MCM Consulting Group, Inc.

Susquehanna County FINAL 2018 Hazard Mitigation Plan

Susquehanna County Emergency Management Agency

Certification of Annual Review Meetings

YEAR	DATE OF MEETING	PUBLIC OUTREACH ADDRESSED? *	SIGNATURE
2019			
2020			
2021			
2022			
2023			

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

Record of Changes

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

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

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1. Introduction

1.1. Background

The Susquehanna 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 Susquehanna County and all of its forty municipalities. The Susquehanna County Emergency Management Agency was charged by the County Board of Commissioners to prepare the 2018 plan. The 2012 HMP has been utilized and maintained during the 5-year life cycle.

The Susquehanna County Commissioners were successful in securing hazard mitigation grant funding to update the county hazard mitigation plan. The pre-disaster mitigation grant funding was administered by the Pennsylvania Emergency Management Agency and provided to Susquehanna County as a sub-grantee. The Susquehanna County Commissioners assigned the Susquehanna County Department of Emergency Management Agency 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 Susquehanna County. This updated HMP will provide another solid foundation for the Susquehanna 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 (HMP) 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
- To comply with both state and federal legislative requirements for local hazard mitigation plans.

1.3. Scope

This Susquehanna County Multi-Jurisdictional Hazard Mitigation Plan serves as a framework for saving lives, protecting assets and preserving the economic viability of the forty municipalities in Susquehanna County. The HMP outlines actions designed to address and reduce the impact of a full range of natural hazards facing Susquehanna 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 Susquehanna 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.

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 Storm Water Management Act of October 4, 1978. P.L. 864, No. 167

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

2. Community Profile

2.1. Geography and Environment

Susquehanna County covers approximately 832 square miles and is situated in the northeast corner of Pennsylvania. The county is bordered by New York in the north, Wayne County to the east, Wyoming and Lackawanna Counties to the south, and Bradford County to the west. Susquehanna County is located within the Glaciated Low Plateaus section of the Appalachian Plateaus Province. There is a small section of the county that is part of the Anthracite Valley section of the Ridge and Valley Province. The county is the fifty-third ranked county in terms of population within the Commonwealth of Pennsylvania. There is a total of 832 square miles of land and ten square miles of water.

Susquehanna County presents a wide range of topographic features. The topography is characterized by rounded hills and broad to narrow valleys created by glacial erosion and deposition. Elevations in the county range from a high of 2,963 (903 meters) feet to a low of 800 (243 meters) feet.

The climate in Susquehanna County is characteristic of a humid continental type that is marked by extreme seasonal temperature changes. The mean daily temperature is 44.7˚F with a maximum mean monthly temperature of 79˚F in July and a mean monthly low of 14˚F in January. Yearly average rainfall is 44.9 inches. The average amount of snowfall each winter is 65 inches.

River and stream valleys dominate the landscape of Susquehanna County. The major water features are: Susquehanna and Lackawanna (west and east branches) rivers and Meshoppen, Tunkhannock, Snake, and Starrucca creeks (and its tributaries).

Susquehanna County is comprised of twenty-one watersheds:

- Apalachin Creek
- Choconut Creek
- Drinker Creek
- Dubois Creek
- East Branch Tunkhannock Creek
- East Middle Branch Wyalusing Creek
- Lackawanna River
- Martins Creek
- Meshoppen Creek
- Mitchell/Denton Creek
- North Branch Wyalusing Creek
- Salt Lick Creek

- Snake Creek
- South Branch Tunkhannock Creek
- Starrucca/Cascade Creek
- Susquehanna River
- Tunkhannock Creek
- Tunkhannock Creek (US of Martins Creek)
- Tunkhannock Creek (US of Nine Partners Creek)
- Wappasening Creek
- Wyalusing Creek

2.1. Community Facts

On February 21, 1810 Susquehanna County was established from portions of Luzerne County and named after the Susquehanna River which runs through the county. Montrose Borough is the county seat and was incorporated as a borough on March 19, 1824. The core communities in Susquehanna County are Auburn Township, Bridgewater Township, Clifford Township, Forest City Borough, Great Bend Township, New Milford Township, and Lenox Township.

The following boroughs and townships are located in Susquehanna County:

- Boroughs: Forest City, Friendsville, Great Bend, Hallstead, Hop Bottom, Lanesboro, Little Meadows, Montrose, New Milford, Oakland, Susquehanna Depot, Thompson, Union Dale.
- Townships: Apolacon, Ararat, Auburn, Bridgewater, Brooklyn, Choconut, Clifford, Dimock, Forest Lake, Franklin, Gibson, Great Bend, Harford, Harmony, Herrick, Jackson, Jessup, Lathrop, Lenox, Liberty, Middletown, New Milford, Oakland, Rush, Silver Lake, Springville, Thompson.

Susquehanna County's leading major industries are natural gas production, education, healthcare, and retail trade. The primary employment providers within Susquehanna County are displayed below in *Table 1 - Top Employers*.

Table 1 - Top Employers

Susquehanna County Top Employers	
Company	**Industry**
Barnes Kasson Hospital	Healthcare
Montrose Area School District	Education
PA State Government	Government
Elk Lake School District	Education
Mountain View School District	Education
Susquehanna County Government	Government
Blue Ridge School District	Education
Susquehanna Community School District	Education
Cabot Oil & Gas Corporation	Oil & Gas Provider
C & G Construction Inc.	Construction
Source: Pennsylvania Department of Labor & Industry	

The dairy industry has played a large role in the economic development in Susquehanna County. Farms cover thirty-six percent of the county land, and Susquehanna County has the twelfth largest number of cows among the sixty-seven counties in Pennsylvania. Additionally, the mining, quarrying, oil, and gas industries have also made a large impact on the economic development in this area of Pennsylvania.

2.3. Population and Demographics

Susquehanna County recorded a population of 43,356 during the 2010 U.S. Census, ranking the county in the 53rd position among Pennsylvania's sixty-seven counties. The population in this county is declining according to the U.S. Census Bureau whom estimated the population to be 40,862 in July of 2016, or -5.7% from the April 1, 2010 population census. The median income of households in Susquehanna County is $50,160. This is approximately $3,000 less than the national median household income (U.S. Census, 2014).

The populations per municipality are identified in *Table 2 - Municipal Population* below.

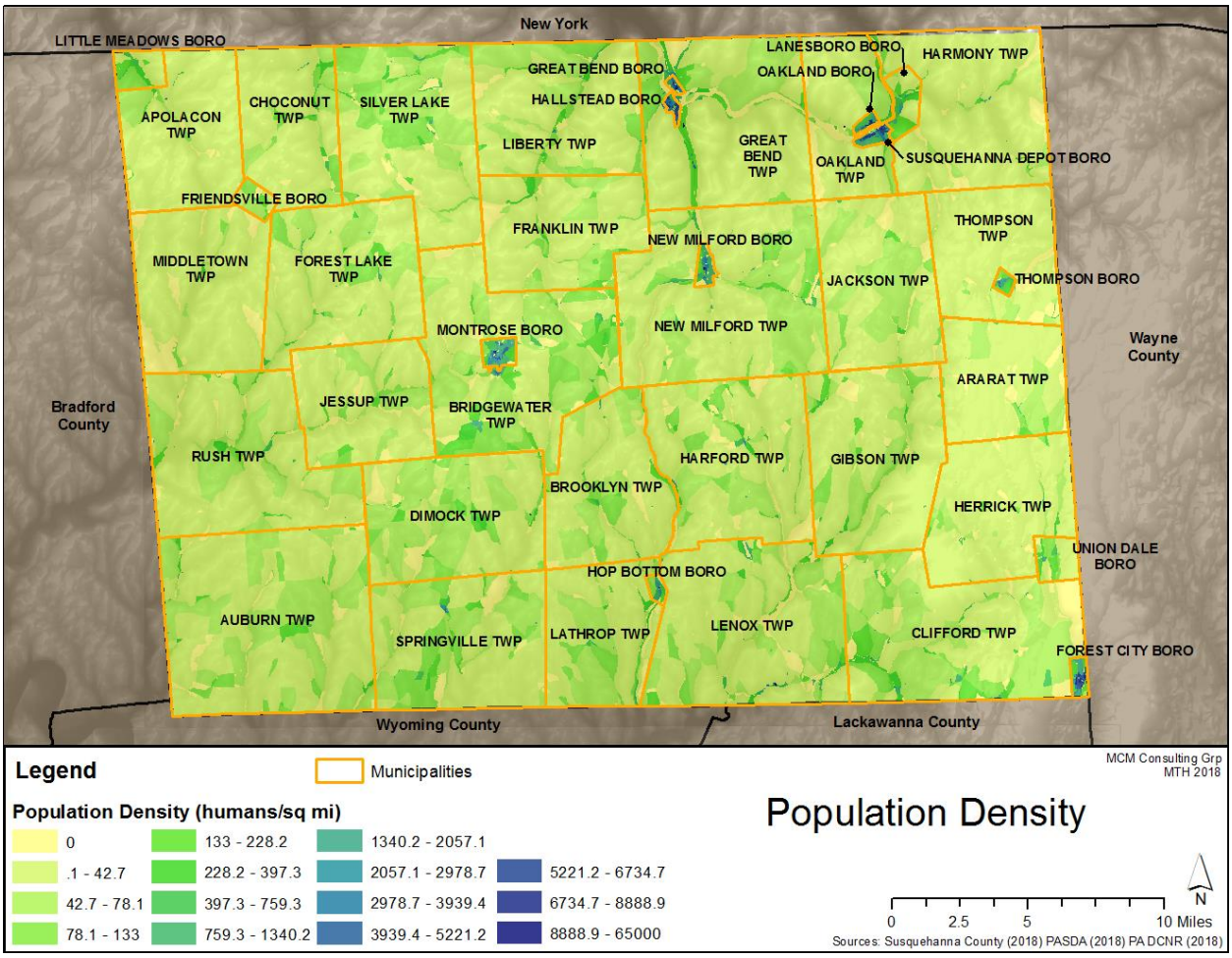
Table 2 - Municipal Population

Susquehanna County Municipality Populations			
Municipality	**Population**	**Municipality**	**Population**
Apolacon township	500	Jackson Township	848
Ararat Township	563	Jessup Township	536
Auburn Township	1,939	Lanesboro Borough	506
Bridgewater Township	2,844	Lathrop Township	841
Brooklyn Township	963	Lenox Township	1,934

Susquehanna County Municipality Populations			
Municipality	**Population**	**Municipality**	**Population**
Choconut Township	713	Liberty Township	1,292
Clifford Township	2,408	Little Meadows Borough	273
Dimock Township	1,497	Middletown Township	382
Forest City Borough	1,911	Montrose Borough	1,617
Forest Lake Township	1,193	New Milford Borough	868
Franklin Township	937	New Milford Township	2,042
Friendsville Borough	111	Oakland Borough	616
Gibson Township	1,221	Oakland Township	564
Great Bend Borough	734	Rush Township	1,267
Great Bend Township	1,949	Silver Lake Township	1,716
Hallstead Borough	1,303	Springville Township	1,641
Harford Township	1,430	Susquehanna Depot Borough	1,643
Harmony Township	528	Thompson Borough	299
Herrick Township	713	Thompson Township	410
Hop Bottom Borough	337	Union Dale Borough	267
Source: 2010 Census Bureau			

The median age in Susquehanna County is 45.1 years old (according to the 2010 United States Census Bureau). The largest population in Susquehanna County is sixty-five years or older years old (21.4 percent). A total of 22,968 housing units were identified during the 2010 census. In total, eighty-three percent of homes within Susquehanna County are 1-unit attached/detached, 13.02 percent are mobile homes, and the remaining percent are homes that are two or more units.

Figure 1 - Population Density Map



2.4. Land Use and Development

Susquehanna County is composed of forty municipalities. Susquehanna County can best be characterized as a rural community where agriculture has lost some of its economic importance, yet open land remains a predominate feature of the landscape. Although declining in recent years, dairy farms continue to operate in the county, with the better land used for field and forage crops. Forest is predominating land cover and timbering remains an important part of the local economy. Susquehanna County recognizes the importance of efficient use of limited financial resources and the need for careful planning. *Figure 2 - Land Use/Land Cover Map* outlines land use across the county.

2.5. Data Sources

- Susquehanna County Comprehensive Plan

- Susquehanna County Conservation District
- Susquehanna County Department of Planning
- Pennsylvania State Data Center
- United States Census Bureau (2010)
- United States Department of Agriculture (2012)
- Pennsylvania Department of Labor and Industry
- Pennsylvania Spatial Data Access (PASDA)
- Pennsylvania Department of Conservation and Natural Resources
- National Oceanic and Atmospheric Administration
- Federal Emergency Management Agency

Figure 2 - Land Use/Land Cover Map

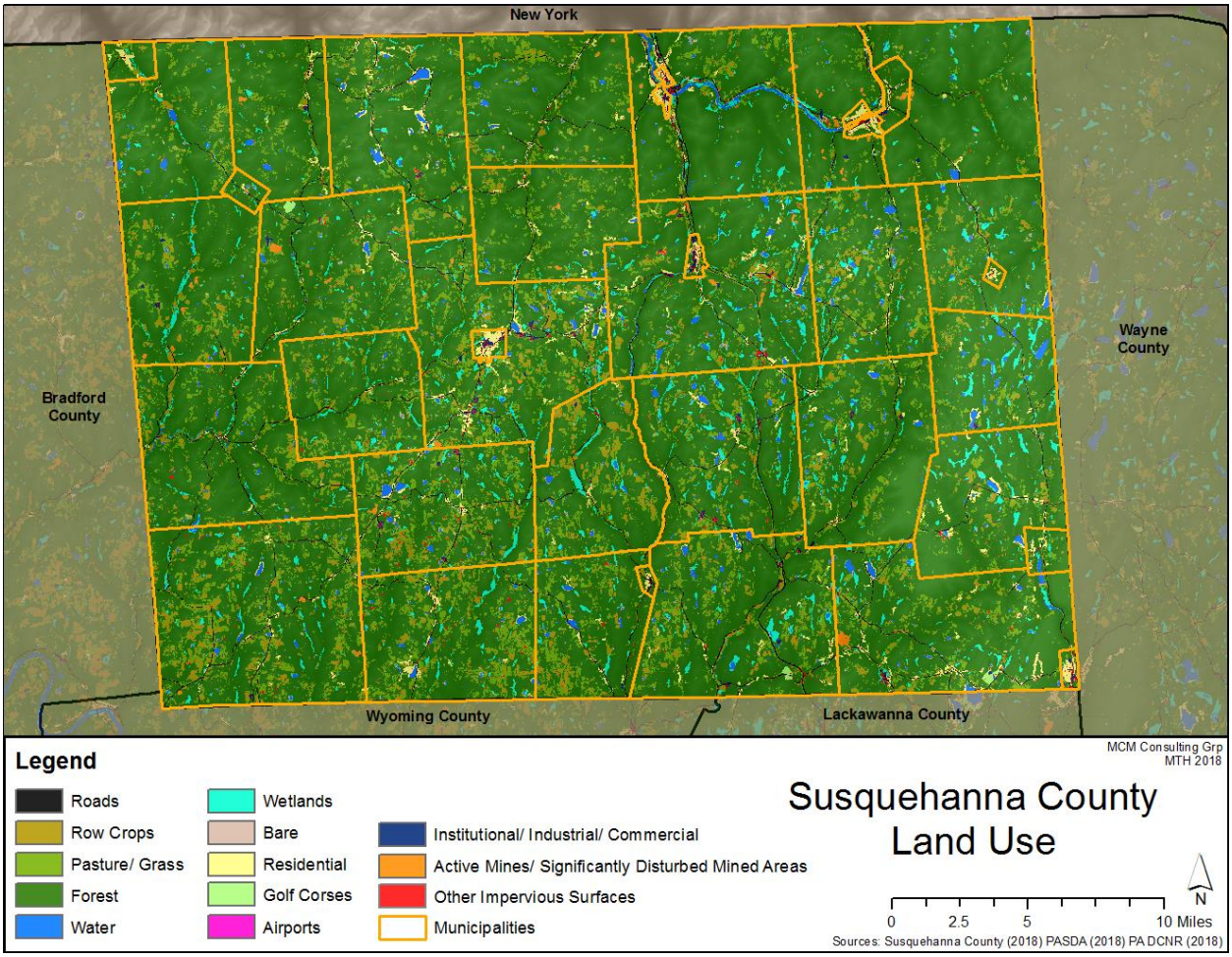


Figure 3 - Susquehanna County Base Map

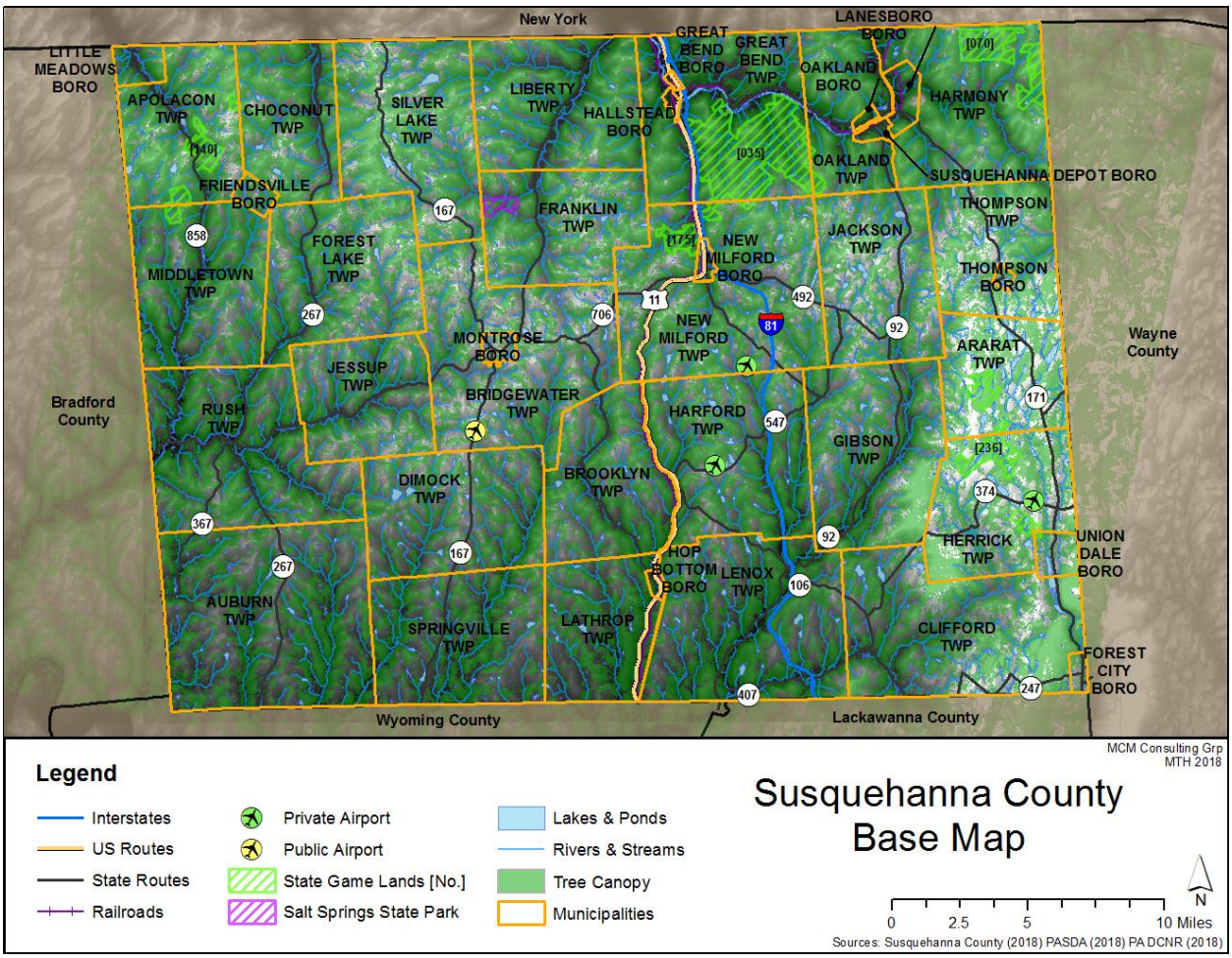


Figure 4 - Recreation Features

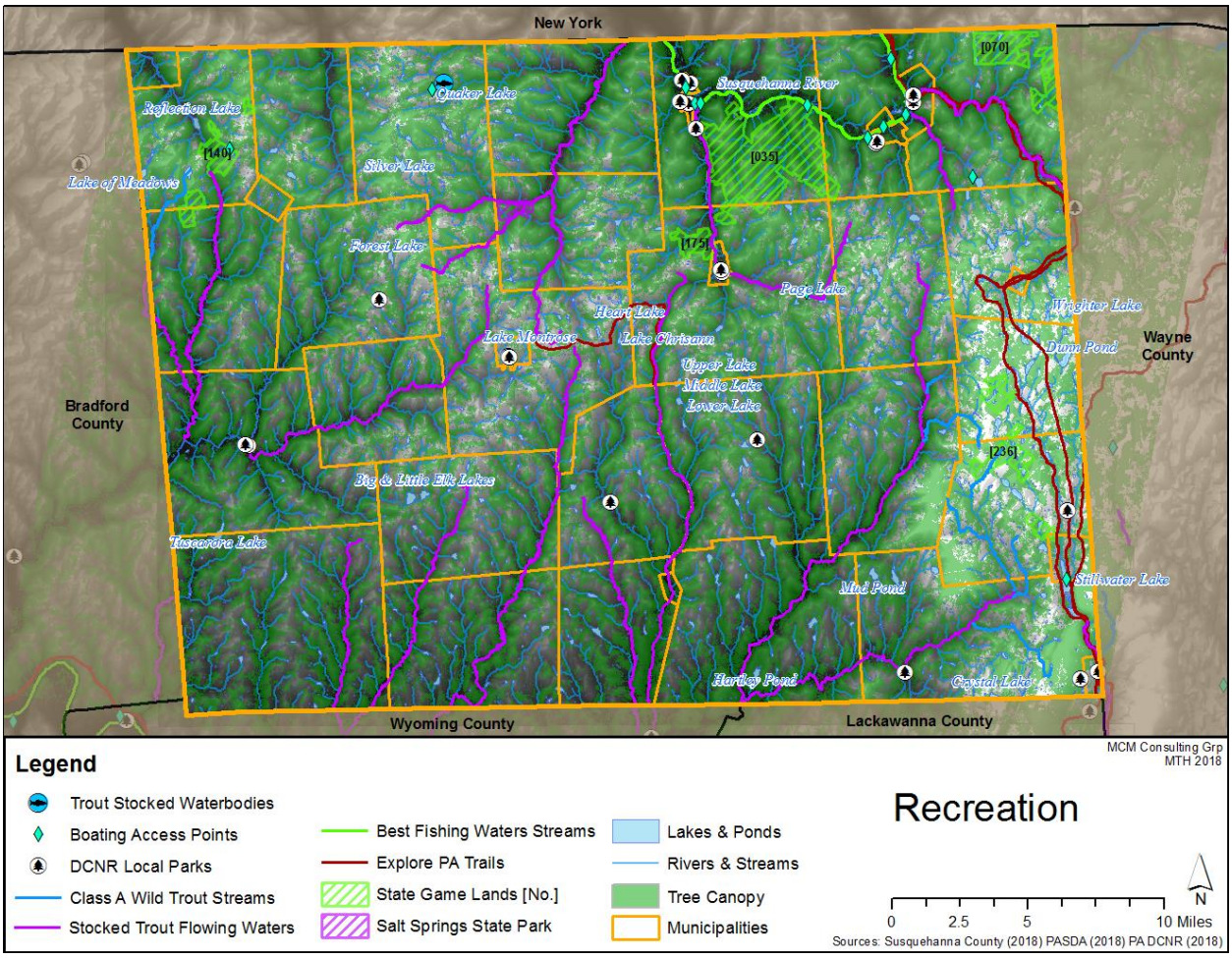
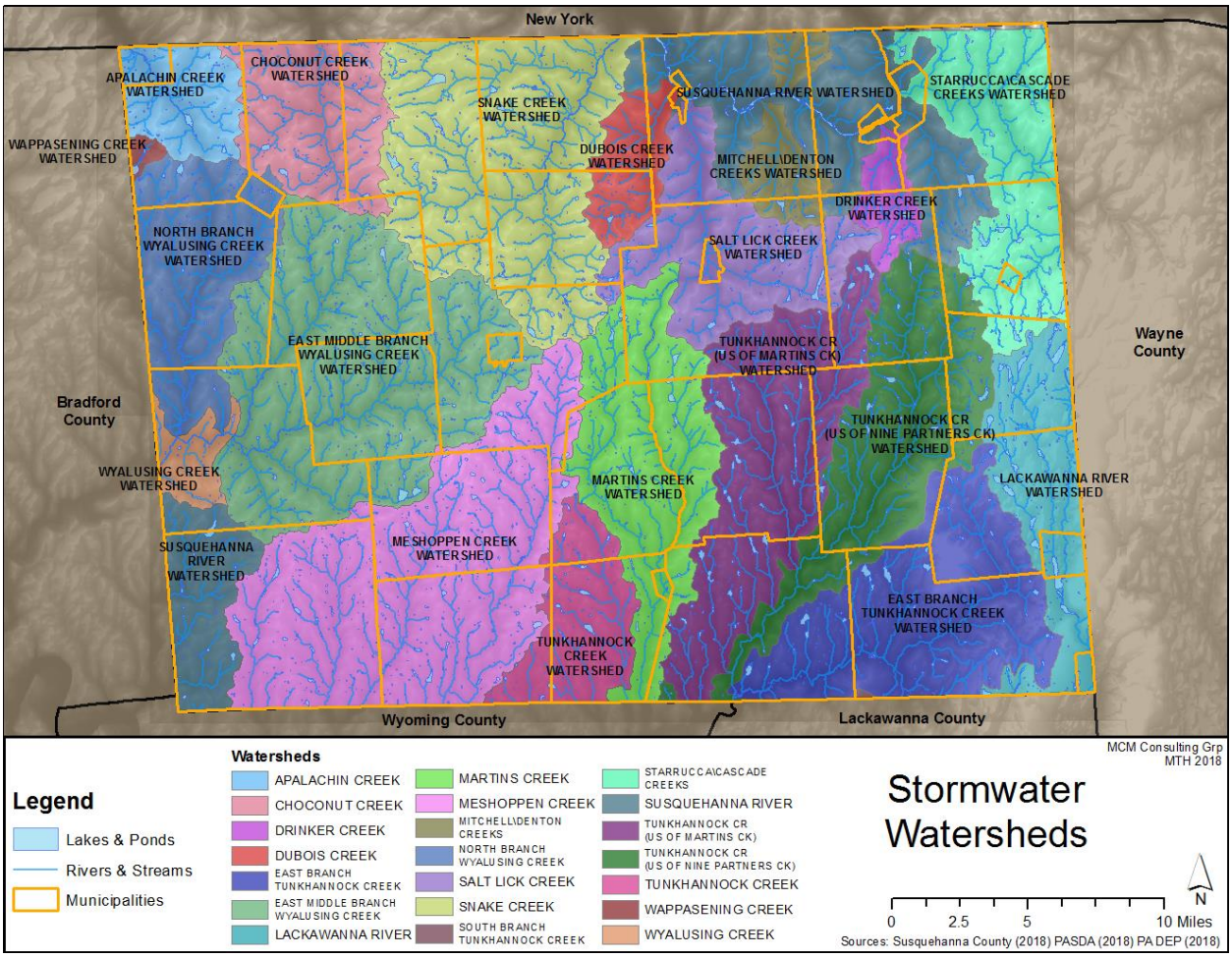


Figure 5 - Hydrologic Features



3. Planning Process

3.1. Update Process and Participation Summary

The Susquehanna County Hazard Mitigation Plan update began July 19, 2017. The Susquehanna County Commissioners were able to secure a hazard mitigation grant to start the process. The Susquehanna County Emergency Management Agency was identified as the lead agency for the Susquehanna County Hazard Mitigation Plan update. The planning process involved a variety of key decision makers and stakeholders within Susquehanna County. Susquehanna County immediately 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 Susquehanna County Emergency Management Agency, Department of Public Safety, GIS Department, Planning Department 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 Crosswalk, 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 Susquehanna County Emergency Management Agency in coordinating and leading public involvement meetings, local planning team meetings, analysis and the writing of the HMP. The Susquehanna 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 Susquehanna 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. Susquehanna 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 planning grant (HMPG) to fund the planning project.
- Announcing the initiative via press releases and postings on the county website.
- 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 Susquehanna County Board of Commissioners.
- Plan submission to FEMA and PEMA.

The 2018 Susquehanna County HMP was completed June 7, 2018. The 2018 plan follows an outline developed by PEMA which provides a standardized format for all local HMPs in the Commonwealth of Pennsylvania. The 2018 HMP format is consistent with the PEMA recommended format. The 2018 Susquehanna 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 2018 Susquehanna County Hazard Mitigation Plan update was led by the Susquehanna County Project Team. The Susquehanna 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

Susquehanna County Hazard Mitigation Plan Update Project Team		
Name	**Organization**	**Position**
EMA Coordinator	Susquehanna County EMA	EMA Coordinator
Kiana Lavery	Susquehanna County EMA	Operations & Trainings Officer
Bruce Butler	Susquehanna County 9-1-1	911 Coordinator
Nancy Tator	Susquehanna County 9-1-1	911 Training & Quality Assurance Supervisor
Matt Osmulski	Susquehanna County GIS	GIS Specialist
Bob Templeton	Susquehanna County Planning	Director

Susquehanna County Hazard Mitigation Plan Update Project Team		
Name	**Organization**	**Position**
Michael Rearick	MCM Consulting Group, Inc.	Project Manager
Robert Anderson	MCM Consulting Group, Inc.	Consultant
Corbin Snyder	MCM Consulting Group, Inc.	Project Coordinator

In order to represent the county, the Susquehanna County Project Team developed a diversified list of potential Local Planning Team (LPT) members. Members that participated in the 2012 hazard mitigation plan were highly encouraged to join the 2018 team. The project team then provided invitations to the prospective members and provided a description of duties to serve on the LPT. The following agencies, departments and organizations were invited to participate in the LPT: Susquehanna County Commissioners, Susquehanna County Planning Commission, DCNR Bureau of Forestry, Northeast Regional Office of Department of Environmental Protections, Susquehanna County Sheriff, Susquehanna GIS, Susquehanna Council of Governments, PennDOT, Susquehanna County Conservation District, American Red Cross, Department of Community and Economic Development, Friends of Salt Springs State Park, Inc., Montrose Minute Men, Inc., Mountain View School, National Weather Service, Penn State Extension, Susquehanna River Basin Commission and all forty municipalities. The invitations for membership of the LPT were disseminated by the Susquehanna County Emergency Management Agency utilizing letters, email and telephone calls. The LPT worked throughout the process to plan and hold meetings, collect information and conduct public outreach.

The stakeholders listed in *Table 4 - Local Planning Team* served on the 2018 Susquehanna 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

Susquehanna County Hazard Mitigation Plan Update Local Planning Team		
Name	**Organization**	**Position**
Kate Crowley	American Red Cross	Elected or appointed official
Craig Benson	Ararat Township	Elected or appointed official
Katherine M Shelly	Ararat Township	Elected or appointed official
Dan Trivett	Auburn Township	Elected or appointed official
Gilbert Oakes	Auburn Township	Elected or appointed official
Chris Harris	Bridgewater Township	Elected or appointed official
Kirk Heffner	Bridgewater Township	Elected or appointed official
Roger Doolittle	Choconut Township	Elected or appointed official
William Dovin	Choconut Township	Elected or appointed official

Susquehanna County Hazard Mitigation Plan Update Local Planning Team		
Name	**Organization**	**Position**
Barry Seakle	Clifford Township	Elected or appointed official
Chris Marcho	Clifford Township	Elected or appointed official
Joan Hertzog	Clifford Township	Elected or appointed official
Kurt Booths	Clifford Township	Elected or appointed official
Larry Wilson	Clifford Township	Elected or appointed official
Philip Price	Clifford Township	Elected or appointed official
Esther Rayias	Dimock Township	Elected or appointed official
Mark Wood	Dimock Township EMC	Elected or appointed official
Brandon Hansingr	Dimock Township	Elected or appointed official
Chris DeGonzague	Forest City Borough	Elected or appointed official
Sharon Vannan	Forest City Borough	Elected or appointed official
Joann Matarese	Forest City Borough Council	Elected or appointed official
Frank Pinkowski	Forest Lake Township	Elected or appointed official
Marvin Small	Forest Lake Township	Elected or appointed official
Philip DePue	Franklin Township	Elected or appointed official
Abe Curley	Friendsville Borough	Elected or appointed official
Laura Legg	Friendsville Borough	Elected or appointed official
Tina Curley	Friendsville Borough	Elected or appointed official
Chris Burdick	Gibson Township	Elected or appointed official
Harold Shay	Gibson Township	Elected or appointed official
Mike Van Gorden	Great Bend Borough/Great Bend Township	Elected or appointed official
Philip Callender	Hallstead Borough	Elected or appointed official
Andrew Belcher	Herrick Township	Elected or appointed official
Deb Norton	Hop Bottom Borough	Elected or appointed official
Chad Wallace	Jackson Township	Elected or appointed official
Bruce Griffis	Jessup Township	Elected or appointed official
Constance Kiefer	Jessup Township	Elected or appointed official
Thomas Nitterour	Lanesboro Borough	Elected or appointed official
Paul Hinka	Lathrop Township	Elected or appointed official
Len Wheatley	Lenox Township	Elected or appointed official
Alton Wilber	Liberty Township	Elected or appointed official
Barry Abbott	Liberty Township	Elected or appointed official
Charlie Fahringer	Little Meadows Borough	Elected or appointed official
Lloyd Wambold	Middletown Township	Elected or appointed official
Thomas Lamont	Montrose Borough	Elected or appointed official
Daniel Totten	New Milford Borough	Elected or appointed official
Kenneth Bondurant	New Milford Township	Elected or appointed official
David Nicosia	NOAA-NWS Binghamton	Elected or appointed official
Paul Dudley	Oakland Borough	Elected or appointed official
Barbara Whitehead	Oakland Township	Elected or appointed official
Dave Juser	Rush Township	Elected or appointed official
Lynda Juser	Rush Township	Elected or appointed official

Susquehanna County Hazard Mitigation Plan Update Local Planning Team		
Name	**Organization**	**Position**
Evan Everitt	Silver Lake Township	Elected or appointed official
Duane Wood	Springville Township	Elected or appointed official
Roy Williams	Susquehanna Borough	Elected or appointed official
Staci Wilson	Susquehanna County Independent	Elected or appointed official
Kim Wallace	Thompson Borough	Elected or appointed official
Alex Komar	Thompson Township	Elected or appointed official
Richard Wademan	Thompson Township	Elected or appointed official
Suzanne Jenkins	Thompson Township	Elected or appointed official
James Montenegro	Union Dale Borough	Elected or appointed official
Tom Yale	Union Dale Borough	Elected or appointed official

3.3. Meetings and Documentation

Monthly public meetings with local elected officials and the local planning team were held. At each of the public 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 June 6, 2018 to present the draft plan and invite public comments. The meeting was advertised in the local newspaper and also made available digitally on the Susquehanna County web site at: www.susqco.com/county-government/emergency-management/hazard-mitigation-plan.

