline spill – less than 55 gallons of gasoline 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.
12/04/2003	Stroudsburg Borough	Diesel fuel	Diesel fuel spill – about 150 gallons spilled from ruptured tank.
03/15/2004	Tannersville	Diesel fuel	Diesel fuel spill – over 250 gallons spilled from a ruptured tank.
07/08/2004	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.
10/10/2005	Smithfield Township	Tar	Chemical spill – two hundred gallons of unknown tar were spilled on the roadway.

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<b>Date</b>	<b>Location</b>	<b>Material Involved</b>	<b>Type of Incident/Details</b>
06/06/2006	Tobyhanna Township	Diesel fuel	Diesel fuel spill – over 100 gallons of diesel fuel was spilled onto the roadway.
07/14/2006	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.
09/04/2006	Delaware Water Gap Borough	Paint	Chemical spill – an unknown amount of paint was reported spilled on I-80.
09/08/2006	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.
01/05/2007	Tobyhanna Township	Ink	Chemical spill – approximately 300 gallons of ink spilled from a ruptured tank when the trailer overturned.
07/03/2007	Middle Smithfield Township	Propane	Propane release – propane was released from a tanker truck after it was struck during a motor vehicle accident.
10/09/2007	Hamilton Township	Diesel fuel	Diesel fuel spill – about 100 gallons spilled from a tractor trailer truck.
11/09/2007	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.
01/02/2008	Pocono Township	Propane	Propane release – propane was released when a tanker truck overturned.
01/23/2008	Pocono Township	Fuel oil	Fuel oil spill – 100 gallons of fuel oil was spilled from a damaged tanker truck.
02/20/2008	Delaware Water Gap Borough	Butly Acetate	Chemical spill – an unknown amount of Butly Acetate was spilled from a tractor trailer onto I-80.
06/11/2008	Tobyhanna Township	Diesel fuel	Diesel fuel spill – 150 gallons of diesel fuel spilled after an accident involving a tanker truck, some fuel leaked toward Tobyhanna Creek.
09/10/2008	Pocono Township	Ammonium Nitrate	Chemical spill – a truck carrying Ammonium Nitrate and dynamite overturned on I-80, an unknown amount of antifreeze and diesel fuel leaked after accident.
02/12/2009	Polk Township	Petroleum	Oil spill – a petroleum product was spilled onto a roadway.
01/03/2010	Tobyhanna Township	Fuel spill	Fuel spill – approximately 120 to 150 gallons of diesel fuel from a vehicle accident on I-80.
06/11/2010	Pocono Township	Diesel fuel	Diesel fuel spill – report of an unknown amount of diesel fuel spilled at the Intersection of SR 611 and the I-80 on/off ramps at Scotrun
10/26/2010	Middle Smithfield Township	Diesel fuel	Diesel fuel spill – Vehicle accident of an 80,000 Crane truck on Marshalls Creek Road.

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<b>Date</b>	<b>Location</b>	<b>Material Involved</b>	<b>Type of Incident/Details</b>
12/03/2010	Chestnuthill Township	Fuel	Fuel leak – Approximately 20 gallons of fuel onto the roadway.
03/26/2011	Pocono Township	Fuel	Fuel spill – Approximately 60 gallons of fuel from a tractor trailer accident spilled.
05/10/2011	Stroud Township	Hydraulic fluid	Hydraulic fluid spill – 25-30 gallons spilled onto a black-top surface.
6/20/2011	Smithfield Township	Oil	Oil spill – 25 gallons of oil spilled when the oil pan plug reportedly dropped off.
06/20/2011	Coolbaugh Township	Diesel fuel	Diesel fuel spill – 25-30 gallons spilled when the fuel tank ruptured on a tractor trailer
08/16/2011	Hamilton Township	Diesel fuel	Diesel fuel spill – 100 gallons spilled when a tractor-trailer hit a road construction sign and ruptured the saddle tank.
11/18/2011	Tobyhanna Township	Hexamethyldisilazane	Hexamethyldisilazane spill – 15 pounds spilled out of a package due to a vehicle accident on I-380.
12/15/2011	Coolbaugh Township	Diesel fuel	Diesel fuel spill – 50 to 100 gallons of diesel fuel spilled following a vehicle accident.
01/28/2012	Smithfield Township	Bioxide	Bioxide spill – 500 to 900 gallons of Bioxide released onto the ground following a two vehicle accident with one vehicle on fire.
02/20/2012	Delaware Water Gap Borough	Hydraulic fluid	Hydraulic fluid spill – 50 gallons from a garbage hauler over a ¼ mile stretch of roadway.
05/12/2012	East Stroudsburg Borough	Diesel fuel	Diesel fuel spill – two tractor trailer accident with diesel fuel leaking.
07/11/2012	Delaware Water Gap Borough	Diesel fuel	Diesel fuel spill – from a broken saddle tank off a tractor trailer on I-80.
09/17/2012	Hamilton Township	Diesel fuel	Diesel fuel spill – from a tractor trailer accident on I-80.
10/03/2012	Stroud Township	Gasoline or Oil	Roadway spill – A spill on Beacon Hill Road of gas or oil as the roadway is slippery.
10/10/2012	Tobyhanna Township	Oil	Oil spill – 10 gallons of oil spilled on I-80 at mm 284.
10/15/2012	Stroudsburg Borough	Diesel fuel	Diesel fuel spill – Approximately 100 gallons of diesel fuel from a tractor trailer that was ripped open.
11/04/2012	Stroudsburg Borough	Fuel	Fuel spill – At the Pump and Pantry gas station – fuel leaked onto the parking lot from a gas can.
11/10/2012	Pocono Township	Diesel fuel	Diesel fuel leak – 5 gallons of fuel on the ground from a tractor trailer rollover.
01/04/2013	Chestnuthill Township	Gasoline	Gasoline spill – under 4 gallons were spilled from a motor vehicle accident.
01/09/2013	Tobyhanna Township	Diesel Fuel	Diesel fuel spill – unknown amount of diesel leaked from one of the saddle tanks of a tractor trailer.

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<b>Date</b>	<b>Location</b>	<b>Material Involved</b>	<b>Type of Incident/Details</b>
01/28/2013	Hamilton Township	Diesel fuel	Diesel fuel spill – Tractor trailer jackknifed and leaked 150 gallons of diesel fuel onto the ground.
02/23/2013	Tobyhanna Township	Diesel fuel	Accident with fuel spill – Approximately 100 gallons of Diesel.
06/30/2013	Unknown location	Diesel fuel	Diesel fuel spill – Approximately 50 gallons spilled as a result of an accident.
07/25/2013	Route 402 and Route 209	Oil, gasoline, transmission fluid	Undetermined amount of fluids spilled as a result of a RV fire.
07/26/2013	Coolbaugh Township	Diesel fuel	Diesel fuel spill – Approximately 20 gallons spilled as a result of a tractor trailer accident.
03/18/2014	Coolbaugh Township	Gasoline	Gasoline spill – between 5-10 gallons on I-380.
04/10/2014	Hamilton Township	Diesel fuel	Diesel fuel leak – Construction equipment being towed on a trailer broke away from the tow vehicle.
06/26/2014	Pocono Township	Unknown liquid	Unknown type liquid leak – a few gallons leaked from a tractor trailer that is placard as Corrosive #2588 and Flammable #1993.
08/05/2014	Tobyhanna Township	Diesel fuel	Accident with spill – Approximately 300 gallons of diesel fuel spilled.
08/11/2014	Jackson Township	Unknown substance	Unknown substance spill – Four 5-gallon containers containing an unknown substance were found. Two had been dumped into the ground.
08/18/2014	Hamilton Township	Oil	Gasoline leak – a 55 gallon drum at the Gas and Goods store leaked approximately 20 gallons of oil/water into the soil.
08/19/2014	Unknown location	Diesel fuel	Accident with a diesel fuel spill – approximately 100 gallons from the fuel tank of a tractor trailer.
08/23/2014	Coolbaugh Township	Oil	Oil spill – covering ½ mile of roadway. The oil caused an accident to occur.
08/23/2014	Stroud Township	Diesel fuel	Fuel leak – 10 gallons of diesel fuel from a disabled charter bus.
10/05/2014	Tobyhanna Township	Diesel fuel	Accident with diesel fuel spill – 130-175 gallons spilled from a tractor trailer roll-over.
10/21/2014	Hamilton Township	Diesel fuel	Diesel fuel spill – from a tractor trailer accident
12/18/2014	Coolbaugh Township	Diesel fuel	Diesel fuel spill – A truck jackknifed on ice and punctured the saddle tank
12/24/2014	Middle Smithfield Township	Gasoline	Gasoline spill – approximately 1 gallon of gasoline
01/30/2015	Jackson Township	Diesel fuel	Diesel fuel spill – Approximately 175 gallons spilled as a result of an accident.
02/27/2015	Tobyhanna Township	Diesel fuel	Diesel fuel spill – 125 gallons spilled as a result of an accident.
05/05/2015	Pocono Township	Oil	Accident with spill – motor oil from a vehicle.

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Date	Location	Material Involved	Type of Incident/Details
07/23/2015	Tobyhanna Township	Chlorine	Spill – An unknown amount of pool chemicals (Chlorine) spilled from a truck

In 2004 a FedEx truck traveling through Monroe County, on Interstate 80, leaked an acid. Ten people were treated after being exposed to this acid; and Interstate 80 was closed near Delaware Water Gap Borough while the acid was contained and then cleaned up.

### Fixed Facility

*Table 41 - Hazardous Materials Fixed Facility Incidents* lists previous hazardous material incidents involving fixed facilities that occurred in Monroe County.

*Table 41 - Hazardous Materials Fixed Facility Incidents*

Date	Location	Material Involved	Type of Incident/Brief Details
10/06/2003	Tannersville	Cupric Sulfate	Chemical spill – 20 pounds of cupric sulfate spilled from a bag when being unloaded from a truck.
11/05/2003	Ross Township	Roof sealant	Chemical spill – about 100 gallons of contaminated water from runoff of a recently treated roof ran into a retention pond.
04/14/2004	Tobyhanna Township	Lead material	Chemical release – an unknown amount of material was released from malfunctioning equipment.
04/16/2004	Delaware Water Gap Borough	Powdered Clay	Well Drilling Discharge – an undetermined amount of powdered clay was released into a pond during drilling.
04/19/2004	Smithfield Township	Bentonite	Chemical spill – two gallons of bentonite was spilled from a drill into Cherry Creek
01/15/2005	Tunkhannock Township	Kerosene	Kerosene spill – over 200 gallons of kerosene was spilled from a storage tank.
01/21/2005	Delaware Water Gap Borough	Propionitrile	Chemical spill – two gallons of propionitrile was spilled at a chemical plant causing one injury.
03/04/2005	Coolbaugh Township	Propane	Chemical release – 1,800 gallons of propane were released during a fire at the Coca Cola plant.
04/07/2005	Coolbaugh Township	Diesel fuel	Diesel fuel spill – an undetermined amount was released from an underground storage tank.
06/03/2005	Coolbaugh Township	Undetermined	Chemical release – an undetermined amount of an undetermined chemical was released into drinking water supply.
07/01/2006	Delaware Water Gap Borough	Oil	Oil spill – an unknown amount of gear box oil was spilled from pumps into the Delaware River.

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<b>Date</b>	<b>Location</b>	<b>Material Involved</b>	<b>Type of Incident/Brief Details</b>
04/16/2007	Smithfield Township	Renalyn	Chemical spill – three gallons of renalyn was spilled at a dialyses center, 14 persons were taken for treatment.
08/03/2007	Delaware Water Gap Borough	Peroxide	Chemical spill – a 55 gallon drum of peroxide exploded in a laboratory, one injury was reported.
08/23/2007	Stroudsburg Borough	Coal tar	Chemical release – an unknown amount of coal tar seeped out of the ground, some leaked into a nearby creek.
12/29/2007	Coolbaugh Township	Kerosene	Kerosene spill – about 250 gallons of kerosene were released from a ruptured holding tank.
01/12/2008	Delaware Water Gap Borough	Maleic Anhydride	Chemical spill – 18,000 pounds of Maleic Anhydride were spilled from holding tank, 4 injuries were reported.
06/28/2009	Middle Smithfield Township	Heating oil	Heating oil spill – Possible as much as 25 gallons from a residential tank was spilled.
02/24/2010	East Stroudsburg Borough	Natural gas	Natural gas leak – Snow plow struck a gas meter at the East Stroudsburg University Reidman Administration Bldg.
05/17/2010	Mt. Pocono Borough	Sodium hydroxide	Chemical spill – two unknown sized drums of sodium hydroxide reported to be reacting with and destroying the nearby ground area at an industrial park.
01/10/2011	East Stroudsburg Borough	Natural gas	Natural gas leak – A construction crew struck a natural gas line resulting in a line break with a gas release.
02/05/2011	Tobyhanna Township	Natural gas	Natural gas leak – Ice came off the roof at Pocono Motor Sports and sheared a 1” pipe line.
03/17/2011	Coolbaugh Township	Propane	Propane leak – a 40lb tank located on the side of Tractor Supply leaking propane. One employee having symptoms but refused EMS.
08/09/2011	Chestnuthill Township	Gasoline spill with fire	Gasoline spill with fire – fire at a gas station, found a gas can that had been on fire. 5-10 gallons of gasoline spilled.
10/16/2011	Stroud Township	Natural gas	Natural gas main break – Accidental rupture by a construction crew at the entrance to the food court at the Stroud Mall. No injuries reported.
02/20/2012	Coolbaugh Township	Meth lab	Meth lab – at a residential dwelling
07/30/2012	East Stroudsburg Borough	Unknown chemical	Unknown chemical spill – at East Stroudsburg University Science and Technology Building.
10/02/2012	Stroud Township	Propane	Propane leak – A 1000 gallon propane tank leaking at a business on Pocono commons Drive.
10/06/2012	Barrett Township	Propane	Propane leak – A 500 gallon tank leaking at a residence.
10/12/2012	East Stroudsburg Borough	Gas leak	Gas leak – with a strong odor of gas from the UGI Sub-Station.

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<b>Date</b>	<b>Location</b>	<b>Material Involved</b>	<b>Type of Incident/Brief Details</b>
10/15/2012	Smithfield Township	Natural gas	Natural gas leak – at JT Lambert School. School was dismissed early for the day.
11/03/2012	Middle Smithfield Township	Propane	Propane odor – From a generator at the sewer pump station at the intersection of Milford Rd and Sellersville Rd. There is also an odor of sewer gas from same location.
02/06/2013	Unknown location in Monroe County	Fuel oil	Fuel oil leak – Six gallons leaked inside a basement of a house from a 275 gallon tank.
06/21/2013	Delaware Water Gap Borough	Sewage	Sewage leak – infiltrating from a man hole cover near the Water Gap Apartments
07/23/2013	Stroudsburg Borough	Natural gas	Natural gas leak – pipe struck outside of a residence.
07/31/2013	Stroudsburg Borough	Natural gas	Natural gas leak – A gas line was struck causing a leak.
09/24/2013	Mt. Pocono Borough	Propane	Propane leak – A forklift knocked off a pipe at the Walmart Store causing a leak.
10/04/2013	Tobyhanna Township	Hazardous Material	Federal Express Terminal reports approximately 1 gallon of “Lagoon Treatment seeped from its package.
02/17/2014	Hamilton Township	Propane	Propane leak – a plow truck struck a gas meter causing a leak.
02/28/2014	Chestnuthill Township	Fuel	Fuel spill in a residence – in a townhouse from one residence into another.
04/01/2014	Tobyhanna Township	Natural gas	Natural gas leak – at a Blakeslee Gate Station regulated by UGI.
05/20/2014	Coolbaugh Township	Natural gas	Natural gas leak – Tobyhanna Army Depot reported a ruptured 2” gas line.
05/20/2014	Snydersville Diner	Sewage	Sewage leak – raw sewage was seeping out of the ground around the Snydersville Diner into Kettle Creek.
07/02/2014	Stroudsburg Borough	Natural gas	Natural gas main break – along Sunset Lane.
08/15/2014	East Stroudsburg Borough	Natural gas	Natural gas line leak – a backhoe dug up a gas line.
08/20/2014	Stroud Township	Natural gas	Natural gas leak – a car struck a house breaking the gas meter off.
09/02/2014	Eldred Township	Propane	Propane leak – large household propane tank fell over and discharged.
12/10/2014	Stroudsburg Borough	Natural gas	Natural gas leak – some kind of structure collapsed at Sherman Theater causing a gas pipe to leak.
09/09/2015	Stroud Township	Natural gas	Natural gas leak – broken gas line with 10 houses evacuated.
09/23/2015	Eldred Township	Sewage	Sewage spill

The following notable incidents occurred at fixed facilities:

- In 2005, 200 gallons of kerosene spilled from a storage tank;
- Also in 2005 1,800 gallons of propane was released during a fire at the Coca-Cola plant;

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- Fourteen were treated in 2007 from 3-gallons of Renalyn spilled at a dialysis center;
- A 55-gallon drum of Peroxide exploded in a lab resulting in one injury in 2007; and,
- In 2008, 18,000 pounds of Maleic Anhydride spilled from a holding tank, injuring 4.

#### **4.3.14.4 Future Occurrence**

##### **Transportation**

Transportation accidents with hazardous materials have occurred in the past and will continue to occur in the future, although there is great difficulty in predicting these accidents. The July 2014 Monroe County Commodity Flow Study predicted approximately nine transportation incidents per year. The 2014 Commodity Flow Study did not include petroleum product release as part of that report.

##### **Fixed Facility**

Facilities that use, manufacture, or store hazardous materials in Pennsylvania must comply with Title III of the federal Superfund Amendments and Reauthorization Act (SARA), and the reporting requirements for the Commonwealth under the Hazardous Materials Emergency Planning and Response Act (1990-165), as amended. The Community Right-to-Know Act was intended to ensure state and local communities are prepared to respond to potential chemical accident through Local Emergency Planning Committees (LEPCs).

The Environmental Protection Agency (EPA) has identified hazardous materials sites (not covered under the SARA Title III Act) these are known as Toxic Release Inventory (TRI) sites. There are 17 facilities in Monroe County listed on the EPA's website (EPA, 2016).

#### **4.3.14.5 Vulnerability Assessment**

##### **Transportation**

Hazardous materials transported on the highways and railways pose the greatest risk. Transportation carriers must have response plans in place to address accidents; otherwise local emergency response teams will step in to secure and restore the area. The volume and concentration of hazardous materials that disperse through air, water and soil needs to be minimized quickly. 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.

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### **Fixed Facility**

Populations within 1.5 miles of SARA Title III and Toxic Release Inventory (TRI) sites are vulnerable to hazardous material incidents. Human carelessness occurs predominantly during the manufacturing or storing of hazardous materials, more so than intentional acts.

A hazardous materials spill or release can be a secondary effect of a natural hazard (e.g., flooding, earthquake, or severe weather).

### **4.3.15. Levee Failure**

#### **4.3.15.1 Location and Extent**

A levee is an embankment built to prevent the overflow of a river; or, a ridge of sediment deposited naturally alongside a river by overflowing water. Artificial levees are constructed of fill or a wall, parallel to a body of water, and are designed to reduce flood risk.

Levee failures have the potential to place large numbers of people and their property at risk, much like dam failures; historically levees have been constructed to protect property rather than people. Failure of a levee can be caused if it is allowed to decay or deteriorate, so regular maintenance is required. Also, flooding events could overtop the levees if these events exceed the levee specifications.

From 1960 – 1962 Pennsylvania Department of Environmental Protection built a system of levees in the Stroudsburg and East Stroudsburg portions of the Brodhead, McMichaels, Pocono and Sambo Creeks following the flooding from Hurricane Diane in August 1955. This levee system was called the Stroudsburg/East Stroudsburg Joint Flood Control Project and was turned over to municipal control post-construction. Stroudsburg and East Stroudsburg Boroughs jointly own, operate and maintain the levee system; which is comprised of nine individual levees, shown in *Table 42 - Levees in Monroe County*. Work was undertaken to repair and upgrade these levees in 1982.

*Table 42 - Levees in Monroe County*

<b>Levee</b>	<b>Flood Source</b>	<b>River Basin</b>	<b>Municipality</b>
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	East Stroudsburg

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<b>Levee</b>	<b>Flood Source</b>	<b>River Basin</b>	<b>Municipality</b>
Brodhead Creek Levee (Right Bank, Upstream)	Brodhead Creek	Upper Delaware	Stroudsburg/Stroud Township
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 Plan Levee	Brodhead Creek	Upper Delaware	Stroudsburg
McMichaels Creek Levee	McMichaels Creek	Upper Delaware	Stroudsburg

**4.3.15.2 Range of Magnitude**

Flooding in landward areas adjacent to the structure could occur during a levee failure. The devastation of flooding from a levee failure depends on the level of flooding and the amount of landward development. Large volumes of water tend to move at high velocities, thus causing severe damage to buildings, trees and other large objects.

Environmental impacts from a levee failure result in significant water quality and debris disposal issues. Raw sewage from flood waters backing up sanitary sewer systems and inundating waste water treatment plans could contaminate residential and commercial buildings. Chemicals, fertilizers, pesticides and other hazardous materials could be added to the flood waters. These chemicals must be properly disposed of after the flood waters subside. Erosion is likely to occur as well, which can impact local ecosystems.

When a levee failure occurs it is generally worse when it happens abruptly, with little to no warning. This results in deep, fast-moving water through highly developed areas. The levees in Monroe County are located in densely populated areas, with real concern in Stroudsburg, East Stroudsburg and lower Stroud Township. The worst case scenario would be if the Stroudsburg Sewer Treatment Plan levee were to fail. Not only would this scenario cause flooding in the areas behind the levee, but also there would likely be a temporary shutdown of the sewer treatment facility, reducing access to clean water.

**4.3.15.3 Past Occurrence**

There have been no reports of levee failures in Monroe County.

**4.3.15.4 Future Occurrence**

As the levees in Monroe County age, the risk of a failure increases. According to the 2010 Report Card for Pennsylvania’s Infrastructure, Dams and Levees approximately one-third of the existing levee systems in Pennsylvania were constructed more than 50

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years ago (ASCE, 2010). The report goes on to state “A levee that is designed to withstand a 1-percent-annual-chance, or 100-year, flood has a roughly one-in-four likelihood of being overtopped by a flood during a 30-year period”. In Pennsylvania, 64 levee systems have been constructed, and included in the U.S. Army Corps of Engineers Rehabilitation and Inspection Program. Four levee systems had an unacceptable rating and are in inactive status, while the remaining 60 levee systems are currently in active status. There are 47 levee segments alone located in the Delaware River basin. The PA Department of Environmental Protection and U.S. Army Corps of Engineers has an effective levee safety program executed. Despite this successful safety program a grade of C- was assigned on the 2010 Report Card (ASCE, 2010). This was due to the advanced age of the levee projects, the numerous flood-prone watersheds existing in Pennsylvania, the residual flood risk inherent in flood damage reduction projects designed to the current flood protection standard, the population at risk, and the often under-appreciated threat to public safety resulting from catastrophic levee failure.

The probability of future occurrence can be reduced through proper design, construction and maintenance measures for levees. A Levee System Evaluation was done in 2014 by RKR Hess, who reviewed historical documentation, conducted a field inspection and geotechnical investigation, and analyzed levee system components and hydraulics. As of April 2014, the levee system was issued a positive NFIP evaluation letter and is in good condition and can reasonably be expected to protect against a flood with a 1-percent annual chance of exceedance.

### **4.3.15.5 Vulnerability Assessment**

A levee characteristically protects the buildings and population within a 2,000 foot buffer. The number of critical facilities and parcels within a 2,000 foot buffer for each levee is shown in *Table 43 – Levee Break Vulnerable Parcels and Critical Facilities* and can be viewed spatially in *Figure 38 - Levee Break Vulnerability*.

NOTE: Due to the physical proximity of these nine levees, the 2000-foot buffers of each levee may overlap. Vulnerable parcels and critical facilities are reported by levee rather than by jurisdiction since it is unlikely all the levees would fail simultaneously.

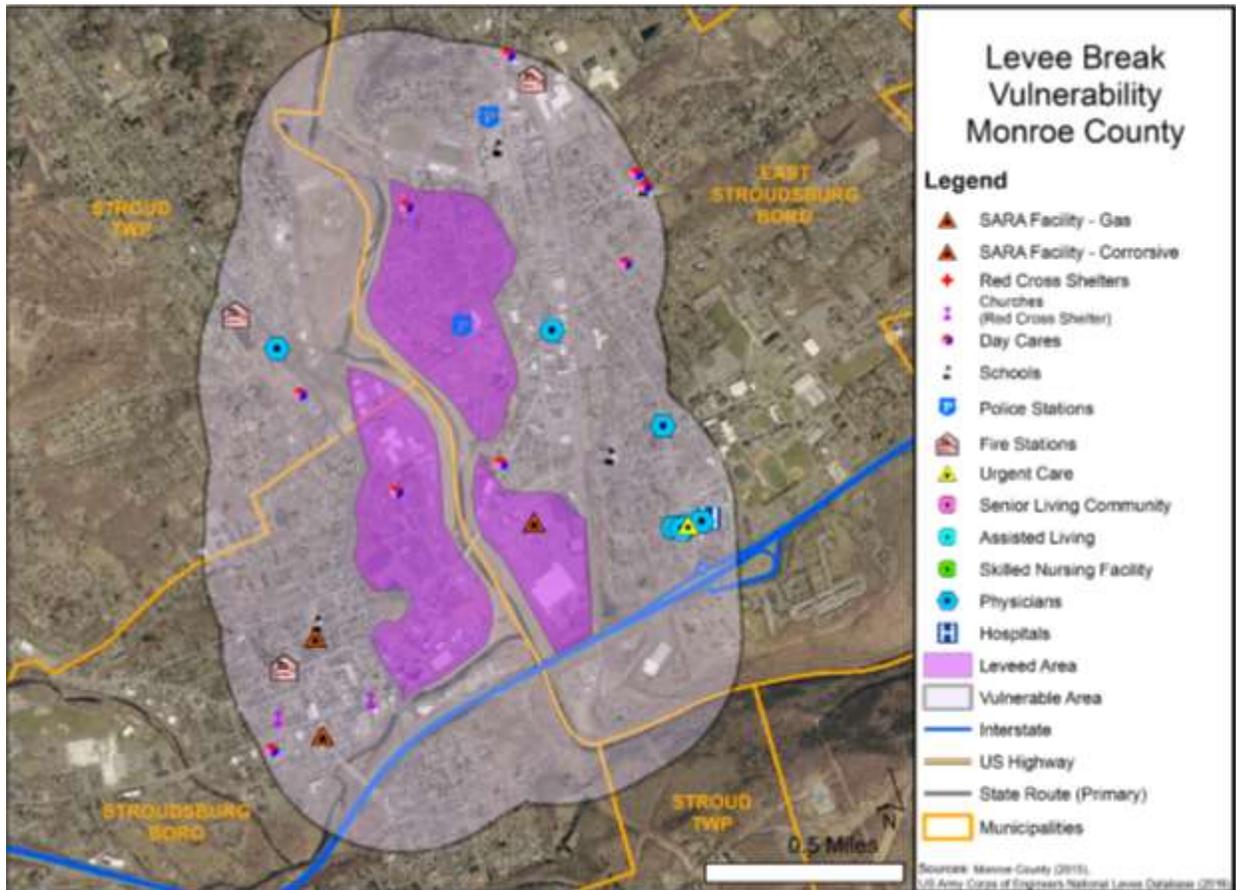
*Table 43 – Levee Break Vulnerable Parcels and Critical Facilities*

<b>Levee</b>	<b>Number of Parcels in buffer zone</b>	<b>Number of Critical Facilities in buffer zone</b>
East Stroudsburg Borough	1,360	45
Stroud Township	312	4
Stroudsburg Borough	1,155	13

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Figure 38 - Levee Break Vulnerability



### 4.3.16. Nuclear Incidents

#### 4.3.16.1 Location and Extent

There are two Fixed Nuclear Facilities within 50 miles of the Monroe County border.

Nuclear accidents generally refer to events involving the release of significant levels of radioactivity or exposure of workers or the general public to radiation. 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 and severe impairment), chronic health effects (e.g. cancer) and psychological effects.

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A power reactor facility makes electricity by continuously splitting uranium atoms. Within the Commonwealth of Pennsylvania there are five nuclear power stations. These are:

Beaver Valley Power Station, Beaver County;  
Limerick Generating Station, Montgomery County;  
Peach Bottom Atomic Power Station, York County;  
Susquehanna Steam Electric Station, Luzerne County; and,  
Three Mile Island Nuclear Generating Station, Dauphin County.

There are two Fixed Nuclear Facilities within 50 miles of the Monroe County border. 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. 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. 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.

### **4.3.16.2 Range of Magnitude**

Fixed facility incidents are not the only types of incidents that could affect Monroe County. Other types of incidents such as transportation or terrorism could also pose a hazard. The Tobyhanna Army Depot located within the county borders could pose a significant threat as a terrorism target.

In the event of a nuclear disaster, radioactive fallout would be the main danger of an incident within a 50 mile radius. Invisible gamma rays from this fallout can cause radiation sickness as a result of physical and chemical changes in the cells of the body. If a person would receive a large dose of radiation, that person would die in a very short time. Non-lethal doses in carrying degrees would cause radiation sickness among the survivors. Depending on the location of the event all of Monroe County could be in the Ingestion Exposure Pathway. *Table 44 - Emergency Planning Zones* lists the Emergency Planning Zones.

*Table 44 - Emergency Planning Zones (U.S.NRC, 2014)*

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Emergency Planning Zones	
EPZ	Description
<b>Plume Exposure Pathway</b>	Has a radius of about 10 miles from each reactor site. Predetermined protective action plans are in place and include sheltering, evacuation and the use of potassium iodide where appropriate.
<b>Ingestion Exposure Pathway</b>	Has a radius of about 50 miles from each reactor site. Predetermined protective action plans are in place and are designed to avoid or reduce dose from potential ingestion of radioactive materials. These actions include a ban of contaminated food and water.

There are three categories of nuclear accidents:

Criticality accidents: Involves loss of nuclear assemblies or power reactors.

Loss of coolant accidents: Occurs when 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.

The Nuclear Regulatory Commission uses four classification levels for nuclear incidents:

Unusual Event: 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: 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 (PAGs).

Site Area Emergency: Involves events in process or which have occurred that result in actual or likely major failures of plant functions needed for protection of the public. Any releases of radioactive material are not expected to exceed the EPA PAGs except near the site boundary.

General emergency: Involves actual or imminent substantial core damage or melting of reactor fuel with the potential for loss of containment integrity. Radioactive releases during a general emergency can reasonably be expected to exceed the EPA PAGs for more than the immediate site area.

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.

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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.

#### **4.3.16.3 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 reactor core at. 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.

Monroe County has not been affected by a fixed nuclear facility incident from any of the two local or other state facilities. The county has not been affected by any type of nuclear incident.

#### **4.3.16.4 Future Occurrence**

Monroe County has minimum potential to be affected by a fixed nuclear facility's incident, but the possibility exists due to the proximity of the Susquehanna and Limerick facilities.

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

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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.

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.

### **4.3.16.5 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.

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 2012, the market value of all agricultural products of these farms exceeded \$10.9 million.

Water contamination is also a concern in nuclear incidents. There are three public water suppliers that operate in or provide water to the county: the Pocono Jackson Joint Water Authority, Stroudsburg Municipal Authority and the Bethlehem Water 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 \$10.9 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



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### **4.3.17.1 Location and Extent**

The probability of terrorism occurring cannot be quantified with as great a level of accuracy as that of many natural hazards. Furthermore, these incidents generally occur at a specific location, such as a government building, rather than encompassing an area such as a floodplain. Thus planning should be asset-specific, identifying potentially at-risk critical facilities and systems in the community. Once a comprehensive list of critical assets has been developed, it should be prioritized so that efforts can be directed to protect the most important assets first. Then, beginning with the highest-priority assets, the vulnerabilities of each facility or system to each type of hazard should be assessed.

For the purpose of developing a realistic prioritization of terrorism hazard mitigation projects, three elements should be considered in concert:

- Relative importance of the various facilities and systems in the asset inventory.
- Vulnerabilities of those facilities.
- Threats that are known to exist.

Monroe County has identified critical facilities located in the county and the hazards to which these facilities are susceptible, however they will not be displayed in this plan and are available at the Monroe County Office of Emergency Management for review by authorized personnel. A critical facility is defined as a facility in either the public or private sector that provides essential products and services to the general public, is otherwise necessary to preserve the welfare and quality of life in the County, or fulfills important public safety, emergency response, and/or disaster recovery functions.

Critical facilities identified in the county are shelters; gas, electric and communication utilities; hospitals and other health care facilities; water and wastewater treatment plants, hazardous waste sites; and schools.

In addition to critical facilities, the county contains at risk populations that should be factored into a vulnerability assessment. These populations include not only the residents and workforce in the County, but also the tourists that visit the area on a daily basis and those that are traveling through the county on any of the interstate or major highways.

Critical assets and infrastructures are systems whose incapacity or destruction would have a debilitating effect on the county; this includes:

- Government services
- Emergency services
- Water supply systems
- Transportation networks
- Telecommunications infrastructure
- Electrical power systems
- Gas and oil facilities
- Sewer Treatment Facilities

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### **4.3.17.2 Range of Magnitude**

Terrorism refers to the use of Weapons of Mass Destruction (WMD), including, biological, chemical, nuclear, and radiological weapons; arson, incendiary, explosive, and armed attacks; industrial sabotage and intentional hazardous materials releases; and “cyber-terrorism”. Within these general categories, however, there are many variations. Particularly in the area of biological and chemical weapons, there are a wide variety of agents and ways for them to be disseminated.

Terrorist methods can take many forms, including:

- Agri-terrorism
- Arson/incendiary attack
- Armed attack
- Biological agent
- Chemical agent
- Cyber-terrorism
- Conventional bomb or bomb threat
- Hazardous material release (intentional)
- Nuclear bomb
- Radiological agent

### **4.3.17.3 Past Occurrence**

As described in the three events below Monroe County is not immune to terrorism.

There are two kinds of Terrorism threats that the County will address, Domestic and International.

#### **Domestic Terrorism**

Since the initial bombing of the World Trade Center in 1993 and with its subsequent destruction in 2001 the United States got its first real look at terrorism on US soil from a foreign entity. However, there have been many terrorist incidents perpetrated by US citizens over the past 20 years. Starting in 1995 with the bombing of the Murrow Building in Oklahoma City America began to wake up to the realization that radical organizations exist that could and have done harm to American citizens.

Groups such as the Ku Klux Klan, Aryan Nation, Black Liberation Army and other similar organizations have been characterized as hate groups. There are also lone operators such as the Unabomber that operate independently causing havoc in mostly rural areas of the country where that type of activity is not expected. Monroe County falls into that category.

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These types of groups and individuals have been responsible for terrorist attacks including Oklahoma City, the Centennial Olympic Park bombing, shootings of police officers in Southern California, the Boston Marathon bombing and the shooting of nine people in a church in Charleston, South Carolina.

In May of 2007 six terrorists known as the Fort Dix 6 were arrested at the culmination of FBI investigation that determined these men had plotted to attack the Fort Dix Army base in New Jersey. What makes this relevant to Monroe County is that they had a training ground on State Game Lands in Gouldsboro, just over the county border in Wayne County.

Active shooters, as defined by the US Department of Homeland Security, is an individual actively engaged in killing or attempting to kill people in a confined area; in most cases, active shooters use firearm[s] and there is no pattern or method to their selection of victims. Recent high-profile incidents involving active shooters include; the Sandy Hook Elementary school shootings in Newtown, Connecticut, the shooting in the Aurora, Colorado movie theater and the shooting in Tucson, Arizona involving U.S. Representative Gabrielle Giffords. Historical active shooter events include the Virginia Tech shootings, the Columbine High School shootings and the University of Texas, Austin shootings.

Monroe County experienced an active shooter event in August 2013 when a disgruntled resident shot and killed three people in Ross Township. The shooter entered the Municipal Building with the intent to kill all township officials. He killed one township official and two residents and wounded three other officials before being taken down by two residents attending the meeting.

Although the initial incident did not occur in Monroe County, the murder of a Pennsylvania State Trooper in September 2014 in neighboring Pike County affected the County. The manhunt that followed put the entire area on lockdown closing schools and canceling Halloween for a six week period until the suspect was apprehended in an abandoned airport hangar in Monroe County. The county's topography lends itself to hide suspects for long periods of time and survivalists even longer.

One of the busiest interstate highways, I-80 traverses Monroe County from east to west. This highway was used by the World Trade Center bombers in 1993 to transport the bomb to the World Trade Center. There are also two other major expressways that go through the county, I-380 connecting I-80 to I-81 and I-84 to the north and US 33 connecting I-80 to I-78 and US 22 in the south. These highways lead to a military facility, major tourist resorts and major manufacturers. Any type of weapon, from small arms to large bombs to biological weapons could be traveling any one of these highways at any given time.

Because of its proximity to many major metropolitan areas Monroe County is not immune to the possibility of domestic terrorism. As such the Local Planning Team gave this hazard a risk factor of 2.8.

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### **International Terrorism**

International terrorism has become an almost daily occurrence throughout the world. It usually takes place in developing countries where radical religion is the focal point. But in recent times even the modern countries are affected. The common definition usually infers to events that take place overseas, but some may have an effect in the United States.

International terrorism comes in many forms including, but not limited to, civil disorder, political terrorism, state-sponsored terrorism in developing countries ruled by revolutionaries and dictators to cyber terrorism.

Cyber terrorism can be defined as activities intended to damage or disrupt vital computer systems. These acts can range from taking control of a host website to using networked resources to directly cause destruction and harm. Protection of databases and infrastructure appear to be the main goals at this point in time. Cyber terrorists can be difficult to identify because the internet provides a meeting place for individuals from various parts of the world. Individuals or groups planning a cyber-attack are not organized in a traditional manner, as they are able to effectively communicate over long distances without delay. One of the more prominent groups involved in large-scale hacking events recently is the group “Anonymous.” They have been known to overtake websites, and alter the content that is presented to the public. The largest threat to institutions from cyber terrorism comes from any processes that are networked and controlled via computer. Any vulnerability that could allow access to sensitive data or processes should be addressed and any possible measures taken to harden those resources to attack. Terrorism is no longer limited to bricks and mortar or the taking of a life. The economy of any country, including the United States, is prey to foreign hackers.

The United States has seen an example of international terrorism in the recent case of the shootings in San Bernardino, California. There are radical training camps all over the country, some not far from Monroe County. The type of incident that happened in California can easily happen here and the County must be prepared. Monroe County is not immune to the possibility of international terrorism. As such the Local Planning Team gave this hazard a risk factor of 2.6.

### **Monroe County Incidents**

According to Knowledge Center™, eight incidents were reported from 2009 to the present and are illustrated in *Table 45 - Terrorist Incidents* (Knowledge Center™).

*Table 45 - Terrorist Incidents (Knowledge Center™)*

<b>Knowledge Center™ Incidents 2009-Present</b>			
<b>Date</b>	<b>Description</b>	<b>Jurisdiction</b>	<b>Location/Disposition</b>
10/06/09	Bomb Threat	East Stroudsburg Borough	East Stroudsburg School - unfounded.

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<b>Knowledge Center™ Incidents 2009-Present</b>			
<b>Date</b>	<b>Description</b>	<b>Jurisdiction</b>	<b>Location/Disposition</b>
01/27/10	Bomb Threat	East Stroudsburg Borough	Walmart East Stroudsburg Borough - unfounded.
10/30/12	Bomb Threat	East Stroudsburg Borough	Iridium Industries - no device found.
06/18/13	Bomb Threat	East Stroudsburg Borough	Iridium Industries - actor advised bomb in a locker room set to go off at 14:00 hrs.
09/04/11	Bomb Threat	Mt Pocono Borough	Walmart SR 940 in Mt. Pocono
01/27/10	Bomb Threat	Smithfield Township	Delaware Water Gap Rest Area - unfounded.
05/19/10	Bomb Threat	Stroud Township	Stroudsburg Junior High School - student located that initiated the call
10/20/12	Bomb Threat	Stroud Township	Cinemark Movie Theater at Stroud Mall. Patron stated there was a bomb in one of the theaters - angry about being denied access to a "R" rated movie

Although Monroe County was not involved in an initial response to the World Trade Center in 2001, the County was prepared to receive refugees and victims of the attack. After the attack the County did send some support services such as the Salvation Army to assist.

#### **4.3.17.4 Future Occurrence**

Based on the risk factor assessment Monroe County has a high risk of terrorism. There are a number of critical facilities within the County, as well as a nuclear facility in Luzerne County that could affect Monroe County in the event of a terrorist attack. Because of the close proximity to the risk area, all of Monroe County may be vulnerable to high levels of radioactive fallout.

#### **4.3.17.5 Vulnerability Assessment**

The severity of terrorist incidents depends upon the type of method used, the proximity of the device to people, animals, or other assets and the duration of exposure to the incident or device. For example, chemical agents are poisonous gases, liquids or solids that have toxic effects on people, animals, or plants. Many chemical agents can cause serious injuries or death. Severity of injuries depends on the type and amount of the chemical agent used, and the duration of exposure.

Biological agents are organisms or toxins that have illness-producing effects on people, livestock and crops. Because some biological agents cannot be easily detected and may take time to develop, it is difficult to know that a biological attack has occurred until victims display symptoms. In other cases the effects are immediate. Those affected by a biological agent require the immediate attention of professional medical personnel. Some agents are contagious, and victims may need to be quarantined.

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Since the probability of terrorism occurring cannot be quantified in the same way as that of many natural hazards, it is not possible to assess vulnerability in terms of likelihood of occurrence. Instead, vulnerability is assessed in terms of specific assets. By identifying potentially at-risk terrorist targets in a community, planning efforts can be put in place to reduce the risk of attack. All communities in Monroe County are vulnerable on some level, directly or indirectly, to a terrorist attack. However, communities where the previously mentioned potential targets are located should be considered more vulnerable. Site-specific assessments should be based on the relative importance of a particular site to the surrounding community or population, threats that are known to exist, and vulnerabilities including:

### **Inherent vulnerability:**

- Visibility – How aware is the public of the existence of the facility?
- Utility – How valuable might the place be in meeting the objectives of a potential terrorist?
- Accessibility – How accessible is the place to the public?
- Asset mobility – is the asset's location fixed or mobile?
- Presence of hazardous materials – Are flammable, explosive, biological, chemical, and/or radiological materials present on site? If so, are they well secured?
- Potential for collateral damage – What are the potential consequences for the surrounding area if the asset is attacked or damaged?
- Occupancy – What is the potential for mass casualties based on the maximum number of individuals on site at a given time?

### **Tactical vulnerability:**

#### **Site Perimeter**

- Site planning and Landscape Design – Is the facility designed with security in mind – both site-specific and with regard to adjacent land uses?
- Parking Security – Are vehicle access and parking managed in a way that separates vehicles and structures?

#### **Building Envelope**

- Structural Engineering – Is the building's envelope designed to be blast-resistant? Does it provide collective protection against chemical, biological, and radiological contaminants?

#### **Facility Interior**

- Architectural and Interior Space Planning – Does security screening cover all public and private areas?
- Mechanical Engineering – Are utilities and HVAC systems protected and/or backed up with redundant systems?
- Electrical Engineering – Are emergency power and telecommunications available? Are alarm systems operational? Is lightning sufficient?

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- Fire Protection Engineering – Are the building’s water supply and fire suppression systems adequate, code-compliant, and protected? Are on-site personnel trained appropriately? Are local first responders aware of the nature of the operations at the facility?
- Electronic and Organized Security – Are systems and personnel in place to monitor and protect the facility?

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### 4.3.18. Transportation Accidents

#### 4.3.18.1 Location and Extent

There are a total of 1,344.8 miles of developed roads in Monroe County; with interstate highways accounting for 40.4 miles of this total, while 487.9 miles are state and US highways. Significant transportation routes such as Interstate 380 and Interstate 80, US 209, PA 115, PA 447, PA 33, and PA 611 intersect the county. *Figure 36 - Major Transportation Routes* (first seen in the Hazardous Materials Profile) shows major transportation routes in Monroe County.

One railroad line, owned by Pennsylvania Northeast Regional Railroad Authority, transports freight of all types in Monroe County. The rail line runs generally northwest to southeast. The Pennsylvania Northeast Regional Railroad Authority (PNRRA) was formed in 2006 by Monroe and Lackawanna counties. According to the Monroe County Comprehensive Plan (December 2014 Monroe County Comprehensive Plan Update) “the majority of rail freight enters into the county as raw material and leaves as finished product by truck”.

Currently, there is an on-going project to restore passenger rail service between Scranton and Hoboken, NJ. Funding, according to the Monroe County Comprehensive Plan, has not been secured for the second phase, Andover to Delaware Water Gap. The third phase between Delaware Water Gap to Scranton also has not had funding secured.