The Susquehanna County website was used to make a digital copy of the draft hazard mitigation plan available.

The public comment period remained open until July 9, 2018. All public comments were submitted in writing to the EMA Coordinator at the Susquehanna County Emergency Management Agency. The public comment that was received has been included in this plan in Appendix C.

Table 5 - HMP Process Timeline

Susquehanna County HMP Process - Timeline		
Date	**Meeting**	**Description**
07/10/17	Susquehanna 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.
10/26/17	Local Planning Team Initial Meeting	Defined hazard mitigation planning and identified roles and responsibilities. Discussed the 2012 hazard mitigation plan and defined a timeline to complete the update.
01/17/18	Public Meeting	Conducted a public meeting to review the draft risk assessment section of the Susquehanna County Hazard Mitigation Plan update.
02/06/18 through 02/08/18	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.
06/07/18	Susquehanna 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

Susquehanna County engaged numerous stakeholders and encouraged public participation during the HMP update process. Advertisements for public meetings were completed utilizing the local newspaper and the Susquehanna County website. Copies of those advertisements 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. Worksheets and surveys completed by the municipalities and other stakeholders are located in appendices of this plan update as well. 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 Susquehanna County Emergency Management Agency Department 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 EMA.

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 2012 mitigation opportunity forms that were included in the current HMP were provided to the municipalities for review and amendment. These opportunities are located in Appendix F. The previous mitigation actions were provided and reviewed at update meetings. New 2018 municipal project opportunity forms are included as well, located 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.

Susquehanna County invited all contiguous counties to review the 2018 draft hazard mitigation plan. A letter was sent to the emergency management coordinator in the surrounding counties on June 8, 2018. Copies of these letters are included in Appendix C.

3.5. Multi-Jurisdictional Planning

Susquehanna 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 municipality participation by completing worksheets, surveys and forms. All forty municipalities within Susquehanna County have adopted the 2012 Susquehanna County Hazard Mitigation Plan as the municipal hazard mitigation plan. The Susquehanna County Local Planning Team goal is 100% participation by municipalities in adopting the 2018 Susquehanna County Hazard Mitigation Plan.

Table 6 - Worksheets, Surveys and Forms Participation

Municipality Participation in Worksheets, Surveys and Forms			
Municipality	**Capability Assessment Survey**	**Risk Assessment Hazard Identification and Risk Evaluation Worksheet**	**Hazard Mitigation Opportunity Form Review and Updates**
Apolacon Township	X	X	X
Ararat Township	X	X	X
Auburn Township	X	X	
Bridgewater Township	X	X	X
Brooklyn Township	X	X	X
Choconut Township	X	X	X
Clifford Township	X	X	X
Dimock Township	X	X	X
Forest City Borough	X	X	
Forest Lake Township	X	X	X
Franklin Township	X	X	X
Friendsville Borough	X	X	
Gibson Township	X	X	
Great Bend Borough	X	X	
Great Bend Township	X	X	
Hallstead Borough	X	X	
Harford Township	X	X	
Harmony Township	X	X	X
Herrick Township	X	X	X
Hop Bottom Borough	X	X	
Jackson Township	X	X	X
Jessup Township	X	X	X
Lanesboro Borough	X	X	X
Lathrop Township	X	X	X
Lenox Township	X	X	X
Liberty Township	X	X	X
Little Meadows Borough	X	X	
Middletown Township	X	X	
Montrose Borough	X	X	X
New Milford Borough	X	X	X
New Milford Township	X	X	X
Oakland Borough	X	X	
Oakland Township	X	X	
Rush Township	X	X	
Silver Lake Township	X	X	X
Springville Township	X	X	X
Susquehanna Depot Borough	X	X	X
Thompson Borough	X	X	
Thompson Township	X	X	
Union Dale Borough	X	X	X

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 Susquehanna County risk assessment provides in-depth knowledge of the hazards and vulnerabilities that affect Susquehanna 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 Susquehanna County Emergency Operations Plan (EOP), local EOPs and other public and private emergency management plans.

The Susquehanna County risk assessment is not a static document, but rather, is a biennial review requiring periodic updates. Potential future hazards include changing technology, new facilities and infrastructure, dynamic development patterns and demographic and socioeconomic changes into or out of hazard areas. By contrast, old hazards, such as brownfields and landfills, may pose new threats as county conditions evolve.

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 Susquehanna County Local Planning Team reviewed and assessed the change in risk for all natural and manmade hazards identified in the 2012 hazard mitigation plan. The mitigation planning team then identified hazards that were outlined within the Pennsylvania Hazard Mitigation Plan but not included in the 2012 Susquehanna County

Hazard Mitigation Plan that could impact Susquehanna County. The team utilized the Hazard Identification and Risk Evaluation worksheet that was provided by the Pennsylvania Emergency Management Agency.

The Susquehanna County Project Team met with municipalities and provided guidance on how to complete the municipal hazard identification and risk evaluation worksheet. All 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 Susquehanna 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 Susquehanna County from 1972 through 2014, according to the Pennsylvania Emergency Management Agency.

Table 7 - Presidential & Gubernatorial Disaster Declarations

Presidential Disaster Declarations and Gubernatorial Declarations and Proclamations		
Date	**Hazard Event**	**Action**
September, 1955	Drought	Gubernatorial Declaration
March, 1963	Ice jam (Susquehanna-Juniata Rivers	Gubernatorial Declaration
March, 1964	Flood (W. Branch Susquehanna River)	Gubernatorial Declaration
January, 1966	Heavy snow	Gubernatorial Declaration
February, 1972	Heavy snow	Gubernatorial Declaration
June, 1972	Flood (Agnes)	Presidential Disaster Declaration
February, 1974	Truckers strike	Gubernatorial Declaration
September, 1975	Flood (Eloise)	Presidential Disaster Declaration
October, 1976	Flooding	Presidential Disaster Declaration
January, 1978	Heavy snow	Gubernatorial Declaration
February, 1978	Blizzard	Gubernatorial Declaration

Presidential Disaster Declarations and Gubernatorial Declarations and Proclamations		
Date	**Hazard Event**	**Action**
September, 1985	Flood	Presidential Disaster Declaration
March, 1993	Blizzard	Presidential Emergency Declaration
January, 1994	Severe winter storms	Presidential Disaster Declaration
September, 1995	Drought	Gubernatorial Declaration
January, 1996	Severe winter storms	Presidential Disaster Declaration
January, 1996	Flooding	Presidential Disaster Declaration
June, 1998	Severe storms, tornadoes	Presidential Disaster Declaration
July, 1999	Drought	Gubernatorial Declaration
September, 1999	Hurricane Floyd	Presidential Disaster Declaration
September, 2003	Hurricane Isabel/Henri	Presidential Disaster Declaration
September, 2004	Tropical Depression Ivan	Presidential Disaster Declaration
April, 2005	Severe storms, flooding, and mud-slides	Presidential Disaster Declaration
September, 2005	Hurricane Katrina – to render mutual aid and to receive and house evacuees	Presidential Emergency Declaration
September, 2005	Hurricane Katrina	Gubernatorial Proclamation of Emergency
June, 2006	Flooding	Presidential Proclamation of Emergency
September, 2006	Tropical depression Ernesto	Gubernatorial Proclamation of Emergency
November, 2006	Flooding	Presidential Proclamation of Emergency
February, 2007	waive the regulations regarding hours of service limitations for drivers of commercial vehicles	Gubernatorial Proclamation of Emergency
February, 2007	Severe winter storm	Gubernatorial Declaration
April, 2007	Severe storm	Gubernatorial Proclamation of Emergency
February, 2010	severe winter storm	Gubernatorial Proclamation of Emergency
January, 2011	Severe winter storm	Gubernatorial Proclamation of Emergency
September, 2011	Severe storms and flooding (Lee/Irene)	Gubernatorial Proclamation of Emergency
September, 2011	Hurricane Irene	Presidential Disaster Declaration
September, 2011	Remnants of Tropical Storm Lee	Presidential Proclamation of Emergency
September, 2011	Remnants of Tropical Storm Lee	Presidential Disaster Declaration
April, 2012	Spring winter storms	Gubernatorial Proclamation of Emergency
October, 2012	Hurricane Sandy	Gubernatorial Proclamation of Emergency
October, 2012	Hurricane Sandy	Presidential Proclamation Emergency Declaration
June, 2013	High winds, thunderstorms, heavy rain, tornado, flooding	Gubernatorial Proclamation of Emergency
January, 2014	Extended prolonged cold	Gubernatorial Proclamation of Emergency

Presidential Disaster Declarations and Gubernatorial Declarations and Proclamations		
Date	**Hazard Event**	**Action**
January, 2014	Driver hours waived due to prolonged and continued severe winter weather	Gubernatorial Proclamation of Emergency
February, 2014	Severe winter weather	Gubernatorial Proclamation of Emergency
February, 2014	Severe winter storm	Presidential Proclamation of Emergency
March, 2017	Severe winter storm	County and Municipal Declarations
July, 2017	Flash Flooding	County and Municipal Declarations

4.2.2. Summary of Hazards

The Susquehanna County Local Planning Team (LPT) was provided the Pennsylvania Standard List of Hazards to be considered for evaluation in the 2018 HMP Update. Following a review of the hazards considered in the 2012 HMP and the standard list of hazards, the Local Planning Team decided that the 2018 plan should identify, profile and analyze twenty hazards. These twenty hazards include all of the hazards profiled in the 2012 plan. The list below contains the twenty hazards that have the potential to impact Susquehanna County as identified through previous risk assessments, the Susquehanna County Hazards Vulnerability Analysis and input from those that participated in the 2018 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).

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.

Hailstorm

In addition to flooding and severe winds, hail is another potential damaging product of severe thunderstorms. Hailstorms occur when ice crystals form within a low pressure front due to the rapid rise of warm air into the upper atmosphere and the subsequent cooling of the air mass. Frozen droplets gradually accumulate on the ice crystals until, having developed sufficient weight, they fall as precipitation in the form of balls or irregularly shaped masses of ice greater than 0.75 inches in diameter (FEMA, 1997). The size of hailstones is a direct function of the size and severity of the storm. High velocity updraft winds are required to keep hail in suspension in thunderclouds. The strength of the updraft is a function of the intensity of heating at the Earth's surface. Damage to crops and vehicles are typically the most significant impacts of hailstorms. Areas in eastern and central Pennsylvania typically experience less than 2 hailstorms per year while areas in western Pennsylvania experience 2-3 annually.

Hurricanes, Tropical Storms, Nor'easter

Hurricanes, tropical storms and nor'easters are classified as cyclones and are any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise (in the Northern Hemisphere) and whose diameter averages 10-30 miles across. While most of Pennsylvania is not directly affected by the devastating impacts cyclonic systems can have on coastal regions, many areas in the state are subject to the primary damaging forces associated with these storms including high-level sustained winds, heavy precipitation and 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).

Landslide

A landslide is the downward and outward movement of slope-forming soil, rock and vegetation reacting to the force of gravity. Landslides may be triggered by both natural and human-caused changes in the environment, including heavy rain, rapid snow melt, steepening of slopes due to construction or erosion, earthquakes and changes in groundwater levels. Mudflows, mudslides, rock falls, rockslides and rock topples are all forms of a landslide. Areas that are generally prone to landslide hazards include previous landslide areas, the bases of steep slopes, the bases of drainage channels, developed hillsides and areas recently burned by forest and brush fires. (Delano & Wilshusen, 2001).

Lightning Strikes

Lightning is a discharge of electrical energy resulting from the build-up of positive and negative charges within a thunderstorm. The flash or "bolt" of light usually occurs within clouds or between clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000°F. On average, 89 people are killed each year by lightning strikes in the United States. Within Pennsylvania, the annual average number of thunder and

lightning events in a given area can expect ranges between 40-70 events per year (FEMA, 1997).

Pandemic 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).

Radon Exposure

Radon is a cancer-causing natural radioactive gas that you can't see, smell, or taste. It is a large component of the natural radiation that humans are exposed to and can pose a serious threat to public health when it accumulates in poorly ventilated residential and occupation settings. According to the USEPA, radon is estimated to cause about 21,000 lung cancer deaths per year, second only to smoking as the leading cause of lung cancer (EPA 402-R-03-003: EPA Assessment..., 2003). An estimated 40% of the homes in Pennsylvania are believed to have elevated radon levels (Pennsylvania Department of Environmental Protection, 2009).

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 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

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

Cyber Crime Attack

Cyber-attacks are maliciously intended actions against a person or organization, often for financial or terror-related reasons. They can take many forms ranging from specifically targeting human operators to a broader computer-based attack on entire systems. Generally, attacks last just minutes but larger events can have lasting impacts on systems and data.

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).

Environmental Hazards

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

- Hazardous material releases; at fixed facilities or as such materials are in transit and including toxic chemicals, infectious substances, biohazardous waste and any materials that are explosive, corrosive, flammable, or radioactive (PL 1990-165, § 207(e)).
- Air or Water Pollution; the release of harmful chemical and waste materials into water bodies or the atmosphere, for example (National Institute of Health Sciences, July 2009; 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).

Opioid Epidemic

The opioid epidemic is the rapid increase in the use of prescription and non-prescription opioid drugs in the United States beginning in the late 1990s and continuing throughout the first two decades of the 2000s. Opioids are a diverse class of moderately strong painkillers, including oxycodone, hydrocodone, and a very strong painkiller, fentanyl, which is synthesized to resemble other opiates such as opium-derived morphine and heroin. The potency and availability of these substances, despite their high risk of addiction and overdose, have made them popular both as formal medical treatments and as recreation-al drugs. Due to their sedative effects on the part of the brain which regulates breathing, opioids in high doses present the potential for respiratory depression, and may cause respiratory failure and death.

The Commonwealth of Pennsylvania, along with other states in the nation has enacted legislation to curb the prescription and distribution of these drugs to try to prevent addiction rising from abuse as a painkiller. This includes but is not limited to restrictions

to prescribing to minors, quantity limits, a prescription database with entry requirements and other limits to its availability.

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 (Susquehanna 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).
- 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 temperatures. 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 4.3.9). 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).

Increasing temperatures will cause rainfall patterns to change over time – warmer air holds more moisture, so the prospect of climate change means that heavier and more intense precipitation events are expected. Over the last 100 years, average annual precipitation in Pennsylvania has increased between 5 and 10 percent, and the amount of precipitation from extreme storm events have increased 70 percent in the Northeast since 1958 (EPA, 2016). Precipitation is thought to increase mostly in the winter and spring and remain somewhat consistent in the summer and fall. Higher temperatures

will cause snow to melt earlier in the spring, and in combination with heightened precipitation conditions, it is expected that the risk of flooding (Section 4.3.3) and dam and levee failures (Section 4.3.15) will be heightened in the winter and spring.

Similarly, extreme winter storms (Section 4.3.13) are expected to occur more frequently – there have been about twice as many extreme snow events in the United States in the latter half of the 20th century as occurred in the first half (NOAA, 2018). This uptick is caused in part by higher than normal ocean surface temperatures that result in an increased source of moisture for storms that develop over the Atlantic Ocean. Conditions for severe winter storms are particularly heightened in the eastern United States due to changes in atmospheric circulation patterns caused by higher temperatures and melting Arctic sea ice (Francis & Vavrus, 2012).

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).

Warmer temperatures and earlier snow melt in the spring is also expected to increase evaporation and dry out soil, resulting in heightened drought (Section 4.3.1) conditions during summer and fall months (EPA, 2016). Correspondingly this will impact wildfires (Section 4.3.12) as 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 Susquehanna County in the Eastern United States.

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.

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 Susquehanna 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, thirty-year average precipitation).
- Reservoir storage levels in a variety of locations such as three New York City reservoirs in the upper Delaware River Basin.
- Groundwater elevations in a number of counties (comparing to past month, past year and historic record).
- 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.

Table 8 - Palmer Drought Severity Index

Severity Category	PDSI
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 (PA DEP)

Phase	General Activity	Actions	Request	Goal
Drought Watch	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%
Drought Warning	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%
Drought Emergency	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%

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, 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. [PEMA, 409 Plan]

4.3.1.3 Past Occurrence

Table 10 - Drought Event History for Susquehanna County shows declared drought status for Susquehanna County from 1980 to November 2017 as reported by the Pennsylvania Department of Environmental Protection (PA DEP) and the table also includes past disaster declarations impacting Susquehanna County due to drought events. Susquehanna County has experienced severe drought (PDSI ≤ -3) between five and ten percent of the time from 1895-1995, which gives a good idea of how often the county has been affected by drought events.

Susquehanna County experienced a significant drought in 1982. The event was widespread across the Commonwealth and caused over $196 million in losses. The drought negatively impacted dairy farmers, and subsidies had to be issued to farmers to offset the substantial losses during this event (Susquehanna County, 2012).

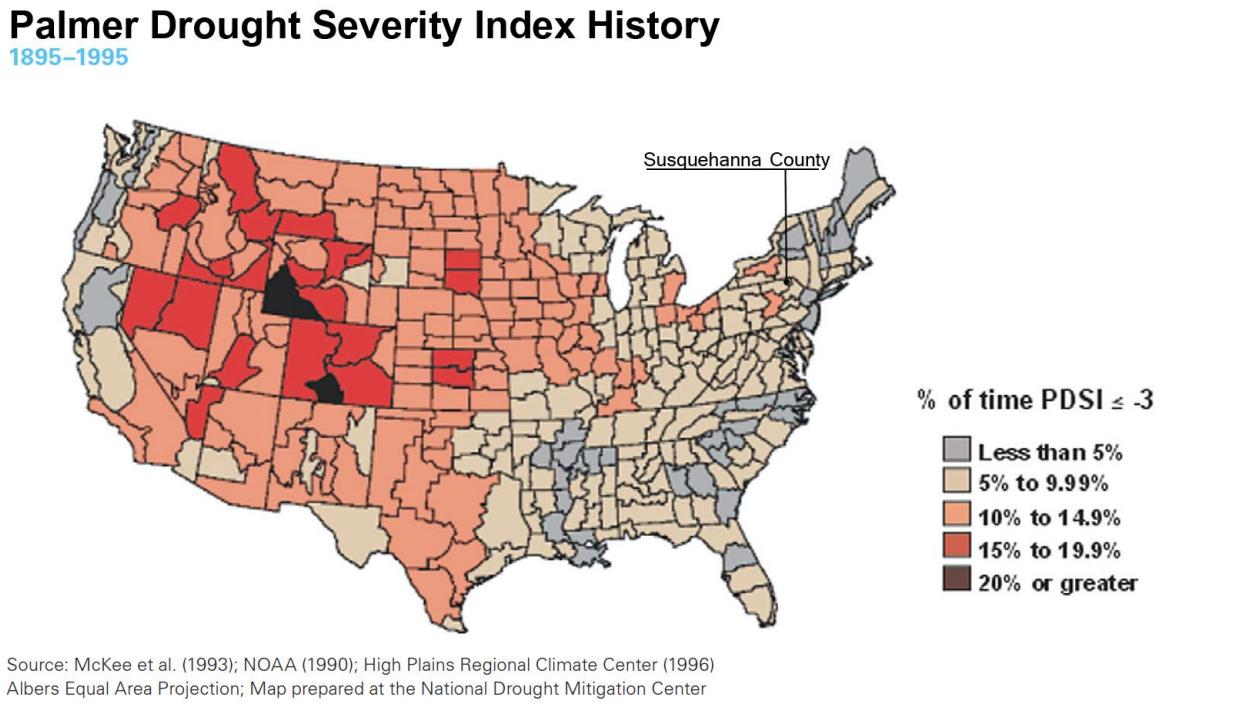
Another significant drought event occurred in September of 1995 in Susquehanna County when much of the eastern portion of the Commonwealth was under a drought emergency. Crop losses were estimated at approximately $300 million statewide.

One of the worst droughts on record for Susquehanna County occurred throughout the year in 1999, culminating with the governor of Pennsylvania declaring a drought emergency for most of the Commonwealth on July 21, 1999, including Susquehanna County. Corn crop losses alone were estimated to be approximately $100 million with total crop losses estimated at over $500 million. Other than agricultural losses, the drought resulted in low stream levels which caused some deaths of fishes in abnormally dry streams. The drought emergency was lifted on September 30, 1999 with the arrival of Hurricane Floyd on the 16th.

Table 10 - Drought Event History for Susquehanna County

Drought Event History for Susquehanna County (PA DEP 2017)			
Start Date	**End Date**	**Drought Status**	**Event Duration**
11/18/80	04/20/82	Emergency	17 months, 2 days
04/26/85	12/19/85	Warning	7 months, 23 days
07/07/88	08/24/88	Watch	10 months, 8 days
08/24/88	12/12/88	Warning	
12/12/88	05/15/89	Watch	
06/28/91	07/24/91	Warning	11 months, 26 days
07/24/91	04/20/92	Emergency	
04/20/92	06/23/92	Warning	
09/01/95	09/20/95	Warning	3 months, 17 days
09/20/95	11/08/95	Emergency	
11/08/95	12/18/95	Warning	
07/19/97	01/16/98	Watch	5 months, 28 days
12/03/98	12/14/98	Watch	17 months, 2 days
12/14/98	03/15/99	Warning	
03/15/99	06/10/99	Watch	
06/10/99	07/20/99	Warning	
07/20/99	09/30/99	Emergency**	
09/30/99	05/05/00	Watch	
12/05/01	06/14/02	Watch	6 months, 9 days
09/05/02	11/02/02	Watch	1 months, 28 days
04/11/06	06/30/06	Watch	2 months, 19 days
08/06/07	09/05/07	Watch	0 months, 30 days
08/05/07	01/11/08	Watch	5 months, 6 days
09/16/10	11/10/10	Watch	1 months, 25 days
03/24/15	07/10/15	Watch	3 months, 16 days
09/22/15	11/03/15	Watch	1 months, 12 days
04/26/16	12/27/16	Watch	8 months, 1 days
**Gubernatorial Disaster Declaration			

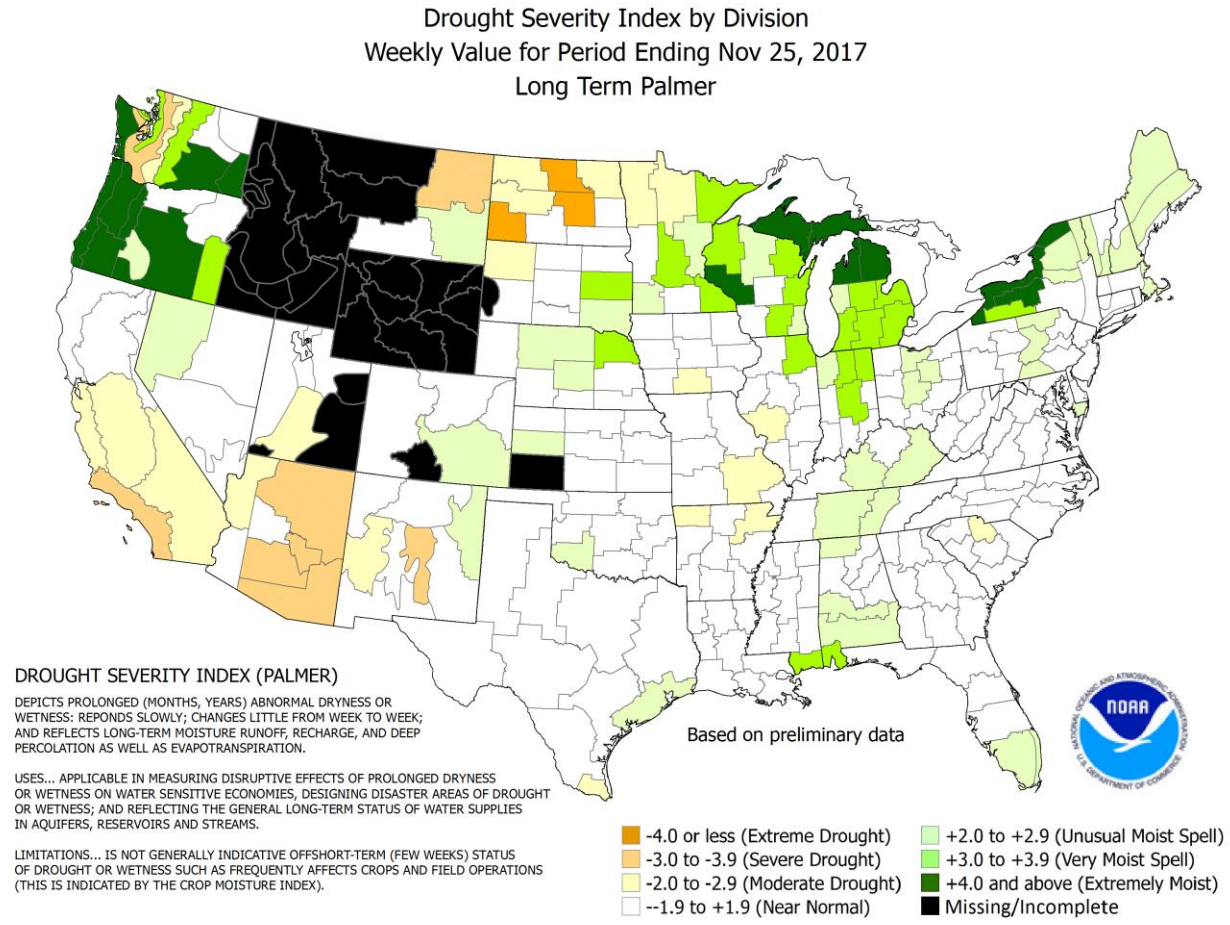
Figure 6 - Palmer Drought Severity Index History (NOAA, 2016)



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. Susquehanna County has experienced severe drought between five and ten percent of the time between 1895 and 1995 (*Figure 6 - Palmer Drought Severity Index History (NOAA, 2016)*), which can be used to make a rough estimate of the future probability of drought in Susquehanna County, although it does not account for uncertainty introduced by climate change. *Figure 7 - Recent Drought Severity Index (NOAA, 2017)* shows a recent Palmer Drought Severity Index reading for the continental United States and as of November 25th, Susquehanna County and the surrounding region are considered in mildly moist conditions, with a PDSI between 2.0 and 2.9.

Figure 7 - Recent Drought Severity Index (NOAA, 2017)



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 Pennsylvania Department of Agriculture indicated possible crop losses across the Commonwealth in excess of $500 million. This estimate did not include a twenty 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. As of the 2012 Census of Agriculture, there were an estimated 1,005 farms in Susquehanna County, at an average size of 166 acres. Susquehanna County ranks thirty-eighth of the sixty-seven counties in the Commonwealth for agricultural production, totaling $43,321,000 dollars

(USDA, 2012). The majority of this production comes from livestock, poultry and their products ($34 million). The remaining agricultural production comes from crops, including nursery and greenhouse crops ($9 million).

Water supplies are also vulnerable to the effects of drought. Public water service areas cover 1.16% of the county, including the majority of Montrose, Great Bend, Hallstead, Oakland, Susquehanna Depot, Lanesboro, Thompson, New Milford and Forest City Boroughs. *(See Figure 8 - Drought Vulnerability).* The majority of the county however 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 Susquehanna County residents who use private domestic wells are vulnerable to drought events. *Table 11 - Domestic Wells (PAGWIS, 2017)* shows the number of wells in each municipality in Susquehanna 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 Susquehanna County, it is not comprehensive due to the voluntary nature of the data submission. Not all wells were reported including a location designation.

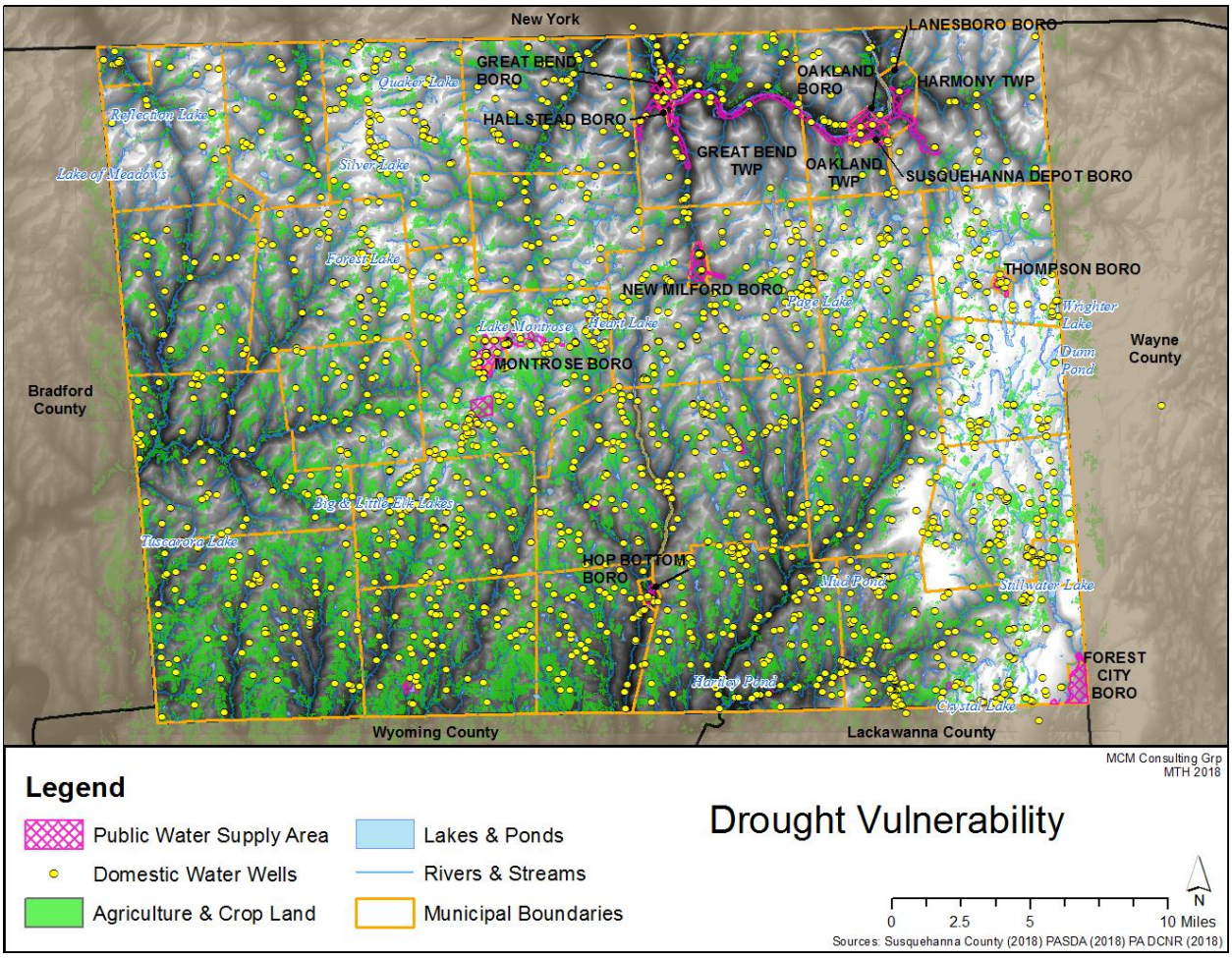
The EPA provides a guide published in October 2017 for water utilities to aid in drought response and recovery. The guide outlines what goes into a good drought response plan, and how to manage water supply and demand during a drought, outlines best practices for communication and partnerships with other local utilities and provides case studies to discuss examples of drought management practices (EPA, 2017).