There are four registered airports in the county: Pocono Mountain Municipal Airport, Stroudsburg-Pocono Airport and the Flying Dollar. The Pocono Mountain Municipal Airport, owned by the Pocono Mountains Municipal Airport Authority, is a public airport located two miles northwest of Mount Pocono. (188 Airport Drive, Tobyhanna 18466). Stroudsburg-Pocono Airport, Pegasus Airport, and the Flying Dollar are privately owned. The county also has three heliports and one ultralight field. For more details see *Table 46 - Air Transportation*. Additionally, Monroe County is in the flyway for JFK Airport, a major airport in New York City.

*Table 46 - Air Transportation*

Type	Facility Name	Owner	City	Ownership	Use
AIRPORT	FLYING DOLLAR	FLYING DOLLAR, LLC	CANADENSIS	Private	Public
AIRPORT	STROUDSBURG-POCONO AIRPORT	POCONO STROUDSBURG AIRPORT INC	EAST STROUDSBURG	Private	Public
AIRPORT	POCONO MOUNTAINS MUNI	POCONO MTNS MUNI ARPT AUTH	MOUNT POCONO	Public	Public
AIRPORT	PEGASUS AIRPORT	PEGASUS GROUP, INC	STROUDSBURG	Private	Private
HELIPORT	POCONO RACEWAY CORPORATE	POCONO RACEWAY	LONG POND	Private	Private
HELIPORT	POCONO MOUNTAIN	AVENTIS PASTEUR	MOUNT POCONO	Private	Private
HELIPORT	MOYER	DAVE MOYER	POCONO LAKE	Private	Private
ULTRALIGHT	ROCKY HILL	WILLIAM G. BARRY	CRESCO	Private	Public

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### 4.3.18.2 Range of Magnitude

Transportation accidents can result in death or serious injury and extensive property loss or damage. Road and railway accidents in particular have a potential to result in hazardous material releases. Accidents involving hazardous materials pose potential environmental impacts such as air, water and/or soil contamination.

Aviation incidents most often occur near landing or take-off sites, as such a five-mile radius around each airport in Monroe County can be considered a high-risk area.

The more heavily traveled roads experience a higher percentage of automobile accidents; typically due to higher speeds and inclement weather.

### 4.3.18.3 Past Occurrence

The most serious transportation concerns in Monroe County involve Interstate 380 and Interstate 80, US Route 209, and PA Route 196 and PA Route 611.

*Table 47 - Transportation Incidents (Knowledge Center™)* shows the accidents that were reported to the Monroe County 9-1-1 as entered into the Monroe County Knowledge Center™ data base between June 25, 2009 and October 27, 2015.

*Table 47 - Transportation Incidents (Knowledge Center™)*

<b>Date</b>	<b>Event</b>	<b>Municipality</b>
6/25/2009	Traffic accident	Hamilton Township
6/27/2009	Vehicle accident	Mt. Pocono Borough
7/1/2009	Firefighter vehicle accident	Coolbaugh Township
7/5/2009	Vehicle accident, road closure	Hamilton Township
7/22/2009	Vehicle accident, road closure	Tunkhannock Township
8/2/2009	Vehicle accident with injuries	Hamilton Township
8/22/2009	Vehicle accident	Pocono Township
8/24/2009	Traffic accident with road closure	Middle Smithfield Township
8/30/2009	Airplane crash	Chestnuthill Township
9/11/2009	School bus accident	Tobyhanna Township
10/13/2009	Vehicle accident	Stroud Township
11/6/2009	School bus accident	Eldred Township
11/12/2009	Neola Road bus accident	Jackson Township
11/25/2009	School bus accident	Stroud Township
12/7/2009	School bus accident	Stroud Township
12/13/2009	EMS accident	Hamilton Township
12/26/2009	Tractor trailer accident	Tobyhanna Township
1/11/2010	School bus accident	Coolbaugh Township
1/28/2010	School bus accident	Stroud Township
1/28/2010	Bus accident	Pocono Township
1/28/2010	School bus accident	Tobyhanna Township
1/28/2010	School bus accident	Tobyhanna Township
2/3/2010	School bus accident	Stroudsburg Borough
2/8/2010	School bus accident	Stroud Township

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<b>Date</b>	<b>Event</b>	<b>Municipality</b>
2/17/2010	School bus accident	Tobyhanna Township
3/25/2010	School bus accident	Tunkhannock Township
3/25/2010	School bus accident	Coolbaugh Township
4/3/2010	Ambulance accident	Middle Smithfield Township
4/7/2010	Tractor trailer accident on I-380	Tobyhanna Township
4/7/2010	School bus accident	Stroud Township
4/8/2010	School bus accident	Coolbaugh Township
4/9/2010	School bus accident	Stroud Township
5/17/2010	School bus accident	East Stroudsburg Borough
7/21/2010	Tractor trailer accident	Pocono Township
7/29/2010	Vehicle accident with a fatality	Middle Smithfield Township
8/9/2010	Vehicle accident with road closure	Hamilton Township
8/16/2010	Traffic accident with road closure	Hamilton Township
8/26/2010	Fatal accident	Tobyhanna Township
9/14/2010	Motorcycle accident	East Stroudsburg Borough
9/23/2010	School bus accident	Stroud Township
9/27/2010	School bus accident	Coolbaugh Township
10/9/2010	School bus accident	Stroudsburg Borough
10/16/2010	School bus accident	Tobyhanna Township
10/18/2010	School bus accident	Ross Township
10/29/2010	School bus accident	Chestnuthill Township
10/29/2010	School bus accident	Stroudsburg Borough
11/11/2010	Vehicle accident with a fatality	Tobyhanna Township
11/17/2010	School bus accident	Stroudsburg Borough
12/3/2010	Vehicle accident with fuel spill	Chestnuthill Township
12/3/2010	Bus accident at the Stroud Mall	Stroud Township
12/9/2010	Bus accident	Stroudsburg Borough
12/9/2010	School bus accident	Stroud Township
12/27/2010	Penn Dot truck accident	Tunkhannock Township
12/29/2010	Vehicle accident with a pedestrian	East Stroudsburg Borough
1/1/2011	Vehicle accident with a fatality	Chestnuthill Township
1/14/2011	School bus accident	Stroudsburg Borough
1/21/2011	Vehicle accident with a pedestrian	Paradise Township
1/24/2011	School bus accident	Smithfield Township
2/4/2011	School bus accident	Coolbaugh Township
2/10/2011	School bus accident	Eldred Township
2/11/2011	School bus accident	Pocono Township
2/15/2011	Vehicle accident	Mt. Pocono Borough
2/28/2011	School bus accident	Stroud Township
3/1/2011	School bus accident	Coolbaugh Township
3/3/2011	Vehicle accident with a fatality	Chestnuthill Township
3/15/2011	Ambulance accident	Chestnuthill Township
3/18/2011	School bus accident	East Stroudsburg Borough
3/23/2011	Ambulance accident	Tobyhanna Township
3/25/2011	School bus accident	Pocono Township
4/11/2011	School bus accident	Polk Township
4/14/2011	School bus accident	Middle Smithfield Township
5/4/2011	School bus accident	Tobyhanna Township
5/13/2011	EMS unit involved in an accident	Stroud Township
5/23/2011	Vehicle accident	Tunkhannock Township

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<b>Date</b>	<b>Event</b>	<b>Municipality</b>
6/3/2011	Tractor trailer accident	Pocono Township
6/9/2011	School bus accident	Stroud Township
7/18/2011	Ambulance accident	Middle Smithfield Township
9/12/2011	School bus accident	Chestnuthill Township
9/20/2011	School bus accident	Coolbaugh Township
9/26/2011	School bus accident	Hamilton Township
9/27/2011	School bus accident	Mt. Pocono Borough
9/30/2011	School bus accident	Pocono Township
10/3/2011	School bus accident	Hamilton Township
10/7/2011	Truck accident on Treible Road	Chestnuthill Township
10/13/2011	School bus accident	Eldred Township
12/19/2011	School bus accident	East Stroudsburg Borough
1/21/2012	Ambulance accident	Jackson Township
2/1/2012	School bus accident	Coolbaugh Township
2/6/2012	School bus accident	Mt. Pocono Borough
3/3/2012	Motorcycle accident	Tobyhanna Township
3/16/2012	School bus accident	Chestnuthill Township
3/21/2012	School bus accident	Coolbaugh Township
4/23/2012	School bus accident	Jackson Township
4/24/2012	Tractor trailer accident	Stroudsburg Borough
5/1/2012	Fatal motorcycle accident	Pocono Township
7/1/2012	Vehicle accident	Tobyhanna Township
7/29/2012	Major traffic accident closing I-80	Stroud Township
8/1/2012	Bus accident	Polk Township
8/31/2012	Aircraft accident	Paradise Township
9/12/2012	School bus accident	Chestnuthill Township
9/14/2012	Bus accident	Chestnuthill Township
9/19/2012	School bus accident	Tobyhanna Township
9/21/2012	School bus accident	Smithfield Township
10/2/2012	School bus accident	Stroud Township
10/3/2012	School bus accident	Ross Township
10/17/2012	Tractor trailer accident	Stroud Township
1/25/2013	School bus accident	East Stroudsburg Borough
2/4/2013	Tour bus accident on I-380 at mile marker 2.3	Pocono Township
2/19/2013	Bus accident	Tobyhanna Township
2/20/2013	Ambulance accident with entrapment	Stroud Township
4/8/2013	Accident between a school bus and a motorcycle	Pocono Township
4/12/2013	Pleasant Valley School bus accident	Chestnuthill Township
5/22/2013	School bus accident	Stroudsburg Borough
6/3/2013	School bus accident	Middle Smithfield Township
6/19/2013	Accident between a school bus and motorcycle	Delaware Water Gap Borough
9/7/2013	Fatal motorcycle accident	Pocono Township
10/28/2013	School bus crash	Monroe County
11/4/2013	Minor accident involving a Pocono Mt. School bus	Tunkhannock Township
12/19/2013	School bus accident	Stroudsburg Borough
12/23/2013	Vehicle accident with six injured.	Coolbaugh Township
12/27/2013	Vehicle accident	Pocono Township
12/30/2013	Vehicle accident involving a Polk Twp. firefighter	Polk Township
1/6/2014	School bus accident	Smithfield Township

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<b>Date</b>	<b>Event</b>	<b>Municipality</b>
1/23/2014	School bus accident, 29 students evaluated by EMS	East Stroudsburg Borough
3/3/2014	School bus accident	Stroud Township
3/5/2014	Pike County Transportation Bus accident with a car	Monroe County
3/13/2014	Ambulance accident I-80 WB MM 296.4	Pocono Township
3/15/2014	Accident involving a PSP vehicle	
3/17/2014	School bus accident	Hamilton
3/28/2014	School bus accident	Stroud Township
4/20/2014	Tractor trailer accident on I-380 NB MM 8.1	Coolbaugh Township
5/27/2014	School bus accident with no injuries	Pocono Township
6/4/2014	Vehicle accident with I-80 closure	Stroud Township
6/6/2014	School bus accident, 10 students with no injuries	Stroud Township
6/9/2014	Stroudsburg Area school bus accident	Monroe County
7/20/2014	Fatal ATV accident	Chestnuthill Township
7/27/2014	Motorcycle accident on Route 209	Monroe County
7/28/2014	Vehicle accident Route 115	Monroe County
8/21/2014	Plane crash	Chestnuthill Township
8/23/2014	Vehicle accident with oil spill on Route 196	Monroe County
9/2/2014	Accident with fire that closed I-80	Hamilton Township
10/13/2014	School bus accident	Stroud Township
10/29/2014	Accident involving PSP	Mt. Pocono Borough
11/6/2014	Vehicle accident	Polk Township
1/4/2015	PSP accident	Jackson Township
1/22/2015	Accidents due to icy roads	Monroe County
1/28/2015	School bus accident	
2/26/2015	Bus accident	East Stroudsburg Borough
2/27/2015	School bus accident with no injury	East Stroudsburg Borough
5/16/2015	Accident on I-80 with injury	Pocono Township
5/21/2015	Vehicle accident with multiple patients	Polk Township
6/3/2015	Accident on I-380	Coolbaugh Township
6/6/2015	Vehicle accident with several trapped	Hamilton Township
6/27/2015	Vehicle accident with entrapment	Hamilton Township
8/1/2015	Motorcycle vs. van accident	Stroud Township
8/14/2015	Vehicle accident with entrapment and fire	Coolbaugh Township
10/15/2015	School bus accident	Jackson Township
10/23/2015	School bus accident	Stroudsburg Borough
10/27/2015	Accident with road closure	Stroudsburg Borough

Between September 11, 2009 and October 27, 2015, there were a total of 85 bus accidents. Bus accidents, whether they are school or mass transit, pose a greater risk for mass casualty incidents. On January 28, 2010 alone there were a total of four (4) bus accidents. The Monroe County statistics for each year are as follows:

2010 – 25  
 2011 – 21  
 2012 – 12  
 2013 – 11  
 2014 – 10  
 2015 – 5 (as of October 27)

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Three aircraft accidents have happened between 2009 and 2015.

- August 30, 2009 – resulted in the death of the pilot;
- August 31, 2012 – there was one occupant, and no injuries. The aircraft accident happened in Seven Pines Park.
- August 21, 2014 – there was one occupant with minor injuries. The accident happened in the area of the cemetery at Kreger Road and Gretchen Road, Polk Township

There were also two possible airplane accidents in Monroe County reported on Knowledge Center; one on October 17, 2012 and another on September 29, 2013, both with no findings.

During the timeframe of 2009 to 2015 there were no railroad accidents reported.

#### **4.3.18.4 Future Occurrence**

Automobile accidents have and will occur more frequently than a rail or aviation accident. The average rate of aviation accidents occur at a rate of one per 1.2 million flights; with the chances of dying in a plane crash at 1 in 11 million. Therefore, the likelihood of an aviation incident in Monroe County is considered low. Rail road accidents, when they occur have a greater likelihood of affecting larger areas of population and/or the environment.

The probability of transportation accidents is characterized as highly likely as defined by the Risk Factor Methodology probability criteria. An overall risk factor of 3.2 has been determined by the local planning team using this methodology.

#### **4.3.18.5 Vulnerability Assessment**

The combination of high traffic volume and severe winter weather in the county increase the chances of traffic accidents occurring. Vulnerability for highways accidents falls within a ¼ mile of Interstate and US highways.

Like highway incidents, rail incidents can impact populations living near rail lines. Vulnerability for rail incidents fall within a ¼ mile of the rail line. This includes populations in Barrett, Coolbaugh, Paradise, Stroud, and Tobyhanna townships, and Delaware Water Gap, East Stroudsburg and Mount Pocono boroughs.

Coolbaugh and Smithfield townships are susceptible to airplane accidents due to the air traffic through the two airports. Vulnerability of airplane accidents occurs in jurisdictions falling within five miles of the airports. *Table 48 - Structures and Critical Facilities Vulnerable to Transportation Accidents* summarizes the addressable structures and critical facilities that are vulnerable to railroad, highway, and airport accidents.

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Table 48 - Structures and Critical Facilities Vulnerable to Transportation Accidents

MUNICIPALITY	ADDRESSABLE STRUCTURES WITHIN 1/4 MILE OF *MAJOR HIGHWAYS AND RAILROAD	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	1,262	3	2,597	6
Chestnuthill Township	2,001	13	3,793	14
Coolbaugh Township	3,554	11	8,056	16
Delaware Water Gap Borough	264	3	390	5
East Stroudsburg Borough	3,169	12	4,036	20
Eldred Township	0	0	1	0
Hamilton Township	1,086	1	3,129	9
Jackson Township	513	2	1,383	0
Middle Smithfield Township	1,015	8	3,999	8
Mount Pocono Borough	1,348	8	1,654	10
Paradise Township	795	1	855	10
Pocono Township	1,864	13	1,283	5
Polk Township	386	3	46	0
Price Township	142	0	1,218	1
Ross Township	303	5	2,043	7
Smithfield Township	893	8	4,295	32
Stroud Township	2,711	14	6,387	20
Stroudsburg Borough	2,732	10	3,466	16
Tobyhanna Township	2,727	11	3,546	7
Tunkhannock Township	885	1	309	0
<b>TOTAL</b>	<b>27,650</b>	<b>127</b>	<b>52,486</b>	<b>1,221</b>

### 4.3.19. Utility Interruptions

#### 4.3.19.1 Location and Extent

Utility interruptions can occur from an internal system failure, or as a secondary impact of another hazard, such as a windstorm or a traffic accident. Examples of other hazards could be severe thunderstorms or winter storms that bring down power lines and cause widespread disruptions in electricity service. Strong heat waves may result in rolling blackouts where power may not be available for an extended period of time.

Natural gas, water, electric and telecommunications capabilities can all experience disruptions. *Figure 40 - Utility Coverage* shows the locations of utility lines throughout Monroe County and *Table 49 - Utility Providers* identifies utility providers in Monroe County.

*Figure 40 - Utility Coverage*

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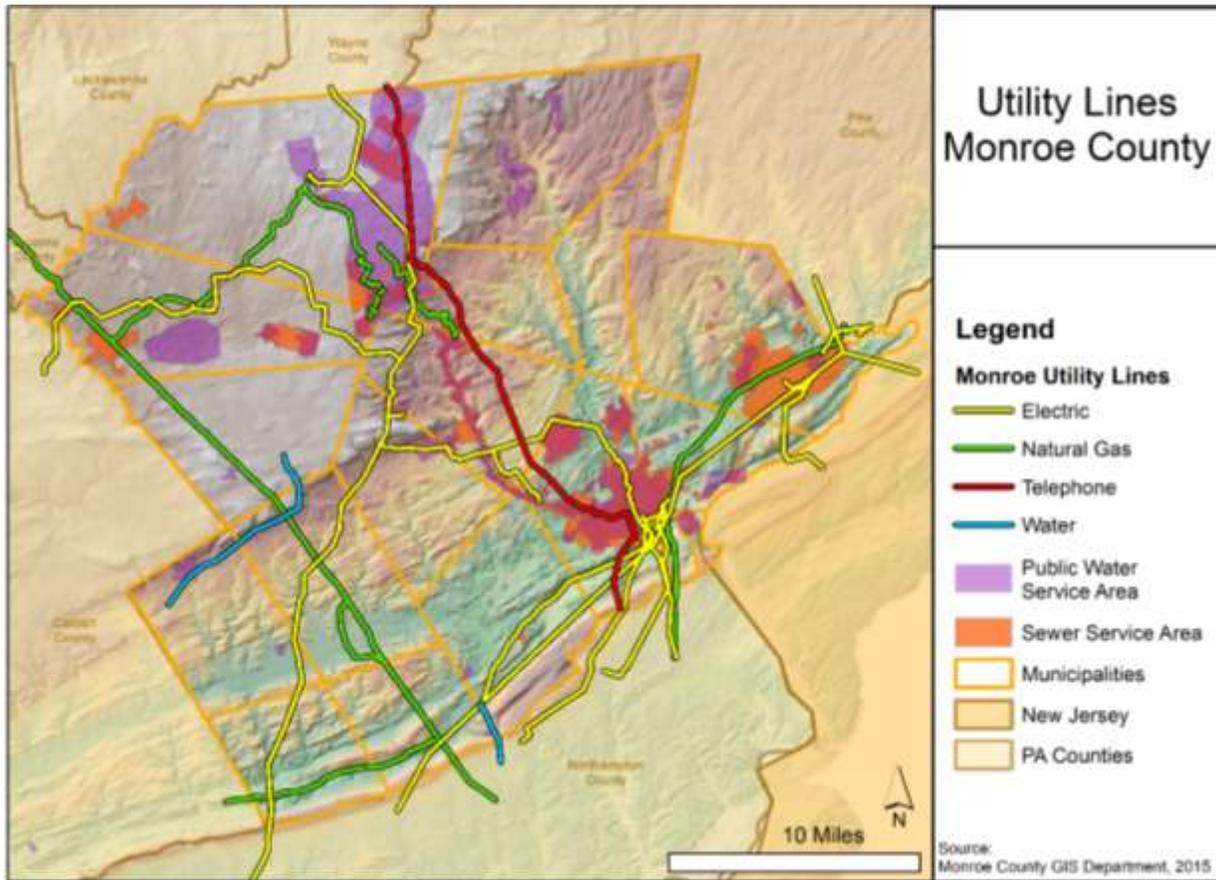


Table 49 - Utility Providers

Name of Utility Provider	Utility provided:
AmeriGas	Propane
Brodhead Creek Regional Authority	Water
Columbia Pipeline Group- Columbia Gas Transmission	Natural Gas
East Stroudsburg Water Billing	Water
Penn Estates Utilities	Water/sewage
Pennsylvania American Water Company	Water
Pennsylvania Power and Light	Electricity
Public Service Electric & Gas (PSE&G)	Electric and natural gas
Quality Propane	Propane
RTE Enterprises LLC	Electric and natural gas
Salvatore Electric	Electric
UGI Utilities, Inc.	Natural Gas/Hydrogen Sulfide

### 4.3.19.2 Range of Magnitude

The degree of harm or damage depends on the population affected and the severity of the outage. At a minimum, utility interruptions can cause short term disruption in

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the orderly functioning of business, government, and private citizen activities. Severe interruptions of utilities can have long term ramifications to lives and business.

### **Electricity**

Interruptions or power failures could have the following impacts:

- Food spoilage
- Loss of heating or air conditioning
- Basement flooding – sump pump failure
- Loss of indoor lighting
- Internet service
- Traffic signals
- Elevators
- Retail sales
- Loss of medical equipment usage
- Loss of functionality of critical facilities such as schools

Of all of these the loss of heating or air conditioning poses the greatest risk to the elderly and very young populations during times of extreme temperatures. Prolonged power outages also pose a risk to residents that rely on home-supply oxygen units.

### **Fuel**

From natural gas to other products transported and delivered by way of pipelines to business and residences, interruptions could have the following impacts:

- Loss of heating
- Loss of manufacturing capabilities

### **Telecommunications**

Interruptions to telecommunications systems include impacts to 9-1-1 capabilities, telephone and internet service. The greatest risk to the loss of this capability would be in reporting a traffic accident or medical emergency.

### **Water**

Interruptions to water supply can cause issues with quantity, thus affecting water quality.

#### **4.3.19.3 Past Occurrence**

Minor utility interruptions occur annually in Monroe County; most often in conjunction with winter and wind storms. Below are tables describing interruptions electric, fuel, telecommunications and water utilities.

### **Electricity**

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Table 50 - Electrical Service Interruptions

Date	Event	Jurisdiction
9/22/2009	Power outage	Pocono Township
5/8/2010	Utility emergency	Chestnuthill township
4/16/2011	Transportation emergency, utility involved	Stroud Township
5/26/2011	Power outage	Monroe County
8/31/2011	Utility threats	Pocono Township
2/23/2012	Planned power outage	Hamilton Township
9/4/2012	Power outages and flooding	Monroe County
11/6/2012	Power outage	Pocono Township
1/5/2014	Power outage	Barrett Township
1/8/2014	Power outage	Pocono Medical Center
1/8/2014	Power outage	Monroe County
11/23/2014	Power outage following a planned power outage	East Stroudsburg Borough
12/25/2014	Power outage	Monroe County
1/18/2015	Transportation emergency – car vs. utility pole	Coolbaugh Township
4/20/2015	Multiple power outages	Monroe County
5/16/2015	Partial power outage –ESASD North	Monroe County
6/30/2015	Transportation emergency with power outage	Pocono Township
9/18/2015	Power outage	Monroe County

Terrorism is also another threat to utility providers. In 2011, a citizen made threats over the telephone to Pennsylvania Power & Light. The citizen was upset over the lack of power to his residence in Pocono Township.

### Natural Gas

Table 51 - Natural Gas Service Interruptions

Date	Event	Jurisdiction
8/23/2011	Gas line beak	Stroudsburg Borough
7/27/2013	Natural gas line work	Ross Township
8/15/2014	Gas line leak	East Stroudsburg Borough

### Telecommunications

There is only one recorded telephone outage, it occurred on 7/1/2015 in Tobyhanna Township.

### Water

Table 52 - Water Service Interruptions

Date	Event	Jurisdiction
7/15/2009	Water main break	East Stroudsburg Borough
4/24/2012	Boil water advisory	Delaware Water Gap Borough
6/9/2012	Water main break	Coolbaugh Township
5/1/2013	Water main break	East Stroudsburg Borough
5/20/2014	Water main break	Stroud Township

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The Monroe County 2011 Hazard Mitigation Plan identified utility interruptions from the Pennsylvania Emergency Incident Reporting System (PEIRS) from 2002 to 2009, shown here in *Table 53 - PEIRS Utility Interruptions* (PEIRS, 2010). This data shows known past occurrences as there was no complete or comprehensive list of utility interruptions for Monroe County.

*Table 53 - PEIRS Utility Interruptions (PEIRS, 2010)*

<b>Incident Type</b>	<b>2002</b>	<b>2004</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>Total by Type</b>
Phone Outage	1	1	2	2	2	1	9
Power Outage	1	2	6	1	2	1	13
Water Main Break	0	0	0	0	1	0	1
Total by Year	2	3	8	3	5	2	23

#### **4.3.19.4 Future Occurrence**

Utility interruptions are difficult to predict, even though minor interruptions to utilities may occur several times a year. Even so, utility interruptions occur more frequently as a secondary factor to severe weather events. Therefore, preparation of utility interruptions should occur during severe storm warnings.

As utility infrastructure ages, interruption events could occur more frequently. Utility providers can reduce Monroe County's vulnerability to power outages by implementing improvements.

In the Hazard Identification and Risk Evaluation worksheet overview of the hazards profiled from the previous Monroe County Hazard Mitigation Plan, of the twenty municipalities in Monroe County: nine (9) reported a decrease in utility interruptions, six (6) reported an increase, while the remaining five (5) stated there was no change. Mount Pocono Borough related that the decrease in this hazard was due to hardware improvements. Those municipalities that indicated an increase; such as Pocono, Polk and Tunkhannock townships, stated this was due to tree growth, ice storms and/or wind storms.

#### **4.3.19.5 Vulnerability Assessment**

Retirement homes, senior centers, assisted living centers and nursing home residents are vulnerable to power outages, as well as those in hospitals and emergency medical facilities. These facilities are shown in

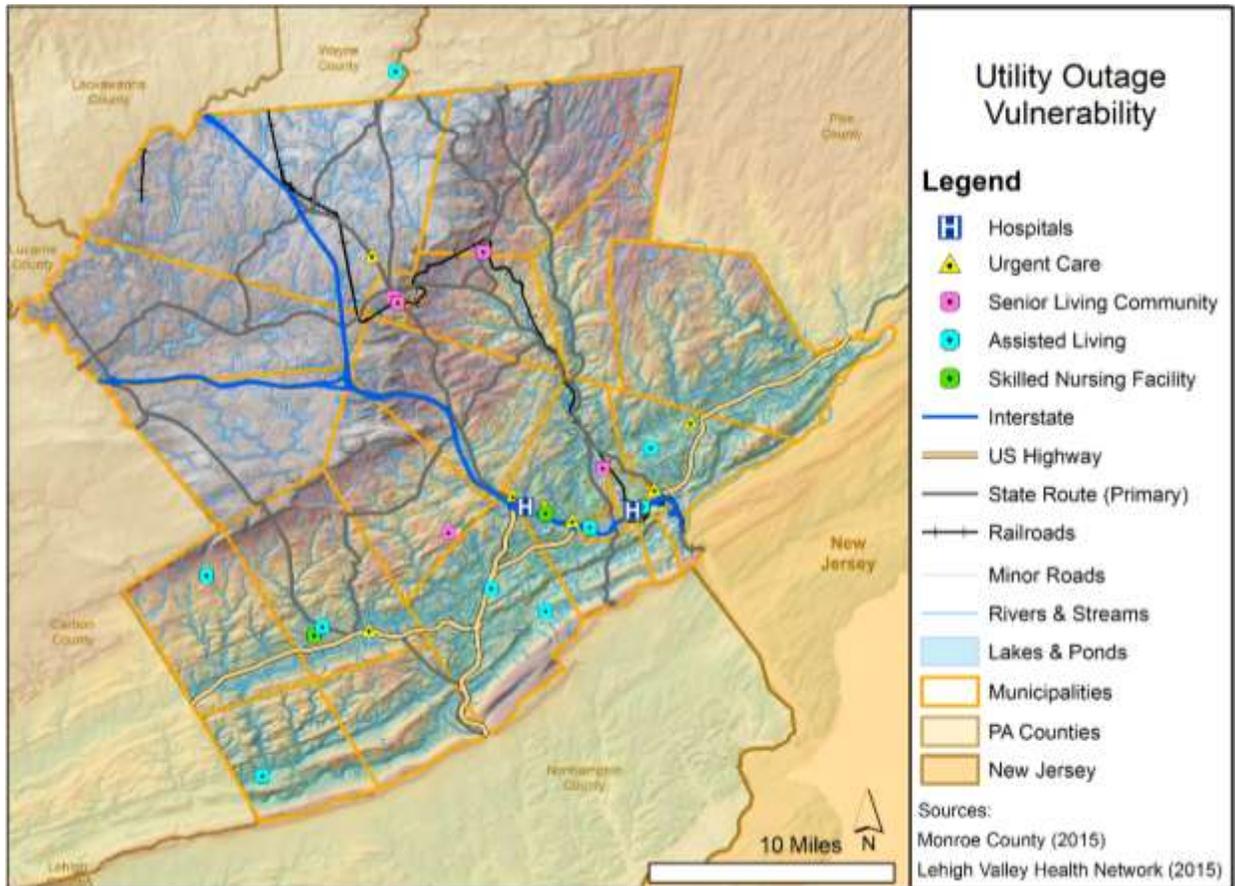
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*Figure 41 - Facilities Vulnerable to Utility **Outages**.* Often back-up power generators are used at these facilities to off-set the extremes of hot or cold temperatures. However, these back-up power generators must be maintained and fuel supplies must be secured in-advance of the utility interruption to ensure a seamless transition from the everyday power source to the emergency generator. Long-term use of back-up power generators should also be planned for when considering maintenance and supplies.

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Figure 41 - Facilities Vulnerable to Utility Outages



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### 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 assist local community officials in ranking and prioritizing hazards that pose the most significant threat to a planning 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 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 hazards profiled in the HMP update. Those categories include *probability, impact, spatial extent, warning time and duration*. Each degree of risk was assigned a value ranging from one to four. The weighting factor agreed upon by the planning team is shown in *Table 54 - Risk Factor Approach Summary*. 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 following example equation:

<b>Risk Factor Value =</b> [(Probability x .30) + (Impact x .30) + (Spatial Extent x .20) + (Warning Time x .10) + (Duration x .10)]
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*Table 54 - Risk Factor Approach Summary* 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.

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Table 54 - Risk Factor Approach Summary

Summary of Risk Factor Approach Used to Rank Hazard Risk.					
RISK ASSESSMENT CATEGORY	DEGREE OF RISK			WEIGHT VALUE	
	LEVEL	CRITERIA	INDEX		
<b>PROBABILITY</b> <i>What is the likelihood of a hazard event occurring in a given year?</i>	<b>UNLIKELY</b>	LESS THAN 1% ANNUAL PROBABILITY	1	30%	
	<b>POSSIBLE</b>	BETWEEN 1 & 10% ANNUAL PROBABILITY	2		
	<b>LIKELY</b>	BETWEEN 10 & 100% ANNUAL PROBABILITY	3		
	<b>HIGHLY LIKELY</b>	100% ANNUAL PROBABILITY	4		
<b>IMPACT</b> <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>	<b>MINOR</b>	VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF CRITICAL FACILITIES.	1	30%	
	<b>LIMITED</b>	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		
	<b>CRITICAL</b>	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		
	<b>CATASTROPHIC</b>	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		
<b>SPATIAL EXTENT</b> <i>How large of an area could be impacted by a hazard event? Are impacts localized or regional?</i>	<b>NEGLECTIBLE</b>	LESS THAN 1% OF AREA AFFECTED	1	20%	
	<b>SMALL</b>	BETWEEN 1 & 10% OF AREA AFFECTED	2		
	<b>MODERATE</b>	BETWEEN 10 & 50% OF AREA AFFECTED	3		
	<b>LARGE</b>	BETWEEN 50 & 100% OF AREA AFFECTED	4		
<b>WARNING TIME</b> <i>Is there usually some lead time associated with the hazard event? Have warning measures been implemented?</i>	<b>MORE THAN 24 HRS</b>	SELF-DEFINED	(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)	1	10%
	<b>12 TO 24 HRS</b>	SELF-DEFINED		2	
	<b>6 TO 12 HRS</b>	SELF-DEFINED		3	
	<b>LESS THAN 6 HRS</b>	SELF-DEFINED		4	
<b>DURATION</b> <i>How long does the hazard event usually last?</i>	<b>LESS THAN 6 HRS</b>	SELF-DEFINED	(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)	1	10%
	<b>LESS THAN 24 HRS</b>	SELF-DEFINED		2	
	<b>LESS THAN 1 WEEK</b>	SELF-DEFINED		3	
	<b>MORE THAN 1 WEEK</b>	SELF-DEFINED		4	

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### 4.4.2. Ranking Results

Using the methodology described in Section 4.4.1, *Table 55 - Risk Factor Assessment* lists the Risk Factor calculated for each of the 19 potential hazards identified in the 2016 HMP. *It should be noted that some of the hazards were ranked individually instead of together and will be broken down as a sub-category in the hazard profiles.* 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 55 - Risk Factor Assessment*

<b>Monroe County Hazard Ranking Based on RF Methodology.</b>							
HAZARD RISK	HAZARD NATURAL (N) OR MANMADE (M)	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
		PROBABILITY	ECONOMIC IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
<b>HIGH</b>	Utility Interruptions (M)	4	3	4	4	4	3.7
	Winter Storms (N)	4	3	4	1	3	3.3
	Transportation Accidents (M)	4	2	4	4	2	3.2
	Terrorism – International (M)	2	2	3	4	4	3.2
	Invasive Species (N)	4	2	4	1	4	3.1
	Wildfire (N)	4	2	3	4	3	3.1
	Dam Failure (M)	2	4	3	3	3	3.0
	Hazardous Materials - Transportation (M)	4	1	4	4	2	2.9
	Pandemic & Infectious Disease (N)	1	4	4	1	4	2.8
	Terrorism – Domestic (M)	3	2	3	4	3	2.8
	Levee Failure (M)	1	4	3	3	3	2.7
	Extreme Temperatures (N)	3	2	4	1	3	2.7
	Drowning (M)	4	2	1	4	1	2.5
	Hurricane/Tropical Storm (N)	2	3	3	1	3	2.5
<b>MODERATE</b>	Flooding (N)	3	2	2	2	3	2.4
	Windstorms (N)	4	1	1	4	2	2.3
	Nuclear Incidents (M)	1	2	3	4	4	2.3
	Drought (N)	2	1	4	1	4	2.2
	Disorientation (M)	4	1	1	4	1	2.2
	Hazardous Materials – Fixed Facilities (M)	1	2	2	4	3	2.0
<b>LOW</b>	Flash Flooding (N)	2	2	1	4	1	1.9
	Tornados (N)	2	2	1	4	1	1.9
	Epidemic (N)	3	2	2	1	3	1.9
	Earthquakes (N)	1	1	3	4	1	1.7
	Ice Jam Flooding	1	1	1	2	2	1.2

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Based on these results, there are 16 *high* risk hazards, 6 *moderate* risk hazards and 5 *low* risk hazards in Monroe County. Mitigation actions were developed for all high, moderate and low risk hazards (see Section 6.4). The threat posed to life and property for moderate and high risk hazards is considered significant enough to warrant the need for establishing hazard-specific mitigation actions. Mitigation actions related to future public outreach and emergency service activities are identified to address low risk hazard events.

A risk assessment result for the entire county does not mean that each municipality is at the same amount of risk to each hazard. *Table 56 - Countywide Risk Factor by Hazard* 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 based on the findings in the hazard profiles located in sections 4.3.1 through 4.3.19.

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Table 56 - Countywide Risk Factor by Hazard

<b>Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk</b>									
<b>IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR</b>									
JURISDICTION	Utility Interruptions (M)	Winter Storms (N)	Transportation Accidents (M)	Terrorism - International (M)	Invasive Species (N)	Wildfire (N)	Dam Failure (M)	Hazardous Materials - Transportation (M)	Pandemic & Infectious Disease (N)
	<b>3.7</b>	<b>3.3</b>	<b>3.2</b>	<b>3.2</b>	<b>3.1</b>	<b>3.1</b>	<b>3.0</b>	<b>2.9</b>	<b>2.8</b>
Barrett Township	=	=	=	=	=	=	>	=	=
Chestnuthill Township	=	=	=	=	<	<	=	=	=
Coolbaugh Township	=	=	>	=	=	=	=	>	=
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	=	=	>	=	>	>	<	>	=

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<b>Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk</b>									
<b>IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR</b>									
JURISDICTION	Terrorism - Domestic (M)	Levee Failure (M)	Extreme Temperatures (N)	Drowning (N)	Hurricane / Tropical Storm (N)	Flooding (N)	Windstorms (N)	Nuclear Incidents (M)	Drought
	<b>2.8</b>	<b>2.7</b>	<b>2.7</b>	<b>2.5</b>	<b>2.5</b>	<b>2.4</b>	<b>2.3</b>	<b>2.3</b>	<b>2.3</b>
Barrett Township	=	<	=	=	=	<	=	=	=
Chestnuthill Township	=	<	=	=	=	<	=	=	=
Coolbaugh Township	=	<	=	=	=	<	=	=	=
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	=	<	=	=	=	<	=	=	=

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<b>Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk</b>							
<b>IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR</b>							
JURISDICTION	Disorientation (M)	Hazardous Materials – Fixed Facilities (M)	Flash Flooding (N)	Tornado (N)	Epidemic (N)	Earthquakes (N)	Ice Jam Flooding (N)
	<b>2.2</b>	<b>2.0</b>	<b>1.9</b>	<b>1.9</b>	<b>1.9</b>	<b>1.7</b>	<b>1.2</b>
Barrett Township	>	=	=	=	=	=	>
Chestnuthill Township	<	=	=	=	=	=	>
Coolbaugh Township	>	=	=	=	=	=	=
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	>	=	=	=	=	=	<

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### **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. 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.

#### **Flooding Loss Estimation:**

Flooding is a moderate risk natural hazard in Monroe County. The estimation of potential loss in this assessment focuses on the monetary damage that could result from flooding. The potential property loss was determined for each municipality and for the entire county. The following primary datasets were utilized for this estimated potential loss analysis: Flood Insurance Rate Maps, Monroe County Structures, Monroe County Municipal Boundaries and the Monroe County Tax Assessment Database.

The Monroe County Assessment Office houses a dataset with the total assessed value for each tax parcel throughout the county. Estimated potential losses were calculated by first determining what tax parcels and structures were intersected by the 1% annual chance floodplain. Once the impacted parcel and structures were identified, then primary residence structures and commercial structures were identified. Monroe County has seasonal structures that are located in the 1% annual chance special flood hazard area. These seasonal structures were not included in the estimation of loss. The county assessed value for all primary residences and commercial structures located in the 1% annual chance special flood hazard area was determined. The total assessed value for each structure in a municipality was tallied to derive the total assessed value per municipality for every structure that was located in the 1% annual chance special flood hazard area.

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*Table 57 - Potential Municipal Flood Loss Estimates* outlines the potential flooding losses for each municipality. Losses shown here can only be viewed as estimates and as potential, based on the random occurrence of flood conditions and limited data. Assessed value include those based on a point within a two-dimensional (latitude and longitude) plane. This data, however, does not include attribute information on first-floor flood elevations, which is essential to assess the base flood elevation's impact on the county's infrastructure. Further, this analysis assumes a total loss for any structure intersected by the floodplain. As a result of these limitations, the estimates are likely overstated, but to what degree the potential losses are overstated cannot be determined. The quantity of commercial and residential structures in each Monroe County municipality is outlined in section 4.3.4 of the flooding hazard profile.

*Table 57 - Potential Municipal Flood Loss Estimates*

<b>Residential and Commercial Structures in the Floodplain</b>		
<b>Municipality</b>	<b>Residential Value</b>	<b>Commercial Value</b>
Barrett Township	\$2,754,440	\$1,446,150
Chestnuthill Township	\$4,826,040	\$895,050
Coolbaugh Township	\$12,264,860	\$68,564,460
Delaware Water Gap Borough	\$327,050	\$462,790
East Stroudsburg Borough	\$380,700	\$2,869,760
Eldred Township	\$1,990,620	\$333,300
Hamilton Township	\$4,611,470	\$4,276,650
Jackson Township	\$1,825,020	\$85,090
Middle Smithfield Township	\$3,857,590	\$2,110,680
Mount Pocono Borough	\$10,800	\$0
Paradise Township	\$1,750,910	\$461,020
Pocono Township	\$17,142,750	\$15,678,140
Polk Township	\$4,302,620	\$792,110
Price Township	\$329,510	\$88,820
Ross Township	\$1,910,310	\$414,210
Smithfield Township	\$7,508,060	\$3,201,980
Stroud Township	\$5,477,200	\$3,763,340
Stroudsburg Borough	\$4,680,910	\$4,316,290
Tobyhanna Township	\$7,387,120	\$3,893,020
Tunkhannock Township	\$63,320	\$178,860
<b>Total Monroe County</b>	<b>\$83,401,300</b>	<b>\$113,831,720</b>

MCM Consulting Group conducted a county wide flood study using the Hazards U.S. Multi-Hazard (HAZUS-MH) software that is provided by the Federal Emergency Management Agency. This software is a standardized loss estimation software deriving economic

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loss, building damage, content damage and other economic impacts that can be used in local flood mitigation planning activities.

Using HAZUS-MH, total building-related losses from a 1%-annual-chance flood in Monroe County are estimated to equal \$483,670,000 Residential occupancies make up 50.93% of the total estimated building-related losses. Total economic loss, including replacement value, content loss, functional loss and displacement cost, from a county-wide 1%-annual-chance flood are estimated to equal \$485,450,000

### Severe Wind Storm and Tornado Loss Estimation:

*Table 58 - Wind & Tornado Loss Estimates*, outlines the potential losses for each municipality due to a high wind related event. Losses shown here can only be viewed as estimates and as potential, based on the random occurrence of wind conditions and the limitations of data. Assessed value data for each municipality was developed by utilizing the land use codes to identify parcels with mobile home structures and the assessed value of each structure on that parcel. Further, this analysis assumes a total loss of a structure that is designated as a mobile home property. As a result of these limitations, the estimates are likely overstated, but to what degree the potential losses are overstated cannot be determined.

*Table 58 - Wind & Tornado Loss Estimates*

<b>Wind and Tornado Estimation of Structure Loss</b>		
<b>Municipality</b>	<b>Residences</b>	<b>Assessed Value</b>
Barrett Township	31	\$112,960.00
Chestnuthill Township	185	\$935,760.00
Coolbaugh Township	126	\$617,060.00
Delaware Water Gap Borough	0	\$0
East Stroudsburg Borough	82	\$50,170.00
Eldred Township	66	\$502,260.00
Hamilton Township	239	\$380,090.00
Jackson Township	76	\$381,850.00
Middle Smithfield Township	352	\$512,360.00
Mount Pocono Borough	0	\$0
Paradise Township	8	\$23,100.00
Pocono Township	282	\$593,920.00
Polk Township	143	\$584,400.00
Price Township	96	\$596,630.00
Ross Township	306	\$1,502,070.00
Smithfield Township	78	\$184,730.00
Stroud Township	151	\$201,350.00
Stroudsburg Borough	4	\$14,300.00
Tobyhanna Township	79	\$319,960.00
Tunkhannock Township	166	\$785,850.00
<b>Total</b>	<b>2,470</b>	<b>\$8,298,820.00</b>

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### **4.4.4. Future Development and Vulnerability**

While it has been documented that many of Monroe County's older boroughs and villages have experienced little or no increase in development activity due to the fact that there is limited undeveloped land remaining in those municipalities, a number of communities throughout the County have experienced slow steady growth in the past two and a half decades.

Risk and vulnerability to natural and manmade 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 the 2011 HMP, the total population of Monroe County has grown by more than 22 percent from 2000 to 2010. This growth was largely due to development pressure from New York and New Jersey to the west. However, according to the July 2014 US Census estimate the population actually decreased 2.1%. 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 (see *Figure 42 - Population Change 2000 to 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.