Table 11 - Domestic Wells (PAGWIS, 2017)

Municipality	Domestic Water Wells	Municipality	Domestic Water Wells
Apolacon Township	53	Jessup Township	81
Ararat Township	128	Lanesboro Borough	2
Auburn Township	280	Lathrop Township	155
Bridgewater Township	395	Lenox Township	341
Brooklyn Township	164	Liberty Township	93
Choconut Township	70	Little Meadows Borough	20
Clifford Township	468	Middletown Township	100
Dimock Township	250	Montrose Borough	88
Forest City Borough	3	New Milford Borough	304

Municipality	Domestic Water Wells	Municipality	Domestic Water Wells
Forest Lake Township	164	New Milford Township	154
Franklin Township	116	Oakland Borough	42
Friendsville Borough	25	Oakland Township	16
Gibson Township	186	Rush Township	207
Great Bend Borough	14	Silver Lake Township	212
Great Bend Township	124	Springville Township	229
Hallstead Borough	15	Susquehanna Depot Borough	32
Harford Township	285	Thompson Borough	100
Harmony Township	109	Thompson Township	43
Herrick Township	173	Union Dale Borough	26
Hop Bottom Borough	17	Undesignated	97
Jackson Township	202	**Total**	**5583**

Figure 8 - Drought Vulnerability



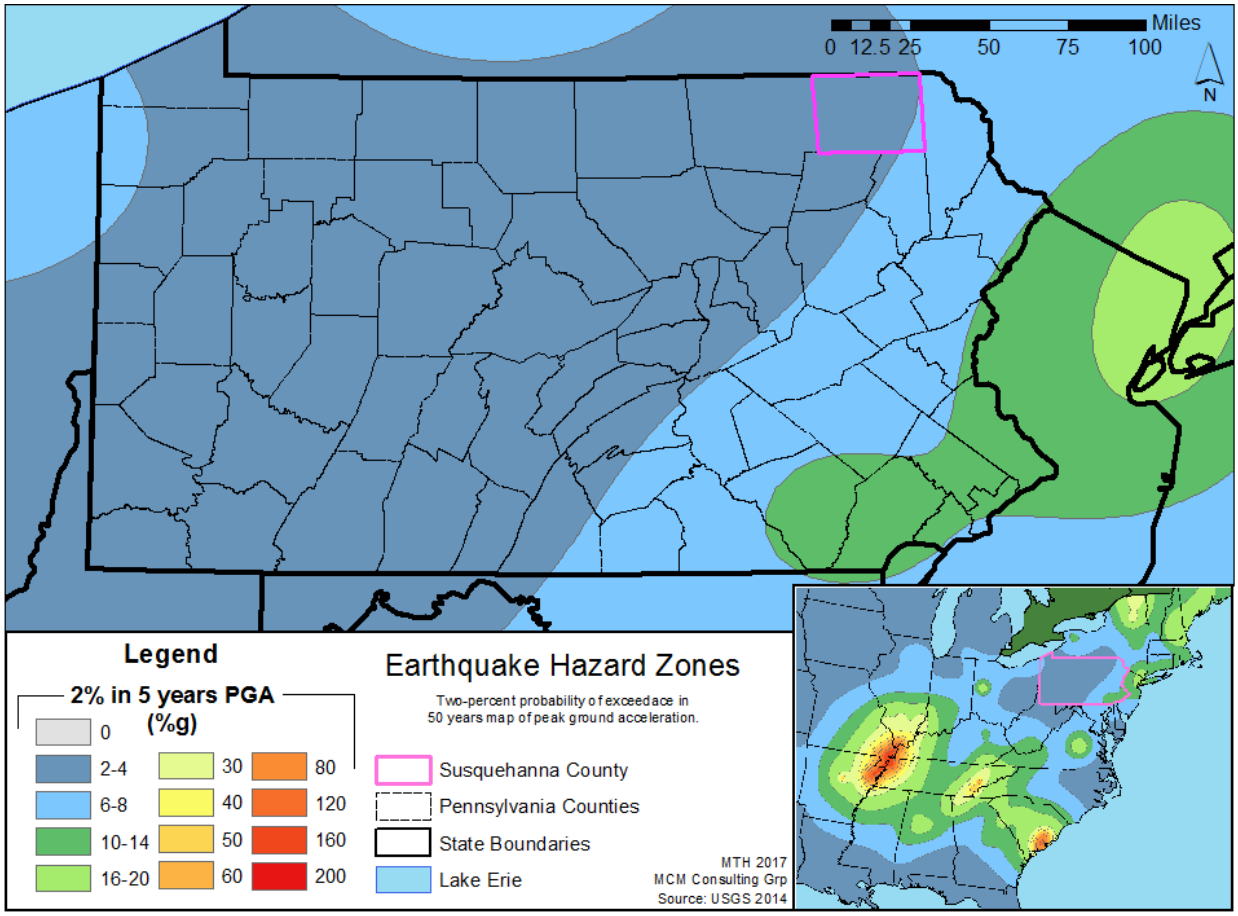
4.3.2. Earthquake

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 off the earth's tectonic plates, a volcanic eruption, or by a human induced explosion (DCNR, 2007). Earthquake events in Pennsylvania, including Susquehanna County are usually mild events; impacting areas no greater than sixty-two miles in diameter from the epicenter. A majority of earthquakes occur along boundaries between tectonic plates, and some earthquakes occur at faults on the interior of plates. Today, Eastern North America, including Susquehanna 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 apart about 200 million years ago, the Atlantic Ocean began to form. Since then, many faults have developed. 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 Susquehanna County is to conduct a probabilistic earthquake-hazard analysis with the earthquakes that have already happened in and around the county (See *Figure 9 - Earthquake Hazard Zones*).

Figure 9 - Earthquake Hazard Zones



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. Earthquakes have many secondary impacts, including disrupting critical facilities, transportation routes, public water supplies and other utilities.

Table 12 - Richter Scale

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

Table 13 - Modified Mercalli Intensity Scale

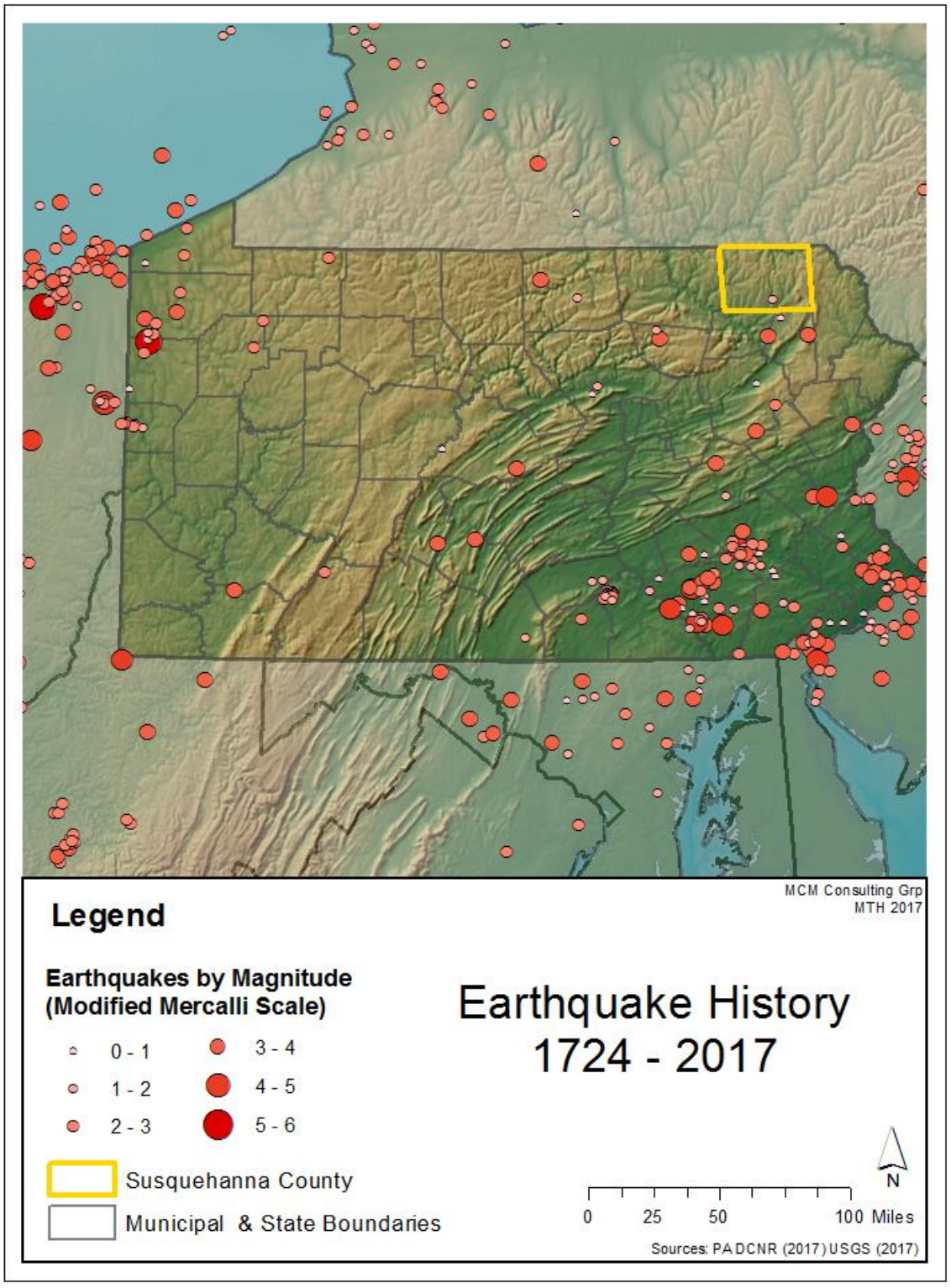
Scale	Intensity	Earthquake Effects	Richter Scale Magnitude
I	**Instrumental**	Detected only on seismographs	<4.2
II	**Feeble**	Some people feel it	
III	**Slight**	Felt by people resting; like a truck rumbling by	
IV	**Moderate**	Felt by people walking	
V	**Slightly Strong**	Sleepers awake; church bells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

The strongest recorded earthquake in Pennsylvania was a magnitude 5.1 on the Richter Scale, so it could be expected that effects of such an event could be felt in Susquehanna County from earthquake events that happen around the Commonwealth.

4.3.2.3 Past Occurrence

One earthquake has been recorded that originated in Susquehanna County – it occurred on August 14th 1982 in Hop Bottom Borough and had a magnitude of 1.8. A total of twenty-three earthquake events occurred within 100 km of Susquehanna County between 1724 and 2003 – all events were relatively minor quakes with Modified Mercalli magnitudes less than four, since 2003, there have been seventeen reported earthquakes within 100 km of Susquehanna County, all minor earthquakes with magnitudes between .85 and 2.79 (USGS, 2017). Most of these nearby past earthquakes have occurred south-south-east of Susquehanna County, and all earthquake events that occurred in the area surrounding Susquehanna County since 1724 can be seen in *Figure 10 - Earthquake History*.

Figure 10 - Earthquake History



4.3.2.4 Future Occurrence

Earthquake activity and intensities are difficult to predict, but a probabilistic analysis of prior earthquakes can assist in gauging the likelihood of future occurrences. *Figure 9 - Earthquake Hazard Zones* shows the majority of Susquehanna County in the lowest non-zero hazard zone for earthquake activity according to the USGS (2014), and a small portion in the south-east corner of the county is in a slightly higher earthquake probability zone, overall suggesting a relatively low probability of earthquake occurrence. However, according to the USGS, there has been a recent trend increasing the frequency of magnitude 3 and larger earthquakes in the central and eastern US (*Table 14 - Recent Earthquake Trends*). This uptick in seismicity is considered to be due to hydraulic fracturing activities, and specifically occurs as a result of waste water from the fracking process being injected into the earth (Meyer, 2016). Recent studies have moved towards being able to predict such induced seismicity by looking at uplift after injections, but more work needs to be done to confirm uplift as a reliable indicator of induced seismicity (Shirzei et al., 2016). As of December 2017, Susquehanna County has 1,079 active wells, third most in the Commonwealth (PA DEP, 2017). It is important to note that seismicity can occur even after wells become inactive and injections rates decline (Shirzaei et al., 2016).

Table 14 - Recent Earthquake Trends

Recent Earthquake Trends in Central and Eastern United States (USGS, 2016)	
Year	**Number of M3+ Earthquakes (average per year)**
1973-2008	21
2009-2013	99
2014	659
2015	1000+

4.3.2.5 Vulnerability Assessment

According to the U.S. Geological Society Earthquake Hazards Program, an earthquake hazard is anything associated with an earthquake that may affect a resident's normal activities. For Susquehanna 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 Susquehanna 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 Susquehanna County's general public during an earthquake.

While historically the risk of earthquakes in south western PA is low (*Figure 9 - Earthquake Hazard Zones*), the uptick in seismicity due to hydraulic fracturing increases the likelihood of Susquehanna County experiencing a damaging earthquake.

4.3.3. Flood, Flash Flood and Ice Jams

4.3.3.1 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. Flash floods are the most common type of flooding in Susquehanna County. 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 then 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.

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% 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) publishes digital flood insurance rate maps (DFIRMs). 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, as seen in *Figure 11 - Flooding and Floodplain*

Diagram. Structures located in the SFHA have a 26% chance of flooding in a thirty-year period. The SFHA serves as the primary regulatory boundary used by FEMA, the Commonwealth of Pennsylvania and Susquehanna County local 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*. Appendix D of this hazard mitigation plan includes a flooding vulnerability map for each municipality in Susquehanna County with vulnerable structures and critical facilities identified using the most current DFIRM data for Susquehanna County dated 2015.

Past flooding events have been primarily caused by heavy rains which cause small creeks and streams to overflow their banks, often leading to road closures. Flooding poses a threat to critical facilities, agricultural areas, and those who reside or conduct business in the floodplain. The most significant hazard exists for facilities in the floodplain that process, use and/or store hazardous materials. A flood could potentially release and transport hazardous materials out of these areas. As the water recedes it would spread the hazardous materials throughout the area. 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.

The major waterways that flow through Susquehanna County are the Susquehanna and Lackawanna rivers (west and east branches), as well as the Meshoppen, Tunkhannock, Snake, and Starrucca creeks. All of the creeks in the County drain into the Susquehanna River and the Susquehanna River Basin. Major watersheds include the Salt Lick, Choconut, and Snake Creeks in the northern part of the county; the Wyalusing, White, and Mehoopany Creeks in the southwest part of the county; the Tunkhannock and Martins Creeks draining most of the central and eastern portions of the county; and the Lackawanna River draining the extreme eastern area of the county (See *Figure 12 - Flooding Vulnerability Map*)

Figure 11 - Flooding and Floodplain Diagram

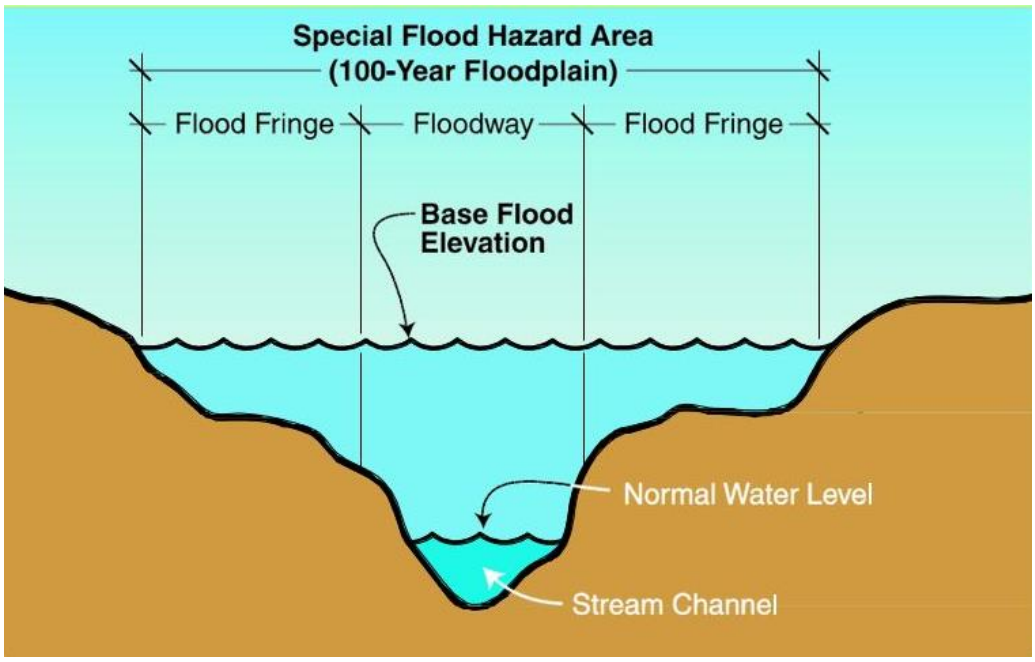


Table 15 - Flood Hazard High Risk Zones

Flood Hazard High Risk Zones (FEMA, 2017)	
Zone	**Description**
A	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
AE	Areas subject to inundation by the 1% annual chance flood event determined by detailed methods. BFEs are shown within these zones.
AH	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.
AO	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.
AR	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.

4.3.3.2 Range of Magnitude

Several factors determine the severity of floods, including rainfall intensity and duration, topography, ground cover and rate of snowmelt. Water runoff is greater in areas with

steep slopes and little to no vegetative ground cover. The mountainous terrain of Susquehanna County can cause more severe floods as runoff reaches receiving water bodies more rapidly over steep terrain. Urbanization typically results in the replacement of vegetative ground cover with impermeable surfaces like asphalt and concrete, increasing the volume of surface runoff and stormwater, particularly in areas with poorly planned stormwater drainage systems. A large amount of rainfall over a short time span can cause flash floods. Additionally, small amounts of rain can cause floods in locations where the soil is frozen, saturated from a previous wet period, or if the area is rife with impermeable surfaces such as large parking lots, paved roadways and other developed areas. The county occasionally experiences intense rainfall from tropical storms in late summer and early fall which can potentially cause flooding as well.

In winter months, local flooding could be exacerbated by ice jams in rivers. Ice jam floods occur on rivers that are totally or partially frozen. A rise in stream level 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.

Severe flooding can cause injuries and deaths and can have long-term impacts on the health and safety of the citizens. Severe flooding can also result in significant property damage, potentially disrupting the regular function of critical facilities and have long-term negative impacts on local economies. 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 identified and located in flooding situations, as they are often home-bound. Mobile homes are especially vulnerable to high water levels. Flooding can have significant environmental impacts when flood waters release and/or transport hazardous materials and can also result in spreading diseases.

Flash floods can occur very quickly with little warning and can be deadly because of the rapid rises in water levels and devastating flow velocities. The more developed areas in the county can be especially susceptible to flash floods because of the significant presence of impervious surfaces, such as streets, sidewalks, parking lots, and driveways.

Severe flooding also comes with many secondary effects that could have long lasting impacts on the population, economy and infrastructure of Susquehanna County. 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 health emergency. Critical infrastructure, such as sewage and water treatment facilities, can be severely damaged, having a significant effect on public health. High flood waters can cause sewage systems to fail and overflow, contaminating groundwater and drinking

water. Flooding also has the potential to trigger other hazards, such as landslides, hazardous material spills and dam failures.

The maximum threat of flooding in Susquehanna 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. In these cases, the severity and frequency of damage can result in permanent population displacement, and businesses may close if they are unable to recover from the disaster.

Although floods can cause deaths, injuries and damage to property, they 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 which improves soil fertility. However, human development often disrupts natural riparian buffers by changing land use and land cover, and the introduction of chemical or biological contaminants that often accompany human presence can contaminate habitats after flood events.

4.3.3.3 Past Occurrence

Susquehanna 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 heavy storms, tropical storms and other issues. A summary of flood event history for Susquehanna County is found in *Table 16 - Flood Event History* – property damage that is reported as "-" was not reported.

A devastating flood occurred in Susquehanna in June 2006. This event, categorized by the NWS as a 300-year flood, was the worst disaster to impact the county in the previous 30 years. During this event, one hundred twenty dwelling units were destroyed, and an additional two hundred fifty sustained major damage. Ove six hundred homes experienced minor damage or were impacted by the flood. The event caused significant damage to public infrastructure like roads, bridges, schools, and hospitals. In response to this disaster, FEMA distributed over seven million in public assistance funding. In the aftermath of this event, nearly 1,200 people contacted PEMA to register for assistance; nine hundred fifty people applied for housing assistance and nearly two hundred households were forced to seek alternative housing arrangements due to heavy damages. Damage to homes led to widespread reductions in property values; this event cost the county more than $2.6 million in lost real estate tax revenue alone.

Irene and the remnants of Tropical Storm Lee in 2011 caused nearly all rivers and streams to flood past historic levels. On the heels of Hurricane Irene, the county was hit with heavy rain that caused major flash flooding in the Little Meadows Borough and major Susquehanna River flooding affecting the municipalities of Harmony, Oakland, Lanesboro, Great Bend, and Hallstead. The river crested in Conklin, New York, at 23.94

feet. FEMA worked with approximately four public assistance applicants who also received damage from Hurricane Irene. Salt Lick Creek, Dubois Creek, and Snake Creek also caused major flooding. The county EOC operated at level I & II for approximately three weeks. A Disaster recovery center was opened and three hundred sixty-eight individuals registered for FEMA assistance. Total individual assistance given was $951,986. The county is applying for the Hazard Mitigation Grant Program (HMPG) to acquire and demolish substantially damaged homes within the county.

Ice jams in New York have also impacted Susquehanna County, including an incidence in March 2007 when a three-mile long ice jam in Broome County, New York caused ice jam-related flooding downstream in Great Bend Township and Borough.

Table 16 - Flood Event History

Susquehanna Flooding History (NCEI, 2018; Knowledge Center, 2017; 2012 HMP)			
Location	**Date**	**Property Damage ($USD)**	**Description**
Southwest Susquehanna County	1967	-	Flooding caused by Wyalusing and Meshoppen Creeks.
Susquehanna (Zone)	1969	-	Damage to crops, buildings, and personal property in the southwestern part of the County, including lands drained by Wyalusing and Meshoppen Creeks.
Susquehanna (Zone)	August 1955	-	Hurricane Diane came ashore on August 17, 1955, becoming the first hurricane in history with $1 billion in damages, and claimed approximately 200 lives from east-northeast Pennsylvania through southern New England.
Hop Bottom	August 1967	-	A cloudburst caused thousands of dollars of damage impacting streets, sidewalks, homes, businesses, and sewer systems.
Hop Bottom, Southwestern Susquehanna County	6/21/1972	-	Hurricane Agnes caused severe flooding in the Hop Bottom Borough, the southwestern sector of the County, in addition to considerable damage to cropland and bridges in the area drained by Wyalusing Creek.
Countywide	2/24/1975	-	Heavy rains caused Route 858 to flood. LR 57137 along the State Game Lands flooded. The Susquehanna River was at 8 feet. Basements flooded across the County.
Franklin Forks	9/25/1975	-	Heavy rains caused the closure of LR 57084. Silver Creek flooded.
Susquehanna (Zone)	9/26/1975	-	Creek banks were flooded by Wyalusing and Meshoppen Creeks. The ASCA reported 350 acres of corn ruined.
Countywide	10/8/1976	-	Extensive flooding occurred, damaging three bridges in the County. Several roads were closed as a result of flooding. Home evacuations were necessary and evacuations were needed.

Susquehanna Flooding History (NCEI, 2018; Knowledge Center, 2017; 2012 HMP)			
Location	**Date**	**Property Damage ($USD)**	**Description**
Brookdale	7/29/1977	-	Heavy rains prompted evacuation of two families near route 29.
Susquehanna (Zone)	1/26/1978	-	Thunderstorms caused closure of Bow Bridge Road. Fire personnel were needed for pumping due to excess drainage.
Susquehanna (Zone)	3/6/1979	-	Heavy thunderstorms forced one-way traffic in the Oakland Susquehanna underpass. Harmony Road was closed by floodwaters 2-1/2 feet deep.
Choconut	7/29/1979	-	Heavy flooding damaged the Choconut Elementary School.
Apolacon Township, Little Meadows	4/9/1980	-	Three inches of rain caused flooding and the closure of several roads.
Susquehanna (Zone)	2/10/1981	-	Flooding was reported.
Little Meadows	6/29/1982	-	Heavy rains caused localized flooding. The Brookside Trailer Park experienced flooding and residents were evacuated.
Countywide	4/15/1983	-	Heaving rains caused significant basement flooding throughout the County along with the closure of several roads.
Middletown Township	12/15/1983	-	Heavy rains caused flooding on Route 858 along with the submersion of several bridges.
Susquehanna (Zone)	2/14/1984	-	Flooding was reported in the County.
Susquehanna (Zone)	7/1/1984	-	Flooding was reported in the County.
Countywide	9/27/1985	-	Heavy rains from Hurricane Gloria caused significant flooding across the County. Susquehanna County received a Presidential Disaster Declaration as a result of the storm.
Countywide	3/15/1986	-	Heavy rains coupled with snowmelt runoff caused flooding in various parts of the County. Parts of the County were submerged under 18 inches of water. Several township roads were washed out.
Harmony Township	3/30/1993	-	Heavy snowmelt caused flooding and forced a trailer park to be evacuated.
Countywide	4/9/1993	-	Heavy rains coupled with saturated soils caused streams and rivers to flood.
Countywide	1/19/1996	$9,900,000	Heavy rains coupled with saturated soils and snowmelt caused streams and rivers to flood.
Susquehanna (Zone)	11/09/96	0	-

Susquehanna Flooding History (NCEI, 2018; Knowledge Center, 2017; 2012 HMP)			
Location	**Date**	**Property Damage ($USD)**	**Description**
Susquehanna (Zone)	01/08/98	$25,000	-
Rushville	06/13/98	0	A slow-moving complex of showers and thunderstorms produced very heavy rains across western portions of the county during the early evening hours. A spotter in Rushville measured nearly two and a half inches of rain in less than an hour's time. As additional showers and storms affected the area thereafter, roadways became flooded and the Wolf Creek left its banks. State routes 367 and 706 were closed for a time due to high water conditions. After 9:00 pm EDT, roads were reopened and the Wolf Creek receded.
Susquehanna (Zone)	01/24/99	0	The combination of locally heavy rainfall and snowmelt caused minor flooding to take place throughout the Susquehanna River Basin in northeastern Pennsylvania. Minor flooding was seen along a major tributary of the Susquehanna River, the Tunkhannock Creek in Wyoming county. The Lazy Brook subdivision took on some water during the evening around the time of crest in Tunkhannock. Damage, however, was quite minor. Along the main stem portion of the Susquehanna River, minor flooding also occurred from Towanda downstream to Wilkes-Barre. At Meshoppen in Wyoming county, some roads immediately adjacent to the river needed to be closed for several hours in the afternoon and evening of the 24th. Otherwise, only minor lowland and flood plain impacts were noted. Waters gradually receded back under flood stage throughout the Susquehanna Basin early in the morning on the 25th.
Susquehanna (Zone)	02/27/00	0	Unseasonably warm temperatures occurred across the area for several days. This resulted in a considerable amount of snowmelt. A strong cold front spread rain, which was heavy at times, across the area on Sunday night the 27th. Rainfall amounts between three quarters of an inch to an inch were common. The rain and snowmelt caused area creeks, small streams and rivers to overflow their banks. Local roads and highways were closed due to the flooding. Numerous basements were flooded. Driveways and backyards were turned into rushing rivers. The creeks, small streams and rivers began to slowly subside late on the 28th and during the 29th as cooler temperatures behind the front reduced the amount of runoff.

Susquehanna Flooding History (NCEI, 2018; Knowledge Center, 2017; 2012 HMP)			
Location	**Date**	**Property Damage ($USD)**	**Description**
Montrose	03/26/02	0	Flash flooding was due to an inch and a half to two and a half inches of precipitation mostly in the form of rain. Most of the rain fell in a 12-hour period during the day on the 26th. The rain fell onto a saturated snow-covered ground. Snow depths were only a few inches with water equivalents less than an inch. Creeks and streams flooded in the area the evening of the 26th. The Susquehanna River also flooded on the 27th and 28th. The rain was caused by a strong slow-moving surface low in West Virginia the morning of the 26th. That evening the low moved to Erie, Pennsylvania before picking up speed to be in Maine the morning of the 27th. Bradford and Susquehanna Counties were in an overrunning event on the north side of a warm front. Several small streams in the Montrose area went out of their banks.
Susquehanna (Zone)	03/27/02	0	Minor flooding occurred on the Susquehanna River in New York on the 27th and 28th. This was due to an inch and a half to two and a half inches of precipitation mostly in the form of rain. Most of the rain fell in a 12-hour period during the day on the 26th. The rain fell onto a saturated snow-covered ground. Snow depths were only a few inches with water equivalents less than an inch. Creeks and streams flooded in the area the evening of the 26th. The Susquehanna River at Bainbridge rose to flood stage of 13 feet at 8:30 AM on the 27th. The river at Bainbridge crested at 13.47 feet 9 PM on the 27th then fell below flood stage at 6 AM on the 28th. The Susquehanna River at Conklin rose to flood stage of 11 feet at 6:30 PM on the 27th. Bainbridge and Conklin river gages are the forecasts points before and after the river dips briefly into Susquehanna County. The river at Conklin crested at 12.13 feet at 7:45 PM on the 27th. The stage at Conklin fell below flood stage at 10 PM on the 28th. The Susquehanna River at Waverly rose to the flood stage of 11 feet at 8 AM on the 27th. The river at Waverly crested at 11.47 feet at 7:45 PM on the 27th before falling back below flood stage at 8 AM on the 28th. The Waverly, New York river gage is actually located in Sayre, Pennsylvania.
Auburn Center	09/04/03	$100,000	Thunderstorms with heavy rain caused streams to overfill their banks onto roads in Auburn, Springville, and Clifford. 1 to 2 inches of rain fell in a short period of time on already saturated ground.
Countywide	12/11/03	$50,000	A cold front slowly moved northeast through the area on the 11th. It brought 1.5 to 2.5 inches of rain to the southwest quarter of the county. The rain and warmer weather also melted most of the snow that fell earlier in the week. The water equivalent of the snow was half an inch to an inch. Many creeks and streams went out of their banks. Roads were flooded in Auburn, Springville and Dimock Townships.
Alford	07/17/04	$10,000	Thunderstorms with heavy rain caused flash flooding. Flooding occurred around Alford and US Route 11 in the town of Harford.

Susquehanna Flooding History (NCEI, 2018; Knowledge Center, 2017; 2012 HMP)			
Location	**Date**	**Property Damage ($USD)**	**Description**
South Montrose	07/17/04	$10,000	Thunderstorms with heavy rain caused flash flooding. Water and debris were across roads.
New Milford	08/30/04	$5,000	Heavy rain caused flash flooding. Many roads were flooded.
Countywide	09/17/04	$10,000,000	Heavy rain with amounts of 4.5 to 7 inches caused flash flooding. The rain which fell from the 16th to the 18th was due to the remnants of hurricane Ivan. Most creeks and streams went out of their banks. Over 300 homes were affected by flooding with 132 having minor damage, 21 having major damage, and 4 being totally destroyed. 27 businesses were affected with 19 having minor damage and 8 having major damage. Dozens of roads and bridges were damaged. About 750 people had to evacuate their homes. There was flooding where there had never been any before. One major bridge was destroyed.
Countywide	11/28/04	$10,000	A slow-moving frontal boundary dropped 1.5 to 3 inches of rain across the county. The rain started as showers late on the 27th, and ended the afternoon of the 28th. Most of the rain fell the morning of the 28th. This rain fell on ground already saturated from recurrent storms including the last one on the 25th. Road flooding happened in many locations. A rock slide occurred on Route 706 in New Milford. Sections of Routes 3013 and 3019 were washed out.
Susquehanna (Zone)	04/01/05	$200,000	The Susquehanna River at Conklin, NY continued above its flood stage of 11 feet into April. This high water was due to 1 to 3 inches of rain and more snowmelt the last week of March. A slow-moving storm from the Ohio Valley brought 2 to 3 inches of rain on April 2nd and 3rd. In additional several inches of water equivalent added to the runoff by snowmelt. Little snow was left after the storm. This additional rain and snowmelt caused the Susquehanna River at Conklin, NY to rise rapidly to a second higher crest of 18.08 feet at 9 AM EST on April 3rd. This was the 8th highest crest at Conklin. The river fell below flood stage the evening of April 6th. This caused flooding upstream in Great Bend and Lanesboro, Pennsylvania. A trailer park in Great Bend was evacuated before the road to it was flooded. 13 to 14 feet at Conklin causes the road to flood. Some roads were damaged.
Countywide	04/02/05	$250,000	A slow-moving storm from the Ohio Valley brought 2 to 4 inches of rain on April 2nd and 3rd. Before this storm, the rivers and streams had high flows due to a previous rainstorm March 28th and snowmelt. All towns were affected in the county by flash flooding. Roads and buildings were damaged. The hardest hit areas from the flash flooding were in Lanesboro, Great Bend, Lenox township, and Silver Lake. Numerous streams and creeks came out of their banks.

Susquehanna Flooding History (NCEI, 2018; Knowledge Center, 2017; 2012 HMP)			
Location	**Date**	**Property Damage ($USD)**	**Description**
Great Bend	01/18/06	$50,000	Heavy rainfall spread into northern Pennsylvania as an intense area of low pressure tracked from southern Indiana Tuesday morning on the 17th to northeast of Lake Huron on the morning of the 18th and through eastern Canada Wednesday afternoon and evening. The heaviest rain occurred in northern Pennsylvania Wednesday morning on the 18th. The rain tapered off by Wednesday afternoon. Rainfall amounts ranging from 1 to 2 inches fell across most of northeast Pennsylvania. The rainfall brought Salt Lick Creek in Great Bend out of its banks, flooding a couple of trailer homes. The trailer park had to be evacuated due to the high waters.
Little Meadows	06/27/06	$50,000	Tropical moisture continued to stream northward into eastern Pennsylvania ahead of a frontal system which slowly moved westward into the eastern Great Lakes by Tuesday morning the 27th. This tropical moisture developed a batch of heavy showers and thunderstorms across much of eastern Pennsylvania late Monday evening the 26th to Tuesday morning the 27th. The northwest corner of Susquehanna County was particularly hard hit with up to 5 inches of rain. This rain fell on saturated ground from previous rains that occurred Sunday and Monday leading to major flash flooding in Little Meadows. Water topped a bridge in Little Meadows and flooded several homes. The rain tapered off Tuesday morning after sunrise allowing the flash flooding to abate.
Countywide	06/27/06	$100,000,000	Tropical moisture continued to stream northward into northeast Pennsylvania ahead of a frontal system which slowly moved westward into the eastern Great Lakes by Tuesday morning the 27th. Additional heavy rain fell Tuesday afternoon into Wednesday morning across Susquehanna County as the front moved back east and combined with a low-pressure system moving up the eastern seaboard. Total rainfall for the three-day period ending Wednesday was over 10 inches in many areas with 14.74 inches reported in Clinton Township. This batch of heavy rain sent most streams and creeks over their banks in what was the worst flash flooding this county has ever seen. The flash flooding lasted until Wednesday afternoon. Hardest hit areas were New Milford, Great Bend, Hallstead, Susquehanna, Lanesboro, Oakland and Little Meadows. One person was killed when he drove his car into a flooded roadway in Springville Township. Total damages to the county were at least 100 million dollars. 183 homes were damaged, 76 destroyed. There were 110 businesses damaged by the flood waters. 400 people were evacuated, with 100 people rescued. At least 50 roads were damaged by flood waters with 10 destroyed. At one point, 150 roads in the county were closed during the height of the flood. Thirty bridges were flooded countywide.