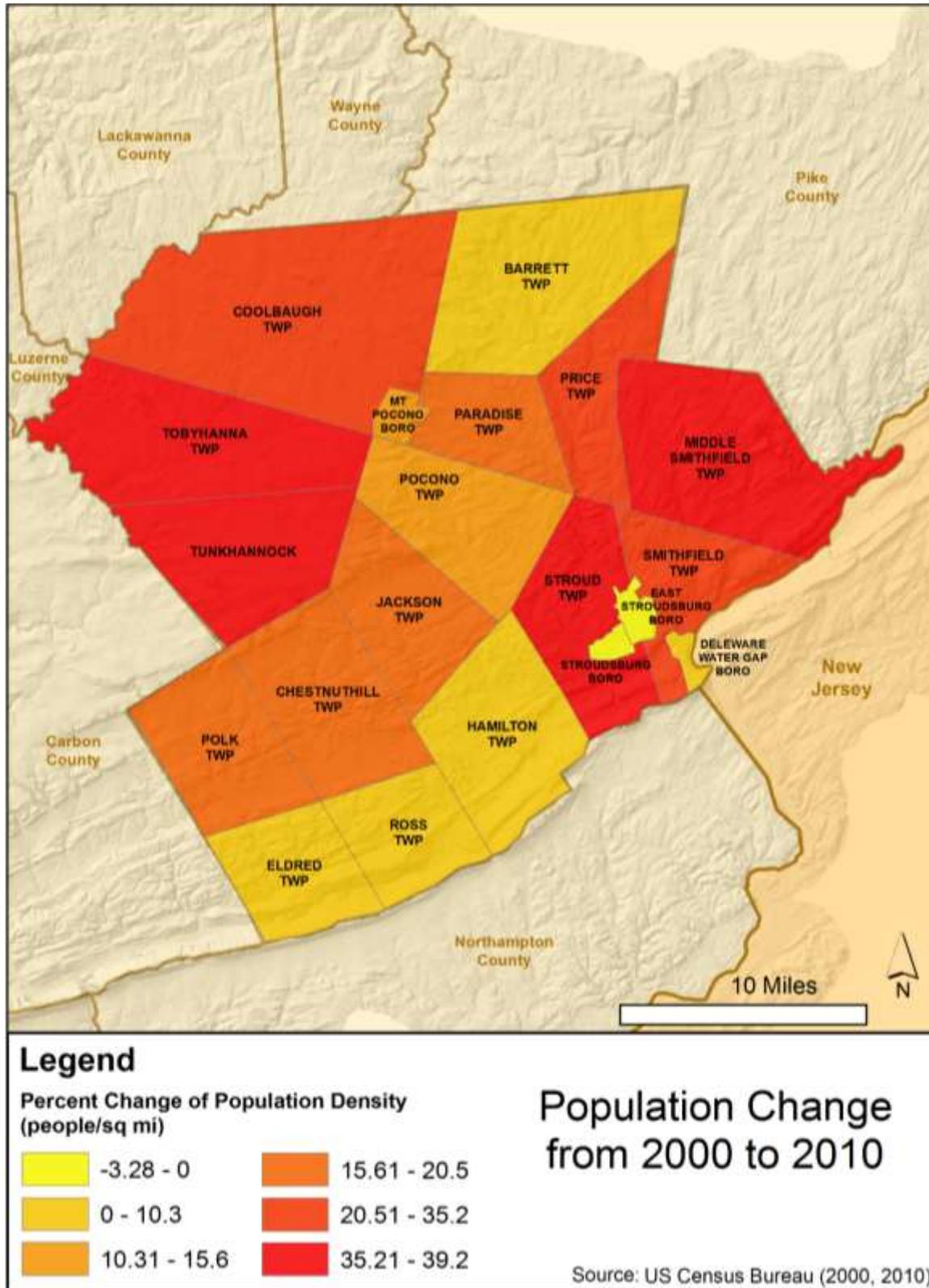
While Monroe County has grown significantly in the last sixteen years, there are still few places with high density. Hazard vulnerability and loss potential will be higher in the places of higher density (namely the boroughs) throughout the County. However, the population growth and associated development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

Growth is considered primarily residential because of past trends and the small percentage of commercial and industrial subdivision application submittals.

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Figure 42 - Population Change 2000 to 2010



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It is interesting to note that geographically the municipalities experiencing the most consistent rates of activity are not in any specific area of the county. Specific information on types and numbers of future structures was not available at the time of this update.

The 1980's was a decade of out-migration due to the loss of a significant number of manufacturing and support jobs. The number of new land developments and residential subdivisions reflected a transition from heavy industry to high-tech employment with the focus on service sector jobs, medical technology employment, and transportation and public utility jobs. Within each part of the county, land is available for non-residential development with access to high volume arterial roadways or railways. Capacity in existing utility systems, however, whether on-site or off, is an issue which must be addressed both locally and at the county level if additional commercial and industrial development will continue to occur.

Increased development pressures in Monroe County are related to the population growth experienced in the last decade and a half. 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 2030. 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. These objective were restated in the 2030 plan. 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.

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- 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 have been updated.

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**

The capability assessment is an evaluation of Monroe County's governmental structure, political framework, legal jurisdiction, fiscal status, policies and programs, regulations and ordinances and resource availability. Each category is evaluated for its strengths and weaknesses in responding to, preparing for and mitigating the effects of the profiled hazards. The capability assessment has two components: an inventory of the county's and municipalities' mission, programs and policies; and an analysis of their capacity to execute them. A capability assessment is an integral part of the hazard mitigation planning process. Here, the County and municipalities identify, review and analyze what they are currently doing to reduce losses and identify the framework necessary to implement new mitigation actions. This information will help the County and municipalities evaluate alternative mitigation actions and address shortfalls in the mitigation plan.

A capabilities assessment matrix/questionnaire was provided to the municipalities during the planning process at meetings of Monroe County officials. These meetings were designed to seek input from key county and municipal stakeholders on legal, fiscal, technical and administrative capabilities of all jurisdictions. As such, the capabilities assessment helps guide the implementation of mitigation projects and will help evaluate the effectiveness of existing mitigation measures, policies, plans, practices and programs.

Throughout the planning process, the mitigation local planning team considered the county's twenty municipalities. Pennsylvania municipalities have their own governing bodies, pass and enforce their own ordinances and regulations, purchase equipment and manage their own resources, including critical infrastructure. These capability assessments, therefore, consider the various characteristics and capabilities of municipalities under study. Additionally, NFPA 1600 recommends that a corrective action program be established to address shortfalls and provide mechanisms to manage the capabilities improvement process.

The evaluation of the categories listed above – political framework, legal jurisdiction, fiscal status, policies and programs and regulations and ordinances – allows the mitigation planning team to determine the viability of certain mitigation actions. The capability assessment analyzes what Monroe County and its municipalities have the capacity to do and provides an understanding of what must be changed to mitigate loss.

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 hazardous event.

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While the capability assessment serves as a good instrument for identifying local capabilities, 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**

All participating municipalities completed and submitted a capability assessment survey. The results of the survey were collected, aggregated and analyzed.

#### **5.2.1. Emergency Management**

The Monroe County Office of Emergency Management 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.

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. Each municipality is required to adopt the countywide EOP. The Notification and Resource Section of the plan was developed individually by each municipality. A copy of each EOP is on file with the office of emergency management. Monroe County updates the EOP every 2 years. The next update will occur in 2017.

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

Floodplain management is the operation of programs or activities that may consist of both corrective and preventive measures for reducing flood damage, including but not limited to such things as emergency preparedness plans, flood control works and flood plain management regulations. The Pennsylvania Floodplain Management Act (Act 166) requires every municipality identified by the Federal Emergency Management Agency (FEMA) to participate in the National Flood Insurance Program (NFIP) and permits all municipalities to adopt floodplain management regulations. It is in the interest of all property owners in the floodplain to keep development and land usage within the scope of the floodplain regulations for their community. This helps keep insurance rates low and makes sure that the risk of flood damage is not increased by property development.

The 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.

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- 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.

The NFIP's Community Rating System (CRS) provides discounts on flood insurance premiums in those communities that establish floodplain management programs that go beyond NFIP minimum requirements. Under the CRS, communities receive credit for more restrictive regulations; acquisition, relocation, or flood-proofing of flood-prone buildings; preservation of open space; and other measures that reduce flood damages or protect the natural resources and functions of floodplains.

The CRS was implemented in 1990 to recognize and encourage community floodplain management activities that exceed the minimum NFIP standards. Section 541 of the 1994 Act amends Section 1315 of the 1968 Act to codify the Community Rating System in the NFIP. The section also expands the CRS goals to specifically include incentives to reduce the risk of flood-related erosion and to encourage measures that protect natural and beneficial floodplain functions. These goals have been incorporated into the CRS and communities now receive credit toward premium reductions for activities that contribute to them.

Under the Community Rating System, flood insurance premium rates are adjusted to reflect the reduced flood risk resulting from community activities that meet a minimum of three of the following CRS goals:

- Reduce flood losses
- Protect public health and safety
- Reduce damage to property
- Prevent increases in flood damage from new construction
- Reduce the risk of erosion damage
- Protect natural and beneficial floodplain functions

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- Facilitate accurate insurance rating
- Promote the awareness of flood insurance

There are 10 Community Rating System classes. Class 1 requires the most credit points and gives the largest premium reduction; Class 10 receives no premium reduction. CRS premium discounts on flood insurance range from five percent for Class 9 communities up to 45 percent for Class 1 communities. The CRS recognizes 18 credible activities, organized under four categories: Public Information, Mapping and Regulations, Flood Damage Reduction and Flood Preparedness.

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. The Pennsylvania Department of Community and Economic Development (DCED) provides communities, based on their 44 CFR 60.3 level of regulations, with a suggested ordinance document to assist municipalities in meeting the minimum requirements of the NFIP and the Pennsylvania Flood Plain Management Act (Act 166). Act 166 mandates municipal participation in and compliance with the NFIP. It also establishes higher regulatory standards for hazardous materials and high risk land uses. As new Digital Flood Insurance Rate Maps (DFIRMs) are published, the Pennsylvania State NFIP Coordinator 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.

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Table 59 - Planning Tool Summary

<b>Table 5.2-1: Summary of planning tools adopted by each municipality in Monroe County (HMP Capability Assessment Surveys, 2015)</b>						
<b>COMMUNITY</b>	<b>COMPREHENSIVE PLAN</b>	<b>BUILDING CODE</b>	<b>NFIP PARTICIPANT</b>	<b>FLOODPLAIN ORDINANCE</b>	<b>SUBDIVISION &amp; LAND DEVELOPMENT ORDINANCE</b>	<b>ZONING ORDINANCE</b>
Barrett Township	Yes 2008	Yes	Yes	Yes 3/26/2013	Yes 2008	Yes
Chestnut Hill Township	Yes	Yes 8/3/2004	Yes	Yes 4/6/2013	Yes 4/23/2015	Yes
Coolbaugh Township	Yes 6/2005	Yes 2005	Yes	Yes 5/2012	Yes 2/5/2013	Yes
Delaware Water Gap Borough		Yes	Yes	Yes 4/2013	Yes	Yes
East Stroudsburg Borough	Yes 1990	Yes 2004	Yes	Yes 2000	Yes 1990	Yes
Eldred Township	Yes	Yes	Yes	Yes	Yes	Yes
Hamilton Township	Yes 6/2005	Yes 5/30/2004	Yes	Yes 4/2013	Yes 9/11/2000	Yes
Jackson Township	Yes 11/2006	Yes 4/2004	Yes	Yes 4/2013	Yes 4/2015	Yes
Middle Smithfield Township	Yes 2/14/2008	Yes 4/13/2004	Yes	Yes 6/13/2013	Yes 7/28/1994	No
Mount Pocono Borough	Yes	Yes	Yes	N/A	Yes	No
Paradise Township	Yes 2/17/2015	Yes 12/15/2009	Yes	Yes 5/20/2013	Yes 3/1/2011	Yes
Pocono Township	Yes	Yes	Yes	Yes	Yes	No
Polk Township	Yes 4/23/2015	Yes 7/15/2004	Yes	Yes 3/25/2013	Yes 4/23/2015	Yes
Price Township	Yes	Yes	Yes	Yes	Yes	No
Ross Township	Yes 4/23/2015	Yes 4/9/2004	Yes	Yes 4/23/2015	Yes 4/23/2015	No
Smithfield Township	Yes 7/1/2001	Yes 5/25/2004	Yes	Yes 4/20/2013	Yes 9/25/2012	Yes
Stroud Township	Yes 6/2005	Yes 5/1/2004	Yes	Yes 4/2/2013	Yes 1/27/2003	No
Stroudsburg Borough	Yes 2005	Yes	Yes	Yes 5/1/2013	Yes 11/13/1991	Yes
Tobyhanna Township	Yes 2005	Yes 2003	Yes	Yes 2013	Yes 1975	No
Tunkhannock Township	Yes 2000 2005	Yes 2002	Yes	Yes 2013	Yes 2013	No

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### **5.2.3. Planning and Regulatory Capability**

Municipalities have the authority to govern more restrictively than state and county minimum requirements; as long as they are in compliance with all criteria established in the Pennsylvania Municipalities Planning Code (MPC) and their respective municipal codes. Municipalities can develop their own policies and programs and implement their own rules and regulations to protect and serve their local residents. Local policies and programs are typically identified in a comprehensive plan, implemented through a local ordinance and enforced by the governmental body or its appointee.

Municipalities regulate land use via the adoption and enforcement of zoning, subdivision and land development, building codes, building permits, floodplain management and/or stormwater management ordinances. When effectively prepared and administered, these regulations can lead to an opportunity for hazard mitigation. For example, the National Flood Insurance Program (NFIP) established minimum floodplain management criteria. Adoption of the Pennsylvania Floodplain Management Act (Act 166 of 1978) established higher standards. A municipality must adopt and enforce these minimum criteria to be eligible for participation in the NFIP. Municipalities have the option of adopting a single-purpose ordinance or incorporating these provisions into their zoning, subdivision and land development, or building codes; thereby mitigating the potential impacts of local flooding. This capability assessment details the existing Monroe County and municipal legal capabilities to mitigate the profiled hazards. It identifies the county's and the municipalities' existing planning documents and their hazard mitigation potential. Hazard mitigation recommendations are, in part, based on the information contained in the assessment. *Table 59 - Planning Tool Summary* outlines the municipal capability assessment survey results for zoning, subdivision and land development, building codes, floodplain management and comprehensive planning.

#### **Building Codes**

Building codes are important in mitigation because they are developed for a region of the country in respect to the hazards existing in that area. Consequently, structures that are built according to applicable codes are inherently resistant to many hazards, such as strong winds, floods and earthquakes; and can help mitigate regional hazards, such as wildfires. In 2003, Pennsylvania implemented the Uniform Construction Code (UCC) (Act 45), a comprehensive building code that establishes minimum regulations for most new construction, including additions and renovations to existing structures.

The code applies to almost all buildings, excluding manufactured and industrialized housing (which are covered by other laws), agricultural buildings and certain utility and miscellaneous buildings. The UCC has many advantages. It requires builders to use materials and methods that have been professionally evaluated for quality and safety, as well as inspections to ensure compliance.

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The initial election period, during which all of Pennsylvania’s 2,565 municipalities were allowed to decide whether the UCC would be administered and enforced locally, officially closed on August 7, 2004. The codes adopted for use under the UCC are the most current version of the International Codes issued by the International Code Council (ICC). Supplements to the original 2003 codes have been adopted for use over the years since.

If a municipality has “opted in”, all UCC enforcement is local, except where municipal (or third party) code officials lack the certification necessary to approve plans and inspect commercial construction for compliance with UCC accessibility requirements. If a municipality has “opted out”, the PA Department of Labor and Industry is responsible for all commercial code enforcement in that municipality; and all residential construction is inspected by independent third party agencies selected by the owner. The department also has sole jurisdiction for all state-owned buildings no matter where they are located. Historical buildings may be exempt from such inspections and Act 45 provides quasi-exclusion from UCC requirements.

The municipalities in Monroe County adhere to the standards of the Pennsylvania Uniform Construction Code (Act 45).

### **Zoning Ordinance**

Article VI of the Municipalities Planning Code (MPC) authorizes municipalities to prepare and enact zoning to regulate land use. Its regulations can apply to: the permitted use of land; the height and bulk of structures; the percentage of a lot that may be occupied by buildings and other impervious surfaces; yard setbacks; the density of development; the height and size of signs; the parking regulations. A zoning ordinance has two parts, including the zoning map that delineates zoning districts and the text that sets forth the regulations that apply to each district. Monroe County has a county zoning ordinance. See *Table 60 - Planning and Regulatory Capability*.

*Table 60 - Planning and Regulatory Capability*

<b>Planning &amp; Regulatory Capability</b>	<b>Implementation</b>
Comprehensive Plan	95%
Building Code	100%
NFIP Participant	100%
Floodplain Ordinance	95%
Subdivision & Land Development Ordinance	100%
Zoning Ordinance	60%

### **Subdivision Ordinance**

Subdivision and land development ordinances include regulations to control the layout of streets, the planning of lots and the provision of utilities and other site improvements. The objectives of a subdivision and land development ordinance are to: coordinate street

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patterns; assure adequate utilities and other improvements are provided in a manner that will not pollute streams, wells and/or soils; reduce traffic congestion; and provide sound design standards as a guide to developers, the elected officials, planning commissions and other municipal officials. Article V of the Municipality Planning Code authorizes municipalities to prepare and enact a subdivision and land development ordinance. Subdivision and land development ordinances provide for the division and improvement of land. See *Table 59 - Planning Tool Summary*.

### **Stormwater Management Plan/Stormwater Ordinance**

The proper management of stormwater runoff can improve conditions and decrease the chance of flooding. Pennsylvania's Storm Water Management Act (Act 167) confers on counties the responsibility for development of watershed plans. The Act specifies that counties must complete their watershed stormwater plans within two years following the promulgation of these guidelines by the DEP, which may grant an extension of time to any county for the preparation and adoption of plans. Counties must prepare the watershed plans in consultation with municipalities and residents. This is to be accomplished through the establishment of a Watershed Plan Advisory Committee. The counties must also establish a mechanism to periodically review and revise watershed plans so they are current. Plan revisions must be done every five years or sooner, if necessary.

Municipalities have an obligation to implement the criteria and standards developed in each watershed stormwater management plan by amending or adopting laws and regulation for land use and development. The implementation of stormwater management criteria and standards at the local level are necessary, since municipalities are responsible for local land use decisions and planning. The degree of detail in the ordinances depends on the extent of existing and projected development. The watershed stormwater management plan is designed to aid the municipality in setting standards for the land uses it has proposed. Municipalities within rapidly developing watersheds will benefit from the watershed stormwater management plan and will use the information for sound land use considerations. A major goal of the watershed plan and the attendant municipal regulations is to prevent future drainage problems and avoid the aggravation of existing problems.

There are twelve watersheds in Monroe County which can be seen in *Figure 1 - Monroe County Watersheds*. Monroe County and other local municipalities have general (non-Act 167 compliant) stormwater management regulations as part of either the county or local subdivision and land development plan.

### **Comprehensive Plan**

A comprehensive plan is a policy document that states objectives and guides the future growth and physical development of a municipality. The comprehensive plan is a blueprint for housing, transportation, community facilities, utilities and land use. It exam-

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ines how the past led to the present and charts the community's future path. The Pennsylvania Municipalities Planning Code (MPC Act 247 of 1968, as reauthorized and amended) requires counties to prepare and maintain a county comprehensive plan. In addition, the MPC requires counties to update the comprehensive plan every 10 years.

With regard to hazard mitigation planning, Section 301.a(2) of the Municipality Planning Code requires comprehensive plans to include a plan for land use, which, among other provisions, suggests that the plan give consideration to floodplains and other areas of special hazards and other similar uses. The MPC also requires comprehensive plans to include a plan for community facilities and services and recommends giving consideration to storm drainage and floodplain management.

Monroe County has a county comprehensive plan that was adopted in December 2014, entitled the Monroe County 2030 Comprehensive Plan.

Article III of the Municipality Planning Code (MPC) enables municipalities to prepare a comprehensive plan; however, development of a comprehensive plan is voluntary. A list of those municipalities within Monroe County that have a comprehensive plan can be found in *Table 59 - Planning Tool Summary* with the remaining municipalities utilizing the county comprehensive plan.

### **Capital Improvements Plan**

The capital improvements plan is a multi-year policy guide that identifies needed capital projects and is used to coordinate the financing and timing of public improvements. Capital improvements relate to streets, stormwater systems, water distribution, sewage treatment and other major public facilities. A capital improvements plan should be prepared by the respective county's planning department and should include a capital budget. This budget identifies the highest priority projects recommended for funding in the next annual budget. The capital improvements plan is dynamic and can be tailored to specific circumstances. There are no municipalities within Monroe County that have an identified capital improvements plan.

#### **5.2.4. Administrative and Technical Capability**

There are four boroughs and sixteen townships within Monroe County. Each of these municipalities conducts its daily operations and provides various community services according to local needs and limitations. Some of these municipalities have formed cooperative agreements and work jointly with their neighboring municipalities to provide services such as police protection, fire and emergency response, infrastructure maintenance and water supply management. Others choose to operate on their own. Municipalities vary in staff size, resource availability, fiscal status, service provision, constituent population, overall size and vulnerability to the profiled hazards.

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### **County Planning Commission**

In Pennsylvania, planning responsibilities traditionally have been delegated to each county and local municipality through the Municipalities Planning Code (MPC). A planning agency acts as an advisor to the governing body on matters of community growth and development. A governing body may appoint individuals to serve as legal or engineering advisors to the planning agency. In addition to the duties and responsibilities authorized by Article II of the MPC, a governing body may, by ordinance, delegate approval authority to a planning agency for subdivision and land development applications. A governing body has considerable flexibility, not only as to which powers and duties are assigned to a planning agency, but also as to what form an agency will possess. A governing body can create a planning commission, a planning department, or both.

### **Municipal Engineer**

A municipal engineer performs duties as directed in the areas of construction, reconstruction, maintenance and repair of streets, roads, pavements, sanitary sewers, bridges, culverts and other engineering work. The municipal engineer prepares plans, specifications and estimates of the work undertaken by the township. All municipalities within Monroe County have a contracted municipal engineer.

### **Personnel Skilled in GIS or FEMA HAZUS Software**

A geographic information system (GIS) is an integrated, computer-based system designed to capture, store, edit, analyze and display geographic information. Some examples of uses for GIS technology in local government are: land records management, land use planning, infrastructure management and natural resources planning. A GIS automates existing operations such as map production and maintenance, saving a great deal of time and money. The GIS also includes information about map features such as the capacity of a municipal water supply or the acres of public land. GIS is used to maintain parcel and owner information, road centerlines and address points. The GIS data goes directly to Monroe County 911 Center where they access it to aid in 911 response. Monroe County has a strong GIS department. No employees have completed Basic HAZUS-MH training, though one is set to.

### **Emergency Management Coordinator**

Emergency Management is a comprehensive, integrated program of mitigation, preparedness, response and recovery for emergencies/disasters of any kind. No public or private entity is immune to disasters and no single segment of society can meet the complex needs of a major emergency or disaster on its own.

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A municipal emergency management coordinator is responsible for emergency management – preparedness, response, recovery and mitigation within his/her respective authority having jurisdiction (AHJ). The responsibilities of the emergency management coordinator are outlined in PA Title 35 §7503:

- Prepare and maintain a current disaster emergency management plan
- Establish, equip and staff an emergency operations center
- Provide individuals and organizational training programs
- Organize and coordinate all locally available manpower, materials, supplies, equipment and services necessary for disaster emergency readiness, response and recovery
- Adopt and implement precautionary measures to mitigate the anticipated effects of a disaster
- Cooperate and coordinate with any public and private agency or entity
- Provide prompt information regarding local disaster emergencies to appropriate Commonwealth and local officials or agencies and the general public
- Participate in all tests, drills and exercises, including remedial drills and exercises, scheduled by the agency or by the federal government

Title 35 requires Monroe County and its municipalities to have an emergency management coordinator.

### **5.2.5. Fiscal Capability**

Fiscal capability is significant to the implementation of hazard mitigation activities. Every jurisdiction must operate within the constraints of limited financial resources. The following information pertains to various financial assistance programs relevant to hazard mitigation.

#### **State and Federal Grants**

During the 1960s and 1970s, state and federal grants-in-aid were available to finance a large number of municipal programs, including streets, water and sewer facilities, airports, parks and playgrounds. During the early 1980s, there was a significant change in federal policy, based on rising deficits and a political philosophy that encouraged states and local governments to raise their own revenues for capital programs. The result has been a growing interest in “creative financing.”

#### **Capital Improvement Financing**

Because most capital investments involve the outlay of substantial funds, local governments can seldom pay for these facilities through annual appropriations in the annual operating budget. Therefore, numerous techniques have evolved to enable local government to pay for capital improvements over a time period exceeding one year. Public finance literature and state laws governing local government finance classify techniques that are used to finance capital improvements. The techniques include: revenue bonds;

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lease-purchase, authorities and special district; current revenue (pay-as-you-go); reserve funds; and tax increment financing.

### **Indebtedness through General Obligation Bonds**

Some projects may be financed with general obligation bonds. With this method, the jurisdiction's taxing power is pledged to pay interest and principal to retire debt. General obligation bonds can be sold to finance permanent types of improvements, such as schools, municipal buildings, parks and recreation facilities. Voter approval may be required.

### **Municipal Authorities**

Municipal authorities are most often used when major capital investments are required. In addition to sewage treatment, municipal authorities have been formed for water supply, airports, bus transit systems, swimming pools and other purposes. Joint authorities have the power to receive grants, borrow money and operate revenue generating programs. Municipal authorities are authorized to sell bonds, acquire property, sign contracts and take similar actions. Authorities are governed by authority board members, who are appointed by the elected officials of the member municipalities.

### **Sewer Authorities**

Sewer authorities include multi-purpose authorities with sewer projects. They sell bonds to finance acquisition of existing systems or for construction, extension, or system improvement. Sewer authority operating revenues originate from user fees. The fee frequently is based on the amount of water consumed and payment is enforced by the ability to terminate service or by the imposition of liens against real estate. In areas with no public water supply, flat rate charges are calculated on average use per dwelling unit.

### **Water Authorities**

Water authorities are multi-purpose authorities with water projects, many of which operate both water and sewer systems. The financing of water systems for lease back to the municipality is among the principal activities of the local government facilities' financing authorities. An operating water authority issues bonds to purchase existing facilities or to construct, extend, or improve a system. The primary source of revenue is user fees based on metered usage. The cost of construction or extending water supply lines can be funded by special assessments against abutting property owners. Tapping fees also help fund water system capital costs. Water utilities are also directly operated by municipal governments and by privately owned public utilities regulated by the PA Public Utility Commission. The PA Department of Environmental Protection has a program to assist with consolidating small water systems to make system upgrades more cost effective.

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### **Circuit Riding Program (Engineer)**

The Circuit Riding Program is an example of intergovernmental cooperation. This program offers municipalities the ability to join together to accomplish a common goal. The circuit rider is a municipal engineer who serves several small municipalities simultaneously. These are municipalities that may be too small to hire a professional engineer for their own operations, yet need the skills and expertise the engineer offers. Municipalities can jointly obtain what no one municipality could obtain on its own.

### **NFPA 1600 – Standard on Disaster/Emergency Management and Business Continuity**

NFPA 1600 recommends a responsive financial management and administrative framework that complies with the authority having jurisdiction's (AHJ) program requirements and is uniquely linked to disaster/emergency operations. The framework should provide for maximum flexibility to expeditiously request, receive, manage and apply funds in a non-emergency and emergency environment to ensure the timely delivery of assistance. The program should also be capable of capturing financial data for future costs recovery, as well as identifying and accessing alternative funding sources and managing budgeted and specially appropriated funds. It is equally important to have procedures in place that will allow an entity to expedite financial decision making and ensure proper accounting occurs.

### **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. Of the municipalities that responded, none of the municipalities completed this section with a numerical response.

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### 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 “L = limited” “M = moderate” or “H = high.” *Table 61 - Capability Self-Assessment Matrix* summarizes the results of the self-assessment survey. All twenty municipalities returned this section of the assessment completed.

*Table 61 - Capability Self-Assessment Matrix*

<b>Monroe County Capability Self-Assessment Matrix</b>				
<b>Municipality Name</b>	<b>Capability Category</b>			
	<b>Planning and Regulatory Capability</b>	<b>Administrative and Technical Capability</b>	<b>Fiscal Capability</b>	<b>Community Political Capability</b>
Barrett Township	L	L	L	L
Chestnuthill Township	H	H	L	H
Coolbaugh Township	M	M	L	M
Delaware Water Gap Borough	L	L	L	L
East Stroudsburg Borough	M	M	L	M
Eldred Township	M	M	M	M
Hamilton Township	M	H	H	H
Jackson Township	M	M	L	M
Middle Smithfield Township	H	H	H	H
Mount Pocono Township	H	M	M	M
Paradise Township	H	M	M	H
Pocono Township	M	M	M	M
Polk Township	M	M	L	M
Price Township	M	M	M	M
Ross Township	H	H	H	H
Smithfield Township	M	H	H	H
Stroud Township	H	H	M	H
Stroudsburg Borough	H	H	M	M
Tobyhanna Township	M	M	M	M
Tunkhanock Township	L	L	L	L

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**5.2.8. Existing Limitations**

Funding has been identified as the largest limitation for a municipality to complete mitigation activities. The acquisition of grants is the best way to augment this process for the municipalities. The county and municipalities representatives will need to rely on regional, state and federal partnerships for future financial assistance. Development of intra-county regional partnerships and intra-municipality regional partnerships will bolster this process.

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## **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 (5) goals and thirteen (13) objectives identified in the 2011 hazard mitigation plan. The 2016 Monroe County Hazard Mitigation Plan Update has six (6) goals and seventeen (17) objectives. Objectives have been added and arranged in order to associate them with the most appropriate goal. These changes are noted in *Table 62 - Mitigation Goals and Objectives (2011)*. A list of these goals and objectives as well as a review summary based on comments received from stakeholders who participated in the HMP update process is included in *Table 63 - Mitigation Actions Review (2011)*. 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 local planning team. Municipal officials then provided feedback on the changes to the goals and objectives via a series of mitigation strategy update meetings. Copies of these meetings and all documentation associated with the meetings are located in Appendix C.

*Table 62 - Mitigation Goals and Objectives (2011)*

<b>Monroe County 2011 Mitigation Goals and Objectives Review Worksheet</b>		
<b>Goal or Objective</b>	<b>Description</b>	<b>Review</b>
<b>GOAL 1</b>	Reduce potential injury, death, and damage to existing community assets due to natural hazards, especially flooding.	This goal remains valid and will remain in the 2016 mitigation plan update.
Objective 1A	Continue to use stormwater management planning as a means to reduce flood losses.	This action remains valid and will remain in the 2016 mitigation plan update. The action will be renumbered to 1.1
Objective 1B	Recommend that flood insurance policies remain affordable through government programs, especially through the NFIP's CRS.	This action remains valid and will remain in the 2016 mitigation plan update. The action will be renumbered to 1.2

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<b>Monroe County 2011 Mitigation Goals and Objectives Review Worksheet</b>		
<b>Goal or Objective</b>	<b>Description</b>	<b>Review</b>
Objective 1C	Ensure adequate and consistent enforcement of ordinances and codes within and between jurisdictions.	This action remains valid and will remain in the 2016 mitigation plan update. The action will be renumbered to 1.3
Objective 1.4 <b>NEW</b>	Assess and implement historical preservation data to increase hazard mitigation planning.	The project team and the local planning team developed this new objective to align with mitigation activities for the 2016 mitigation plan update.
<b>GOAL 2</b>	Reduce the potential impact and losses stemming from natural and human made disasters on public and private property.	This goal remains valid and will remain in the 2016 mitigation plan update.
Objective 2A	Reduce wildfire potential through planning and outreach.	This action remains valid and will remain in the 2016 mitigation plan update. The action will be renumbered to 2.1
Objective 2B	Ensure that existing streams and drainage systems are adequate and functioning properly, when funding and technical assistance is available.	This action remains valid and will remain in the 2016 mitigation plan update. The project team and local planning team recommended adding the word “located” to the objective as they felt it is necessary to know where the systems are located. The action will be renumbered to 2.2
Objective 2C	Reduce the number of repetitive loss and severe repetitive loss properties in the County.	This action remains valid and will remain in the 2016 mitigation plan update. The action will be renumbered to 2.3

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<b>Monroe County 2011 Mitigation Goals and Objectives Review Worksheet</b>		
<b>Goal or Objective</b>	<b>Description</b>	<b>Review</b>
Objective 2.4 <b>NEW</b>	Develop and maintain GIS data that supports hazard mitigation planning.	The project team and the local planning team developed this new objective to align with mitigation activities for the 2016 mitigation plan update.
Objective 2.5 <b>NEW</b>	Encourage and facilitate the development of continuity planning to reduce impact of natural and man-made hazards	The project team and the local planning team developed this new objective to align with mitigation activities for the 2016 mitigation plan update.
<b>GOAL 3</b>	Increase public education awareness regarding natural and man-made hazard risk and vulnerability, preparedness, and mitigation.	This goal remains valid and will remain in the 2016 mitigation plan update.
Objective 3A	Support public education programs for business, household and individual mitigation, safety measures and preparedness.	This action remains valid and will remain in the 2016 mitigation plan update. The action will be renumbered to 3.1
Objective 3B	Advise the public on small-scale conservation measures.	This action remains valid and will remain in the 2016 mitigation plan update. The action will be renumbered to 3.2
<b>GOAL 4</b>	Improve emergency preparedness, warning and response procedures and capabilities.	This goal remains valid and will remain in the 2016 mitigation plan update.
Objective 4A	Maintain and upgrade emergency services equipment, especially snow and ice removal equipment.	This action remains valid and will remain in the 2016 mitigation plan update. The project team and local planning team removed the wording, “especially snow and ice removal equipment” to all the goal to be all inclusive of emergency response equipment. The action will be renumbered to 4.1

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<b>Monroe County 2011 Mitigation Goals and Objectives Review Worksheet</b>		
<b>Goal or Objective</b>	<b>Description</b>	<b>Review</b>
Objective 4B	Provide residents with adequate warning of potential floods and other weather related events.	This action remains valid and will remain in the 2016 mitigation plan update. The action will be renumbered to 4.2
Objective 4C	Continue increasing 911 response capabilities in the county, especially by encouraging volunteers and regionalization.	This action remains valid and will remain in the 2016 mitigation plan update. The action will be renumbered to 4.3
<b>GOAL 5</b>	Reduce or redirect the impact of natural disaster away from at-risk environmental and population areas.	This goal remains valid and will remain in the 2016 mitigation plan update.
Objective 5A	Research possible structural mitigation projects to redirect or reduce the impact of disasters.	This action remains valid and will remain in the 2016 mitigation plan update. The action will be renumbered to 5.1
Objective 5B	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.	This action remains valid and will remain in the 2016 mitigation plan update. The action will be renumbered to 5.2
<b>GOAL 6</b> <b>NEW</b>	Reduce the potential impact and losses stemming from technological disasters on public and private property	The project team and the local planning team developed this new goal to align with mitigation activities for the 2016 mitigation plan update.
<b>Objective 6.1</b> <b>NEW</b>	Provide education programs to public and private property owners and business owners.	The project team and the local planning team developed this new objective to align with mitigation activities for the 2016 mitigation plan update.

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**Monroe County 2011 Mitigation Goals and Objectives Review Worksheet**

Goal or Objective	Description	Review
Objective 6.2  NEW	Disseminate information to the private and public sectors on hazard specific plans, response procedures and post disaster restoration plans	The project team and the local planning team developed this new objective to align with mitigation activities for the 2016 mitigation plan update.

Actions provide more detailed descriptions of specific work tasks to help the county and its municipalities achieve prescribed goals and objectives. There were forty two (42) actions identified in the 2011 mitigation action plan. A review of the 2011 mitigation actions was completed by the local planning team. The progress of each action was also determined. The results of this review is identified in the 2011 mitigation actions review worksheet.

*Table 63 - Mitigation Actions Review (2011)*

2011 Monroe County Mitigation Actions Review						
Existing Mitigation Actions	Status					Review Comments
	No Progress / Unknown	In Progress / Not Yet Complete	Continuous	Completed	Discontinued	
1. Upgrade snow removal equipment when funding is available					<b>X</b>	2015 ACTION REMOVED: This action is not attainable by the County, as a County Roads Crew does not exist.
2. Support the PennDOT Winter Storm education Program for road maintenance					<b>X</b>	2013 ACTION REMOVED: All municipalities participate in the Annual Winter Weather PennDOT Meeting. Unaware of the "PennDOT Winter Storm Education Program"
3. Expand public education programs for homeowner conservation measures to deal with drought events	<b>X</b>					The local planning team identified that no progress has been made with this action. The team did feel that this action should remain in the hazard

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<b>2011 Monroe County Mitigation Actions Review</b>						
<b>Existing Mitigation Actions</b>	<b>Status</b>					<b>Review Comments</b>
	<b>No Progress / Unknown</b>	<b>In Progress / Not Yet Complete</b>	<b>Continuous</b>	<b>Completed</b>	<b>Discontinued</b>	
						mitigation plan. The action was renumbered to action 3.2.1.
4. Continue environmental education center programs for school students	<b>X</b>					The local planning team identified that no progress has been made with this action. The team did feel that this action should remain in the hazard mitigation plan. The action was renumbered to action 3.1.2.
5. Enforce UCC and promote the establishment of best practices on implementation			<b>X</b>			2015 ACTION COMPLETED. This action will remain continuous. The action will be renumbered to 5.2.1
6. Improve emergency broadcast system by implementing an early warning system to provide additional time for evasive action				<b>X</b>		2014 ACTION COMPLETED. The Monroe County Office of Emergency Management advise that this project has been completed. The exact completion date is unknown.
7. Adopt the updated Stormwater Management Plan and Ordinance for the Brodhead and McMichaels Creeks, which includes an updated floodplain ordinance			<b>X</b>			2015 ACTION COMPLETED: Continuous review of ordinances needed. The action will be reworded as follows: "Review the updated Stormwater Management Plan and Ordinance for the Brodhead and McMichaels Creeks, which includes an updated floodplain ordinance and conduct outreach". The action will be renumbered to 1.1.1. Ross Township completed this action.
8. Complete 911 re-addressing project				<b>X</b>		This mitigation action was completed during 2013 by the county and the local planning team.

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<b>2011 Monroe County Mitigation Actions Review</b>						
<b>Existing Mitigation Actions</b>	<b>Status</b>					<b>Review Comments</b>
	<b>No Progress / Unknown</b>	<b>In Progress / Not Yet Complete</b>	<b>Continuous</b>	<b>Completed</b>	<b>Discontinued</b>	
9. Complete the activities to secure "Storm Ready" designation			<b>X</b>			2015 ACTION COMPLETED: Tunkhannock Twp., Hamilton Twp. and Monroe County have all received STORM READY designation. Monroe County has received second 3-year designation which will run out in 2018. This action will remain for municipalities that have not accomplished the action. Renumbered to action 2.5.3.
10. Complete the activities to secure "Firewise" designation	<b>X</b>					The Firewise program is no longer an option in PA. No progress to date for Tunkhannock. Renumbered to 2.1.1. No progress by Jackson Twp.
11. Encourage wildfire-prone municipalities to implement outdoor burning bans, providing ordinance-writing assistance where necessary			<b>X</b>			The local planning team identified this action as continuous and want the action to remain in the 2016 mitigation action plan. Renumbered to 2.1.2
12. Get updated FEMA digital floodplain maps and make them available to communities				<b>X</b>		This mitigation action was completed during 2013 by the county and the local planning team.
13. Update Tobyhanna/Tunkhannock Creek Watershed 167 Plan				<b>X</b>		This mitigation action was completed during 2013 by the county and the local planning team.
14. Correct drainage problems as identified in Brodhead/McMichaels and Tobyhanna Creek Watershed Act 167 Plans		<b>X</b>				Middle Smithfield Township and Mount Pocono Borough will submit any projects they have on project opportunity forms, Not applicable to

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<b>2011 Monroe County Mitigation Actions Review</b>						
<b>Existing Mitigation Actions</b>	<b>Status</b>					<b>Review Comments</b>
	<b>No Progress / Unknown</b>	<b>In Progress / Not Yet Complete</b>	<b>Continuous</b>	<b>Completed</b>	<b>Discontinued</b>	
						Tunkhannock. Paradise Township has a grant to complete a stream bank restoration project and will submit on an HMPO forms. Barton Glenn Dam reduced to a low risk dam in Jackson. Chestnuthill completed this. Renumbered to 2.2.1
15. Conduct Commodity Flow Study to evaluate the transportation of hazardous materials on Route 611 and enable the selection of priority mitigation activities				<b>X</b>		The Monroe County LEPC completed this study September 2015.
16. Clean up brush and debris in waterways in identified locations and jurisdictions to alleviate flooding		<b>X</b>				Delaware Water Gap is not applicable to this. Stroudsburg Township has completed some of these projects in the borough. Stroud Township has encountered regulatory items in reference to this action. Barrett Township has complete some stream bank trimming but still has additional debris removal that needs completed. Price has identified permitting issues with the completion of this action. Renumbered to action 2.2.2. The municipality will place any structural based projects on the Hazard Mitigation Opportunity Forms and submit them for inclusion in the hazard mitigation plan update.

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<b>2011 Monroe County Mitigation Actions Review</b>						
<b>Existing Mitigation Actions</b>	<b>Status</b>					<b>Review Comments</b>
	<b>No Progress / Unknown</b>	<b>In Progress / Not Yet Complete</b>	<b>Continuous</b>	<b>Completed</b>	<b>Discontinued</b>	
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.			<b>X</b>			The local planning team identified this action as continuous and want the action to remain in the 2016 mitigation action plan. Renumbered to action 2.1.3.
18. Conduct emergency planning for transportation routes to reduce business interruption from transportation accidents	<b>X</b>					The local planning team identified this action as continuous and want the action to remain in the 2016 mitigation action plan. Chestnuthill Completed this. Renumbered to action 2.5.1
19. Upgrade municipal radio system for identified jurisdictions				<b>X</b>		Hamilton and Smithfield townships. Smithfield and Hamilton completed this action by upgrading the emergency response radios and municipal communication radios.
20. Conduct two public outreach campaigns to private communities in the Township around the emergency operations plan and opportunities for mitigation assistance				<b>X</b>		Middle Smithfield Township advised at the January 13, 2016 municipal meeting that they completed this action.
21. Conduct community outreach and public education materials for all hazards, including household safety, preparedness and personal mitigation measures, especially flooding and wildfire			<b>X</b>			The local planning team identified this as a continuous action. Renumbered to action 3.1.1.

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<b>2011 Monroe County Mitigation Actions Review</b>						
<b>Existing Mitigation Actions</b>	<b>Status</b>					<b>Review Comments</b>
	<b>No Progress / Unknown</b>	<b>In Progress / Not Yet Complete</b>	<b>Continuous</b>	<b>Completed</b>	<b>Discontinued</b>	
22. Restore road shoulders with Gabion Baskets at identified locations throughout the Township				<b>X</b>		This action was completed by Polk Township in 2013.
23. Maintain, repair, and/or replace roadway drainage systems at identified locations to alleviate flooding and prevent transportation incidents			<b>X</b>			The local planning team identified this action as continuous and want the action to remain in the 2016 mitigation action plan. Coolbaugh completed numerous projects over the last 5 years. Paradise has projects for bridges that they will be submitting. Renumbered to action 5.1.1.
24. Purchase an emergency generator for the new municipal center				<b>X</b>		Smithfield Township installed new generator to run the entire facility. This unit went in service on January 1, 2016
25. Distribute NOAA weather alert radios to public facilities municipality-wide				<b>X</b>		The local planning team advised this action was completed in 2013
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				<b>X</b>		The local planning team advised this action was completed in 2013
27. Encourage participation in the NFIP-CRS program through outreach and education to municipal officials		<b>X</b>				2015 UPDATE: Monroe County OEM and Planning Commission are working on a guidance sheet to help municipalities identify where they stand with

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<b>2011 Monroe County Mitigation Actions Review</b>						
<b>Existing Mitigation Actions</b>	<b>Status</b>					<b>Review Comments</b>
	<b>No Progress / Unknown</b>	<b>In Progress / Not Yet Complete</b>	<b>Continuous</b>	<b>Completed</b>	<b>Discontinued</b>	
						the points counts. Renumbered to action 1.2.1.
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	<b>X</b>					Chestnut Hill Township started discussion with PennDOT.  Stroudsburg Borough feels that they cannot implement this action in their small municipality.
29. Replace and/or elevate (as appropriate) bridges at identified locations to prevent flood-related circulation issues and prevent business interruption		<b>X</b>				Pocono Township. Stadden Road enhancements, Frantzhill Road considerable enhancements. The municipality will place any structural based projects on the Hazard Mitigation Opportunity Forms and submit them for inclusion in the hazard mitigation plan update
30. Mitigate roadway flooding and conduct stream stabilization at identified locations					<b>X</b>	Pocono Township. Remove. No progress. The municipality will place any structural based projects on the Hazard Mitigation Opportunity Forms and submit them for inclusion in the hazard mitigation plan update
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			<b>X</b>			This action is an ongoing action and will remain in the 2016 mitigation plan update for all municipalities. Hamilton Township has a property that they would like to pursue for this action. This action will be renumbered to action 2.3.1.