Susquehanna Flooding History (NCEI, 2018; Knowledge Center, 2017; 2012 HMP)			
Location	**Date**	**Property Damage ($USD)**	**Description**
Little Meadows, Brackney, Friendsville	11/16/06	0	A strong low-pressure system tracked northeast from Kentucky to western New York state during the daylight hours on Thursday the 16th. A large fetch of Gulf and Atlantic moisture was pulled northward ahead of the cold front, which produced a squall line of thunderstorms. This line of thunderstorms produced 45 to 58 mph winds across much of north central Pennsylvania and into western and central Bradford County, PA. As the squall line moved farther east in northeast Pennsylvania, late in the afternoon of the 16th, it slowed down and stalled for a time across eastern Bradford County, Susquehanna County, Wyoming County, Lackawanna and Luzerne counties, which includes Scranton and Wilkes-Barre, and over portions of Wayne County, PA. Significant flash flooding occurred as rainfall amounts ranged from 1.5 to 3.5 inches in about 3 hours. Many hillsides and creeks turned into raging torrents, causing mudslides and debris flows that cascaded into more populated valley areas. In the urban valley regions, the flash flood reports were numerous with road washouts, highway closings, and some parking lots that were entirely flooded, ruining many cars. The flash flooding evolved into a minor to moderate river flood event on the Susquehanna River near the New York border from the 17th to the early on the 19th.
Harford	03/08/08	0	A low-pressure system developed over the Gulf Coast and moved northeast through the Mid-Atlantic states, spreading heavy rain across northeast Pennsylvania from Friday afternoon through Saturday night. Rainfall amounts of 1 to 2 inches and melting snowfall caused flooding of some roadways, basements, and smaller creeks.
Little Meadows	07/23/08	$5,000	A stationary front extending from southern New England through the Delmarva region pulled eastward as low pressure developed along the boundary. As moisture pulled northward, heavy rain showers and thunderstorms developed, producing severe weather and flooding. A bridge was flooded from Cork Hill Creek near Little Meadows. A road was also flooded.
Little Meadows	06/20/09	$75,000	Slow-moving thunderstorms produced 2 to 4 inches of rain which caused flash flooding in far northern Susquehanna County, Pennsylvania. A major flash flood occurred in the Little Meadows area, when 2 to 4 inches of rain fell in less than 2 hours. The heavy rain caused debris to block 3 large drainage pipes, which then caused significant flash flooding. Flooding occurred on the lower part of Cork Hill Road. The water ran down from the upper part of the road into this area. The water then entered a home owner's yard. A small bridge was also washed out on State Route 4013.

Susquehanna Flooding History (NCEI, 2018; Knowledge Center, 2017; 2012 HMP)			
Location	**Date**	**Property Damage ($USD)**	**Description**
Little Meadows, Auburn Center, Montrose	01/25/10	$20,000	A slow-moving cold front moved northeastward toward northern Pennsylvania, and through the region on the 25th. A surge of deep moisture associated with this system produced a period of heavy rain from late on the 24th, through the morning hours on the 25th. In addition, mild temperatures combined with the rain to melt an existing snow-pack to cause isolated areas of flash flooding. Several roads were flooded in the Little Meadows area including Bolles Road. Route 267 was flooded in the Auburn Center area, about 2 miles north of the Wyoming county line. Several roads were flooded in the Montrose area due to heavy rains. This included Route 29 in Montrose.
Little Meadows	09/30/10	$5,000	An upper level low pressure system interacting with abundant tropical moisture from the remnants of what had been Tropical Storm Nicole dropped 2 to 7 inches of rain across northeast Pennsylvania. Steady and occasionally heavy rain fell across much of northeast Pennsylvania, causing flash flood problems, as well as minor flooding of the larger main stem rivers. The rain and flooding continued into the overnight and next day (October 1), especially across parts of the northern Poconos. Locally higher amounts of rain were reported, with the highest amount of 10.38 inches in Moscow. Several roads were flooded in Little Meadows.
Brooklyn, Hop Bottom	07/08/11	0	An upper level disturbance and weak, nearly stalled frontal boundary helped to produce scattered showers and thunderstorms during the heating the afternoon and early evening. Some of the storms became severe, producing large hail and damaging wind gusts. Heavy rains from the storms also caused flash flooding across portions of Lackawanna and Wayne counties, where 3 to 5 inches of rain fell. Parts of Route 167 were flooded.

Susquehanna Flooding History (NCEI, 2018; Knowledge Center, 2017; 2012 HMP)			
Location	**Date**	**Property Damage ($USD)**	**Description**
Hallstead, New Milford, Great Bend	08/28/11	$225,000	Hurricane Irene brought heavy rains and high winds from northeast Pennsylvania to the Catskill Mountains of New York from Saturday evening the 27th to Sunday afternoon the 28th. Rainfall totaled from 2 to 5 inches over most of northeast Pennsylvania and in the Susquehanna Region of central New York. Between 4 and 8 inches of rain fell in the western Catskills with portions of Wyoming and northern Susquehanna Counties in northeast Pennsylvania and southern Broome County in New York receiving 6 to 8 inches of rain. The heavy rains caused catastrophic flash flooding in Forkston and Noxen of Wyoming County where nearly one hundred homes were flooded. At least 25 roads were closed due to flooding in this area. Many people were cut off and had to be rescued by helicopter. Damages are estimated to be in the tens of millions. Susquehanna County also was hard hit by flash flooding, especially in the northern part of the county. In addition, to the heavy rains, high winds from Irene knocked down numerous trees and power-lines across much of northeast Pennsylvania, especially in the higher terrain areas and the Poconos. Almost 50,000 residences were without power, some not seeing power restored for up to one week. Flash flooding was threatening a trailer park in the Great Bend. Twenty homes were affected. There were also numerous road closures due to flooding. Two bridges were also flooded. Ten trailer homes were flooded in the New Milford area. There were also numerous roads flooded.

Susquehanna Flooding History (NCEI, 2018; Knowledge Center, 2017; 2012 HMP)			
Location	**Date**	**Property Damage ($USD)**	**Description**
Little Meadows	09/07/11	$1,250,000	The remnants of Tropical Storm Lee moved northward from the southern Appalachians on the 6th to the middle Atlantic states on the 7th before stalling on the 8th. The moisture from Lee interacted with a frontal system to the west across the eastern Ohio Valley and eastern Great Lakes. In addition, moisture was drawn into New York and Pennsylvania from Hurricane Katia which was moving northward off the east coast in tandem with the remnants of Lee. This complicated scenario led to an extreme amount of rain for central New York and northeast Pennsylvania, most of which fell over a 48-hour period from the 6th to the 8th. Rainfall of 6 to 12 inches occurred over most of the upper Susquehanna river basin in New York and northeast Pennsylvania. The heavy rain caused massive, record breaking flooding on small streams, creeks and the Susquehanna River and its larger tributaries. The main branch of the Susquehanna River in New York from Binghamton to Vestal, Owego and Waverly crested from 1 to 4 feet higher than the previous record crests set in June 2006. In Pennsylvania, record crests occurred along the Susquehanna River at Meshoppen and Wilkes Barre which exceeded the long-standing record crests by around 1 foot associated with Hurricane Agnes in 1972. Damages in the upper Susquehanna River Basin in New York and Pennsylvania are close to 1 billion dollars. Unfortunately, the flooding claimed 1 life and injured 1 person in central New York and northeast Pennsylvania. Catastrophic flash flooding occurred in Little Meadows from very heavy rains. Numerous roads, homes and bridges were severely damaged. National guard was called in to rescue trapped residents due to catastrophic flash flooding. Many roads were severely flooded. Rescues took place as people were cut off from so many road closures.
Brooklyn, Little Meadows, Hallstead	09/28/11	0	A slow-moving upper level low pressure system brought unsettled weather to the region. An extensive plume of Atlantic moisture into the system brought periods of heavy rain. Several areas that had been very wet from previous rains earlier in the month received additional minor flood problems. Route 167 was flooded south of Montrose, near Brooklyn. Some flooding was also reported in Dimock. Several roads were flooded and water went over bridges in Little Meadows. Dubois Creek went out of the banks. A bridge was over-topped by water at New York Avenue and Bogart Street.
Ararat, Starruca	06/28/13	$250,000	A low-pressure system acted on a moist and unstable airmasses to bring severe thunderstorms to northeast Pennsylvania. A dirt road was washed out, and a bridge collapsed due to severe flash flooding. Other roads in the township were impassable with flowing water. Major flash flooding of the Starrucca and Shadigee creeks caused a house to collapse and fall into the Starrucca Creek.

Susquehanna Flooding History (NCEI, 2018; Knowledge Center, 2017; 2012 HMP)			
Location	**Date**	**Property Damage ($USD)**	**Description**
Forest Lake, Brackney, Montrose, Friendsville, Rush, Birchardville	08/21/14	$600,000	A low-pressure system located over southern Ontario along with surface boundaries in the vicinity of northeast Pennsylvania resulted in severe thunderstorms during the late afternoon and evening hours. These storms developed in an unstable airmass with severe thunderstorms producing torrential rainfall and flooding. A solitary, long lasting thunderstorm produced in excess of 6 of rain across northwest Susquehanna county. There was significant devastation to the road network, and a trailer park was seriously flooded. Severe flash flooding damaged several roads in the area, with significant flooding on County Route 267. Three to four other roads were destroyed and impassable. Severe flooding was occurring along County Route 267, rendering it impassable. Numerous roads in the northwest and central part of the county were inundated by flood waters. Severe flash flooding forced the evacuation of a trailer court on Pamela Drive.
Susquehanna (Zone)	3/13/2015	-	Elevated Ice Jam Concern
Clifford Township	2/16/2016	-	Ice Jam Salt Lick Creek
Susquehanna (Zone)	3/16/2017	-	Ice Jam Salt Lick Creek
Hallstead, Susquehanna, Lanesboro	07/17/17	$30,000	Warm and humid air was in place across the region as a slow-moving frontal system drifted into Northeast Pennsylvania. An upper level disturbance passed over the frontal boundary during the afternoon, triggering numerous torrential rains producing thunderstorms. Flash flooding developed in several locations across the northern tier counties. Flood waters were entering a residence through the front and back doors. Water was entering residences in the village.
Little Meadows, Brackney, Friendsville	07/24/17	$1,401,000	A stationary front poised in the vicinity of central New York and northeast Pennsylvania was the focus for very warm and moist atmospheric conditions across the region. Heavy rain producing thunderstorms developed during the late afternoon and evening hours as an upper level jet stream punched into the area. Widespread thunderstorms produced swaths of 3 to 4 inches of rain in just a few hours' time during the late evening and overnight hours across the Endless Mountains of Northeast Pennsylvania. Rapid rises of area streams and creeks resulted in severe flash flooding in parts of Bradford and Susquehanna counties. Estimated damages to public infrastructure totaled approximately $3 Million dollars. Torrential downpours caused several bridge wash overs in the area. Several roads were washed out by flash flooding, including portions of Route 267. Flash flooding covered the intersection of PA 267 and the Milford-Owego turnpike.

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. The hazard mitigation assistance (HMA) definition of a repetitive loss property is a structure covered by a contract for flood insurance made available under the NFIP that has incurred flood-related damage on two occasions, in which the cost of the repair, on the average, equaled or exceeded twenty five percent of the market value of the structure at the time of each such flood event; and at the time of the second incidence of flood-related damage, the contract for flood insurance contains in-creased cost of compliance coverage.

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 October 31st 2017, there are seventy-six repetitive loss properties and no severe repetitive loss properties in Susquehanna County. This is an increase from 2010 when there were thirty-four repetitive loss properties, however a decrease from two severe repetitive loss properties in 2010.

Most municipalities in Susquehanna County participate in the NFIP except for Ararat Township, Friendsville Borough and Union Dale Borough. Information on each participating municipality is located in *Table 18 - Municipal NFIP Policies & Vulnerability,* where NFIP data for non-participating municipalities appears as "-".

Table 17 - Repetitive Loss Properties

Repetitive Loss Properties (FEMA, 2018)						
Community Name	**Comm. Nbr**	**Building Payments**	**Contents Payments**	**Total Payments**	**Losses**	**Properties**
Apolacon Township	422072	$14,582	$741	$15,323	3	1 Residential
Bridgewater Township	422585	$41,134	$5,866	$47,001	2	1 Residential
Brooklyn Township	422075	$19,432	$	$19,432	2	1 Residential
Choconut Township	422076	$55,737	$	$55,737	2	1 Residential
Franklin Township	422079	$128,434	$1,179	$129,613	7	2 Residential 1 Non-Residential
Gibson Township	422080	$33,488	$	$33,488	2	1 Residential
Great Bend Borough	422068	$267,676	$861,245	$1,128,921	8	2 Residential 2 Non-Residential
Great Bend Township	421212	$669,865	$88,702	$758,568	23	9 Residential 2 Non-Residential
Hallstead Borough	422069	$192,359	$24,291	$216,650	8	4 Residential
Harmony Township	422082	$290,430	$51,143	$341,573	32	11 Residential

Repetitive Loss Properties (FEMA, 2018)						
Community Name	**Comm. Nbr**	**Building Payments**	**Contents Payments**	**Total Pay-ments**	**Losses**	**Properties**
Hop Bottom Borough	420812	$84,349	$	$84,349	5	2 Residential
Lanesboro Borough	420813	$913,344	$139,536	$1,052,880	45	20 Residential 1 Non-Residential
Liberty Township	422087	$111,793	$25,780	$137,573	2	1 Residential
Little Mead-ows Borough	420814	$46,949	$4,756	$51,705	2	1 Residential
New Milford Borough	420815	$348,607	$50,000	$398,607	14	6 Residential
New Milford Township	422089	$143,692	$10,663	$154,355	2	1 Residential
Oakland Borough	422071	$12,345	$	$12,345	2	1 Residential
Oakland Township	422581	$128,031	$11,270	$139,301	2	1 Residential
Rush Township	422090	$22,121	$	$22,121	3	1 Residential
Springville Township	422092	$26,657	$13,032	$39,689	3	1 Residential
Susquehanna Depot Bor-ough	420816	$12,672	$819	$13,491	4	2 Residential
Total	**-**	**$3,563,698**	**$1,289,022**	**$4,852,720**	**173**	**76**

Table 18 - Municipal NFIP Policies & Vulnerability

Municipal NFIP Policies & Vulnerability ***(FEMA, 2018; Susq. Co. GIS, 2018)***				
Municipality	**Losses**	**Active Contracts**	**Addressable Structures in SFHA**	**Critical Facilities in SFHA**
Apolacon Township	5	6	19	0
Ararat Township	-	-	1	0
Auburn Township	0	2	7	0
Bridgewater Township	4	6	29	0
Brooklyn Township	5	5	8	0
Choconut Township	9	4	13	0
Clifford Township	4	7	39	0
Dimock Township	3	2	5	0
Forest City Borough	1	0	0	0
Forest Lake Township	0	1	5	0
Franklin Township	12	9	15	1
Friendsville Borough	-	-	0	0
Gibson Township	2	2	12	0

Municipal NFIP Policies & Vulnerability *(FEMA, 2018; Susq. Co. GIS, 2018)*				
Municipality	**Losses**	**Active Contracts**	**Addressable Structures in SFHA**	**Critical Facilities in SFHA**
Great Bend Borough	18	6	9	2
Great Bend Township	77	128	262	2
Hallstead Borough	22	16	23	0
Harford Township	0	3	27	0
Harmony Township	61	8	53	0
Herrick Township	1	3	5	0
Hop Bottom Borough	12	8	30	4
Jackson Township	0	0	1	0
Jessup Township	1	3	7	0
Lanesboro Borough	76	22	69	1
Lathrop Township	1	3	12	0
Lenox Township	0	10	61	2
Liberty Township	7	7	29	0
Little Meadows Borough	8	5	8	0
Middletown Township	3	0	2	0
Montrose Borough	3	0	3	0
New Milford Borough	38	48	147	8
New Milford Township	3	2	8	0
Oakland Borough	2	2	4	0
Oakland Township	17	4	21	2
Rush Township	9	8	30	0
Silver Lake Township	1	6	18	0
Springville Township	1	3	16	0
Susquehanna Depot Borough	10	5	11	1
Thompson Borough	0	2	3	0
Thompson Township	0	3	25	0
Union Dale Borough	-	-	0	0
Total	**416**	**349**	**1037**	**23**

4.3.3.4 Future Occurrence

Table 19 - Flood Probability Summary

Flood Probability Summary (FEMA)	
Flood Recurrence Intervals	**Annual Chance of Occurrence**
10-year	10.00%
50-year	2.00%
100-year	1.00%
500-year	0.20%

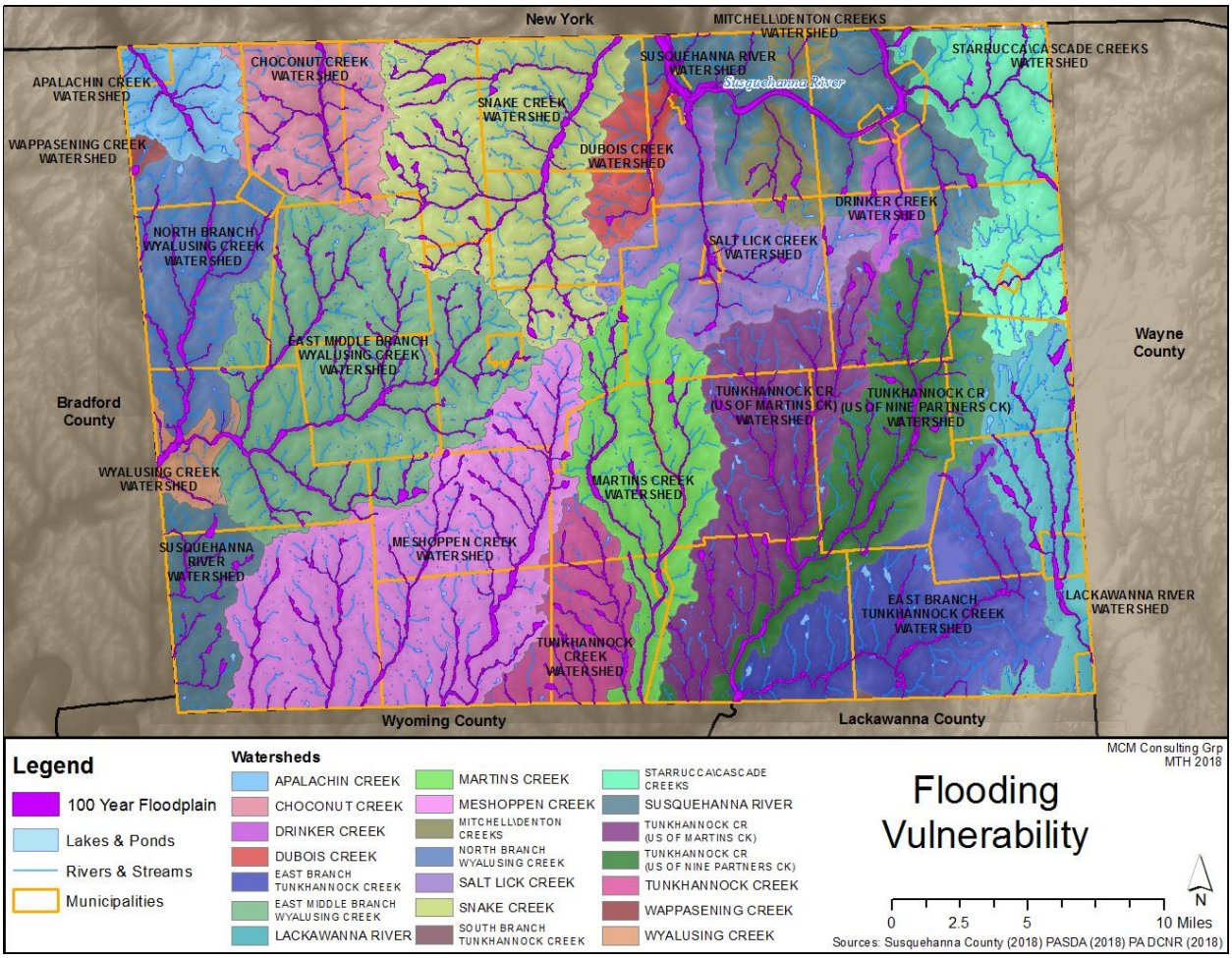
Flooding is a frequent problem throughout Pennsylvania. Susquehanna County will certainly be impacted by flooding events in the future - Susquehanna experiences some degree of flooding annually. The threat of flooding is compounded in the late

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 or one-hundred-year 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 or is likely once every one hundred years. 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. Properties 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 ten-year flood zone is the area that has a ten percent chance of being flooded every year. However, this label does not mean that this area can-not flood more than once every ten years. It just designates the probability of a flood of this magnitude every year. Further away from this area is the fifty-year floodplain. This area includes all of the ten-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*.

4.3.3.5 Vulnerability Assessment

Susquehanna 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. *Table 18 - Municipal NFIP Policies & Vulnerability* identifies how many structures located in the special flood hazard area by municipality using county GIS data. Critical facilities are facilities that if damaged would present an immediate threat to life, public health and safety. Critical Facilities that are located in the special flood hazard area are identified in *Table 18 - Municipal NFIP Policies & Vulnerability.* Appendix D of this hazard mitigation plan includes a flooding vulnerability map for each municipality in Susquehanna County with vulnerable structures and critical facilities identified. A list of critical facilities located in the special flood hazard area is located in Appendix D as well.

Figure 12 - Flooding Vulnerability Map



4.3.4. Hailstorms

4.3.4.1 Location and Extent

Hail is possible within most thunderstorms. It is produced by cumulonimbus (storm clouds) and within two nautical miles of the parent storm. In the form of solid precipitation, hail is produced when an ice crystal collects additional water in the lower part of the storm but is pushed upward by the storm's updraft. The liquid water freezes in the upper regions of the storm, making the ice crystal larger, this is also known as a hailstone. The hail will continue to grow in this manner until its weight exceeds the force of the updraft. Hailstones can take the shape of balls or irregular lumps of ice.

Hailstorms are not limited to any particular geographic area of the county. Prediction of the duration of the storm nor the extent of area affected by such an occurrence can't be predicted.

4.3.4.2 Range of Magnitude

Hailstones can measure between 0.2 inches to six inches in diameter. The METAR (a format for reporting weather information, predominately used by pilots) reporting code for hail 0.20 inches or greater is GR, while smaller hailstones are coded GS. Hail that is larger than 0.80 inches are usually considered large enough to cause damage. The US National Weather Service will issue severe thunderstorm warnings when hail that is 1 inch or greater in diameter is expected.

National Oceanic and Atmospheric Administration Skywarn program requests trained Skywarn Spotters measure hail with a ruler, but if one is not available, related terms can be used. See *Table 20 - Size of Hail in Related Terms.* Hail should only be measured when it is safe to do so.

Table 20 - Size of Hail in Related Terms

Size of Hail in Related Terms	
Related Item	**Size of Hail**
BB	Less than 1/4”
Pea	1/4”
Dime	7/10”
Penny	3/4"
Nickel	7/8”
Quarter	1”
Half Dollar	1 1/4"
Walnut or ping-pong ball	1 1/2"
Golf ball	1 3/4"
Lime	2”
Tennis ball	2 1/2"
Baseball	2 3/4"
Large apple	3”
Softball	4”
Grapefruit	4 1/2"

Environmental and other impacts from hailstorms ranges from:

- Crop production damage;
- Flooding caused by accumulation of hail that blocks drains;
- Loss of electric power;
- Trees brought down;
- Flash flooding; and,
- Mudslides.

4.3.4.3 Past Occurrence

In the 1960's the National Weather Service (NWS) developed the Skywarn® program. Skywarn® has trained weather spotters who provide reports of severe weather to NWS. These reports assist meteorologists to make life-saving warning decisions. Concerned citizens, amateur radio operators, truck drivers, emergency management personnel and others volunteer their time and energy to report hazardous weather impacting their communities.

Even with data from Doppler radar, satellite, and surface weather stations, NWS technology can't detect every instance of weather such as hail. So, reports from Skywarn® volunteers is a vital service for making warnings to those in the storm's path.

NOAA's National Weather Service storm prediction center reports on hail events for Susquehanna County are detailed in *Table 21 - National Weather Service Hail Reports*.

Table 21 - National Weather Service Hail Reports

National Weather Service Hail Reports				
Date	**Time**	**Location**	**Size (inches)**	**Comments**
07/26/69	13:00	Countywide	2.75	N/A
07/09/85	15:35	Countywide	1	N/A
05/31/86	16:00	Countywide	2	N/A
04/24/92	14:20	Countywide	1.75	N/A
08/25/92	15:05	Countywide	1	N/A
05/09/00	23:50	Harford	0.75	Reported by Cornell University storm spotters.
06/11/01	16:30	Laurel Lake	0.75	Reported by storm spotter
05/23/04	18:00	Great Bend	0.88	N/A
06/06/05	12:22	Countywide	1.75	Reports of $5,000 in damages.
07/09/06	19:20	New Milford	0.75	N/A
05/10/07	13:50	Auburn Center	2.75	An EF0 tornado was also reported in Elk Lake this date at 14:05. Reports of $25,000 in damages.
05/10/07	14:21	Montrose	0.75	N/A
06/27/07	16:30	Forest City	1	N/A
06/16/08	13:18	Countywide	1.25	N/A
06/16/08	14:45	Montrose	0.75	N/A
06/16/08	14:50	Harford	0.88	N/A
08/02/08	15:00	Hallstead	0.88	N/A

National Weather Service Hail Reports				
Date	**Time**	**Location**	**Size (inches)**	**Comments**
08/02/08	15:25	Countywide	1	N/A
08/02/08	15:30	North Jackson	0.75	N/A
08/10/08	13:47	Gibson	1.00	Hail covering the ground.
08/10/08	13:58	New Milford	0.88	N/A
08/10/08	14:04	Thompson	1	N/A
08/10/08	20:28	Montrose	0.88	N/A
05/04/10	15:02	Gibson	1.00	N/A
05/04/10	15:15	Burnwood	0.75	N/A
07/21/10	12:13	Hallstead	0.88	N/A
09/13/10	12:30	Brackney	1.00	N/A
09/13/10	12:32	Gibson	1.00	N/A
09/13/10	13:15	New Milford	0.88	N/A
09/13/10	13:15	Heart Lake	1.00	N/A
09/13/10	13:32	Gibson	1.00	N/A
09/13/10	13:36	Thompson	0.75	N/A
09/13/10	13:50	West Auburn	0.88	N/A
09/13/10	15:03	Lynn	1.00	N/A
09/13/10	20:03	Springville	1.00	Slightly larger than quarter size hail fell at Sheldon Hill Tree Farm. The hail fell for about 10 minutes.
04/25/11	20:03	St. Joseph	0.75	N/A
04/25/11	20:15	Montrose	0.75	N/A
04/25/11	20:39	New Milford	1.75	N/A
04/26/11	20:02	Montrose	0.75	N/A
4/26/11	20:11	Montrose	0.75	N/A
4/26/11	20:45	Elk Lake	1	N/A
06/09/11	13:24	Little Meadows	1	N/A
06/09/11	14:30	Montrose	1	N/A
08/09/11	17:28	3 W. Dimock	1.50	N/A
08/19/11	12:28	Elk Lake	1.50	N/A
08/19/11	12:33	Elk Lake	1.50	N/A
08/19/11	17:28	Dimock	1.50	N/A
07/23/12	14:39	New Milford	1.00	N/A
07/23/12	14:45	Starruca	1.00	Windshields broke and other damage to cars. Reports of $15,000 in damages.
07/23/12	16:42	Forest City	1.25	N/A
07/23/12	17:02	Forest City	1.25	N/A
07/23/12	27:42	Montrose	1.00	N/A
07/26/12	15:54	Montrose	1.00	An EF1 tornado was also reported in this area at 16:00.
09/06/12	16:35	Friendsville	1.00	N/A
06/24/13	13:58	Ararat	1.00	N/A
09/11/13	14:12	Brooklyn	1.75	Reported along State Route 167. Also, wires down on an occupied vehicle at the intersection of SR 167 and SR 2024. Reports of $5,000 in damages.
05/22/14	14:10	Friendsville	1.00	N/A
05/22/14	14:18	Middletown Center	0.75	N/A
07/02/14	10:35	Friendsville	1.75	Reports of $5,000 in damages.
07/02/14	10:36	Birchardville	1.75	Widespread hail damage. Relayed by WBNG TV. Reports of $5,000 in damages.

National Weather Service Hail Reports				
Date	**Time**	**Location**	**Size (inches)**	**Comments**
07/02/14	10:59	Montrose	0.88	N/A
07/02/14	11:20	Brooklyn	2.00	Reports of $5,000 in damages.
07/03/14	15:46	Thompson	0.75	N/A
05/31/17	18:30	West Auburn	0.75	N/A
06/27/17	14:00	Brackney	1.50	Silver dollar size. Relayed from Fox 56 and Facebook pictures. Reports of $1,000 in damages.

It should be noted that all occurrences of hail in Susquehanna County may not have been recorded in the table above. This is due to lack of reports to the NWS, either because the hail happened at: locations uninhabited, during overnight hours, or residents that observed the hail were not Skywarn® spotters.

4.3.4.4 Future Occurrence

Hail storms are associated with thunderstorms and should be considered highly likely for Susquehanna County.

4.3.4.5 Vulnerability Assessment

Automobiles, aircraft, skylights, livestock, and farmers' crops can all be seriously damaged by hail. Roofs can also be damaged by hail, although it most likely will go undetected until structural damage is seen, such as leaks and cracks. Although it is rare, hail has been known to cause concussions or fatal head traumas to humans. To alleviate damages from hail: automobiles could be placed in garages, grounded aircraft could be placed in a hanger, livestock and people moved inside structures during the storm. Unfortunately crops, skylights, roofs, and flying aircraft are unable to be protected from hail.

4.3.5. Hurricane, Tropical Storms, Nor'easter

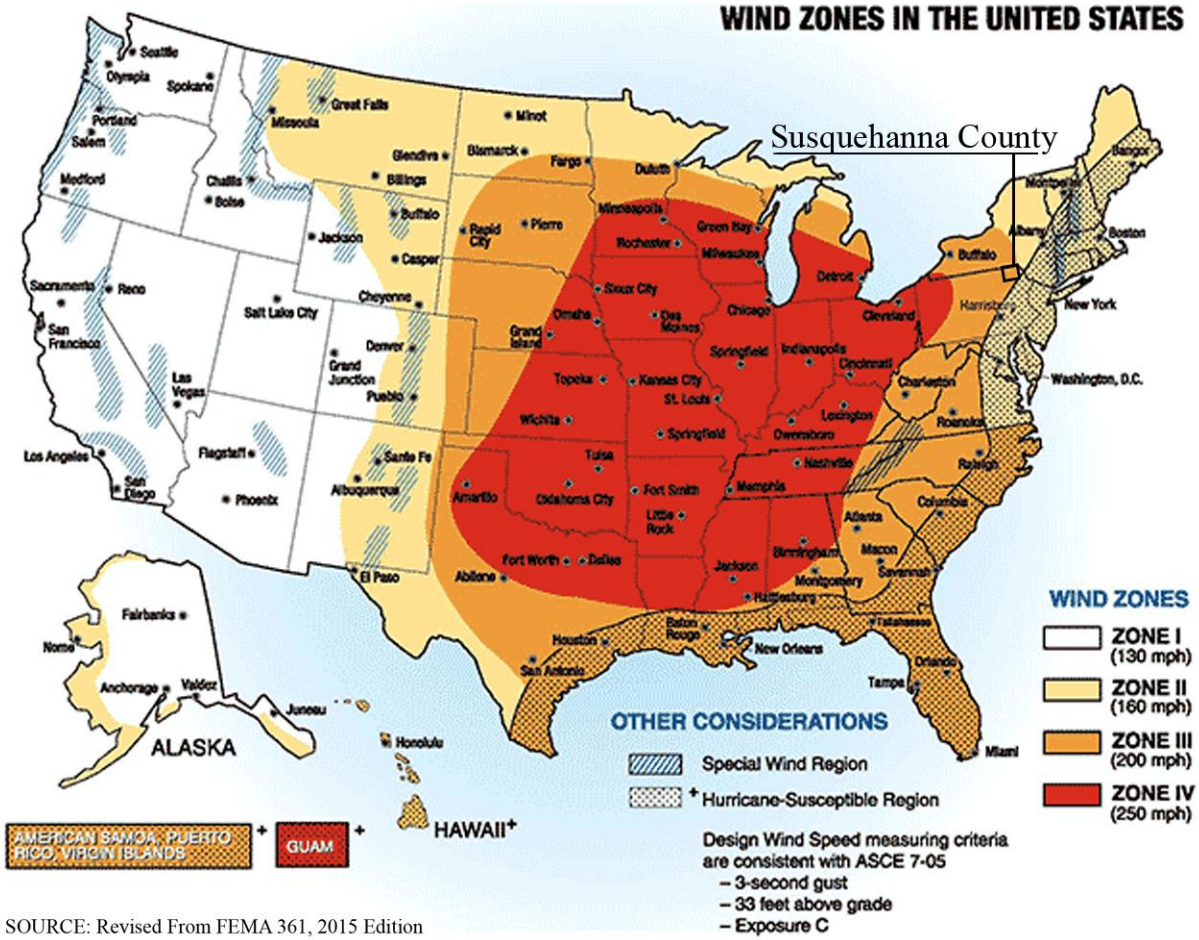
4.3.5.1 Location and Extent

Tropical depressions are cyclones with maximum sustained winds of less than thirty-nine miles per hour (mph). The system becomes a tropical storm when the maximum sustained winds reach between thirty-nine to seventy-four miles per hour. When wind speeds exceed seventy-four mph, the system is considered a hurricane. Tropical storms impacting Susquehanna County develop in tropical or sub-tropical waters found in the Atlantic Ocean, Gulf of Mexico, or Caribbean Sea. Another type of tropical storm is nor'easters, which are large cyclones that rotate clockwise and are typically associated with the Atlantic Ocean and the East Coast of the United States between North Carolina

and Massachusetts. The name nor'easter comes from the direction that the strongest winds typically blow from the cyclone.

Susquehanna County is located over one hundred miles inland of the East Coast of the United States and is located just inland of the region designated by FEMA as being Hurricane-Susceptible (see *Figure 13 - Wind Zones*). However, tropical storms can track inland potentially causing heavy rainfall and strong winds in Susquehanna County. All communities within Susquehanna County are equally subject to the impacts of hurricanes and tropical storms that track near the county. Areas in Susquehanna County which are subject to flooding, wind and winter storm damage are particularly vulnerable.

Figure 13 - Wind Zones



SOURCE: Revised From FEMA 361, 2015 Edition

4.3.5.2 Range of Magnitude

Table 22 - Saffir-Simpson Scale

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

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 22 - 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 Susquehanna County). Categories 3, 4, and 5 are classified as "major" hurricanes. While major hurricanes comprise only twenty of all tropical cyclones making landfall, they account for over seventy percent of the damage in the United States. While hurricanes can cause high winds and associated impacts, it is also important to recognize the potential for flooding events during hurricanes, tropical storms and nor'easters; the risk assessment and associated impact for flooding events is included Section 4.3.3.5.

4.3.5.3 Past Occurrence

Table 23 - History of Coastal Storms Impacting Susquehanna County lists all coastal storms that have impacted Susquehanna County from 1970 to December 2017. Although impacts of tropical storms are commonly felt in the Commonwealth, it is rare that a hurricane would track through Susquehanna County. Tropical Storm Lee caused flash flooding in Susquehanna County in 2011 causing nearly $1.5 million in damages. Most recently in June of 2017, Tropical Storm Cindy caused heavy rains in eastern Pennsylvania with some accompanying flash flooding.

Table 23 - History of Coastal Storms Impacting Susquehanna County

History of Coastal Storms Impacting Susquehanna County (NCEI, 2017)	
Year	**Name**
1972	Tropical Storm Agnes
1999	Hurricane Floyd
2003	Tropical Storm Henri
2003	Tropical Storm Isabel
2004	Tropical Depression Frances
2004	Tropical Depression Ivan
2005	Hurricane Katrina
2006	Tropical Depression Ernesto
2008	Hurricane Ike
2011	Hurricane Irene
2011	Tropical Storm Lee
2012	Hurricane Sandy
2017	Tropical Storm Cindy

4.3.5.4 Future Occurrence

Although hurricanes and tropical storms can cause flood events consistent with 100 and 500-year flood levels, the probability of occurrence of hurricanes and tropical storms is measured relative to wind speed. *Table 24 – Annual Probability of Wind Speeds* shows the annual probability of winds that reach the strength of tropical storms and hurricanes in Susquehanna County and the surrounding areas based on a sample period of forty-six years. NOAA's Hurricane Research Division estimates that Susquehanna County will experience impacts from a named tropical storm or hurricane about once every five years, with a probability between 10% and 20% annually (*Figure 14 - Mean Occurrence of Named Storms)*. However according to FEMA, there is a high probability each year that Susquehanna County will experience winds from coastal storms that could cause minimal to moderate damages (*Table 24 – Annual Probability of Wind Speeds*). The probability of winds exceeding 118 mph is less than .1% annually.

Figure 14 - Mean Occurrence of Named Storms

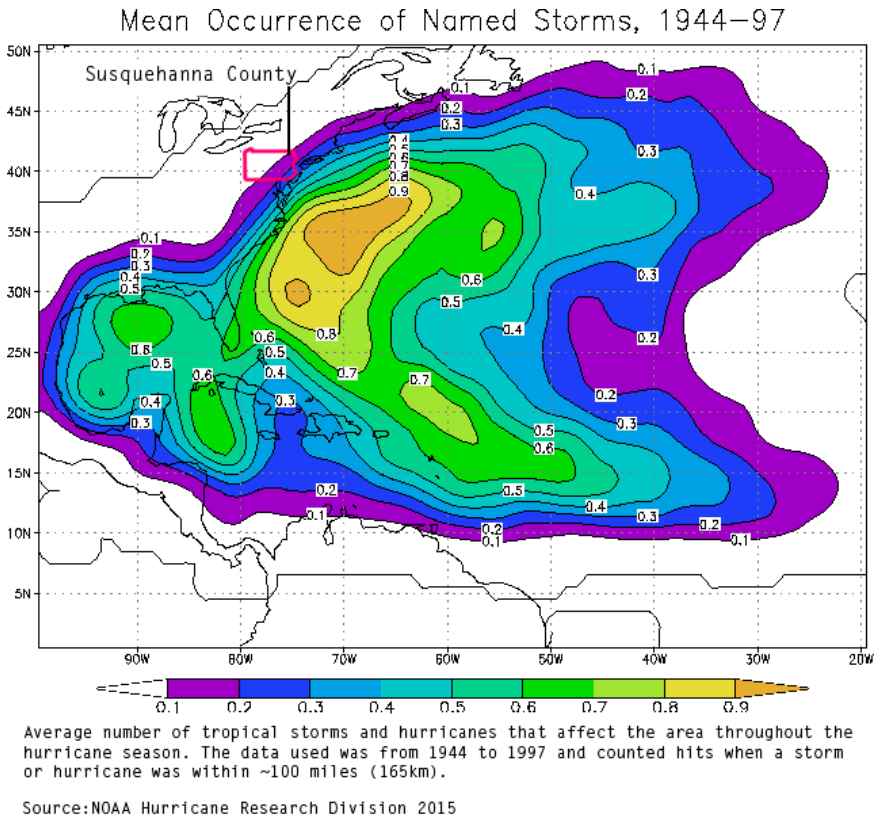


Table 24 – Annual Probability of Wind Speeds

Annual Probability of Wind Speeds (FEMA, 2000)		
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

Climate change is causing atmospheric temperatures to rise, which corresponds to a rise in ocean surface temperatures, resulting in warmer and moister conditions where tropical storms develop (Stott et al., 2010). Warmer oceans store more energy and are capable of fueling stronger storms and it is projected that Atlantic hurricanes will become more intense and produce more precipitation as ocean 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. Susquehanna County can be 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

While Susquehanna County is located just outside of the East Coast region acutely susceptible to hurricanes, tropical storms tracking nearby can still cause high winds and heavy rains. A vulnerability assessment for hurricanes and tropical storms focuses on the impacts of flooding and severe wind. The assessment for flood-related vulnerability is addressed in Section 4.3.3.5 and discussion of wind related vulnerability is addressed in Section

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 species 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, fishes, aquatic plants, and microbes that threaten the diversity or abundance of native species, the ecological

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

Terrestrial Invasive Species (TIS) are nonnative 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 25 - Non-Native Species* lists invasive species that have been found in Susquehanna County.

4.3.6.2 Range of Magnitude

Some invasive species are not considered agricultural pests, do not harm humans and do not cause significant ecological problems. Other invasive species can have many negative impacts and cause significant changes in the composition of ecosystems. For example, the Emerald Ash Borer has a ninety-nine percent mortality rate for any ash tree it infects. Didymo, an aggressive form of algae not yet found in Susquehanna County, 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 worst-case scenario for invasive species is the success of the Emerald Ash Borer in Susquehanna County and the surrounding region. The Emerald Ash Borer has already become established in Susquehanna County and the surrounding region, and there is a high mortality rate for trees associated with this pest. Hardwood forests in the county have been negatively impacted due to this invasive species and there have been many ash tree fatalities. Degradation of forest health which 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, foraging 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. There are several invasive pests that have moved through Susquehanna County and the

surrounding region which have resulted in the deaths of many trees. PennDOT summarizes these invasive species:

> *Pennsylvania has been inhabited by an invasive beetle known as the Emerald Ash Borer. This green-colored insect has infested many ash trees, which has resulted in a pandemic level of dead ash trees. In addition, the Gypsy Moth Caterpillar defoliated Western Pennsylvania at least twice within the last twenty years. This insect infested the oak tree species and many of those trees have died as well. The Wooly Adelgid and needle blight fungi are also currently affecting the white pine and hemlock trees, resulting in their premature deaths. (PennDOT, 2017)*

These occurrences represent lost battles to invasive species, and these species are widespread in Susquehanna County and the surrounding region. Once a species is established in an area and it causes a change in the ecology, it is quite difficult if somewhat futile to turn back the clock on the prevalence of the species, however Susquehanna County can work towards mitigating the negative impacts of such widespread invasive species. In the case of the Emerald Ash Borer and other tree killing invasive species, PennDOT has identified one way that the threat needs to be mitigated in the wake of the surge of dead trees:

> *The Emerald Ash Borer, Gypsy Moth and Wooly Adelgid] have left … tens of thousands of dead trees either within the State Department of Transportation's (PennDOT) right-of-way or on private property, but within close proximity to falling on our highways. Although random in nature, several fatalities have been associated with trees falling on motorists or motorists running into downed trees across the highway…*
>
> *PennDOT has been incorporating select tree removal into roadway construction projects using both federal and state funding. Since July 1, 2016, PennDOT Department Force Crews have also increased their efforts in select manual tree removal. This work is often done during the winter when crews are not engaged in snow removal operations. Dead tree removal is quickly becoming a major focus of PennDOT, however a sustained funding source to remove all of these potential hazards is simply not available. The PA Department of Agriculture has established strict firewood and lumber quarantine areas in some of these districts so additional costs may be incurred.*

Table 25 - Non-Native Species lists all non-native species that are established in Susquehanna County. While all species listed here are not native to Susquehanna County, those species highlighted in yellow pose a larger ecological threat than others (see 4.3.5.5. Vulnerability Assessment for additional discussion). For some species such as the Asian Long-horned Beetle, the Spotted Lanternfly, Autumn Olive and Japanese Stiltgrass Susquehanna County is on the edge of the species range, meaning control efforts taken in the county can help limit the propagation of the threat even beyond the county (*Table 26 - Vulnerable Species*).

Table 25 - Non-Native Species

Non-Native Species Present in Susquehanna County (EDDMaps, 2018; PA DCNR, 2018; USDA FS, 2018; iMapInvasives, 2018)		
Scientific Name	**Common Name**	**Type**
Dreissena polymorpha	Zebra Mussel	Aquatic Animal
Lemna minor	Common Duckweed	Aquatic Plant
Potamogeton crispus	Curly-Leaf Pondweed	Aquatic Plant
Epilobium hirsutum	Great Hairy Willowherb	Aquatic Plant
Persicaria hydropiper	Marshpepper Knotweed, Smartweed	Aquatic Plant
Polygonum amphibium	Water Knotweed	Aquatic Plant
Nasturtium officinale	Watercress	Aquatic Plant
Neonectria (N.) & Cryptococcus fagisuga	Beech Bark Disease Complex	Disease
Sirococcus clavigignenti-juglandacea-rum	Butternut Canker	Disease
Diaporthales: Cryphonectriaceae	Chestnut Blight	Disease
Hemiptera: Diaspididae	Elongate Hemlock Scale	Disease
Neonectria faginata	Neonectria Canker	Disease
Cronartium ribicola	White Pine Blister Rust	Disease
Fenusa pusilla	Birch Leafminer	Insect
Coleoptera: Buprestidae	Emerald Ash Borer	Insect
Letpidoptera: Tortricidae	European Pine Shoot Moth	Insect
Malacosoma disstria	Forest Tent Caterpillar	Insect
Lepidoptera: Lymantriidae	Gypsy Moth	Insect
Hemiptera: Adelgidae	Hemlock Woolly Adelgid	Insect
Coleoptera: Scarabaeidae	Japanese Beetle	Insect
Choristoneura conflictana	Large Aspen Tortrix	Insect
Pristiphora geniculata	Mountain-Ash Sawfly	Insect
Hymenoptera: Tenthredinidae	Pear Sawfly	Insect
Coleoptera: Cuculionidae	Pine Shoot Beetle	Insect
Medicago sativa	Alfalfa	Plant
Trifolium hybridum	Alsike Clover	Plant
Glyceria grandis var. grandis	American Mannagrass	Plant
Poa annua	Annual Bluegrass	Plant
Sonchus oleraceus	Annual Sowthistle	Plant
Bromus racemosus	Bald Brome	Plant
Echinochloa crus-galli	Barnyardgrass	Plant
Lotus corniculatus	Birdsfoot Trefoil	Plant
Solanum dulcamara	Bittersweet Nightshade	Plant
Celastrus spp.	Bittersweets	Plant
Medicago lupulina	Black Medic	Plant
Brassica nigra	Black Mustard	Plant
Silene latifolia ssp. alba	Bladder Campion	Plant
Saponaria officinalis	Bouncingbet	Plant

Non-Native Species Present in Susquehanna County (EDDMaps, 2018; PA DCNR, 2018; USDA FS, 2018; iMapInvasives, 2018)		
Scientific Name	**Common Name**	**Type**
Rumex obtusifolius	Broadleaf Dock	Plant
Plantago major	Broadleaf Plantain	Plant
Centaurea jacea	Brown Knapweed	Plant
Centaurea jacea	Brown Starthistle	Plant
Plantago lanceolata	Buckhorn Plantain	Plant
Fagopyrum esculentum	Buckwheat	Plant
Cirsium vulgare	Bull Thistle	Plant
Lonicera spp.	Bush Honeysuckles (Exotic)	Plant
Poa compressa	Canada Bluegrass	Plant
Cirsium arvense	Canada Thistle	Plant
Erigeron canadensis	Canadian Horseweed	Plant
Nepeta cataria	Catnip	Plant
Bromus tectorum	Cheatgrass	Plant
Tussilago farfara	Colt'S Foot	Plant
Tussilago farfara	Coltsfoot	Plant
Arctium minus	Common Burdock	Plant
Carum carvi	Common Caraway	Plant
Stellaria pallida	Common Chickweed	Plant
Xanthium strumarium	Common Cocklebur	Plant
Taraxacum officinale ssp. officinale	Common Dandelion	Plant
Malva neglecta	Common Mallow	Plant
Cerastium fontanum	Common Mouse-Ear Chickweed	Plant
Verbascum thapsus	Common Mullein	Plant
Vinca minor	Common Periwinkle	Plant
Ambrosia artemisiifolia	Common Ragweed	Plant
Prunella vulgaris	Common Selfheal	Plant
Veronica officinalis	Common Speedwell	Plant
Hypericum perforatum	Common St. Johnswort	Plant
Tanacetum vulgare	Common Tansy	Plant
Dipsacus fullonum	Common Teasel	Plant
Holcus lanatus	Common Velvetgrass	Plant
Achillea millefolium	Common Yarrow	Plant
Veronica arvensis	Corn Speedwell	Plant
Spergula arvensis	Corn Spurry	Plant
Salix fragilis	Crack Willow	Plant
Campanula rapunculoides	Creeping Bellflower	Plant
Agrostis stolonifera	Creeping Bentgrass	Plant
Ranunculus repens	Creeping Buttercup	Plant
Lysimachia nummularia	Creeping Yellow Loosestrife, Creeping Jenney	Plant
Ribes rubrum	Cultivated Currant	Plant

Non-Native Species Present in Susquehanna County (EDDMaps, 2018; PA DCNR, 2018; USDA FS, 2018; iMapInvasives, 2018)		
Scientific Name	**Common Name**	**Type**
Rumex crispus ssp. crispus	Curly Dock	Plant
Dipsacus laciniatus	Cutleaf Teasel	Plant
Hesperis matronalis	Dames Rocket	Plant
Taraxacum officinale	Dandelion	Plant
Chaenorhinum minus	Dwarf Snapdragon	Plant
Toxicodendron radicans	Eastern Poison-Ivy	Plant
Juniperus virginiana	Eastern Redcedar	Plant
Pinus strobus	Eastern White Pine	Plant
Inula helenium	Elecampane	Plant
Rubus idaeus	European Red Raspberry	Plant
Panicum dichotomiflorum	Fall Panicum	Plant
Equisetum arvense	Field Horsetail	Plant
Thlaspi arvense	Field Pennycress	Plant
Alliaria petiolata	Garlic Mustard	Plant
Veronica chamaedrys	Germander Speedwell	Plant
Myosoton aquaticum	Giant Chickweed	Plant
Arctium lappa	Great Burdock	Plant
Setaria viridis var. viridis	Green Bristlegrass	Plant
Setaria viridis	Green Foxtail	Plant
Glechoma hederacea	Ground Ivy	Plant
Galinsoga quadriradiata	Hairy Galinsoga	Plant
Vicia villosa	Hairy Vetch	Plant
Epilobium hirsutum	Hairy Willowherb	Plant
Calystegia sepium	Hedge Bindweed	Plant
Sisymbrium officinale	Hedge Mustard	Plant
Apocynum cannabinum	Hemp Dogbane	Plant
Geranium robertianum	Herb-Robert	Plant
Trifolium aureum	Hop Clover	Plant
Cynoglossum officinale	Houndstongue	Plant
Brassica juncea	Indian Mustard	Plant
Berberis thunbergii	Japanese Barberry	Plant
Lonicera japonica	Japanese Honeysuckle	Plant
Reynoutria japonica	Japanese Knotweed	Plant
Poa pratensis	Kentucky Bluegrass	Plant
Persicaria maculosa	Ladysthumb	Plant
Chenopodium album	Lambsquarters	Plant
Trifolium campestre	Large Hop Clover	Plant
Stellaria graminea	Little Starwort	Plant
Hylotelephium telephium	Live-Forever Stonecrop	Plant
Gnaphalium uliginosum	Low Cudweed	Plant
Festuca pratensis	Meadow Fescue	Plant

Non-Native Species Present in Susquehanna County (EDDMaps, 2018; PA DCNR, 2018; USDA FS, 2018; iMapInvasives, 2018)		
Scientific Name	**Common Name**	**Type**
Hieracium caespitosum	Meadow Hawkweed	Plant
Tragopogon lamottei	Meadow Salsify	Plant
Leonurus cardiaca	Motherwort	Plant
Hieracium pilosella	Mouseear Hawkweed	Plant
Rosa multiflora	Multiflora Rose	Plant
Malva moschata	Musk Mallow	Plant
Picea abies	Norway Spruce	Plant
Hieracium aurantiacum	Orange Hawkweed	Plant
Dactylis glomerata	Orchardgrass	Plant
Celastrus orbiculatus	Oriental Bittersweet	Plant
Leucanthemum vulgare	Oxeye Daisy	Plant
Polygonum lapathifolium	Pale Smartweed	Plant
Malus pumila	Paradise Apple	Plant
Lolium perenne	Perennial Ryegrass	Plant
Vinca spp.	Periwinkle	Plant
Matricaria discoidea	Pineapple-Weed	Plant
Carduus spp.	Plumeless Thistle	Plant
Lactuca serriola	Prickly Lettuce	Plant
Persicaria orientalis	Princess-Feather	Plant
Polygonum aviculare	Prostrate Knotweed	Plant
Lythrum salicaria	Purple Loosestrife	Plant
Elymus repens	Quackgrass	Plant
Daucus carota	Queen Anne'S Lace, Wild Carrot	Plant
Trifolium pratense	Red Clover	Plant
Rumex acetosella	Red Sorrel	Plant
Amaranthus retroflexus	Redroot Pigweed	Plant
Agrostis gigantea	Redtop	Plant
Phalaris arundinacea	Reed Canarygrass	Plant
Taraxacum erythrospermum	Rock Dandelion	Plant
Capsella bursa-pastoris	Shepherd'S-Purse	Plant
Potentilla argentea	Silvery Cinquefoil	Plant
Galium mollugo	Smooth Bedstraw	Plant
Bromus inermis	Smooth Brome	Plant
Carduus acanthoides	Spiny Plumeless Thistle	Plant
Sonchus asper	Spiny Sowthistle	Plant
Galeopsis bifida	Splitlip Hempnettle	Plant
Anthemis cotula	Stinking Chamomile	Plant
Potentilla recta	Sulfur Cinquefoil	Plant
Prunus avium	Sweet Cherry	Plant
Anthoxanthum odoratum	Sweet Vernalgrass	Plant
Rosa rubiginosa	Sweetbriar	Plant

Non-Native Species Present in Susquehanna County (EDDMaps, 2018; PA DCNR, 2018; USDA FS, 2018; iMapInvasives, 2018)		
Scientific Name	**Common Name**	**Type**
Acorus calamus	Sweetflag, Calamus	Plant
Ranunculus acris	Tall Buttercup	Plant
Arrhenatherum elatius	Tall Oatgrass	Plant
Dipsacus spp.	Teasel	Plant
Veronica serpyllifolia ssp. serpyllifolia	Thymeleaf Speedwell	Plant
Phleum pratense	Timothy	Plant
Myosotis scorpioides	True Forget-Me-Not	Plant
Lepidium virginicum	Virginia Pepperweed	Plant
Silene latifolia	White Campion	Plant
Trifolium repens	White Clover	Plant
Muhlenbergia frondosa	Wirestem Muhly	Plant
Hylotelephium telephium ssp. telephium	Witch'S Moneybags	Plant
Fragaria vesca	Woodland Strawberry	Plant
Rorippa sylvestris	Yellow Fieldcress	Plant
Setaria pumila	Yellow Foxtail	Plant
Iris pseudacorus	Yellow Iris	Plant
Cyperus esculentus	Yellow Nutsedge	Plant
Barbarea vulgaris	Yellow Rocket	Plant
Melilotus officinalis	Yellow Sweet-Clover	Plant
Linaria vulgaris	Yellow Toadflax	Plant
Oxalis stricta	Yellow Woodsorrel	Plant

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.

There are several invasive species that are found near Susquehanna County but have not yet been detected inside the county (see *Table 26 - Vulnerable Species*). Especially in cases like this, control efforts, heightened awareness, and public outreach and education can help prevent an invasive species from becoming established. Once a species is established, it is much more difficult to eradicate it from an ecosystem meaning prevention is very important. For a more inclusive list of invasive plants found in Pennsylvania and a list of invasive plants on the Pennsylvania watch list, see the referenced PA DCNR publication "DCNR Invasive Plants" (PA DCNR, 2016). Species highlighted in yellow were identified as priority species for prevention (see 4.3.4.5. Vulnerability Assessment for more additional discussion).

Table 26 - Vulnerable Species

Vulnerable Species - Invasives found Near Susquehanna County (EDDMaps, 2018; PA DCNR, 2018; USDA FS, 2018; iMapInvasives, 2018)		
Scientific Name	**Common Name**	**Type**
Corbicula fluminea	Asiatic Clam	Aquatic Animal
Nelumbo lutea	American Water Lotus	Aquatic Plant
Myriophyllum spicatum	Eurasian Water-Milfoil	Aquatic Plant
Veronica anagallis-aquatica	Water Speedwell	Aquatic Plant
Discula destructiva	Dogwood Anthracnose	Disease
Ophiostoma ulmi, Ophiostoma himal-ulmi, Ophiostoma novo-ulmi	Dutch Elm Disease	Disease
Asterolecanium minus	Oak Pit Scale A. Minus	Disease
Matsucoccus matsumurae	Red Pine Scale	Disease
Anoplophora glabripennis	Asian Long-Horned Beetle	Insect
H. Opacus	European Bark Beetle	Insect
Neodiprion sertifer	European Pine Sawfly	Insect
Gilpinia hercyniae	European Spruce Sawfly	Insect
Plagiodera versicolora	Imported Willow Leaf Beetle	Insect
Coleophora laricella	Larch Casebearer	Insect
Pristiphora erichsonii	Larch Sawfly	Insect
Taeniothrips inconsequens	Pear Thrips	Insect
Trichiocampus viminalis	Poplar Sawfly	Insect
Hylurgus ligniperda	Redhaired Pine Bark Beetle	Insect
Quadraspidiotus perniciosus	San Jose Scale	Insect
Sirex noctilio	Sirex Woodwasp	Insect
Scolytus multistriatus	Smaller European Elm Bark Beetle	Insect
Lycroma delicatula	Spotted Lanternfly (Lycorma)	Insect
Otiorhynchus ovatus	Strawberry Root Weevil	Insect

Vulnerable Species - Invasives found Near Susquehanna County (EDDMaps, 2018; PA DCNR, 2018; USDA FS, 2018; iMapInvasives, 2018)		
Lonicera maackii	Amur Honeysuckle	Plant
Elaeagnus umbellata	Autumn Olive	Plant
Lonicera spp. (species unknown)	Bush Honeysuckle (Species Unknown)	Plant
Phragmites australis ssp. australis	European Common Reed	Plant
Heracleum mantegazzianum	Giant Hogweed	Plant
Microstegium vimineum	Japanese Stiltgrass	Plant
Persicaria perfoliata	Mile-A-Minute Vine	Plant
Lonicera morrowii	Morrow'S Honeysuckle	Plant
Conium maculatum	Poison Hemlock	Plant
Cardamine impatiens	Touch-Me-Not Bittercress	Plant
Ailanthus altissima	Tree-Of-Heaven	Plant

4.3.6.5 Vulnerability Assessment

Susquehanna 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.

An interesting facet of the invasive species problem in Pennsylvania is that deer do not eat many invasive plants, giving invasive species a competitive advantage over the native species that fall prey to deer. As such, the management of deer populations in Susquehanna County has a significant impact on the vulnerability of an ecosystem to invasive species, where overpopulation of deer favors invasive species.

There are five primary components to managing invasive plants:

Prioritize: Public use areas such as state parks and other healthy forest ecosystems should be prioritized over developed and private areas. Locations with lower densities of invasive plants are often easier to control and should be given quick attention. Locations where humans are disturbing the landscape opens up niche space, and often times the aggressive invasive species move in faster than native species. Such locations include: road work, ditch/ culvert work, logging activities, stream improvement/stabilization and bridge work. Some species pose a higher risk than others - members of County Conservation Districts and State Parks across Pennsylvania have identified priority species for management. Those priority species as well as other priority species are highlighted in yellow in *Table 25 - Non-Native Species* and *Table 26 - Vulnerable Species*. The most

notable species that are established in Susquehanna County that are a priority to manage include:

- Bush Honeysuckle
- Multiflora Rose
- Japanese Knotweed
- Oriental Bittersweet
- Purple Loosestrife

Invasive species are easiest to control before they become widespread and established in an area, and for that reason, management should prioritize management of species that are listed as priorities in *Table 26 - Vulnerable Species*. Public outreach and education is important for these species in order to improve identification and prevention of invasion. Japanese Stiltgrass is not yet found in Susquehanna County, but is aggressive and fast moving, forming a thick mat that nothing else can grow through. It is also quite shade tolerant, so it can take over the understory of forests. The Asian Long-horned Beetle first attacks red maple trees, followed by many other hardwoods by boring half inch holes through the trees, weakening them structurally and causing limbs to break off, ultimately killing trees. Susquehanna County has many red and sugar maple trees, so if the Asian Long-horned Beetle ever became established in the county, it could spread quickly and have a devastating impact.

Locate: Detailed locations should be recorded for invasive plants so sites can be easily relocated, treated and monitored.

Delineate: The scale and extent of the infestation should be recorded and mapped so that the progress of the infestation can be monitored.

Control: Methods of control depend on the specific infestation, but the most common approaches are mechanical (cutting and hand-pulling) and chemical (herbicide treatments).

Monitor: Identified sites should be monitored and revisited as often as several times in a growing season (depending on the location / species). Monitoring can allow for early detection of spreading infestations. Most importantly, it prevents a relapse towards full-blown infestation.

4.3.7. Landslides

4.3.4.1 Location and Extent

Landslides are described as downward and outward movement of slope-forming soil, rock and vegetation reactive to the force of gravity. Rockfalls, rockslides, rock topples, block glides, debris flows, mudflows and mudslides are all forms of landslides. Natural causes of landslides include heavy rain, rapid snow melt, erosion, earthquakes and

changes in groundwater levels. Landslides occur most frequently in areas with moderate to steep slopes and high precipitation, and most often slope failures happen during or after periods of sustained above average precipitation or snowmelt events. Human activity can increase the likelihood of landslides by reducing vegetation cover, altering the natural slope gradient or increasing the soil water content. One location where this type of human activity is common are areas that were excavated along highways and other roadways.

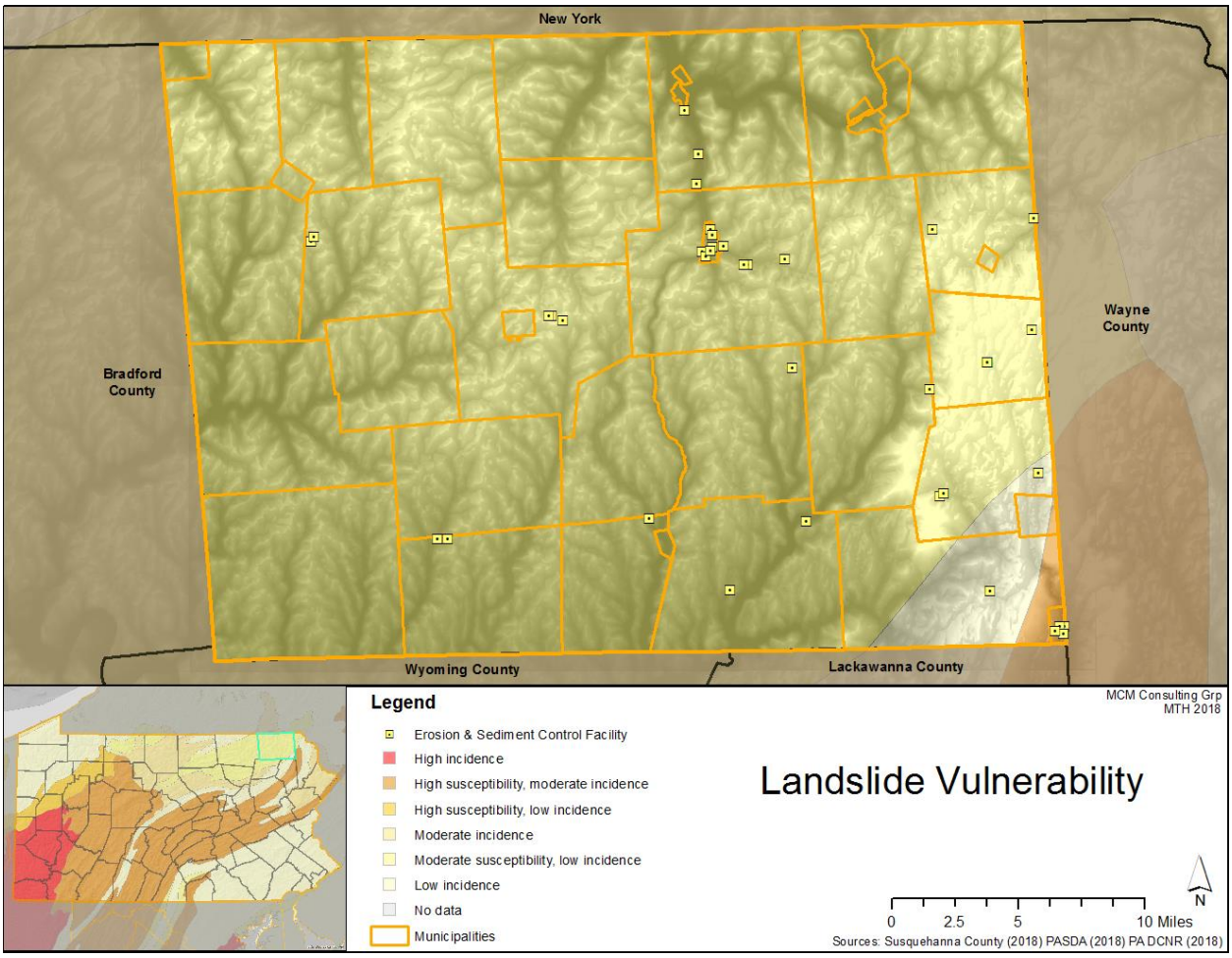
Most landslides in Susquehanna County are slow moving and more often cause property damage rather than causing human injury. These landslides are due to geologic properties of the area that make it easily prone to erosion.

4.3.4.2 Range and Magnitude

Landslides can cause damage to utilities as well as transportation routes, resulting in road closure or travel delays. Fortunately, deaths and injuries due to landslides are rare in Pennsylvania and Susquehanna County. Most reported deaths due to landslides have occurred when rockfalls or other slides along highways have involved vehicles. Storm-induced debris flows can also sometimes cause death and injury. As residential and recreational development increases on and near steep mountain slopes, the hazard from these rapid events will also increase. Most Pennsylvania landslides are moderate to slow moving and damage property rather than people.

The Pennsylvania Department of Transportation and large municipalities incur substantial costs due to landslide damage and to extra construction costs for new roads in known landslide-prone areas. A 1991 estimate showed an average of ten million per year is spent on landslide repair contracts across the Commonwealth and a similar amount is spent on mitigation costs for grading projects. A number of highway sites in Pennsylvania are in need of permanent repair at estimated costs of $300,000 to $2 million each (DCNR, 2010). The USGS identifies the vast majority of Susquehanna County as falling into a moderate susceptibility and low incidence zone for landslides, with a small Southeastern portion of the county considered to be a high susceptibility and moderate incidence zone, as well as a small area of low incidence (see *Figure 15 - Landslide Susceptibility*). Areas that are susceptible to landslides are geologically prone to giving way after significant precipitation events.

Figure 15 - Landslide Susceptibility



4.3.4.3 Past Occurrence

In 2004 a minor landslide occurred as a result of heavy rains from Tropical Depression Ivan. No comprehensive list of landslide incidents in Susquehanna County is available, as there is no formal reporting system in place. PennDOT and municipal maintenance departments are responsible for slides that inhibit the flow of traffic or damage to roads and bridges, but they can generally only repair the road itself and right-of-way areas.

4.3.4.4 Future Occurrence

The majority of Susquehanna County is not at high risk for landslides, however mismanaged development in steeply sloped areas would increase the frequency of occurrence of landslides. Road cuts are the most common development that puts an area at a heightened probability of a slide. The PA Department of Environmental Protection has

an Erosion and Sediment (E&S) program that sets requirements for development projects of a certain scale that are intended to mitigate erosion, which are similar practices to prevent causing landslides.