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<b>2011 Monroe County Mitigation Actions Review</b>						
<b>Existing Mitigation Actions</b>	<b>Status</b>					<b>Review Comments</b>
	<b>No Progress / Unknown</b>	<b>In Progress / Not Yet Complete</b>	<b>Continuous</b>	<b>Completed</b>	<b>Discontinued</b>	
on the benefits of mitigation						
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			<b>X</b>			The local planning team identified this action as continuous and want the action to remain in the 2016 mitigation action plan. Renumbered to action 6.2.1.
33. Implement traffic calming measures on key roadways	<b>X</b>					Delaware Water Gap advises that no progress has been made with this action. The borough does have serious concern on traffic issues and requested that the action remain.
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					<b>X</b>	2013 ACTION REMOVED: County EMA's are no longer authorized to have contact information for farms within the County. This action can no longer be performed due to this.
35. Conduct stream bank restoration to prevent flooding					<b>X</b>	Paradise Township has received a grant to complete stream bank restoration. This project will be placed on a hazard mitigation opportunity form and submitted for the 2016 mitigation plan update. All hazard mitigation opportunity forms will be documented in an appendix of the 2016 mitigation plan.

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<b>2011 Monroe County Mitigation Actions Review</b>						
<b>Existing Mitigation Actions</b>	<b>Status</b>					<b>Review Comments</b>
	<b>No Progress / Unknown</b>	<b>In Progress / Not Yet Complete</b>	<b>Continuous</b>	<b>Completed</b>	<b>Discontinued</b>	
36. Enact wildfire protection plan and any appropriate ordinances					<b>X</b>	Paradise Township states that this action should be removed and is no longer supported
37. Enact best management plan for flood-related natural resources protection				<b>X</b>		Paradise Township has complete the new floodplain ordinance and considers this action complete.
38. Enact local airport zoning protection				<b>X</b>		2015 ACTION COMPLETE: Date unknown of completion
39. Use forest management to protect open space and prevent wildfire events			<b>X</b>			Paradise Township has been completing these plans and will continue to complete these.
40. Maintain and/or reconstruct identified bridges to prevent transportation accidents and improve the transportation network			<b>X</b>			2015 UPDATE: This action should remain continuous. Renumber to mitigation action 5.1.2. Tobyhanna rebuilt Old Route 940 in 2015 and in 2014 Miller Bridge was repaired.
41. Remove excess sediment and install channel stabilization at specified locations					<b>X</b>	Tobyhanna Township: No progress on this. This is a structural based project. The municipality will place any structural based projects on the Hazard Mitigation Opportunity Forms and submit them for inclusion in the hazard mitigation plan update
42. Develop and implement an Emergency Action Plan for the East Stroudsburg/Stroudsburg Joint Flood Control Project		<b>X</b>				Renumbered to mitigation action 2.5.2.

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### 6.2. Mitigation Goals and Objectives

Based on results of the goals and objectives evaluation exercise and input from the local planning team, a list of six (6) goals and seventeen (17) corresponding objectives was developed. *Table 64 - Goals and Objectives (2016)* details the mitigation goals and objectives established for the 2016 Monroe County Hazard Mitigation Plan.

The Pennsylvania Museum and Historic Commission has coordinated a two (2) phase historical preservation and mitigation project for Monroe County and all the municipalities in Monroe County. Phase 1 of this project entails an inventory of the historical properties and buildings of the county. Phase 2 of the project will provide mitigation strategies, actions and projects for inclusion into the Monroe County Hazard mitigation Plan. Objective 1.4 was added to the 2016 HMP for the future inclusion of mitigation actions supporting historical property mitigation efforts. Mitigation actions will be added to the 2016 HMP through the standard update process to support objective 1.4 in the future.

*Table 64 - Goals and Objectives (2016)*

<b>Monroe County 2016 Goals and Objectives</b>	
<b>GOAL 1</b>	Reduce potential injury, death, and damage to existing community assets due to natural hazards, especially flooding.
<b>Objective 1.1</b>	Continue to use stormwater management planning as a means to reduce flood losses.
<b>Objective 1.2</b>	Recommend that flood insurance policies remain affordable through government programs, especially through the NFIP's CRS.
<b>Objective 1.3</b>	Ensure adequate and consistent enforcement of ordinances and codes within and between jurisdictions.
<b>Objective 1.4</b>	Assess and implement historical preservation data to increase hazard mitigation planning.
<b>GOAL 2</b>	Reduce the potential impact and losses stemming from natural and human made disasters on public and private property.

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<b>Monroe County 2016 Goals and Objectives</b>	
<b>Objective 2.1</b>	Reduce wildfire potential through planning and outreach.
<b>Objective 2.2</b>	Ensure that existing streams and drainage systems are located, adequate and functioning properly, when funding and technical assistance is available.
<b>Objective 2.3</b>	Reduce the number of repetitive loss and severe repetitive loss properties in the County.
<b>Objective 2.4</b>	Develop and maintain GIS data that supports hazard mitigation planning.
<b>Objective 2.5</b>	Encourage and facilitate the development of continuity planning to reduce impact of natural and man-made hazards
<b>GOAL 3</b>	Increase public education awareness regarding natural and man-made hazard risk and vulnerability, preparedness, and mitigation.
<b>Objective 3.1</b>	Support public education programs for business, household and individual mitigation, safety measures and preparedness.
<b>Objective 3.2</b>	Advise the public on small-scale preservation and conservation measures.
<b>GOAL 4</b>	Improve emergency preparedness, warning and response procedures and capabilities.
<b>Objective 4.1</b>	Maintain and upgrade emergency services equipment.
<b>Objective 4.2</b>	Provide residents with adequate warning of potential floods and other weather related events.
<b>GOAL 5</b>	Reduce or redirect the impact of natural disaster away from at-risk environmental and population areas.
<b>Objective 5.1</b>	Research possible structural mitigation projects to redirect or reduce the impact of disasters.

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<b>Monroe County 2016 Goals and Objectives</b>	
<b>Objective 5.2</b>	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.
<b>GOAL 6</b>	Reduce the potential impact and losses stemming from technological disasters on public and private property.
<b>Objective 6.1</b>	Provide education programs to public and private property owners and business owners.
<b>Objective 6.2</b>	Disseminate information to the private and public sectors on hazard specific plans, response procedures and post disaster restoration plans.

### **6.3. Identification and Analysis of Mitigation Techniques**

This section includes an overview of alternative mitigation actions based on the goals and objectives identified in Section 6.2. There are four general mitigation strategy techniques to reducing hazard risks:

- Local plans and regulations
- Structure and infrastructure
- Natural systems protection
- Education and awareness

**Local Plans and Regulations:** These actions include government authorities, policies or codes that influence the way land and buildings are developed and built. The following are some examples:

- Comprehensive plans
- Land use ordinances
- Subdivision regulations
- Development review
- Building codes and enforcement
- National Flood Insurance Program and Community Rating System
- Capital improvement programs
- Open space preservation
- Stormwater management regulations and master plans

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The local plans and regulations technique will protect and reduce the impact of specific hazards on new and existing buildings by improving building code standards and regulating new and renovation construction. The improved building codes will decrease the impact of risk hazards. Subdivision and land development enhancements will also augment this process. Ensuring that municipalities participate in the National Flood Insurance Program and encourage participation in the Community Rating System will decrease the impact as well.

**Structure and infrastructure implementation:** These actions involve modifying existing structures and infrastructure or constructing new structures to reduce hazard vulnerability. The following are examples:

- Acquisitions and elevations of structures in flood prone areas
- Utility undergrounding
- Structural retrofits
- Floodwalls and retaining walls
- Detention and retention structures
- Culverts
- Safe rooms

Structure and infrastructure implementation is a technique that removes or diverts the hazard from structures or protects the structure from a specific hazard. The new or renovated structures are therefore protected or have a reduced impact of hazards.

**Natural Resource Protection:** These are actions that minimize damage and losses and also preserve or restore the functions of natural systems. They include the following:

- Erosion and sediment control
- Stream corridor restoration
- Forest management
- Conservation easements
- Wetland restoration and preservation

Natural resource protection techniques allow for the natural resource to be used to protect or lessen the impact on new or renovated structures through the management of these resources. Utilization and implementation of the examples above will protect new and existing buildings and infrastructure.

**Education and Awareness:** These are actions to inform and educate citizens, elected officials and property owners about hazards and potential ways to mitigate them and may also include participation in national programs. Examples of these techniques include the following:

- Radio and television spots
- Websites with maps and information
- Real estate disclosure
- Provide information and training

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- NFIP outreach
- StormReady
- Firewise Communities

The education and awareness technique will protect and reduce the impact of specific hazards on new and existing buildings through education of citizens and property owners on the impacts that specific hazards could have on new or renovated structures. This information will allow the owner to make appropriate changes or enhancements that will lessen or eliminate the impact of hazards.

*Table 65 - Mitigation Strategy Technique Matrix* provides a matrix identifying the mitigation techniques used for all low, moderate and high risk hazards in the county. The specific actions associated with these techniques are included in *Table 66 - Mitigation Action Plan*.

*Table 65 - Mitigation Strategy Technique Matrix*

<b>Monroe County Mitigation Strategy Technique Matrix</b>				
<b>HAZARD</b>	<b>MITIGATION TECHNIQUE</b>			
	<b>Local Plans and Regulations</b>	<b>Structural and Infrastructure</b>	<b>Natural Systems Protection</b>	<b>Education and Awareness</b>
Utility Interruptions	<b>x</b>	<b>x</b>		<b>x</b>
Winter Storm and Nor'easter				<b>x</b>
Transportation Accidents	<b>x</b>	<b>x</b>		
Invasive Species	<b>x</b>		<b>x</b>	<b>x</b>
Wildfire	<b>x</b>			<b>x</b>
Dam Failure	<b>x</b>			
Hazardous Materials – Transportation and Fixed Facility	<b>x</b>	<b>x</b>		<b>x</b>
Pandemic and Infectious Disease	<b>x</b>			<b>x</b>
Terrorism – Domestic and International	<b>x</b>			<b>x</b>
Extreme Temperature				<b>x</b>
Levee Failure	<b>x</b>			<b>x</b>
Hurricane/Tropical Storm	<b>x</b>		<b>x</b>	<b>x</b>

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HAZARD	MITIGATION TECHNIQUE			
	Local Plans and Regulations	Structural and Infrastructure	Natural Systems Protection	Education and Awareness
Drowning				<b>X</b>
Flooding, Flash Flooding and Ice Jam Flooding	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
Windstorms and Tornado				<b>X</b>
Nuclear Incidents	<b>X</b>			<b>X</b>
Disorientation	<b>X</b>			<b>X</b>
Drought				<b>X</b>
Earthquake				<b>X</b>
All Hazards	<b>X</b>			<b>X</b>

#### **6.4. Mitigation Action Plan**

The Monroe County Hazard Mitigation Local Planning Team (LPT) immediately began work on the mitigation strategy section of the 2016 hazard mitigation plan (HMP) update after the risk assessment section was completed. The LPT started this section by reviewing the 2011 HMP mitigation strategy section. A review of the previous goals, objectives, actions and project opportunities documented in the 2011 HMP was conducted. The next step the LPT completed was the brainstorming of possible new actions based on new identified risks. The LPT compiled all this information for presentations to the municipalities.

The LPT identified the following accomplishments since the development of the 2011 Monroe County Hazard Mitigation Plan:

- Monroe County Office of Emergency Management assisted with the improvement of the emergency broadcast system by implementing an early warning system to provide additional time for evasive action.
- The stormwater management plans for the Brodhead and McMichaels Creeks were adopted and ordinances were executed.
- The 9-1-1 readdressing project was completed for all of Monroe County. The readdressing will assist first responders in responses to emergencies.
- The Monroe County LEPC conducted a hazardous materials commodity flow study focused on Route 611. The results of this study were used by the LEPC to develop hazardous material mitigation activities.
- Hamilton Township and Smithfield Township successfully completed upgrades to the municipal radio systems.

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- Smithfield Township installed a new emergency generator at the municipal building. The municipal building is considered a critical facility.
- The updated digital flood insurance rate maps and updated floodplain ordinances were adopted by the Monroe County municipalities in 2013. The ordinances exceeded the minimum FEMA requirements for the floodplain protections and the functions to stop or slow floodwaters to support strong participation in the national flood insurance program.
- New local airport zoning protection was enacted in 2015.
- The updated Monroe County Comprehensive Plan 2030 was adopted on December of 2014. The update was completed by the Monroe County Planning Commission.

MCM Consulting Group, Inc. completed municipality meetings at various time periods at the Monroe County Office of Emergency Management. The meetings were conducted on January 13, 2016 through January 14, 2016; January 27, 2016 through January 28, 2016 and February 19, 2016. During all these meetings, an overview of mitigation strategy was presented and the municipalities were informed that they needed to have at least one hazard-related mitigation action or mitigation opportunity for their municipality. All municipalities were invited to attend these meetings.

The municipalities were notified of draft mitigation actions and encouraged to provide new mitigation actions that could be incorporated into the plan. Municipalities were provided copies of their previously submitted mitigation actions and asked to determine if the projects were still valid. Municipalities were solicited for new project opportunities as well. All agendas, sign in sheets and other support information from these meetings is included in Appendix C.

Mitigation measures for the 2016 Monroe County HMP are listed in the mitigation action plan. *Table 66 - Mitigation Action Plan (2016)* is the 2016 Monroe County Mitigation Action Plan. This plan outlines mitigation actions and projects that comprise a strategy for Monroe County. The action plan includes actions, a benefit and cost prioritization, a schedule for implementation, any funding sources to complete the action, a responsible agency or department. *Table 67 - Municipal Hazard Mitigation Actions Checklist* is a matrix that identifies the county and/or municipalities responsible for mitigation actions in the new mitigation action plan.

Mitigation actions to support objective 1.4 will be submitted in the future based on recommendations from the Pennsylvania Historic and Preservation Commission Phase 2 historical property hazard mitigation strategies report that is anticipated to be finalized in July 2016.

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Table 66 - Mitigation Action Plan (2016)

Monroe County 2016 Mitigation Action Plan									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Responsibility
1.1.1	Local Plans and Regulations	Review the updated Stormwater Management Plan and Ordinance for the Brodhead and McMichaels Creeks, which includes an updated floodplain ordinance and conduct outreach	Flood, Flash Flood and Ice Jam Flooding		X		Continuous	Staff Time	Monroe County Conservation District
1.2.1	Education and Awareness	Encourage participation in the NFIP-CRS program through outreach and education to municipal officials	Flood, Flash Flood and Ice Jam Flooding	X			2016-2021	Staff Time	Monroe County Emergency Management, Planning Office and Conservation District
1.2.2	Education and Awareness	Develop CRS information sheet based on the CRS pointing system to assist municipalities in obtaining CRS certification	Flood, Flash Flood and Ice Jam Flooding	X			2016-2021	Staff Time	Monroe County Planning Department
1.3.1	Local Plans and Regulations	Enforce the municipal floodplain ordinances to reduce the impact of flooding	Flood, Flash Flood and Ice Jam Flooding	X			Continuous	Staff Time	Monroe County Municipalities
2.1.1	Education and Awareness	Develop work group to investigate the initiation of a Firewise program	Wildfire		X		2016-2021	FEMA and DCNR	Monroe County OEM and Municipalities
2.1.2	Local Plans and Regulations	Encourage wildfire-prone municipalities to implement outdoor burning bans, providing ordinance-writing assistance where necessary	Wildfire		X		2016-2021	Staff Time	Monroe County Planning Commission and Emergency Management
2.1.3	Education and Awareness	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	Wildfire	X			Continuous	FEMA and DCNR	Township Emergency Management Coordinators
2.1.4	Education and Awareness	Complete the activities to secure Firewise designation	Wildfire		X		2016-2021	DCNR	Tunkhannock and Jackson Townships
2.2.1	Structural and Infrastructure	Correct drainage problems as identified in Brodhead/McMichaels and Tobyhanna Creek Watershed Act 167 Plans	Flood, Flash Flood and Ice Jam		X		Continuous	FEMA and HMGP	Monroe County Conservation District

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<b>Monroe County 2016 Mitigation Action Plan</b>									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Responsibility
2.2.2	Natural Systems Protection	Clean up brush and debris in waterways in identified locations and jurisdictions to alleviate flooding	Flood, Flash Flood and Ice Jam		<b>X</b>		Continuous	FEMA and HMGP	Township Supervisors
2.2.3	Local Plans and Regulations	Develop a workgroup to discuss and investigate the permitting process for debris removal in at risk waterways	Flood, Flash Flood and Ice Jam		<b>X</b>		2016-2021	Staff Time	Monroe County Office of Emergency Management and municipalities
2.3.1	Structural and Infrastructure	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 opportunity	Flood, Flash Flood and Ice Jam		<b>X</b>		Continuous	HMGP FMA and PDM	Monroe County Office of Emergency Management and municipalities
2.3.2	Structural and Infrastructure	Identify the lowest floor elevation of the most vulnerable structures to flooding, especially historical, repetitive loss and severe repetitive loss properties.	Flood, Flash Flood and Ice Jam		<b>X</b>		2016-2021	HMGP FMA and PDM	Monroe County Office of Emergency Management and municipalities
2.4.1	Local Plans and Regulations	Develop additional and maintain current GIS layers for critical facilities and infrastructure	All Hazards	<b>X</b>			Continuous	Staff Time	Monroe County Office of Emergency Management and Planning Office, East Stroudsburg University
2.4.2	Local Plans and Regulations	Develop additional GIS layers for public utility services	Utility Interruptions, Flood, Windstorms, Tornado, Hurricane and Tropical Storms, Nor'Easters, Wildfire, Transportation, HazMat Fixed facility, Dam Failure, Terrorism, Drought.	<b>X</b>			2016-2021	Staff Time	Monroe County OEM and GIS

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Monroe County 2016 Mitigation Action Plan									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Responsibility
2.5.1	Local Plans and Regulations	Conduct emergency planning for transportation routes to reduce business interruption from transportation accidents	Transportation Accidents and Hazardous Materials - Transportation	X			2016-2021	Staff Time	Township Supervisors
2.5.2	Local Plans and Regulations	Develop and implement an Emergency Action Plan for the East Stroudsburg/Stroudsburg Joint Flood Control Project	Flood, Flash Flood and Ice Jam	X			2016-2021	DEP and Boroughs	Stroudsburg and East Stroudsburg Boroughs
2.5.3	Education and Awareness	Complete the activities to secure "Storm Ready" designation	Flood, Flash Flood, Ice Jam, Winter Storm, Wildfire, Tornado, Windstorm, Hurricane, Tropical Storm, Nor'easter, Extreme Temperature	X			2016-2021	NOAA	Monroe County Office of Emergency Management and municipalities
2.5.4	Education and Awareness	Continue the activities to maintain "Storm Ready" designation	Flood, Flash Flood, Ice Jam, Winter Storm, Wildfire, Tornado, Windstorm, Hurricane, Tropical Storm, Nor'easter, Extreme Temperature	X			Continuous	NOAA and Local Taxes	Monroe County Office of Emergency Management and municipalities
2.5.5	Local Plans and Regulations	Establish a hazard mitigation workgroup that includes utility providers to investigate ways to decrease utility outages	Utility Interruptions		X		2016-2021	Staff Time	Monroe County Office of Emergency Management and municipalities
3.1.1	Education and Awareness	Conduct community outreach and public education materials for all hazards, including household safety, preparedness and personal mitigation measures, especially flooding and wildfire	All Hazards		X		Continuous	FEMA LEPC and HMGP	Monroe County Office of Emergency Management
3.1.2	Education and Awareness	Continue environmental education center programs for school students	All Hazards		X		Continuous	Staff Time	Monroe County Conservation District
3.1.3	Education and Awareness	Public outreach on the vulnerabilities and risk factors of drowning.	Drowning			X	2016-2021	Staff Time	Monroe County Office of Emergency Management

**Monroe County, Pennsylvania**  
**2016 Hazard Mitigation Plan *DRAFT***

<b>Monroe County 2016 Mitigation Action Plan</b>									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Responsibility
3.2.1	Education and Awareness	Expand public education programs for homeowner conservation measures to deal with drought events	Drought		X		2016-2021	Staff Time	Monroe County Conservation District
4.1.1	Structural and Infrastructure	Identify emergency response equipment and training that is needed by first responders for response to hazardous material incidents.	Hazardous materials – Transportation and Fixed Facility	X			2016-2021	LEPC	Monroe County LEPC
4.1.2	Local Plans and Regulations	Conduct primary road commodity flow study in Monroe County.	Hazardous materials – Transportation	X			2016-2018	HMEP	Monroe County LEPC and ESU
4.1.3	Local Plans and Regulations	Conduct secondary road commodity flow study in Monroe County.	Hazardous materials – Transportation	X			2018-2020	HMEP	Monroe County LEPC and ESU
4.1.4	Structural and Infrastructure	Identify emergency generator capabilities for critical facilities in Monroe County.	Utility Interruptions	X			2016-2021	Local and FEMA	Monroe County OEM and ESU
4.1.5	Structural and Infrastructure	Install emergency generators at critical facilities and other essential facilities to enhance capabilities during utility outages	Utility Interruptions	X			2016-2021	Local and FEMA	Monroe County OEM and ESU
4.2.1	Local Plans and Regulations	Integrate any municipal public notification systems with the Monroe County notification system to enhance dissemination of emergency information and public warning	All Hazards	X			2016-2021	Staff Time	Monroe County OEM, Middle Smith Field Township, Chestnuthill Township, East Stroudsburg University
4.2.2	Local Plans and Regulations	Develop a county wide notification and early warning plan for vulnerable populations in Monroe County	Flooding, Flash Flooding, Ice Jam, Hazardous Materials- Transportation and Fixed Facility	X			2016-2021	Staff Time	Monroe County Office of Emergency Management
5.1.1	Structural and Infrastructure	Maintain, repair, and/or replace roadway drainage systems at identified locations to alleviate flooding and prevent transportation incidents	Flood, Flash Flood, Ice Jam, Transportation Accidents and Hazardous Material - Transportation	X			Continuous	Local Taxes and HMGF	All Municipalities

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## 2016 Hazard Mitigation Plan **DRAFT**