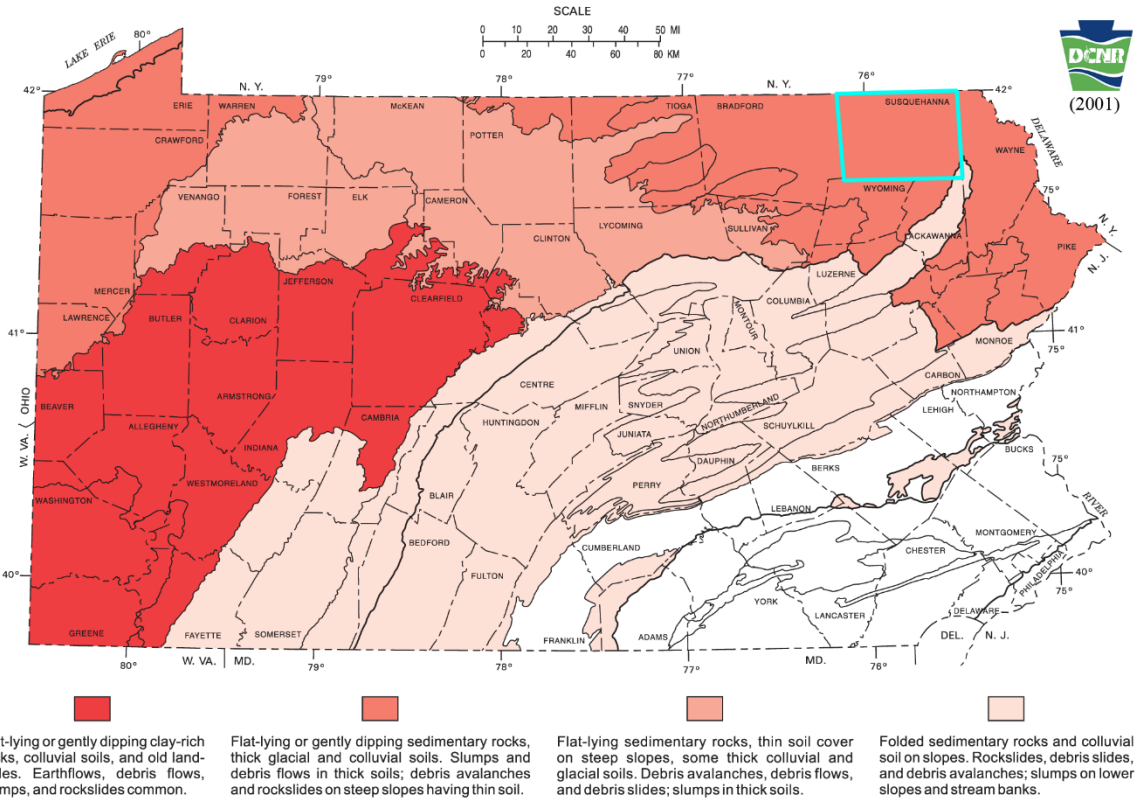
4.3.4.5 Vulnerability Assessment

Landslides are often precipitated by other natural hazards such as earthquakes or floods, and a serious landslide can cause millions of dollars in damages. Continued enforcement of floodplain management and proper road and building construction helps to mitigate the threat of landslides. Floodplain management is important where mining has occurred within close proximity to watercourses and associated flat-lying areas. Surface water may permeate into areas that still have open fractures and the build-up of surface water in fractures could lead to unexpected flood events.

A comprehensive database of land highly prone to erosion and landslides is difficult to come by. Construction projects in Susquehanna County should be wary of erosion and the potential for landslides. There are several general factors that can be indicators of a landslide prone area:

- On or close to steep hills
- Areas of steep road cuts or excavations
- Steep areas where surface run-off is channeled
- Fan shaped areas of sediment and rock accumulations
- Evidence of past sliding such as tilted utility lines, tilted trees, cracks in the ground and irregularly surfaced ground.

Figure 16 - Landslide Rock Type (PA DCNR 2001)



The distribution of types of landslides most likely to occur in different geologic settings in Pennsylvania. Stream-bank slumps, soil creep, and rockfall/rockslide combinations on cut slopes can occur throughout Pennsylvania.

4.3.8. Lightning Strike

4.3.8.1 Location and Extent

While the impact of lightning events is highly localized, strong storms can result in numerous widespread events over a broad area within Susquehanna County. Impacts of an event can be serious or widespread if lightning strikes a particularly significant location such as a power station or large public venue.

Lightning can strike at any time of the day or season but is more frequent during the summer months. A by-product of thunderstorms, lightning is a discharge of electrical energy resulting from the buildup of positive and negative charges. The flash or "bolt" of light usually occurs within clouds or between clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000°F. Nearly as many people lose their lives to lightning strikes as they do to tornadoes. But, because fatalities due to lightning happen to just one or two people at a time, there is less publicity.

4.3.8.2 Range of Magnitude

Each year, lightning is responsible for the deaths of a hundred or so people, injuries to several hundred more, and millions of dollars in property damage, in the United States. Case histories of those injured can experience any of the following:

- Loss of consciousness,
- Amnesia
- Paralysis
- Burns
- Heart damage.

Also present in many lightning fatalities are inflated lungs and brain damage. Deaths and injuries to livestock and other animals, thousands of forest and brush fires, as well as millions of dollars in damage to buildings, communications systems, power lines, and electrical systems are also the result of lightning.

Between 1959 and 1994, Pennsylvania ranked third among all states in the United States with 644 casualties (i.e., combination of deaths and injuries). This represents approximately five percent of casualties that occurred throughout the U.S. over that thirty-five-year period. Pennsylvania ranked first among all states in the U.S. with 1,441 damage reports. However, it is unclear what the total dollar value is for these damages (NOAA NWS, 1997).

NOAA recommends that when thunder roars, go indoors! Thunderstorms are categorized by their physical characteristics. Since there is a continuous spectrum of storms in the sky, it is difficult to sometimes place a storm into a specific category. There are five types used in describing storms and are in *Table 27 - Types of Thunderstorms.*

Table 27 - Types of Thunderstorms

Types of Thunderstorms	
Type	**Classification**
Ordinary or Single Cell Storm	Single cell storms are short lived, and usually not severe.
Pulse Storm	A Pulse Storm is a single-cell thunderstorm that is usually not strong; when it is of substantial intensity, it produces severe weather for short periods of time. Such a storm weakens and then generates another short burst or pulse.
Multicellular Cluster	This type is the most common storm, consisting of a group of ordinary cells at various stages of the thunderstorm life cycle.
Multicellular Line	This category is a long line of storms with a continuous, well developed gust front along the leading edge.
Supercell	A supercell is a highly organized thunderstorm with an extremely strong updraft. They exhibit persistent storm-scale rotation of the updraft-downdraft couplet or mesocyclone.

A worst-case scenario for lightning would be if, during a severe storm, lightning struck one of the county's radio communications towers, which are located at high elevations. In this instance, the lightning strike could cripple emergency communications and prevent the swift deployment of police, fire, and rescue resources. This would compound the effects of the event, potentially worsening losses and increasing the potential for human casualties due to lack of response.

4.3.8.3 Past Occurrence

A lightning event is defined as a lightning strike that results in fatality, injury, and/or property or crop damage.

Table 28 - Lightning Events in Susquehanna County

Lightning Events in Susquehanna County				
Date	**Injuries**	**Deaths**	**Property Damage**	**Location**
06/14/08	0	0	$5,000	Harford
07/08/14	0	0	$10,000	Dimock
08/21/14	0	0	$8,000	Montrose
08/21/14	0	0	$8,000	West Lenox

4.3.8.4 Future Occurrence

It is reasonable to suggest that future lightning strike events that cause injuries, deaths or property damage are possible in Susquehanna County, since lightning is a regular occurrence with thunderstorms. Even though there are only four events listed for Susquehanna County, there has been a total of 161 thunderstorms noted between 1954 and 2017 by NOAA NCEI storm events. This averages out to 2.6 thunderstorms a year over the past 63 years.

4.3.8.5 Vulnerability Assessment

The most vulnerable structures in the county are the five radio communication towers that are positioned at high elevations. These towers are key to emergency services communications during any event, no matter how minor or major, and to the daily deployment of police, fire, and rescue services as well as communications between the county emergency management agency and local coordinators.

Lightning also poses a threat to barns and grain storage silos in Susquehanna County.

Here are some important safety guidelines for dealing with lightning:

- Remain in a hard-topped vehicle or an indoor location for at least thirty minutes after you hear the last thunder clap. If you use radio equipment, avoid contact with it or other metal items inside your vehicle to minimize the impacts should lightning strike.
- If you are out on the water and skies are threatening, get back to land and find a fully enclosed building or hard-topped vehicle.
- Do not use a corded phone during a thunderstorm. Use a cordless phone or cell phone for all calls.
- Lighting victims do not carry an electrical charge, are safe to touch, and need urgent medical attention.

4.3.9. Pandemic and Infectious Disease

4.3.9.1 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 Susquehanna 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 Susquehanna County.

Studies after the 2009 H1N1 influenza pandemic disproportionately impacted people younger than twenty-four (CIDRAP, 2010). Universities and other large schools have potential to become outbreak centers due to their large young adult population, high levels of close social contact, and permeable boundaries. During a pandemic or disease outbreak, the population affected may exceed the seasonal norm of one-third of the student population. Because universities and schools can be sites of transmission, they may cause a virus to spread among the surrounding community as well.

Infectious Disease

West Nile Virus has been detected in all sixty-seven counties in the Commonwealth at least once in the past ten years, making it a hazard to Susquehanna 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. Blacklegged ticks in Susquehanna County can also spread Lyme disease, a bacterial disease with symptoms including fever, headaches and a characteristic skin rash (erythema migrans). Untreated, Lyme disease can spread to joints, the heart and the nervous system (CDC, 2016).

4.3.9.2 Range of Magnitude

Pandemic

Advancements in medical technologies have greatly reduced the number of deaths caused by influenza over time. In the early 1900s, flu pandemics could cause tens of millions of deaths, while the 2009 Swine Flu caused fewer than 20,000 deaths worldwide, and many people infected with Swine Flu in 2009 have recovered without needing medical treatment. However, the modern flu viruses are still quite dangerous. About seventy percent of those who were hospitalized with the 2009 H1N1 flu virus in the United States 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.

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 twenty percent of infections cause symptoms and less than one percent of cases result in severe neurological disease or death. Symptoms typically appear between two and fifteen 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.

Each year since 2005, there are consistently well over 3,000 cases of Lyme disease in Pennsylvania, with 6,470 confirmed cases in 2014 (CDC, 2016). While most cases of Lyme disease can be treated with a few weeks of antibiotic use, undetected Lyme disease can seriously damage a body's musculoskeletal and nervous system, sometimes resulting in death.

4.3.9.3 Past Occurrence

Pandemic & Epidemic

Table 29 - Past Influenza Outbreaks and Pandemics

Past Influenza Outbreaks and Pandemics			
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	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 Flu claimed fifty 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 fifteen percent 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 Susquehanna County was the 2009 outbreak of Swine flu. There were 10,940 cases reported in Pennsylvania resulting in seventy eight deaths (PA DOH, 2010).

Infectious Disease

West Nile Virus was first detected in Pennsylvania in the year 2000. The most annual reported cases of West Nile occurred in 2003, with 237 infected Pennsylvanians resulting in nine 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 forty one of sixty-seven counties in the Commonwealth in 2016, with sixteen human cases (PA West Nile Virus Control Program, 2017). West Nile Virus has been detected in Susquehanna County in four out of the last seventeen years with one human case (See *Table 30 - West Nile Disease Reported Cases*). Cases of Lyme disease are consistently reported in Susquehanna County with a recent spike in cases throughout the Commonwealth – reported cases are summarized in *Table 31 - Lyme Disease Reported Cases*.

Table 30 - West Nile Disease Reported Cases

West Nile Disease Reported Cases (PAWNVCP, 2017)			
Year	**Positive Detection**	**Human Cases**	**Deaths**
2001			
2002	✓		
2003	✓	1	0
2004	✓		
2005			
2006			
2007			
2008			
2009			
2010			
2011	✓		
2012			
2013			
2014			
2015			
2016			
2017			
Totals	**4**	**1**	**0**

Table 31 - Lyme Disease Reported Cases

Lyme Disease Reported Cases (CDC, 2017)			
Year	**Number of Cases**	**Year**	**Number of Cases**
1980	0	1999	<4
1981	0	2000	2
1982	0	2001	2
1983	0	2002	4
1984	0	2003	6
1985	0	2004	2
1986	0	2005	5
1987	0	2006	1
1988	0	2007	1
1989	0	2008	6
1990	0	2009	4
1991	5	2010	6
1992	0	2011	23
1993	<4	2012	14
1994	<4	2013	41
1995	<4	2014	73
1996	0	2015	99
1997	0	2016	85
1998	<4	**Total**	**~383**

4.3.9.4 Future Occurrence

Pandemic & Epidemic

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 to occur every eleven to forty-one years. In the event of an influenza pandemic, colleges and universities can plan an integral role in protecting the health and safety of university members as well as the greater community.

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).

Lyme disease has become increasingly prevalent in recent years and is expected to continue this trend. Researchers point to climate change among other factors that bolster tick populations (Templeton, 2017). Ticks often use mice as hosts, and warmer winters have allowed small rodents such as mice to flourish, and in turn tick populations flourish. Human activity has also eliminated natural predators (like coyote) of small rodents, compounding the problem. Human suppression of natural fires may also increase the prevalence of ticks as fires in natural areas kills many insects including ticks, so fewer fires yields more ticks (Templeton, 2017).

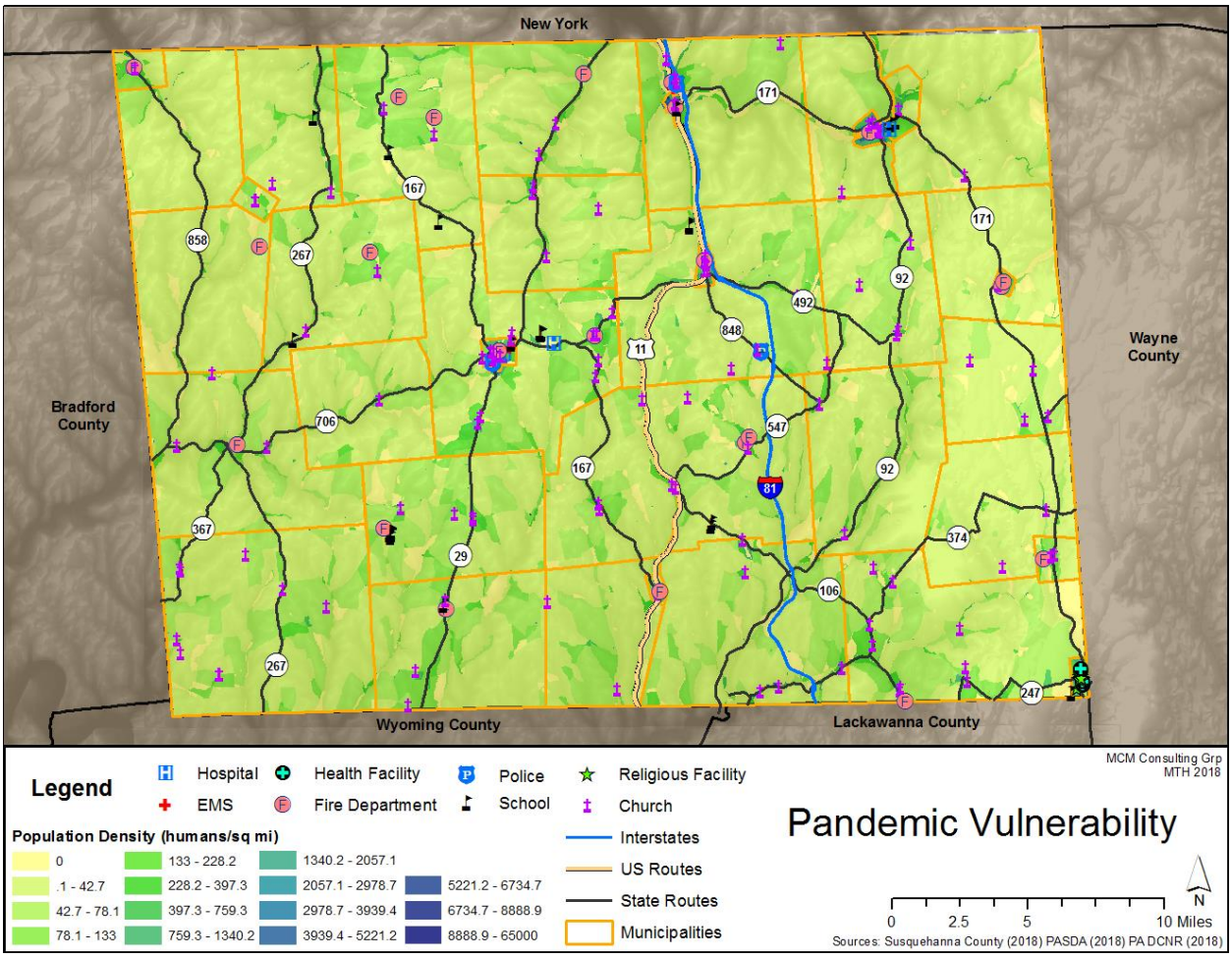
4.3.9.5 Vulnerability Assessment

Pandemic & Epidemic

Certain groups are at higher risk of infectious disease infection, including people sixty-five years and older, children younger than five years, pregnant women, and people with certain chronic medical conditions. Such conditions include but are not limited to diabetes, heart disease, asthma, and kidney disease. Schools, convalescent centers, and other institutions serving those younger than five years old and older than sixty-five are locations that are 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. *Figure 17 - Pandemic & Infectious Disease Vulnerability* shows the population density according to 2010 census data and locations of schools, daycares and health care facilities, shedding light on areas where the disease may more readily spread. The highest concentration of elevated-transmission risk locations in the county such as schools and medical facilities are found in the Montrose Borough and Forest City Borough areas.

Persons who spend time in wooded areas are most at risk for contracting Lyme disease via tick bite. The application of tick repellent with DEET or permethrin is highly recommended. Residents should conduct thorough tick checks after spending time in woodland areas and keep on the lookout for the characteristic "bulls-eye" rash indicative of a tick bite infected with Lyme disease.

Figure 17 - Pandemic & Infectious Disease Vulnerability



4.3.10. Radon Exposure

4.3.10.1 Location and Extent

Airborne radon gas is radioactive and is a step in the radioactive decay of uranium to radium. Radon is a noble gas, cannot be seen and has no odor. Like other noble gasses, radon gas is very stable, so it does not easily combine with other chemicals. Two isotopes of radon are commonly found: 222Rn and 220Rn. The 220Rn isotope has a very short half-life, so it often only exists for 55 seconds, not long enough to pose a hazard to humans. The 222Rn isotope has a half-life of 3.8 days which is long enough to pose a threat to humans. Still, due to the relatively short half-life of 222Rn, it only exists in relatively close proximity to its radioactive parent, usually within tens of feet away. Radon is a carcinogen and when inhaled, it causes humans to develop lung cancer.

Radon was discovered as a significant source of natural radiation for humans in 1984 in the Reading Prong geologic province in Eastern Pennsylvania (south of Susquehanna County), when routine monitoring of employees leaving the not yet active Limerick nuclear power plant showed readings that a construction worker working on the plant frequently exceeded expected radiation levels despite the fact that the plant was not active. The Environmental Protection Agency (EPA) guidelines state that mitigation actions should be taken if levels exceed 4pCi/L in a home, and most uranium miners have a maximum exposure of 67 pCi/L. Subsequent testing of the Limerick power plant worker's home showed high radon levels of 2,500 pCi/L (pico Curies per Liter), triggering the Reading Prong to become the focus of the first large-scale radon scare.

Radon gas is considered ubiquitous and can be found in indoor and outdoor environments, however there is no known safe level of exposure to radon. For most people in Pennsylvania, the greatest risk of radon exposure is from within their home in rooms that are below, directly in contact with, or immediately above the ground. Sources of radon include: radon in the air from soil and rock beneath homes, radon dissolved in water from private wells and exsolved during water use (rare in Pennsylvania), and radon emanating from uranium-rich building materials such as concrete blocks or gypsum wallboard (also rare in Pennsylvania). Key factors in radon concentration in homes are the rates of air flow into and out of the house, the location of air inflow, and the radon content of air in the surrounding soil. Because of the flow dynamics of air inside of most houses, even a small rate of soil radon gas inflow can lead to elevated radon concentrations.

There are several factors that contribute to higher radon levels in soil gas:

- Proximity to elevated uranium rich deposits (>50ppm). Areas within a few hundred feet of such deposits are most at risk. Such deposits are rare in Pennsylvania.
- Some more common rocks have higher than average uranium content (5 to 50 ppm), and proximity to such rocks also increases the risk of radon exposure. These rock

types include black shales as well as granitic and felsic alkali igneous rocks. This is the most common source of high radon levels in Pennsylvania. The Reading Prong elevated radon levels come from Precambrian granitic gneisses.

- Other soil and bedrock properties that facilitate radon mobility. The amount of pore space in the soil and its permeability – more porous soils will allow radon to travel more easily. Limestone-dolomite soils can also be predisposed to collect radon from radium resultant from weathering of iron oxide or clay surfaces. In some cases (like in State College, Centre County PA) even with underlying bedrock having normal uranium concentrations (.5 to 5 ppm), the vast majority of locations built on lime-stone-dolomite soils exceed radon concentrations of 4pCi/L, and many exceeded 20 pCi/L.

4.3.10.2 Range of Magnitude

According to EPA, about 21,000 lung cancer deaths each year in the U.S. are related to radon - it is the second leading cause of lung cancer after smoking and the number one cause of lung cancer among nonsmokers. There is no evidence that children are at a greater risk than adults. Radon causes lung cancer by continuing to radioactively decay after being inhaled, and turning into a daughter product (218Po, 214Pb, 214Bi) which may become attached to lung tissue and induce lung cancer due to their continued radioactive decay. Table 32 - Radon Risk (EPA, 2017) describes the relative risk to lung cancer that people experience depending on the radon level and their experience with smoking.

The EPA reports that the national average radon concentration of indoor air of homes is about 1.3 pCi/L, and they recommend that homes be fixed if the radon level is 4pCi/L or more. There is however no safe level of radon exposure, so the EPA also recommends to consider fixing a home if the radon level is between 2 pCi/L and 4 pCi/L.

Table 32 - Radon Risk

Radon Risk (EPA, 2017)			
RADON LEVEL (pCi/L)	**IF 1,000 PEOPLE WERE EXPOSED TO THIS LEVEL OVER A LIFETIME…***	**RISK OF CANCER FROM RADON EXPOSURE COMPARES TO…*** **	**ACTION THRESHOLD**
SMOKERS			
20	About 260 people could get lung cancer	250 times the risk of drowning	Fix Structure
10	About 150 people could get lung cancer	200 times the risk of dying in a home fire	
8	About 120 people could get lung cancer	30 times the risk of dying in a fall	
4	About 62 people could get lung cancer	5 times the risk of dying in a car crash	

Radon Risk (EPA, 2017)			
RADON LEVEL (pCi/L)	**IF 1,000 PEOPLE WERE EXPOSED TO THIS LEVEL OVER A LIFETIME…***	**RISK OF CANCER FROM RADON EXPOSURE COMPARES TO…*** **	**ACTION THRESHOLD**
2	About 32 people could get lung cancer	6 times the risk of dying from poison	Consider fixing structure between 2 and 4 pCi/L
1.3	About 20 people could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2pCi/L is difficult
0.4	About 3 people could get lung cancer	(Average outdoor radon level)	
NON-SMOKERS			
20	About 36 people could get lung cancer	35 times the risk of drowning	Fix Structure
10	About 18 people could get lung cancer	20 times the risk of dying in a home fire	
8	About 15 people could get lung cancer	4 times the risk of dying in a fall	
4	About 7 people could get lung cancer	The risk of dying in a car crash	
2	About 4 people could get lung cancer	The risk of dying from poison	Consider fixing structure between 2 and 4 pCi/L
1.3	About 2 people could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2pCi/L is difficult
0.4	-	(Average outdoor radon level)	
*Note: Risk may be lower for former smokers * Lifetime risk of lung cancer deaths from EPA Assessment of Risks from Radon in Homes (EPA 402-R-03-003). ** Comparison data calculated using the Centers for Disease Control and Prevention's 1999-2001 National Center for Injury Prevention and Control Reports.*			

4.3.10.3 Past Occurrence

The EPA estimates that the average indoor radon concentration in Pennsylvania basements is about 7.1 pCi/L (3.6 pCi/L on the first floor), well above their estimated national average of 1.3 pCi/L. Data on abundance and distribution of radon as it impacts individual houses in Susquehanna County and Pennsylvania at large is incomplete and biased towards higher radon concentrations – most data is based on test results submitted by concerned homeowners who suspect they might be at risk for high radon levels. Results are skewed to over-represent homes that have high radon levels and under-represent homes with low radon levels. That being said, any homes with high radon levels are problematic, and there are many reported homes in Susquehanna County with elevated radon concentrations.

The Pennsylvania Department of Environmental Protection (PA DEP) provides information for homeowners about how to test for radon in their homes, and when they receive a test result over 4 pCi/L, the PA DEP Bureau of Radiation Protection works to help homeowners repair the home and mitigate the hazard. The PA DEP records all the tests they receive and categorize them in a searchable database by zip code. *Table 33 - Basement Radon Level Test Results* shows there are sixteen zip codes in Susquehanna County where sufficient tests were reported for the PA DEP to report their findings. Many reported zip codes in Susquehanna County have average basement Radon levels above the suggested EPA action level of 4 pCi/L.

Table 33 - Basement Radon Level Test Results

Basement Radon Level Test Results					
Zip Code	**Municipalities**	**Location**	**Number of Tests**	**Max Result pCi/L**	**Avg Result pCi/L**
18407	Parts of Clifford Township	Basement	616	100.5	4.2
		First Floor	159	34	2.6
18419	Parts of Springville Township	Basement	357	113	4.7
		First Floor	44	4.6	1.3
18421	Forest City Borough, Parts of Clifford Township	Basement	221	41.6	3.9
18446	Parts of Lenox Township, Lanthrop Township & Springville Township	Basement	128	69.7	6.2
18465	Thompson Borough, most of Thompson Township & Ararat Township, parts of Jackson Township, Gibson Township & Herrick Township	Basement	45	13.8	3.9
18470	Uniondale Borough, Most of Herrick Township, Parts of Clifford Township, Gibson Township & Lenox Township	Basement	96	61.7	5.3
18630	Most of Auburn Township, Parts of Rush Township & Springville Township	Basement	67	79.5	6.3
18801	Montrose Borough, Jessup Township, Most of Bridgewater Township, Rush Township & Forest Lake Township, Parts of Middletown Township, Dimock Township, Franklin Township, Liberty Township & Silver Lake Township	Basement	283	85.6	6.1
		First Floor	47	13.1	2.1
18812	Most of Silver Lake Township, Parts of Apolacon Township, Choconut Township & Liberty Township	Basement	73	55.1	7.6

Basement Radon Level Test Results					
Zip Code	**Municipalities**	**Location**	**Number of Tests**	**Max Result pCi/L**	**Avg Result pCi/L**
18818	Friendsville Borough, Most of Middletown Township & Choconut Township, Parts of Forest Lake Township, Silver Lake Township & Apolacon Township	Basement	49	24.9	4.6
18822	Most of Hallstead Borough & Liberty Township, Parts of Franklin Township & Great Bend Township	Basement	54	20.9	4.8
		First Floor	53	4.2	1.2
18824	Hop Bottom Borough, Parts of Lenox Township, Lanthrop Township, Springville Township, Dimock Township & Brooklyn Township	Basement	33	50	10.1
18826	Parts of Brooklyn Township, Harford Township, Gibson Township & Lenox Township	Basement	51	25.4	7.7
18834	New Milford Borough, Most of New Milford Township, Parts of Harford Township, Great Bend Township, Franklin Township, Bridgewater Township	Basement	103	92.3	8.8
18844	Most of Springville Township, Parts of Dimock Township & Lanthrop Township	Basement	51	68.5	6
18847	Lanesboro Borough, Oakland Borough, Harmony Township & Oakland Township, Parts of Great Bend Township, Jackson Township, Thompson Township & Gibson Township	Basement	117	53.3	5.1

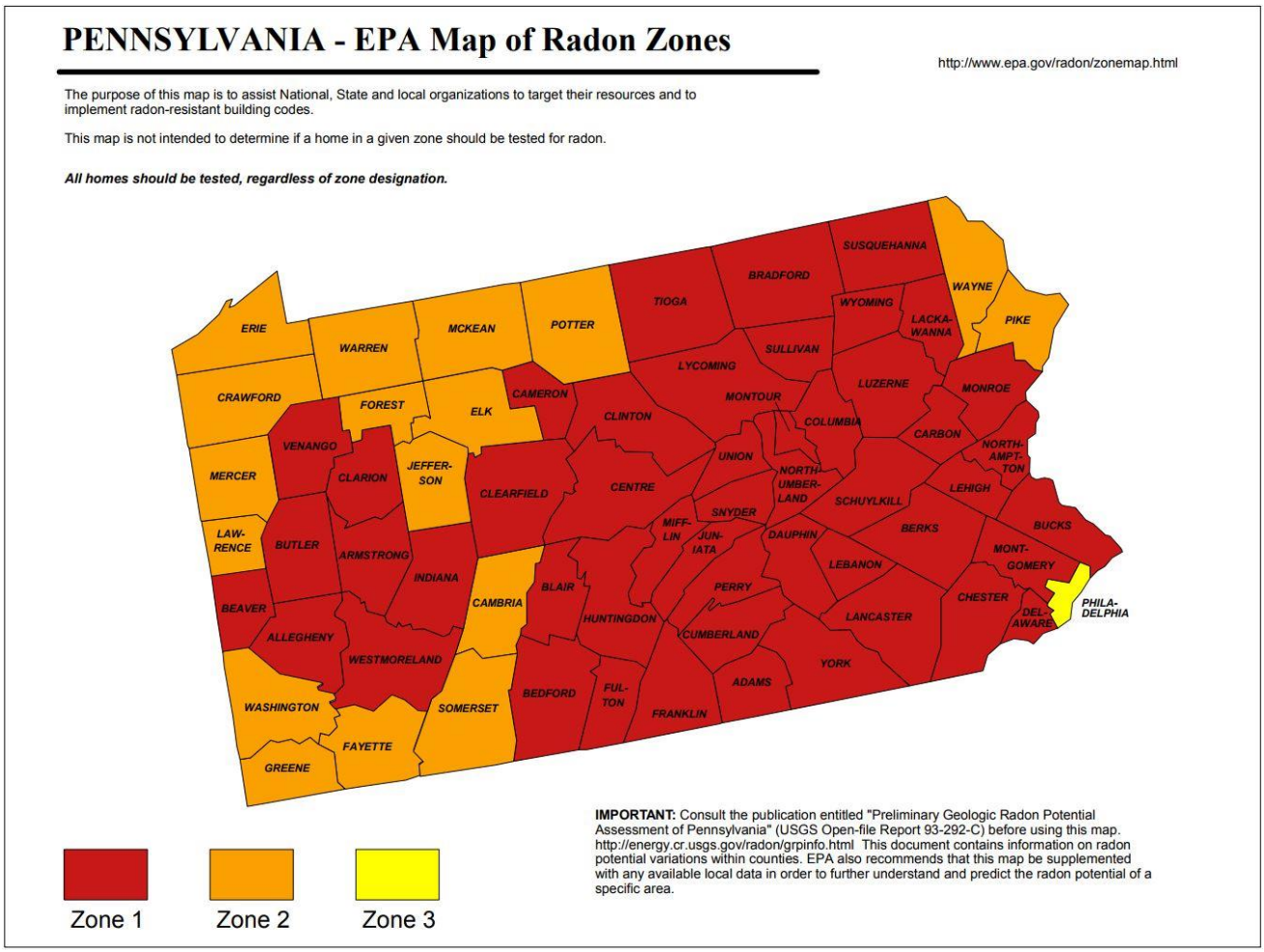
4.3.10.4 Future Occurrence

Radon exposure is inevitable given the geologic and geomorphic conditions in Susquehanna County. The EPA and USGS have mapped radon potential in the US to help target resources and assist local governments in determining if radon-resistant features are applicable for new construction. The designations are broken down in three zones and are assigned by county, as shown in *Figure 18 - Radon Zones.* Each zone reflects the average short-term measurement of radon that can be expected in a building without radon controls. Susquehanna County is located within Zone 1, with a high potential for radon.

1. Zone 1 has the highest potential and readings can be expected to exceed the 4 pCi/L recommended limit.
2. Zone 2 has a moderate potential for radon with levels expected to be between 2 and 4 pCi/L and

3. Zone 3 has a low potential with levels expected to be less than 2 pCi/L.

Figure 18 - Radon Zones



4.3.10.5 Vulnerability Assessment

Susquehanna County is in the EPA radon hazard zone 1, meaning there is a high risk of radon exposure. Older homes that have crawl spaces or unfinished basements are more vulnerable to having high radon levels. Average basement radon levels for homes who reported their results to the PA DEP are consistently found to be above the EPA action level of 4 piC/L. Homeowners across Susquehanna County should test radon levels in their homes in order to determine their level of radon exposure. The EPA estimates that an average radon mitigation system costs approximately $1,200. The PA DEP Bureau of Radiation Protection provide short and long-term tests to determine radon levels, as well as information on how to mitigate high levels of radon in a building.

4.3.11. Tornados and Windstorms

4.3.11.1 Location and Extent

Tornados & Windstorms

Tornados occur in the Commonwealth most frequently during the spring and summer months and are most likely at the warmest times of the day. In the past sixty seven years, records show that 826 tornados have been reported in all sixty seven counties in Pennsylvania during the period of 1950- January 2017 (NOAA NCEI, 2017). The National Weather Service estimates the Commonwealth will experience ten tornados annually. According to the National Centers for Environmental Information (NCEI, formerly NCDC), wind speeds in tornados range from values below that of hurricane speeds to more than 300 miles per hour. The NCEI 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. The width of tornados can vary greatly, from 100 feet wide to over a mile, and the forward motion of tornados can range from speeds between zero and fifty miles per hour.

Windstorms may be caused by thunderstorms, hurricanes and tornadoes, but the most frequent cause of windstorms in Pennsylvania are thunderstorms. Straight-line winds and windstorms are experienced on a more regional scale. While such winds usually also accompany tornados, straight-line winds are caused by the movement of air from areas of high pressure to low pressure. Windstorms are generally defined with sustained wind speeds of forty mph or greater, lasting for at least one hour, or simply winds of fifty-eight mph or greater for any duration. A microburst is a very-localized column of sinking air, capable of producing damaging opposing and straight-line winds at the surface. A wind shear is usually found when a violent weather front is moving through; wind speeds have been recorded up to one hundred mph. Wind shear is defined as a difference in wind speed and direction over a relatively short distance in the atmosphere.