<b>Monroe County 2016 Mitigation Action Plan</b>									
Action Number	Mitigation Actions		Hazard Vulnerability	Prioritization			Implementation		
	Category	Description/ Action Items		High	Medium	Low	Schedule	Funding	Responsibility
5.1.2	Structural and Infrastructure	Maintain and/or reconstruct identified bridges to prevent transportation accidents and improve the transportation network	Flood, Flash Flood, Ice Jam Flooding, Transportation Accidents and Hazardous Material - Transportation	<b>X</b>			Continuous	PennDOT and Federal Highway Administration	Monroe County Municipalities
5.2.1	Local Plans and Regulations	Enforce UCC and promote the establishment of best practices on implementation	All Hazards	<b>X</b>			Continuous	Staff Time	Monroe County Planning Commission
5.2.2	Local Plans and Regulations	Integrate the 2016 Monroe County hazard mitigation data and principals into local municipal planning efforts.	All Hazards	<b>X</b>			2016-2021	Staff Time	Monroe County Municipalities
5.2.3	Local Plans and Regulations	Integrate the 2016 Monroe County hazard mitigation plan with the East Stroudsburg University hazard mitigation plan	All Hazards	<b>X</b>			2016-2021	Staff Time	Monroe County and East Stroudsburg University
6.1.1	Education and Awareness	Develop a list of problem potholes within the county and submit to PennDOT and appropriate municipalities	Transportation Accident, Hazardous Materials - Transportation		<b>X</b>		2016-2021	Staff Time	Monroe County Office of Emergency Management
6.2.1	Local Plans and Regulations	Conduct outreach to private owners of high-hazard dams on the importance of dam safety planning and on mitigation opportunities for dam failure hazards	Dam Failure		<b>X</b>		Continuous	Staff Time	Monroe County Office of Emergency Management
6.2.2	Local Plans and Regulations	Develop a Route 611 transportation planning work group to conduct planning for transportation items related to major interstate shutdowns	Transportation Accidents and Hazardous Materials - Transportation		<b>X</b>		2016-2021	Staff Time	NEPA-MPO and Municipalities along Route 611
6.2.3	Local Plans and Regulations	Develop a transportation planning work group to conduct planning for transportation items related to major highway shutdowns	Transportation Accidents and Hazardous Materials - Transportation		<b>X</b>		2016-2021	Staff Time	NEPA-MPO and Municipalities along Route 611

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## **2016 Hazard Mitigation Plan *DRAFT***

Funding acronym definitions:

FMA: Flood Mitigation Assistance Grant Program, administered by the Federal Emergency Management Agency

HMGP: Hazard Mitigation Grant Program, administered by the Federal Emergency Management Agency

PDM: Pre-Disaster Mitigation Grant, administered by the Federal Emergency Management Agency

EMPG: Emergency Management Performance Grant, administered by the Federal Emergency Management Agency

HSGP: Homeland Security Grant Program, administered by the Federal Emergency Management Agency

HMEP: Hazardous Material Emergency Planning Grant, administered by the Pennsylvania Emergency Management Agency

HMRP: Hazardous Material Response Fund, administered by the Pennsylvania Emergency Management Agency

*Table 67 - Municipal Hazard Mitigation Actions Checklist*

<b>Municipality</b>	<b>1.1.1</b>	<b>1.2.1</b>	<b>1.2.2</b>	<b>1.3.1</b>	<b>2.1.1</b>	<b>2.1.2</b>	<b>2.1.3</b>	<b>2.1.4</b>	<b>2.2.1</b>	<b>2.2.2</b>
Barrett Township	X			X	X	X	X			X
Chestnuthill Township	X			X	X	X	X			X
Coolbaugh Township	X			X	X	X	X			X
Delaware Water Gap Borough	X			X						X
East Stroudsburg Borough	X			X						X
Eldred Township	X			X	X	X	X			X
Hamilton Township	X			X	X	X	X			X
Jackson Township	X			X	X	X	X	X		X
Middle Smithfield Township	X			X	X	X	X			X
Mount Pocono Borough	X			X	X	X	X			X
Paradise Township	X			X	X	X	X			X
Pocono Township	X			X	X	X	X			X
Polk Township	X			X	X	X	X			X
Price Township	X			X	X	X	X			X
Ross Township	X			X	X	X	X			X
Smithfield Township	X			X	X	X	X			X
Stroud Township	X			X	X	X	X			X
Stroudsburg Borough	X			X						X
Tobyhanna Township	X			X	X	X	X			X
Tunkhannock Township	X			X	X	X	X	X		X
Monroe County	X	X	X	X	X	X	X	X	X	X

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<b>Municipality</b>	<b>2.2.3</b>	<b>2.3.1</b>	<b>2.3.2</b>	<b>2.4.1</b>	<b>2.4.2</b>	<b>2.5.1</b>	<b>2.5.2</b>	<b>2.5.3</b>	<b>2.5.4</b>	<b>2.5.5</b>
Barrett Township	X	X				X		X	X	X
Chestnuthill Township	X	X				X		X	X	X
Coolbaugh Township	X	X				X		X	X	X
Delaware Water Gap Borough	X	X				X		X	X	X
East Stroudsburg Borough	X	X				X	X	X	X	X
Eldred Township	X	X				X		X	X	X
Hamilton Township	X	X				X		X	X	X
Jackson Township	X	X				X		X	X	X
Middle Smithfield Township	X	X				X		X	X	X
Mount Pocono Borough	X	X				X		X	X	X
Paradise Township	X	X				X		X	X	X
Pocono Township	X	X				X		X	X	X
Polk Township	X	X				X		X	X	X
Price Township	X	X				X		X	X	X
Ross Township	X	X				X		X	X	X
Smithfield Township	X	X				X		X	X	X
Stroud Township	X	X				X		X	X	X
Stroudsburg Borough	X	X				X	X	X	X	X
Tobyhanna Township	X	X				X		X	X	X
Tunkhanock Township	X	X				X		X	X	X
Monroe County	X	X	X	X	X	X		X	X	X

<b>Municipality</b>	<b>3.1.1</b>	<b>3.1.2</b>	<b>3.1.3</b>	<b>3.2.1</b>	<b>4.1.1</b>	<b>4.1.2</b>	<b>4.1.3</b>	<b>4.1.4</b>	<b>4.1.5</b>	<b>4.2.1</b>
Barrett Township	X	X						X		X
Chestnuthill Township	X	X						X	X	X
Coolbaugh Township	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
Hamilton Township	X	X						X		X
Jackson Township	X	X						X		X
Middle Smithfield Township	X	X						X		X
Mount Pocono Borough	X	X						X		X
Paradise Township	X	X						X		X
Pocono Township	X	X						X		X
Polk Township	X	X						X		X
Price Township	X	X						X		X
Ross Township	X	X						X		X
Smithfield Township	X	X						X		X

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<b>Municipality</b>	<b>3.1.1</b>	<b>3.1.2</b>	<b>3.1.3</b>	<b>3.2.1</b>	<b>4.1.1</b>	<b>4.1.2</b>	<b>4.1.3</b>	<b>4.1.4</b>	<b>4.1.5</b>	<b>4.2.1</b>
Stroud Township	X	X						X		X
Stroudsburg Borough	X	X						X		X
Tobyhanna Township	X	X						X		X
Tunkhanock Township	X	X						X		X
Monroe County	X	X	X	X	X	X	X	X	X	X

<b>Municipality</b>	<b>4.2.2</b>	<b>5.1.1</b>	<b>5.1.2</b>	<b>5.2.1</b>	<b>5.2.2</b>	<b>5.2.3</b>	<b>6.1.1</b>	<b>6.2.1</b>	<b>6.2.2</b>	<b>6.2.3</b>
Barrett Township		X	X	X	X		X	X		X
Chestnuthill Township		X	X	X	X		X	X		X
Coolbaugh Township		X	X	X	X		X	X		X
Delaware Water Gap Borough		X	X	X	X		X	X	X	X
East Stroudsburg Borough		X	X	X	X	X	X	X		X
Eldred Township		X	X	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		X	X		X
Mount Pocono Borough		X	X	X	X		X	X	X	X
Paradise Township		X	X	X	X		X	X		X
Pocono Township		X	X	X	X		X	X	X	X
Polk Township		X	X	X	X		X	X		X
Price Township		X	X	X	X		X	X		X
Ross Township		X	X	X	X		X	X		X
Smithfield Township		X	X	X	X		X	X		X
Stroud Township		X	X	X	X		X	X		X
Stroudsburg Borough		X	X	X	X	X	X	X	X	X
Tobyhanna Township		X	X	X	X		X	X		X
Tunkhanock Township		X	X	X	X		X	X		X
Monroe County	X	X	X	X	X	X	X	X	X	X

**National Flood Insurance Program (NFIP) Related Mitigation Actions**

The Federal Emergency Management Agency (FEMA) requires that every participating jurisdiction that either participates in the NFIP or has identified Special Flood Hazard Areas (SFHAs) have at least one specific action in its mitigation action plan that relates to continued compliance with the NFIP. Action numbers 1.1.1; 1.2.1; 1.2.2; 1.3.1 and 2.3.1 comply for Monroe County and all its municipalities.

**Evaluate and Prioritize Mitigation Actions**

**Mitigation Action Evaluation:**

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Evaluating mitigation actions involves judging each action against certain criteria to determine whether or not it can be executed. The feasibility of each mitigation action is evaluated using the ten evaluation criteria set forth in the Mitigation Action Evaluation methodology as outlined in the Commonwealth of Pennsylvania's All-Hazard Mitigation Planning, Standard Operating Guide. The methodology solicits input on whether each action is highly effective or feasible and ineffective or not feasible for the criteria. These criteria are listed below and aid in determining the feasibility of implementing one action over another.

- Life Safety: Will the action be effective in promoting public safety?
- Property Protection: Will the action be effective in protecting public or private property?
- Technical: How effective will the action be in avoiding or reducing future losses?
- Political: Does the action have public and political support?
- Legal: Does the community have the authority to implement the proposed measure?
- Environmental: Will the action provide environmental benefits and will it comply with local, state and federal environmental regulations?
- Social: Will the action be acceptable by the community or will it cause any one segment of the population to be treated unfairly?
- Administrative: Is there adequate staffing and funding available to implement the action in a timely manner?
- Local Champion: Is there local support for the action to help ensure its completion?
- Other Community Objectives: Does the action address any current or future community objectives either through municipal planning or community goals?

To evaluate the mitigation actions, each action is identified as highly effective or feasible; ineffective or not favorable and no cost or benefit. For each criterion, the prioritization methodology assigns a "+" if the action was highly effective or feasible, a "-" if the action was ineffective or not feasible, and a "N" if no cost or benefit could be associated with the suggested action or the action was not applicable to the criteria.

### **Mitigation Action Prioritization:**

Actions should be compared with one another to determine a ranking or priority by applying the multi-objective mitigation action prioritization criteria. Scores are assigned to each criterion using the following weighted, multi-objective mitigation action prioritization criteria:

- Effectiveness (weight: 20% of score): The extent to which an action reduces the vulnerability of people and property.
- Efficiency (weight: 30% of score): The extent to which time, effort, and cost is well used as a means of reducing vulnerability.

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- Multi-Hazard Mitigation (weight: 20% of score): The action reduces vulnerability for more than one hazard.
- Addresses High Risk Hazard (weight: 15% of score): The action reduces vulnerability for people and property from a hazard(s) identified as high risk.
- Addresses Critical Communications/Critical Infrastructure (weight: 15% of score): The action pertains to the maintenance of critical functions and structures such as transportation, supply chain management, data circuits, etc.

Scores of 1, 2, or 3 are assigned for each multi-objective mitigation action prioritization criterion where 1 is a low score and 3 is a high score. Actions are prioritized using the cumulative score assigned to each. Each mitigation action is given a priority ranking (Low, Medium, and High) based on the following:

- **Low Priority:** 1.0 – 1.8
- **Medium Priority:** 1.9 – 2.4
- **High Priority:** 2.5 – 3.0

The cumulative results of the prioritization of mitigation actions is identified in the mitigation action evaluation and prioritization tool.

The results for the mitigation action evaluation and prioritization are located in Appendix I of this plan.

## **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 Monroe County HMP Local Planning Team decided to alter the current maintenance procedures. The 2016 HMP update establishes a review of the plan within 30 days of a disaster event in addition to continuing with an annual plan evaluation. This HMP update also defines the municipalities' role in updating and evaluating the plan. Finally, the 2016 HMP update encourages continued public involvement and how this plan may be integrated into other planning mechanisms in the county.

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### **7.2. Monitoring, Evaluating and Updating the Plan**

Hazard mitigation planning in Monroe County is a responsibility of all levels of government (i.e., county and local), as well as the citizens of the county. The Monroe County Local Planning Team will be responsible for maintaining this multi-jurisdictional HMP. The local planning team will meet annually and following each emergency declaration to review the plan. Every municipality that has adopted this plan will also be afforded the opportunity to provide updated information or information specific to hazards encountered during an emergency or disaster. Each review process will ensure that the hazard vulnerability data and risk analysis reflect current conditions of the county, that the capabilities assessment accurately reflects local circumstances and that the hazard mitigation strategies are updated based on the county's damage assessment reports and local mitigation project priorities. The HMP must be updated on a five-year cycle. An updated HMP must be completed and approved by the end of the five year period. The monitoring, evaluating and updating of the plan every five years will rely heavily on the outcomes of the annual HMP local planning team meetings.

The Monroe County Local Planning Team will complete a hazard mitigation progress report to evaluate the status and accuracy of the multi-jurisdictional HMP and record the local planning team's review process. The Monroe County Office of Emergency Management will maintain a copy of these records and place them in Appendix J of this plan. Monroe County will continue to work with all municipalities regarding hazard mitigation projects, especially those municipalities that did not submit projects for inclusion in this plan.

### **7.3. Incorporation into Other Planning Mechanisms**

#### **Monroe County Comprehensive Plan**

Article III of the Pennsylvania Municipalities Planning code (Act 247 of 1968, as reenacted and amended) requires all Pennsylvania counties (except Philadelphia) to adopt a comprehensive plan and update it at least every 10 years. The Monroe County Commissioners adopted the updated Monroe 2030 Comprehensive Plan in December 2014.

The Monroe County Planning Commission is responsible for maintaining and updating the Monroe County Comprehensive Plan and many other regulatory tools. It uses this information to identify necessary revisions and to amend these plans, ordinances and other regulatory tools.

Technical assistance on community planning matters is provided to the Monroe County Board of Commissioners through the Monroe County Planning Commission. The planning commission administers the county comprehensive plan. The planning commission also performs technical reviews of municipal subdivision and land development

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plans, municipal floodplain ordinances and other community planning and development matters.

The next scheduled complete update of the comprehensive plan will be by 2024 based on the municipalities planning code's 10-year review cycle. Certain sections of the county comprehensive plan may be updated prior to 2024. Coupling this requirement with the DMA 2000-required five-year update cycle for county hazard mitigation plans, when possible, will allow the county to better integrate the Monroe County Comprehensive Plan and the Monroe County Hazard Mitigation Plan planning processes and strengthen public participation for both efforts.

The risk assessment section 4.3.1 through 4.3.19; section 4.4.4; Capability Assessment Section 5 and the Mitigation Strategy Section 6 of the Monroe County Hazard Mitigation Plan will provide valuable information for the update of the next comprehensive plan and any section specific updates prior to 2024. Consideration and incorporation of data from this plan will ensure the inclusion of hazard mitigation practices in the county comprehensive plan. The local planning team has identified a new mitigation action for the integration of the county hazard mitigation plan into all other local plans.

### **Monroe County Emergency Operations Plan**

The Pennsylvania Emergency Management Services Code, 35 PA C.S. Sections 7701-7707, as amended, requires each county and municipality to prepare, maintain and keep current an emergency operations plan (EOP). Monroe County Office of Emergency Management is responsible for preparing and maintaining the county's EOP, which applies to both the county and municipal emergency management operations and procedures.

The EOP is reviewed at least biennially. Whenever portions of the plan are implemented in an emergency event or training exercise, a review is performed and changes are made where necessary. These changes are then distributed to the county's municipalities as necessary.

The complete risk assessment section, mitigation actions and mitigation project opportunities identified in the Monroe County Hazard Mitigation Plan will assist with decreasing hazard specific risk and vulnerability. Understanding the risks and vulnerability in the county and municipalities will allow for emergency management and other response agencies to better direct planning, response and recovery aspects.

EMA will consider the Monroe County Hazard Mitigation Plan during the biennial review of the county EOP. Recommended changes to the HMP will then be coordinated with the hazard mitigation local planning team. The next update to the county EOP is anticipated by January 2017.

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### **Plan Interrelationships**

Ensuring consistency between these planning mechanisms is critical. In fact, Section 301 (4.1) of the Pennsylvania Municipalities Planning Code requires that comprehensive plans include a discussion of the interrelationships among their various plan components, “which may include an estimate of the environmental, energy conservation, fiscal, economic development and social consequences on the environment.”

To that end, Monroe County and its municipalities must ensure that the components of the hazard mitigation plan are integrated into existing community planning mechanisms and are generally consistent with goals, policies and recommended actions. Monroe County and the hazard mitigation planning team will utilize the existing maintenance schedule of each plan to incorporate the goals, policies and recommended actions as each plan is updated. Mitigation action 5.2.2 was developed to ensure that the county and all municipalities make every effort to integrate hazard mitigation plan data into all local plans and planning mechanisms. The LPT feels that this is a very achievable action.

### **7.4. Continued Public Involvement**

The Monroe County Office of Emergency Management will ensure that the 2016 Monroe County Hazard Mitigation Plan is posted and maintained on the Monroe County hazard mitigation website and will continue to encourage public review and comment on the plan. The Monroe County hazard mitigation website that the plan will be located at is as follows: [www.monroecountypa.gov/haz-mit](http://www.monroecountypa.gov/haz-mit)

The public will have access to the 2016 HMP through their local municipal office, the Monroe County Planning Commission, or the Monroe County Office of Emergency Management. Information on upcoming events related to the HMP or solicitation for comments will be announced via newsletters, newspapers, mailings, and the county hazard mitigation website.

The citizens of Monroe County are encouraged to submit their comments to elected officials and/or members of the Monroe County HMP Local Planning Team. To promote public participation, the Monroe County Local Planning Team will post a public comment form as well as the hazard mitigation project opportunity form on the county’s website. These forms will offer the public various opportunities to supply their comments and observations. All comments received will be maintained and considered by the Monroe County Hazard Mitigation Planning Team.

## **8. Plan Adoption**

### **8.1. Resolutions**

In accordance with federal and state requirements, the governing bodies of each participating jurisdiction must review and adopt by resolution, the 2016 Monroe County Hazard Mitigation Plan. Copies of the adopting resolutions are included in this plan in Appendix K. FEMA Region III in Philadelphia is the final approval authority for the Hazard Mitigation Plan. PEMA also reviews the plan before submission to FEMA.

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### **9. Acronyms**

ALPB:	Agricultural Land Preservation Board
BFE:	Base Flood Elevations
CFR:	Code of Federal Regulations
CRS:	Community Rating System
DCED:	Department of Community and Economic Development
DCNR:	Department of Conservation and Natural Resources
DCNR-BOF:	Department of Conservation and Natural Resources-Bureau of Forestry
DEP:	Department of Environmental Protection
DFIRM:	Digital Flood Insurance Rate Maps
EMA:	Emergency Management Agency
EMPG:	Emergency Management Performance Grant
EOP:	Emergency Operations Plan
EPA:	Environmental Protection Agency
EPCRA:	Emergency Planning and Community Right-to-Know Act
EPZ:	Emergency Planning Zone
FBFM:	Flood Boundary and Floodway Maps
FEMA:	Federal Emergency Management Agency
FIRM:	Flood Insurance Rate Map
FMA:	Flood Mitigation Assistance Grant Program
GIS:	Geographic Information Systems
HAZUS-MH:	Hazards U.S. Multi-Hazard
HMP:	Hazard Mitigation Plan
HMPU:	Hazard Mitigation Plan Update
HMPG:	Hazard Mitigation Planning Grant
HMRF:	Hazardous Material Response Fund
HSGP:	Homeland Security Grant Program
LEPC:	Local Emergency Planning Commission
LPT:	Local Planning Team
MCEMA:	Monroe County Emergency Management Agency
MCPC:	Monroe County Planning Commission
MPC:	Municipalities Planning Code
MRLC:	Multi-Resolution Land Characteristics Consortium
NCDC:	National Climatic Data Center
NDIS:	National Drought Information System
NDMC:	National Drought Mitigation Center
NFIP:	National Flood Insurance Program
NFPA:	National Fire Protection Association
NHC:	National Hurricane Center
NOAA:	National Oceanic & Atmospheric Administration

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NOAA HRD:	National Oceanic & Atmospheric Association – Hurricane Research Division
NWS	National Weather Service
PA DEP	Pennsylvania Department of Environmental Protection
PaGWIS:	Pennsylvania Groundwater Information System
PASDA:	Pennsylvania Spatial Data Access
PASTEEL:	<b>P</b> olitical <b>A</b> dministrative <b>S</b> ocial <b>T</b> echnical <b>E</b> conomic <b>E</b> nvironmental <b>L</b> egal
PDM:	Pre-Disaster Mitigation Grant
PDSI:	Palmer Drought Severity Index
PEIRS:	Pennsylvania Emergency Incident Reporting System
PEMA:	Pennsylvania Emergency Management Agency
PHGA:	Peak Horizontal Ground Acceleration
RF:	Risk Factor
SALDO:	Subdivision and Land Development Ordinance
SARA:	Superfund Amendments and Reauthorization Act
SFHA:	Special Flood Hazard Area
SFIP:	State Flood Insurance Program
SOG:	Standard Operating Guide
TRI:	Toxic Release Inventory
UCC:	Uniform Construction Code
US DOT:	United States Department of Transportation
USACE:	United States Army Corps of Engineers
USDA:	United States Department of Agriculture
USGS:	United States Geological Survey
WMD:	Weapons of Mass Destruction

## **10. Appendices**

<b>APPENDIX A:</b>	<b>Bibliography</b>
<b>APPENDIX B:</b>	<b>FEMA Local Mitigation Review Tool</b>
<b>APPENDIX C:</b>	<b>Meetings and Support Documents</b>
<b>APPENDIX D:</b>	<b>Municipal Flood Maps</b>
<b>APPENDIX E:</b>	<b>Critical and Special Needs Facilities</b>
<b>APPENDIX F:</b>	<b>Dam Failure Hazard Profile (Section 4.3.11)</b>
<b>APPENDIX G:</b>	<b>2016 Mitigation Project Opportunities</b>
<b>APPENDIX H:</b>	<b>2016 HAZUS Report</b>
<b>APPENDIX I:</b>	<b>2016 Mitigation Action Evaluation and Prioritization</b>
<b>APPENDIX J:</b>	<b>Annual Review Documentation</b>
<b>APPENDIX K:</b>	<b>Monroe County &amp; Municipal Adoption Resolutions</b>