Figure 19 - Microburst

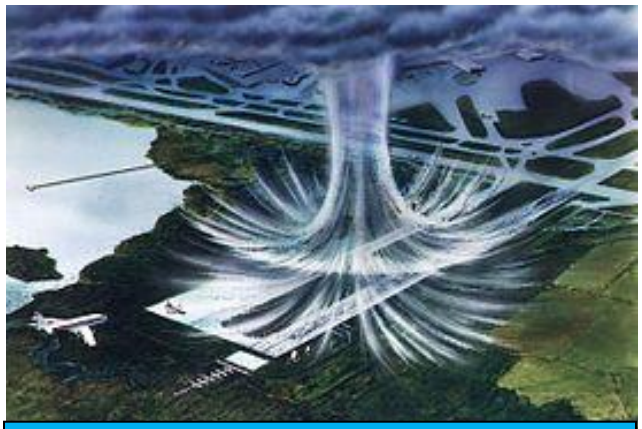
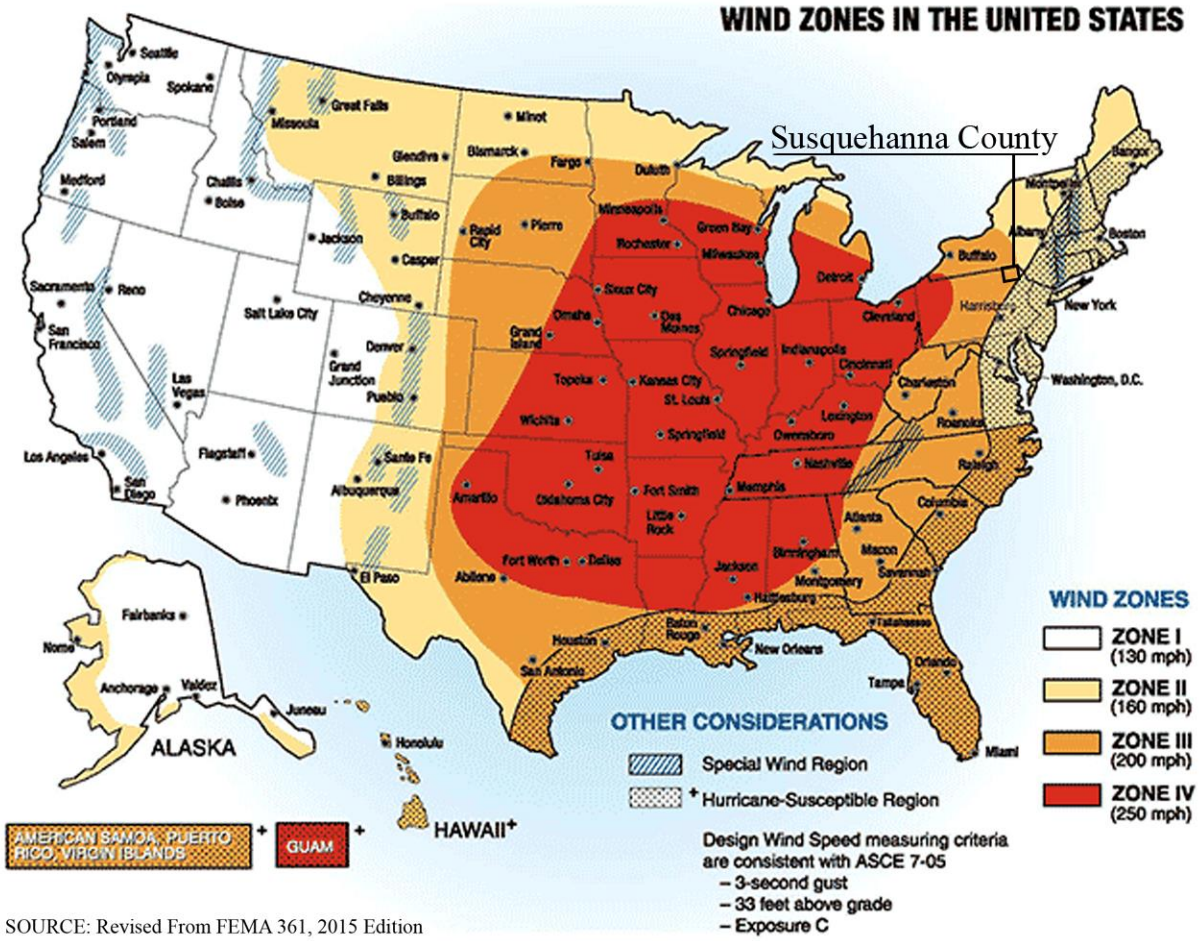


Figure 20 - Wind Zones



4.3.11.2 Range of Magnitude

Tornado & Windstorm

Each year, tornados account for $1.1 billion in damages and cause over eighty deaths nationally. 2011 was the second worst year on record for deadly tornados, the worst being 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 one hundred mph to more than two hundred fifty mph. In addition, a tornado's speed of forward motion can range from zero to fifty mph. Therefore, some estimates place the maximum velocity (combination of ground speed, wind speed, and upper winds) of tornados at about three hundred 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 two hundred fifty miles per hour or more and are capable of causing extreme destruction and turning normally harmless objects into deadly missiles.

Damages and deaths can be especially significant when 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, based upon the estimated maximum winds occurring within the wind vortex *(Table 34 - Enhanced Fujita Scale)*. 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. Previously recorded tornadoes are reported with the older F-Scale values, but *Table 34 - Enhanced Fujita Scale* shows F-Scale categories with corresponding EF-Scale wind speeds.

Figure 20 - Wind Zones 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. Because Susquehanna County falls within Zone III, design wind speeds for shelters and critical facilities should be able to withstand a 3-second gust of up to 200 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 EF4 tornado event. 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 typically more prone to tornados. Susquehanna is on the edge for the designated Hurricane-Susceptible Region as seen in *Figure 20 - Wind Zones*; hurricane vulnerability is discussed further in Section 4.3.5 Hurricane, Tropical Storm, Nor'easter.

Tornados can have varying secondary effects. The most common is power failure. The severe wind can dismantle power sources and cause significant structural damage. 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 Susquehanna County:

- Power failures lasting four hours or longer
- Loss of communications networks lasting four hours or more
- Residents requiring evacuation or provision of supplies or temporary shelter
- Severe crop loss and or damage

Table 34 - Enhanced Fujita Scale

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

4.3.11.3 Past Occurrence

Tornado

Susquehanna County has directly experienced ten tornados since 1954. One of the worst tornados in Susquehanna history occurred on June 2nd, 1998 when an EF1 tornado touched down in Ararat Township. The tornado was one hundred yards wide and traveled twelve miles across Springville and Lanthrop Townships, destroying homes, farms, and woodlands in its path. Property damage was estimated at $300,000. *Table 35 - Tornado History 1950-2017* and *Figure 20 - Wind Zones* outline previous tornados recorded in Susquehanna County. There have been no reported injuries or deaths from these tornados in Susquehanna County.

Windstorm

From 1950 to December 2017, Susquehanna County has experienced 115 severe wind events aside from hurricanes and tornados causing an estimated one million dollars in damages (*Table 36 - Windstorm History*). Most often these are the result of intense thunderstorms, which may fell trees, damaging power lines and cause power outages for upwards of four days in some areas. There have been no reported injuries or deaths from these windstorms in Susquehanna County.

Table 35 - Tornado History 1950-2017

Tornado History 1950-2017 (NCEI, 2017)					
Location	**Date**	**Magnitude**	**Estimated Property Damage**	**Tornado Length (Miles)**	**Tornado Width (Feet)**
Kingsley	7/8/2014		$100,000	1.4	150
Montrose Arpt	7/26/2012	EF1	$35,000	1.24	150
Herrick Center	4/28/2011	EF0	$40,000	1.03	80
Uniondale	7/23/2010	EF1	$25,000	1.09	200
Elk Lake	5/10/2007	EF0	$15,000	2.9	75
Little Meadows	6/17/2004	F0	$100,000	1	100
Auburn Center to Springville	6/2/1998	F1	$300,000	12	100
Clifford	8/14/1994	F0	$ -	0.1	10
Not Available	9/18/1991	F2	25,000	3	440
Not Available	4/17/1954	F2	$2,500	2	3

Table 36 - Windstorm History

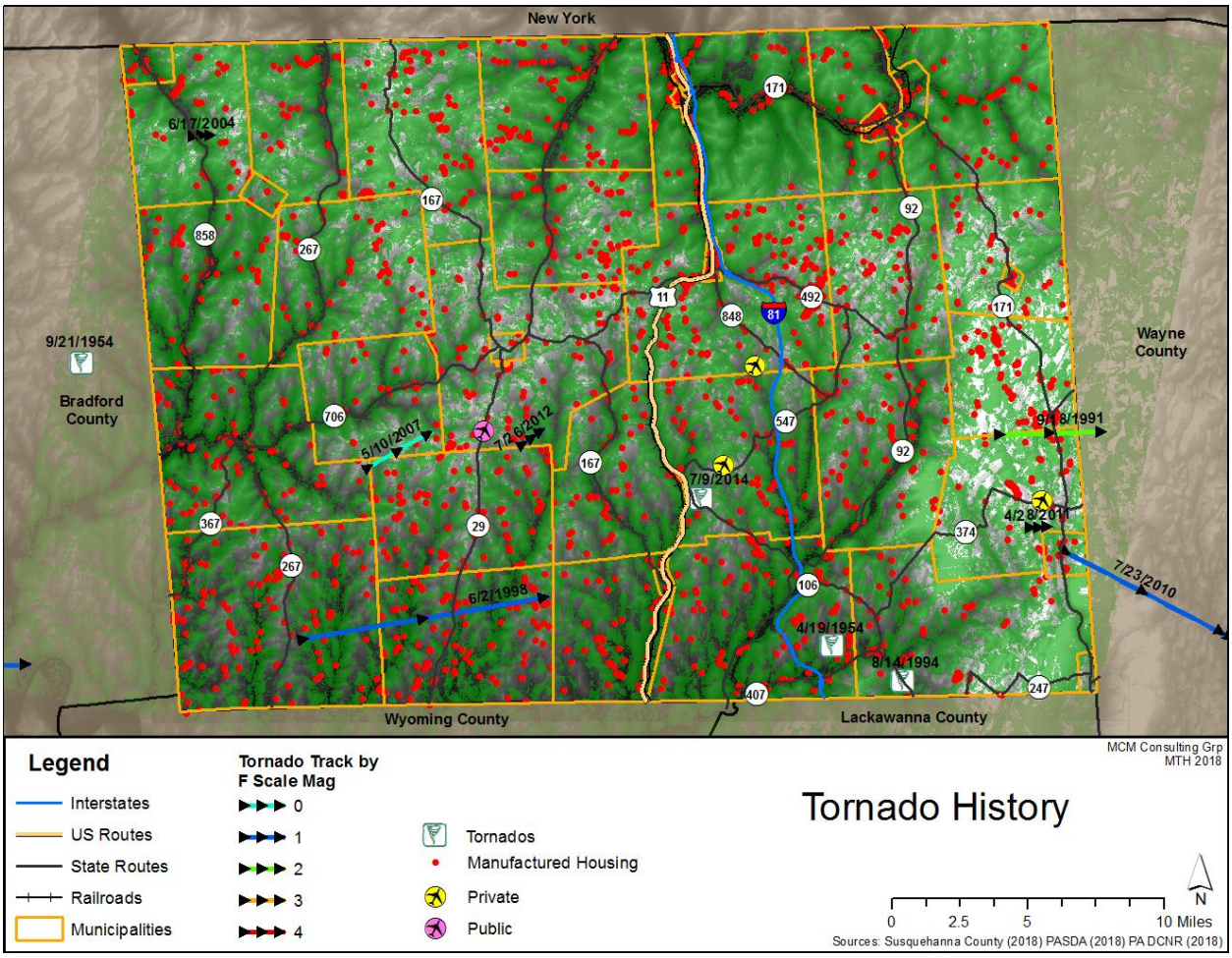
Windstorm History 1950-2017 (NCEI, 2017) *"-" denotes no information available*				
Location	**Date**	**Type**	**Wind Speed (Knots)**	**Property Damage**
Herrick Center & Gibson	8/18/2017	Thunderstorm Wind	60	$13,000

Windstorm History 1950-2017 (NCEI, 2017) *"-" denotes no information available*				
Location	**Date**	**Type**	**Wind Speed (Knots)**	**Property Damage**
Rush & South Gibson	7/20/2017	Thunderstorm Wind	55	$11,000
Hallstead, Montrose & New Milford	7/17/2017	Thunderstorm Wind	60	$13,000
Friendsville, Auburn Center, Forest Lake, Harford & Lakeside	5/31/2017	Thunderstorm Wind	50	$9,000
Hallstead, New Milford, Great Bend, Jefferson Jct, Susquehanna	5/1/2017	Thunderstorm Wind	65	$44,000
Lakeside, Lakeview & Upsonville	7/13/2014	Thunderstorm Wind	50	$30,000
Auburn Center & New Milford	7/8/2014	Thunderstorm Wind	50	$55,000
Montrose	5/16/2014	Thunderstorm Wind	70	$10,000
Birchardville, Dimock, Lakeside & Jefferson Jct	10/7/2013	Thunderstorm Wind	50	$12,000
Hallstead	8/31/2013	Thunderstorm Wind	50	$2,000
Rush	7/28/2013	Thunderstorm Wind	50	$3,000
Jefferson Jct	5/22/2013	Thunderstorm Wind	50	$ -
South Auburn & Springville	4/19/2013	Thunderstorm Wind	91	$55,000
Auburn Center	9/8/2012	Thunderstorm Wind	50	$1,000
Montrose, Dimock & New Milford	7/26/2012	Thunderstorm Wind	50	$13,000
Lawton	7/23/2012	Thunderstorm Wind	50	$2,000
Hop Bottom, Kingsley, West Lenox, Royal & West Clifford	6/22/2012	Thunderstorm Wind	50	$4,000
Montrose	7/29/2011	Thunderstorm Wind	65	$75,000
Rush	7/19/2011	Thunderstorm Wind	50	$5,000
Springville	7/8/2011	Thunderstorm Wind	50	$3,000
Hallstead & Lanesboro	5/26/2011	Thunderstorm Wind	50	$20,000
Dimock & Hallstead	4/26/2011	Thunderstorm Wind	50	$23,000
Ararat	7/23/2010	Thunderstorm Wind	61	$20,000
Lenoxville	7/21/2010	Thunderstorm Wind	50	$2,000
Friendsville & Montrose	6/28/2010	Thunderstorm Wind	50	$4,000
St Joseph, Montrose & Hop Bottom	6/24/2010	Thunderstorm Wind	50	$6,000
Gibson	5/4/2010	Thunderstorm Wind	50	$1,000
Hickory Grove	6/9/2009	Thunderstorm Wind	50	$4,000
Harford	5/16/2009	Thunderstorm Wind	50	$20,000
Hallstead	8/2/2008	Thunderstorm Wind	50	$ -
Forest Lake	7/23/2008	Thunderstorm Wind	50	$ -
West Lenox	7/13/2008	Thunderstorm Wind	50	$15,000
Springville	6/21/2008	Thunderstorm Wind	52	$ -
Harford	6/14/2008	Thunderstorm Wind	50	$2,000
Rush	10/9/2007	Thunderstorm Wind	50	$1,000
Hallstead & Montrose	8/17/2007	Thunderstorm Wind	50	$20,000
Clifford	8/3/2007	Thunderstorm Wind	50	$10,000
Jefferson Jct	7/27/2007	Thunderstorm Wind	50	$3,000
Montrose	6/27/2007	Thunderstorm Wind	50	$ -
Springville	6/19/2007	Thunderstorm Wind	50	$ -
Dimock	6/12/2007	Thunderstorm Wind	50	$ -
Susquehanna	6/8/2007	Thunderstorm Wind	50	$ -
Montrose	5/10/2007	Thunderstorm Wind	50	$5,000

Windstorm History 1950-2017 (NCEI, 2017) *"-" denotes no information available*				
Location	**Date**	**Type**	**Wind Speed (Knots)**	**Property Damage**
Brackney	12/1/2006	Thunderstorm Wind	50	$ -
Clifford & Ararat	9/28/2006	Thunderstorm Wind	50	$11,000
Hallstead & New Milford	8/3/2006	Thunderstorm Wind	50	$4,000
New Milford	6/30/2006	Thunderstorm Wind	50	$5,000
	11/29/2005	Strong Wind	50	$5,000
Auburn Center	11/6/2005	Thunderstorm Wind	50	$10,000
Montrose	9/29/2005	Thunderstorm Wind	50	$5,000
Brackney, Brookdale & Great Bend	8/12/2005	Thunderstorm Wind	50	$7,000
Middletown Center & Montrose	7/26/2005	Thunderstorm Wind	50	$4,000
Montrose	6/6/2005	Thunderstorm Wind	50	$10,000
	12/23/2004	Strong Wind	45	$5,000
Clifford	11/25/2004	Thunderstorm Wind	50	$50,000
Montrose & Susquehanna	7/14/2004	Thunderstorm Wind	60	$4,000
Little Meadows & Friendsville	6/17/2004	Thunderstorm Wind	60	$15,000
Montrose	6/9/2004	Thunderstorm Wind	60	$5,000
Harford & Herrick Center	5/10/2004	Thunderstorm Wind	60	$4,000
Auburn Center	9/4/2003	Thunderstorm Wind	60	$50,000
Montrose	8/16/2003	Thunderstorm Wind	55	$4,000
Lawton & Jackson	7/22/2003	Thunderstorm Wind	50	$4,000
Great Bend & Susq Co.	7/21/2003	Thunderstorm Wind	55	$7,000
Gibson	8/2/2002	Thunderstorm Wind	50	$ -
Montrose	7/23/2002	Thunderstorm Wind	50	$2,000
Susquehanna	5/31/2002	Thunderstorm Wind	50	$10,000
Countywide	3/9/2002	Thunderstorm Wind	60	$ -
Dimock	7/1/2001	Thunderstorm Wind	55	$ -
Springville & Hop Bottom	6/20/2001	Thunderstorm Wind	55	$ -
Harford & Clifford	6/11/2001	Thunderstorm Wind	55	$ -
Lakeview	8/1/2000	Thunderstorm Wind	52	$ -
Springville	6/2/2000	Thunderstorm Wind	55	$ -
Montrose	5/24/2000	Thunderstorm Wind	60	$ -
Countywide	5/18/2000	Thunderstorm Wind	60	$ -
Clifford	5/13/2000	Thunderstorm Wind	52	$ -
Great Bend	5/9/2000	Thunderstorm Wind	52	$ -
Springville	3/9/2000	Thunderstorm Wind	50	$ -
Lanesboro	8/13/1999	Thunderstorm Wind	50	$ -
Dimock	7/24/1999	Thunderstorm Wind	50	$ -
Clifford	7/18/1999	Thunderstorm Wind	50	$5,000
New Milford	7/9/1999	Thunderstorm Wind	50	$ -
Countywide	7/6/1999	Thunderstorm Wind	50	$ -
Great Bend	6/7/1999	Thunderstorm Wind	-	$15,000
Countywide	5/24/1999	Thunderstorm Wind	-	$35,000
Little Meadows	9/27/1998	Thunderstorm Wind	-	$15,000
Forest Lake	6/30/1998	Thunderstorm Wind	-	$10,000
Rush	6/17/1998	Thunderstorm Wind	-	$10,000
Springville	6/2/1998	Thunderstorm Wind	-	$10,000
Montrose	5/31/1998	Thunderstorm Wind	-	$10,000
Forest Lake	5/29/1998	Thunderstorm Wind	-	$30,000
Susquehanna	8/16/1997	Thunderstorm Wind	-	$25,000

Windstorm History 1950-2017 (NCEI, 2017) *"-" denotes no information available*				
Location	**Date**	**Type**	**Wind Speed (Knots)**	**Property Damage**
Montrose	11/8/1996	Thunderstorm Wind	-	$10,000
Montrose	8/23/1996	Thunderstorm Wind	-	$5,000
Kingsley & Oakland	6/4/1996	Thunderstorm Wind	-	$7,000
Great Bend	5/10/1996	Thunderstorm Wind	-	$25,000
Harford	4/23/1996	Thunderstorm Wind	-	$15,000
Northern Half	8/31/1995	Thunderstorm Wind	-	$22,000
Gibson	8/5/1995	Thunderstorm Wind	-	$25,000
New Milford	8/4/1995	Thunderstorm Wind	-	$6,000
Western & Hop Bottom	7/27/1995	Thunderstorm Wind	-	$8,000
Dimock	8/1/1994	Thunderstorm Wind	-	$ -
Hop Bottom	6/13/1994	Thunderstorm Wind	-	$ -
Lenoxville	8/2/1993	Thunderstorm Wind	-	$ -
Not Available	8/28/1992	Thunderstorm Wind	-	$ -
Not Available	8/4/1992	Thunderstorm Wind	-	$ -
Not Available	7/29/1992	Thunderstorm Wind	-	$ -
Not Available	1/14/1992	Thunderstorm Wind	-	$ -
Not Available	5/1/1991	Thunderstorm Wind	-	$ -
Not Available	9/2/1990	Thunderstorm Wind	-	$ -
Not Available	6/18/1990	Thunderstorm Wind	-	$ -
Not Available	7/16/1988	Thunderstorm Wind	-	$ -
Not Available	6/5/1979	Thunderstorm Wind	-	$ -
Not Available	8/26/1975	Thunderstorm Wind	-	$ -
Not Available	4/14/1974	Thunderstorm Wind	-	$ -
Not Available	7/1/1971	Thunderstorm Wind	-	$ -
			Total	**$ 1,025,000**

Figure 21 - Tornado History 1950-2017 (NCEI, 2017)



4.3.11.4 Future Occurrence

Tornado & Windstorm

It is possible for a disastrous tornado to hit Susquehanna County. While the chance of being hit by a tornado is somewhat small, the damage that results when the tornado arrives can be devastating. An EF5 tornado with a 0.019 percent annual probability of occurring can carry wind velocities of two hundred mph, resulting in a force of more than one hundred 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 2017, Susquehanna County lies within an area that has experienced one to five EF4 or EF5 tornados per 3,700 square miles. 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. However, the high historical number of windstorms with winds over fifty knots indicates that annual chance of a windstorm is higher.

4.3.11.5 Vulnerability Assessment

Tornado & Windstorm

Tornados can occur at any time of the year, though they're more likely during peak months, which are during the summer for the northern part of the United States. 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. 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 such 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. There can be many secondary impacts of tornados and windstorms, including transportation accidents, hazardous material spills, flooding, and power outages. A proper warning system is vital for the public to be informed of what to do and where to go. Because of the abundance of forested areas in Susquehanna, numerous hikers and hunters visit Susquehanna County annually. In the event of a tornado or severe storm, these tourists and hunters have limited emergency notification measures.

Dangers that accompany thunderstorms which can produce tornados:

- 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.

Critical facilities are highly vulnerable to high wind storms. While many severe storms can cause exterior damage to structures, tornados can also completely destroy structures, along with their surrounding infrastructure, abruptly halting operations. Severe storms and their secondary effects often accompanying tornados and can be just as threatening to the critical facilities within the county. Many critical facilities are particularly vulnerable to power outages which can leave facilities functionless, potentially crippling infrastructure supporting the population of the county. With a storm's ability to destroy structures, citizens and their possessions are often left at the will of the storm. The elderly and disabled people are 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. Mobile homes are also particularly vulnerable to tornados and windstorms – as can be seen in *Figure 21 - Tornado History 1950-2017 (NCEI, 2017)*, manufactured housing is prevalent throughout Susquehanna County.

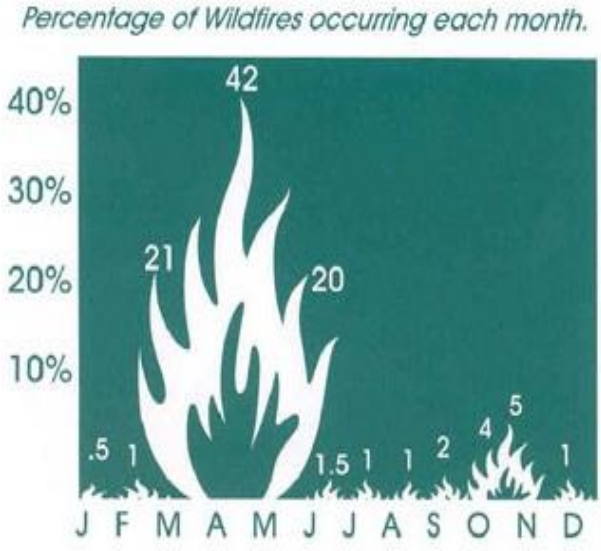
The local economy can also be crippled by tornados and windstorms and their secondary effects when buildings and supporting infrastructure are destroyed in the storm. Power outages can create work stoppages while transportation accidents and road closings can limit the transportation of goods and services. Additionally, flooding cannot be discounted as it can destroy the physical structures, merchandise and equipment essential for business operation. In the case of hazardous material spills caused by windstorms, the local environment can also be negatively impacted, requiring extensive clean-up and mitigation efforts.

4.3.12. Wildfire

4.3.12.1 Location and Extent

The most prevalent causes of devastating wildfires are droughts, lightning strikes, arson, human carelessness, and in rare circumstances, spontaneous combustion. Most fires in Pennsylvania are caused by anthropogenic fires such as debris burns that get out of control. A fire, started in somebody's backyard, could travel through dead grasses and weeds into bordering woodlands starting a wildfire. Major urban fires can cause significant property damage, loss of life, and residential or business displacement. While wildfires are a natural and essential part of many native Pennsylvania ecosystems (e.g. pitch pine – scrub oak woodlands), wildfires can also cause devastating damage if they are undetected and allowed to propagate unfettered. Wildfires most often occur in less developed areas such as open fields, grass, dense brush or forests where they can spread rapidly by feeding off of vegetative fuels. Wildfires are most prevalent under prolonged dry and hot spells, or generally drought conditions. The greatest potential for wildfires (83% of all PA wildfires) occur in the spring months of March, April, and May, and the autumn months of October and November. In the spring, bare trees allow sunlight to reach the forest floor, drying fallen leaves and other ground debris and increasing wildfire vulnerability. In the fall, the surplus of dried leaves are fuel for fires. *Figure 22 - Seasonal Wildfire Percentage* (PA DCNR, 2017) shows the wildfire percentage occurrence during each month occurring in Pennsylvania.

Figure 22 - Seasonal Wildfire Percentage (PA DCNR, 2017)



4.3.12.2 Range of Magnitude

Forested areas, croplands and properties that are at the interface between wild lands and human development are most at risk for being impacted by and causing wildfires. If an urban fire or wildfire is not contained, secondary impacts such as power outages may result. Other negative impacts of wildfires include killing people, livestock, fish and wildlife, destroying valuable property, timber, forage, recreational and scenic values. Wildfires can also cause severe erosion, silting of stream beds and reservoirs, and flooding due to a loss of ground cover.

The United States Forest Service utilizes the Forest Fire Assessment System to classify the dangers of wildfire. *Table 37 - Wildland Fire Assessment System* identifies each threat classification and provides a description of the level.

Table 37 - Wildland Fire Assessment System

Wildland Fire Assessment System (U.S. Forest Service)	
Rank	**Description**
Low (L)	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.
Moderate (M)	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.
High (H)	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.
Very High (VH)	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.
Extreme (E)	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.

4.3.12.3 Past Occurrences

Between 2009 and December 2017, there were one hundred twenty-seven fires reported to the Knowledge Center - these reported fires are primarily urban fires and some brush fires as well as oil & gas well fires. Wildfires in natural lands may be reported less frequently to the Knowledge Center and thus could be under-represented in *Table 39 - Fire*

Occurrence 2009-2017. This list should be treated as a sample of fire history in Susquehanna County and not an all-inclusive database.

In recent years, the number of prescribed burns in Pennsylvania have been increasing. This corresponds to an embrace of the need for fire in many natural ecosystems and management strategies for reducing vulnerability to wildfires. *Table 38 - PA Prescribed Burns* (PA DCNR, 2017) shows prescribed burn data for Pennsylvania from 2010 to 2015. No data on prescribed burns was available for 2016 or 2017.

Table 38 - PA Prescribed Burns (PA DCNR, 2017)

Year	All Agencies and Organizations - Number of Prescribed Fires	All Agencies and Organizations - Number of Prescribed Fire Acres	DCNR - Number of Prescribed Fires	DCNR - Number of Prescribed Fire Acres
2010	56	2737	12	186
2011	70	6301	11	189
2012	96	4133	10	208
2013	142	8058	35	866
2014	161	7094	26	338
2015	244	14553	47	1317

Table 39 - Fire Occurrence 2009-2017

Fire Occurrence 2009-2017 (Knowledge Center™, 2017)		
Start Time	**Jurisdiction**	**Description**
11/28/17	Forest City Borough	Structure Fire
11/07/17	Susquehanna	Structure Fire
10/20/17	Susquehanna	Fully Involved Structure Fire
08/27/17	Forest City Borough	Structure Fire
08/27/17	Forest City Borough	Structure Fire
08/26/17	Forest City Borough	Structure Fire
07/02/17	Forest City Borough	Structure Fire
06/21/17	Forest City Borough	Structure Fire
06/14/17	Susquehanna	Structure Fire
05/22/17	Forest City Borough	Structure Fire
05/24/17	Susquehanna	Structure Fire with Firefighter Injuries
05/12/17	Susquehanna	Structure Fire-Injured Firefighter
05/02/17	New Milford Township	Structure Fire with Firefighter Injury
03/09/17	Susquehanna	Natural Gas Compressor Station Fire
10/21/16	Susquehanna	Commercial Structure Fire
09/09/16	Susquehanna Depot Borough	Commercial Building Structure Fire
07/08/16	Susquehanna	Residential Structure Fire
07/07/16	Susquehanna	Structure Fire
06/19/16	Susquehanna	Sr 267 Structure Fire
04/18/16	Susquehanna	Brush Fire Windsor District Ny
03/30/16	Susquehanna	Structure Fire with Brush
03/26/16	Susquehanna	Brush Fire

Fire Occurrence 2009-2017 (Knowledge Center™, 2017)		
Start Time	**Jurisdiction**	**Description**
03/21/16	Susquehanna	Brush Fire
03/09/16	Springville Township	Brush Fire
03/06/16	Susquehanna	Structure Fire
02/11/16	Springville Township	Susq Co-Structure Fire, Springville Twp.
02/02/16	Susquehanna	Structure Fire
01/29/16	Susquehanna	Town Of Windsor, NY Structure Fire
11/30/15	Susquehanna	Structure Fire
10/29/15	Thompson Borough	Structure Fire
10/24/15	Susquehanna	Structure Fire-3 Alarm
10/12/15	Brooklyn Township	Compressor Fire
09/21/15	Susquehanna	Working Structure Fire
09/21/15	Susquehanna	Working Garage Fire
09/18/15	Franklin Township	Residential Structure Fire
07/05/15	Susquehanna	Structure Fire
05/14/15	Apalacon Township	Residential Structure Fire W/ Fatality
05/04/15	Susquehanna	Brush Fire
05/04/15	Montrose Borough	Working Structure Fire
05/02/15	Susquehanna	Brush Fire
03/24/15	Herrick Township	Structure Fire
03/05/15	Susquehanna	Structure Fire
03/02/15	Susquehanna	Structure Fire
01/26/15	Bridgewater Township	Structure Fire In A Nursing Home
01/08/15	Susquehanna	Mutual Aid to Lackawanna Co House Fire
12/27/14	Susquehanna	Structure Fire
12/01/14	Auburn Township	Compressor Station Fire
11/20/14	Susquehanna	Barn Fire
11/11/14	Susquehanna	Jenny Leighs Structure Fire
08/31/14	Susquehanna	Well Pump Fire
08/04/14	Susquehanna	Structure Fire
07/10/14	Susquehanna	Compressor Station Fire
07/08/14	Dimock Township	Structure Fire-Home Struck by Lightning
04/17/14	Susquehanna	Compressor Station Fire
04/10/14	Susquehanna	Multiple Brush Fires
02/23/14	Susquehanna	Structure Fire
01/16/14	Forest Lake Township	Fire On Gas Well Pad
01/07/14	Auburn Township	Structure Fire on Well Site
01/03/14	Susquehanna	Structure Fire-Assist to Wyoming County
01/03/14	Susquehanna	Barn Fire-Assist to Wyoming County
11/25/13	Susquehanna	Structure Fire
11/16/13	Susquehanna	Structure Fire
11/15/13	Susquehanna	Structure Fire
11/12/13	Susquehanna	Structure Fire
10/31/13	Jackson Township	Residential Structure Fire
10/26/13	Bridgewater Township	Structure Fire
09/04/13	Susquehanna	Structure Fire
09/01/13	Susquehanna	Structure Fire
08/25/13	Susquehanna	Firefighter Injury
08/12/13	Susquehanna	Working Structure Fire
07/08/13	Lathrop Township	Structure Fire
05/01/13	Lenox Township	Job Trailer Fire

Fire Occurrence 2009-2017 (Knowledge Center™, 2017)		
Start Time	**Jurisdiction**	**Description**
04/26/13	Susquehanna	Barn Fire
04/09/13	Springville Township	Brush Fire
04/07/13	Lenox Township	Pine Hill Brush Fire
04/03/13	Lenox Township	Brush Fire
03/28/13	Susquehanna Depot Borough	Smoke In Building
02/04/13	Susquehanna	Structure Fire
01/13/13	Franklin Township	Structure Fire
12/30/12	Harford Township	Structure Fire
10/04/12	Forest Lake Township	Structure Fire
09/21/12	Clifford Township	Structure Fire
08/25/12	Brooklyn Township	Structure Fire
08/10/12	New Milford Township	Vehicle Fire
07/07/12	Great Bend Township	Brush Fire
06/28/12	Great Bend Township	Vehicle Fire
06/12/12	Harford Township	Vehicle Fire I-81 South 215.6
06/03/12	Great Bend Township	Structure Fire-Entrapment-Fatality
05/07/12	Apalacon Township	Structure Fire
05/07/12	Great Bend Township	Structure Fire
05/07/12	Oakland Township	Structure Fire
04/16/12	Auburn Township	Barn Fire
10/29/11	New Milford Township	Residential Structure Fire
10/18/11	Middletown Township	Structure Fire
07/29/11	Springville Township	Brine Tank Fire
07/12/11	Springville Township	Junk Yard Fire
06/08/11	New Milford Borough	Structure Fire
05/13/11	Silver Lake Township	Structure Fire
04/23/11	New Milford Township	Tractor Trailer Fire
04/21/11	Forest City Borough	Structure Fire
04/06/11	Springville Township	Barn Fire Springville Twp.
03/06/11	Thompson Borough	Residential Structure Fire
01/08/11	Lenox Township	Structure Fire
12/30/10	Forest City Borough	Structure Fire Assist with Wayne Co
12/29/10	Springville Township	Structure Fire -Springville Township
12/17/10	Hallstead Borough	Structure Fire
12/09/10	Forest Lake Township	Barn Fire
12/08/10	Springville Township	Structure Fire
11/12/10	Harford Township	Barn Fire Richardson Rd
10/24/10	Montrose Borough	Structure Fires
10/10/10	Lenox Township	Barn Fire
09/04/10	Little Meadows Borough	Structure Fire
07/13/10	Auburn Township	Well Fire
06/30/10	Montrose Borough	Structure Fire
04/24/10	New Milford Township	Junk Yard Fire
04/12/10	Gibson Township	Structure Fire Gibson Twp
04/11/10	Lenox Township	Structure Fire
04/10/10	Silver Lake Township	Structure Fire
03/18/10	Susquehanna	Multiple Brush Fires
03/10/10	Susquehanna	Test
03/03/10	Thompson Borough	Structure Fire
01/27/10	Susquehanna Depot Borough	Pleasant Ave Apartment Fire

Fire Occurrence 2009-2017 (Knowledge Center™, 2017)		
Start Time	**Jurisdiction**	**Description**
12/25/09	Oakland Township	Fire with Injury
12/16/09	Montrose Borough	Structure Fire in Apartment Building
12/06/09	Rush Township	Structure Fire
11/11/09	Montrose Borough	Structure Fire
06/15/09	Lenox Township	Residential Structure Fire

4.3.12.4 Future Occurrence

Annual occurrences of urban and wildfires in Susquehanna County are expected. Urban fires are most often a result of human errors, outdated wiring or occasionally malintent (arson). The occurrence of large scale and intensity wildfires is somewhat unpredictable and highly dependent on environmental conditions and human response. Weather conditions play a major role in the occurrence of wildfires, so in the event of dry drought conditions, wildfire caution should be heightened. Any fire without the quick response or attention of fire-fighters, forestry personnel, or visitors to the forest, has the potential to become a wildfire.

4.3.12.5 Vulnerability Assessment

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 may often mitigate the effects of wildfires, however during a drought, wildfires can be devastating. Wildfires are most common in the spring (March–May) and fall (October–November) months. During spring and fall months, the lack of leaves on the trees allows the sunlight to heat and dry the existing leaves on the ground, increasing the risk of forest fires. Firefighters and other first responders can encounter life threatening situations due 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 Wildland Urban Interface (WUI) was nationally mapped by a United States Department of Agriculture Forest Service effort in 2015 that used data from 1990-2010 to develop a robust dataset that relates housing density and vegetative density. The dataset provides a way to help identify locations where larger numbers of humans are living in or near natural areas that could be at risk in the event of a wildfire. The WUI defines two types of communities – interface and intermix: intermix WUI refers to areas where housing and wildland vegetation intermingle, and interface WUI refers to areas where housing is in the vicinity of a large area of dense wildland vegetation (Martinuzzi et al., 2015). Pennsylvania is among the states with the largest area of WUI and the most housing units in a WUI designated area.

Table 41 - Buildings in High Wildfire Hazard Areas shows the total addressable structures and critical facilities that are located in state game lands, state parks and locations designated by the Wildland Urban Interface. Wildfire hazard is defined based on conditions that affect wildfire ignition and/or behavior such as fuel, topography and local weather.

There are nineteen fire departments that cover Susquehanna County. *Table 40 - Fire Departments* shows which municipalities have fire departments. Each fire department conducts its own schedule of in-house training sessions for their members.

Table 40 - Fire Departments

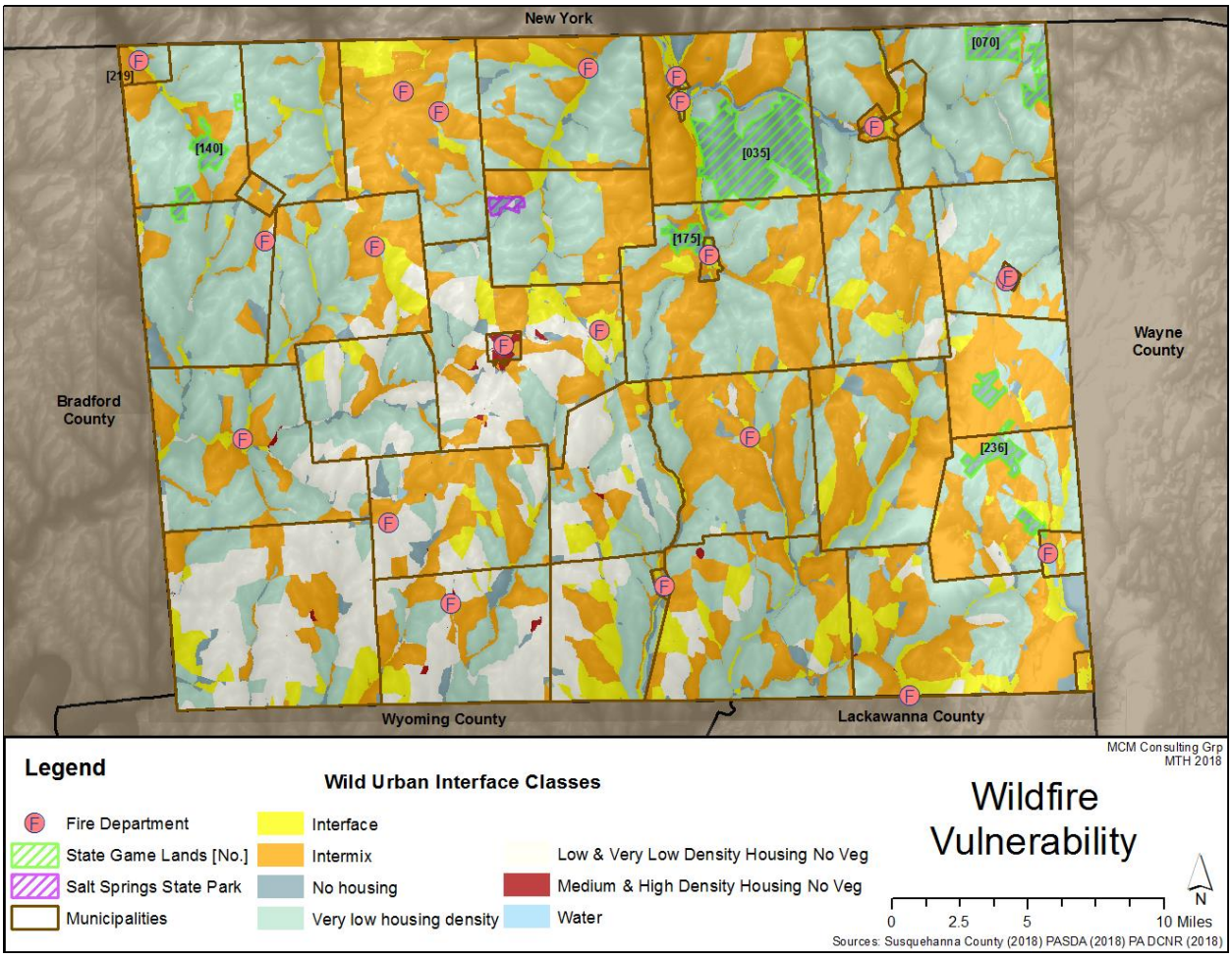
Fire Departments (Susquehanna GIS, 2018)		
Name	**Municipality**	**Address**
Clifford VFD	Clifford Township	1035 State Route 106
Elk Lake Vol Fire Dept	Dimock Township	11550 State Route 3001
Forest City VFD	Forest City Borough	380 Railroad St
Forest Lake VFD	Forest Lake Township	12055 Forest Lake Rd
Great Bend Fire Co	Great Bend Borough	54 Tannery St
Hallstead Fire Dept	Hallstead Borough	133 Lackawanna Ave
Harford VFD	Harford Township	142 Fair Hill Rd
Hop Bottom VFD	Hop Bottom Borough	150 S Center St
Snake Creek VFD	Liberty Township	25601 State Route 29
Little Meadows Fire	Little Meadows Borough	836 Maple St
United VFD	Montrose Borough	72 Monument St
New Milford VFD	New Milford Borough	22 Spring St
Rush VFD	Rush Township	11084 State Route 267
Silver Lake VFD	Silver Lake Township	3417 Quaker Lake Rd
Springville Fire Dept	Springville Township	3866 State Route 29
Susquehanna Fire Dept	Susquehanna Depot Borough	43 Erie Blvd
Thompson VFD	Thompson Borough	53 Water St
Union Dale VFD	Union Dale Borough	880 N Main St

Table 41 - Buildings in High Wildfire Hazard Areas

Buildings in High Wildfire Hazard Areas (Susquehanna County GIS, 2018)				
Municipality	**Wild Urban Interface and Intermix**		**State Game Lands and Parks**	
	Addressable Structures	**Critical Facilities**	**Addressable Structures**	**Critical Facilities**
Apolacon Township	168	2	0	1
Ararat Township	438	5	0	0
Auburn Township	392	5	0	0
Bridgewater Township	770	9	0	0
Brooklyn Township	230	2	0	0

Buildings in High Wildfire Hazard Areas (Susquehanna County GIS, 2018)				
Municipality	**Wild Urban Interface and Intermix**		**State Game Lands and Parks**	
	Addressable Structures	**Critical Facilities**	**Addressable Structures**	**Critical Facilities**
Choconut Township	273	4	0	0
Clifford Township	1176	14	0	0
Dimock Township	494	8	0	0
Forest City Borough	785	14	0	0
Forest Lake Township	474	6	0	0
Franklin Township	367	6	4	0
Friendsville Borough	46	3	0	0
Gibson Township	534	3	0	0
Great Bend Borough	480	11	0	0
Great Bend Township	720	10	2	0
Hallstead Borough	506	7	0	0
Harford Township	668	11	0	0
Harmony Township	146	1	1	0
Herrick Township	706	10	0	0
Hop Bottom Borough	144	6	0	0
Jackson Township	481	6	0	0
Jessup Township	90	2	0	0
Lanesboro Borough	189	8	0	0
Lathrop Township	282	0	0	0
Lenox Township	759	9	0	0
Liberty Township	479	7	0	0
Little Meadows Borough	129	3	0	0
Middletown Township	101	1	0	0
Montrose Borough	93	5	0	0
New Milford Borough	407	14	0	1
New Milford Township	1024	14	0	0
Oakland Borough	275	3	0	0
Oakland Township	167	3	0	0
Rush Township	356	9	0	0
Silver Lake Township	1062	10	0	0
Springville Township	243	2	0	0
Susquehanna Depot Borough	732	5	0	0
Thompson Borough	141	8	0	0
Thompson Township	205	3	0	0
Union Dale Borough	173	5	0	0
Total	**16905**	**254**	**7**	**2**

Figure 23 - High Wildfire Hazard Areas



4.3.13. Winter Storms

4.3.13.1 Location and Extent

There is an average of thirty-five winter weather events that impact Pennsylvania each year. Such winter storms are regional events, so each county in Pennsylvania shares these hazards, however, the northern tier, western counties and mountainous regions generally experience storms more frequently and with a greater severity due to lake effects and geographic influence. Within Susquehanna County there are variations in the average amount of snowfall that is received throughout the county because of differences in terrain; higher elevations experience greater snowfalls than lower-lying areas.

On occasion Susquehanna 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 (NWS).

4.3.13.2 Range of Magnitude

Winter storms consist of cold temperatures, heavy snow or ice and sometimes strong winds. Descriptions of types of winter storms can be found in *Table 42 - Winter Weather Events*. In severe cases, secondary effects of winter storms involve flooding, disruption to traffic, EMS response capabilities, communications, electric power and other utilities. Power outages can be caused by large amounts of snow or ice weighing on and breaking power lines. Especially in rural areas, loss of electric power can result in a loss of heat for residential customers, potentially posing a threat to human life.

Long cold spells can cause rivers and lakes to freeze over. A subsequent thaw and rise in the water level then breaks the ice into large chunks and can result in ice jams when the ice begins to flow. The ice jams can act as a dam and result in flooding. 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. While gradual melting of snow and ice provides excellent groundwater recharge, high

temperatures following a heavy snowfall can cause rapid surface water runoff and severe flooding. *Figure 24 - Pennsylvania Annual Snowfall* shows mean annual snowfall in Susquehanna County to be between forty-one to seventy inches. *Table 43 – Recent Annual Snowfall* summarizes annual snowfall accumulation for recent years not covered in *Figure 24 - Pennsylvania Annual Snowfall* as recorded in the weather station in Montrose.

Table 42 - Winter Weather Events

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

Figure 24 - Pennsylvania Annual Snowfall

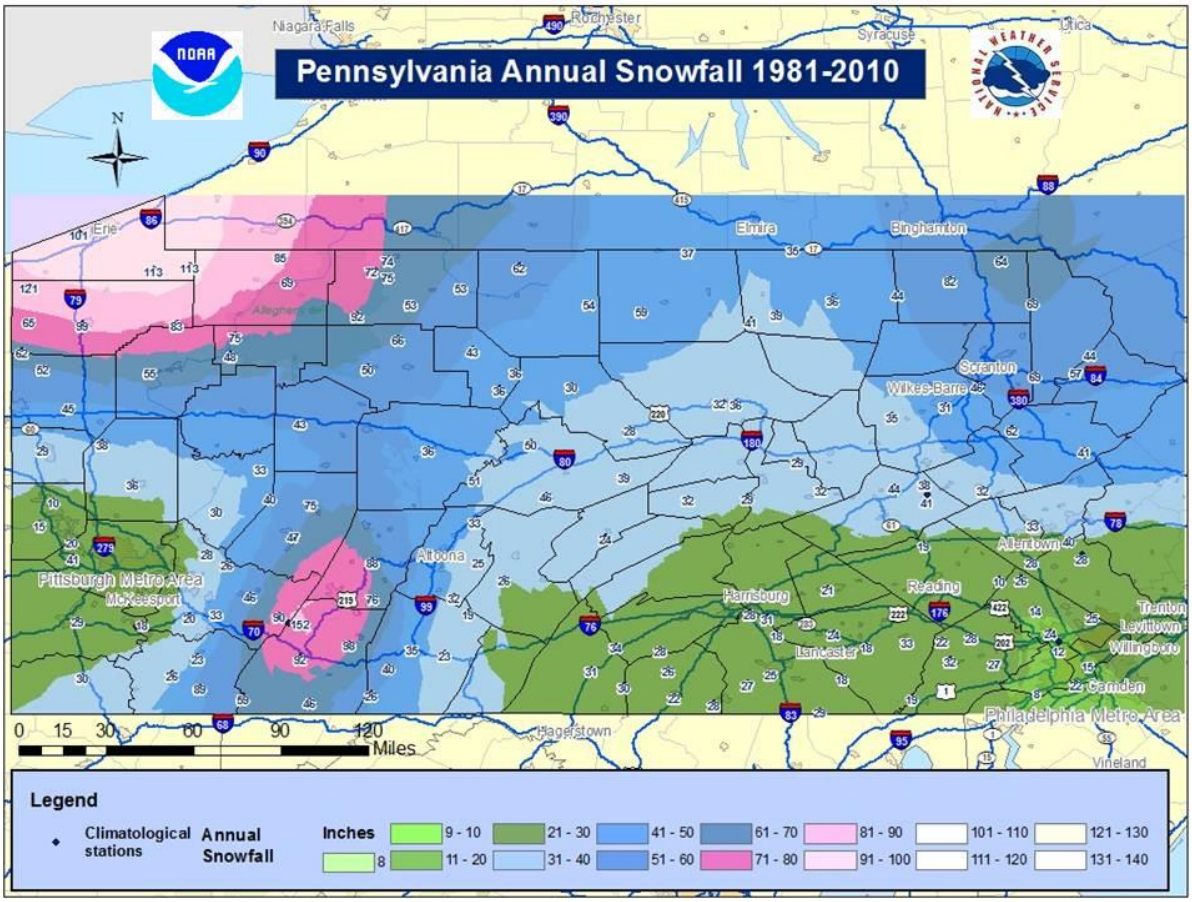


Table 43 – Recent Annual Snowfall

Recent Annual Snowfall (NOAA, 2017)			
Winter Season	**Total Snowfall (inches)**	**Winter Season**	**Total Snowfall (inches)**
2010-2011	76.3"	2014-2015	60"
2011-2012	28.7"	2015-2016	14.7"
2012-2013	44.8"	2016-2017	93.5"
2013-2014	55.9"		

4.3.13.3 Past Occurrence

Historically, winter storms have occurred on the average of five times a year in Susquehanna County. One of the most severe winter events in the county's history was in the

winter of 1993 – 1994 when 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. One of these devastating winter storms occurred in early January 1994 with record snowfall depths in many areas of the Commonwealth, strong winds and sleet/freezing rains. Numerous storm-related power outages were reported and as many as 600,000 residents were without electricity, in some cases for several days at a time. A ravaging ice storm followed which closed major arterial roads and downed many trees and power lines. Utility crews from a five-state area were called to assist in power restoration repairs. Officials from PPL Corporation stated that this was the worst winter storm in the history of the company – related damage-repair costs exceeded $5,000,000. Serious and sporadic power supply outages continued through mid-January in many locations due to record cold temperatures. 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 (with temperatures as low as -31˚F) resulted in numerous water-main breaks and interruptions of service to thousands of municipal and city water customers throughout the Commonwealth. The extreme cold in conjunction with accumulations of frozen precipitation resulted in acute shortages of road salt. Trucks were dispatched to haul salt from New York to expedite deliveries to Pennsylvania Department of Transportation storage sites.

All other recorded winter weather events in Susquehanna County from 1966-December 2017 are summarized in *Table 44 - Severe Winter Weather Events*.

Table 44 - Severe Winter Weather Events

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
January 1966	Heavy snow*	$ -	No Description Available
February 1972	Heavy snow*	$ -	No Description Available
January 1978	Heavy snow*	$ -	No Description Available
February 1978	Blizzard*	$ -	No Description Available
March 1993	Blizzard**	$ -	No Description Available

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
01/04/94	Heavy snow**	$ -	No Description Available
01/17/94	Heavy snow**	$ -	No Description Available
01/27/94	Ice**	$ -	No Description Available
01/02/96	Heavy Snow**	$3,000	A major winter storm formed over the Gulf Coast and tracked up the Eastern Seaboard, bringing heavy snow to northeast Pennsylvania. Snowfall amounts of 8 to 12 inches were widely observed.
01/07/96	Heavy Snow**	$20,000	A winter storm brought heavy snow to northeast Pennsylvania as it moved up the East Coast. Snowfall amounts of 6 to 12 inches were common in Bradford County, but further to the east, amounts of one to two feet were observed. As much as 27 inches of snow fell in Pike County. The 21 inches of snow which fell at the Wilkes-Barre Scranton Airport in Avoca broke the previous record for greatest 24-hour snowfall. That record was 20.5 inches set on November 24-25, 1971.
01/12/96	Heavy Snow	$7,000	A winter storm formed off the coast of North Carolina and moved northward along the Eastern Seaboard. The storm brought a general 8 to 12-inch snow accumulation to northeast Pennsylvania. However, a nearly stationary band of heavy snow dumped as much as three feet of snow in the Northern Tier. In Susquehanna County, Oakland reported 36 inches, Hickory Grove 34 inches, and Montrose 25 inches. In Bradford County, 20 inches of snow fell in Tuscarora.
03/06/96	Heavy Snow	$ -	A winter storm formed over the Carolinas and tracked up the coast, bringing heavy snow to northeast Pennsylvania. Snowfall accumulations ranged from 6 to 10 inches by the time the snow tapered off on the evening of the 7th. During the height of the storm, there were several minor accidents due to slippery roads and poor visibilities, but no injuries were reported.
05/11/96	Winter Weather	$ -	A late season snowfall blanketed the northern tier of Pennsylvania. Accumulations ranged from about an inch in the valleys, to as much as 3 inches in the higher elevations.
10/04/96	Cold/Wind Chill	$ -	A very cold air mass entered central New York and northeastern Pennsylvania on the morning of the 4th. Widespread freeze conditions were observed.
01/17/97	Cold/Wind Chill	$ -	A bitterly cold arctic air mass invaded northeast Pennsylvania during the evening hours of the 16th and remained over the area through the 18th. Air temperatures dropped to near zero degrees over much of the region by early morning of the 17th. During the day, readings only managed to reach the single digits and lower teens. That night, temperatures from 5 to 15 below zero were observed in many areas. Perhaps the biggest problem, though, was the strong winds accompanying this cold snap. Wind chills of 35 to 55 below zero were common over the northern tier of Pennsylvania on the morning of the 17th. This prompted many school districts to cancel classes that day.

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
03/31/97	Heavy Snow	$ -	A slow-moving low-pressure system exited the New Jersey coast during the pre-dawn hours of the 31st and intensified into a powerful system during the day just south of Long Island. Significant Atlantic moisture was thrown inland over north-eastern Pennsylvania. This moisture combined with colder air moving south into the region to bring heavy snow. Rain changed to snow early in the morning on the 31st. Snow quickly became heavy by mid to late morning. Blinding, heavy wet snow belted the Poconos from midday on the 31st into the early morning hours of April 1st. The wet nature of the snow and strong accompanying winds brought down many trees and caused widespread power outages, especially over the high-est elevations. State police and emergency management officials reported that hundreds of motorists had to be rescued and placed in Red Cross shelters or other accommodations on the night of the 31st. The Pennsylvania turnpike and inter-states 81 and 84 were among the many roadways that became impassable and were closed by late in the day on the 31st. States of emergency were declared in Pike and Wayne counties. By the time snow finally began to wind down after mid-night on April 1st, a general 12 to 30 inches had fallen from the Wilkes-Barre Scranton area eastward through the Poconos. The hardest hit areas were eastern Lackawanna, Pike, and Wayne Counties. Hamlin and Gouldsboro in southern Wayne County picked up 30 inches of snow while Lords Valley in Pike county got 24 inches. Significant 6 to 12-inch accumulations extended as far back westward as hilltop sections of Wyoming and Susquehanna counties.
04/01/97	Heavy Snow	$ -	The major late season snowstorm that struck northeast Pennsylvania on the 31st of March began to wind down during the pre-dawn hours of April 1st. By sunrise on the 1st, much of the accumulating snowfall had moved out of the region. This left total accumulations ranging from a foot to upwards of 30 inches in an area from the Wilkes-Barre Scranton vicinity eastward through the Poconos. It took road crews and power companies much of the day to move stranded vehicles, clear major roadways, and restore electricity to the hardest hit localities.
12/10/97	Heavy Snow	$ -	No Description Available
12/29/97	Heavy Snow	$ -	No Description Available
02/23/98	Heavy Snow	$ -	No Description Available
03/20/98	Heavy Snow	$ -	A low-pressure system slowly intensified over the Carolinas from the evening of the 20th through much of the day on the 21st. A notable spoke of upper level energy rotated around this storm and affected parts of northeastern Pennsylvania from late in the evening on the 20th into the early morning hours on the 21st. A burst of heavy snow resulted, which was mixed with sleet and freezing rain. This round of mixed precipitation brought an ice coating up to a quarter of an inch thick on exposed surfaces across the higher elevations just outside of the Wilkes-Barre/Scranton metropolitan area. Also, 2 to 5 inches of snow fell within roughly a 6-hour period in areas north of Scranton. From the evening of the 21st through the 22nd, the storm center began to move northeastward off the Mid-Atlantic coast while strengthening further. As this occurred, narrow bands of very heavy snowfall developed overnight into the early morning of the 22nd across the north-ern tier and Pocono regions. Snowfall totals for this entire event were heaviest to the north and east of Scranton. Accumulations of 6 to 10 inches were common. Equinunk and Dyberry Township in Wayne County picked up 8 to 10 inches of snow while Bushkill in Pike county and Great Bend in Susquehanna county re-ceived 6 to 7 inches of fresh powder.

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
01/02/99	Ice Storm	$ -	A low-pressure system intensified across the Ohio Valley and lower Great Lakes region during the afternoon and evening hours of the 2nd. As it did so, it spread a mix of snow, sleet, and patchy freezing rain across northeastern Pennsylvania late in the afternoon. Snow accumulations were fairly minor in this event, generally only an inch or less. The reason for this was that the precipitation quickly changed over to sleet and then freezing rain from south to north. Steady freezing rain persisted across much of northeastern Pennsylvania during the overnight and early morning hours from the 2nd into the 3rd. Freezing rain resulted in a substantial buildup of ice. The hardest hit regions stretched from the Poconos into areas just north and east of Scranton. Ice accumulations to nearly one inch over parts of this area brought down trees and power lines. Power outages were widespread across Wayne, Pike, eastern Susquehanna, and northern Lackawanna Counties. Department of Transportation and State Police officials also reported very treacherous travel conditions, especially early on Sunday the 3rd. Warmer air pushed into northeastern Pennsylvania from the south and west during the early morning hours on the 3rd. This milder air changed freezing rain over to light rain showers and drizzle. Finally, by late morning on the 3rd, temperatures pushed above freezing in the normally colder sections of the Poconos.
01/08/99	Winter Storm	$ -	A low-pressure system developed over the lower Ohio Valley early on the 8th, then tracked northeastward across New York State, eventually reaching northern New England by the evening of the 9th. This storm spread substantial amounts of Gulf moisture northward into northeastern Pennsylvania. As this moisture encountered the cold air mass in place, a variety of wintery type precipitation again resulted. Snow began to fall over much of northeastern Pennsylvania during the late morning and early afternoon hours of the 8th. Amounts of 1 to 3 inches were common across the northern tier counties before snow began to change over to sleet and freezing rain late in the day. A mixture of sleet, freezing rain, and even light rain occurred over Bradford, Susquehanna, and Wayne Counties during the overnight hours from the 8th into the 9th. Many areas received a thin glaze of ice on top of already fallen snow. This created very hazardous travel conditions. During the day on the 9th, as the main storm center pulled east into New England, colder air began to wrap back into central New York from the northwest. The result was another burst of snow. Additional accumulations of 2 to 4 inches were seen in many areas, especially the higher elevations. Storm totals of 6 to 7 inches of snow plus ice were observed over the Endless Mountain region of Susquehanna county and northern Wayne County near Pleasant Mount. Snow tapered off from west to east on the afternoon on the 9th.
01/13/99	Winter Storm	$ -	No Description Available
03/06/99	Heavy Snow	$ -	A storm system moved out of the Ohio Valley early in the morning on the 6th and crossed the Delmarva region that evening. The system then redeveloped near Long Island early on the 7th and moved slowly through central New England thereafter. Two distinct bouts of snowfall affected portions of northern Pennsylvania during this time frame. The initial shot of snow fell primarily during the day on Saturday the 6th. After a lull that evening, snowfall picked up again overnight and continued into the morning hours of the 7th before tapering off. On the 6th, snow first developed just prior to daybreak and quickly spread eastward. Late in the afternoon, the first shot of snow moved off to the east. Accumulations over the northern tier of Pennsylvania generally ranged from 2 to 4 inches. During the overnight hours from the 6th into the 7th, the brief respite from snowfall ended as heavier precipitation once again formed over the region. By the time the snow wound down by mid-morning on the 7th, an additional 3 to 5 inches had fallen. Storm totals from the two-day event were in the 5 to 8 inch range over most of Bradford and Susquehanna Counties with 8 inches reported at Thompson, 7 inches at Montrose, and 5 inches at Sayre.

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
03/21/99	Heavy Snow	$ -	A low-pressure system developed near the Virginia Capes on the evening of the 21st, then intensified rapidly as it moved slowly northward up the Atlantic seaboard and eventually on to the Gulf of Maine by the morning of the 23rd. Rain or a mixed bag of rain and wet snow began across northeastern Pennsylvania during the afternoon of the 21st. However, precipitation changed to all snow by early evening over the northern tier, then towards daybreak in the Poconos as colder air wrapped into the area from the northwest. Heavy wet snow pelted much of northeastern Pennsylvania into the daylight hours on the 22nd. Snow gradually wound down and ended over the region by midday. The heavy wet nature of the snowfall created many hazards across the region by the early morning hours on the 22nd. Many trees and power lines weighed down heavily or collapsed altogether. Many area roadways were closed early on the 22nd as crews scrambled to clear both heavy snow and in some cases fallen and/or live wires. Once the snow ended over all areas by early afternoon on the 22nd, accumulations generally ranged from 8 to 12 inches across most of the northern tier counties to about 6 inches in the Wilkes-Barre/Scranton area and adjacent portions of the Poconos. Some of the more impressive totals were as follows: Litchfield in Bradford county - 12 inches, Dimock, Quaker Lake, and Thompson in Susquehanna County - 8 inches, and Pleasant Mount in Wayne County - also 8 inches.
01/12/00	Heavy Snow	$ -	A low-pressure system tracked across Ohio into Maryland late on the 12th spreading snow into the Northern Tier of Pennsylvania. The low tracked off the mid-Atlantic coast during the day of the 13th. Snow continued across the area during the morning of the 13th before tapering off to a few flurries during the afternoon. Generally, between 3 to 6 inches of snow fell. Many automobile accidents were reported throughout the area, but none were serious. Numerous schools closed.
01/20/00	Heavy Snow	$ -	A low-pressure system formed during the early morning hours of Thursday the 20th off the mid-Atlantic coast. The low intensified rapidly as it moved northeast during the day and was located off the Delaware coast by evening. Snow overspread northeast Pennsylvania after midnight on the 20th and continued throughout the day. Cold northwest winds behind the low generated lake effect snow showers Thursday night into Friday. Generally, between 2 to 5 inches of snow fell. Scores of motor vehicle accidents were reported, including one fatality. There were also a number of school closings.
01/25/00	Heavy Snow	$ -	A major winter storm impacted northeast Pennsylvania from Tuesday the 25th until early Wednesday the 26th. Low pressure rapidly developed and tracked up the mid-Atlantic coast on Tuesday, reaching just off of the tip of Long Island by evening. The storm then moved along the New England coast into the Canadian Maritimes on Wednesday. Heavy snow spread into the Pocono Mountains early Tuesday morning and across the rest of northeast Pennsylvania by midday Tuesday. The snow continued heavy at times into the evening hours, before tapering off to snow showers Tuesday night and early Wednesday. Gusty north winds led to considerable blowing and drifting of the snow over the entire area. Total snowfall ranged from 10 to 15 inches over the Pocono Mountains to 5 to 12 inches across the northern tier counties and Wyoming Valley. The storm was blamed on two highway deaths.
01/30/00	Heavy Snow	$ -	Low pressure organized over the North Carolina coast Sunday evening the 30th and tracked north up the eastern seaboard to southern New England by Monday morning the 31st. The low moved into the Canadian Maritimes by Monday evening. Heavy snow spread into northeast Pennsylvania during the late evening Sunday. The snow tapered off during the late morning and early afternoon hours Monday across the area. Snowfall rates reached up to 2 inches per hour at times over the Poconos where the highest snowfall amounts occurred. Snowfall totals ranged from 12 to 18 inches across the Poconos, to around 10 inches in the Wyoming Valley of northeast Pennsylvania. Bradford County in northern Pennsylvania saw between 3 and 8 inches of snowfall.

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
02/13/00	Ice Storm	$ -	A strengthening storm system moved out of the Ohio Valley on Sunday the 13th and then tracked across northern Pennsylvania early on the 14th. Abundant Gulf moisture associated with this system in combination with a shallow layer of cold air at the surface produced a mixed bag of wintry precipitation over northeast Pennsylvania. Snow, sleet and freezing rain changed over to rain by Monday morning. Ice accumulations up to a quarter of an inch on exposed surfaces were observed before the precipitation changed over to rain. There were numerous automobile accidents but no serious injuries reported.
02/18/00	Heavy Snow	$ -	A low-pressure system moved out of the Ohio valley on Friday the 18th spreading snow into northeast Pennsylvania. The low then tracked across southern Pennsylvania Friday night, before weakening on Saturday the 19th. In most places, the snow began to mix with or change over to rain and freezing rain after midnight on the 19th. Generally, 4 to 7 inches of snow fell. Many motor vehicle accidents were reported throughout the area, but most were minor. Schools were once again closed in some of the districts due to inclement weather. A jet slid off the runway due to icy conditions at the Wilks Barre/Scranton International Airport. No injuries were reported.
04/08/00	Heavy Snow	$ -	A late season winter storm system moved out of the Mississippi Valley on April 7th and across the mid-Atlantic states into southern New England by the 9th. A surge of warm air ahead of the system brought rain and a round of thunderstorms to the region. When the trailing cold front associated with this storm crossed through northeast Pennsylvania, temperatures fell quickly from the 60s to the 30s changing the rain to snow during the evening of the 8th and predawn hours of the 9th. The snow continued heavy at times during the predawn hours of the 9th before tapering off by early afternoon. All of northeast Pennsylvania received some snowfall but areas from Interstate 81 eastward received substantially higher amounts. In these locations, amounts generally ranged from 4 to 6 inches with maximum amounts of 8 inches reported in the higher elevations of Luzerne County. The rapid changeover from rain to snow, along with the intensity of precipitation, made travel quite hazardous. There were many traffic accidents, some with multiple injuries, reported throughout the area.
09/28/00	Extreme Cold/Wind Chill	$ -	On the evening of the 28th and the morning of the 29th a widespread killing freeze occurred across central New York and northeast Pennsylvania. Most observations had low temperatures below 30 degrees Fahrenheit. Record lows for the 29th of September were set in Syracuse and Binghamton New York and Avoca Pennsylvania. All three were at least in the coldest five temperatures for September.
12/19/00	Heavy Snow	$ -	A coastal storm formed off the mid-Atlantic coast late on the morning of the 19th. Snow moved north well ahead of the storm into northeast Pennsylvania also on the morning of the 19th. The storm was off the New England coast on the morning of the 20th. A narrow band of moderate snow set up across these counties the afternoon of the 19th and continued to around midnight. Snowfall amounts were 4 to 7 inches. To the east of these counties, closer to the coast the warmer air kept snow amounts lower.
12/30/00	Heavy Snow	$ -	A major winter storm developed off the Delmarva Peninsula early on Saturday, December 30th. The storm rapidly spread moderate to heavy snow north and west into extreme eastern Pennsylvania by 8 AM. As the storm center moved north and intensified further off the New Jersey coast during the day on Saturday, the snow continued across northeast Pennsylvania. The snow tapered to snow showers from south to north during the late evening and early morning hours on Sunday December 31st. The heavy snow remained confined to locations east of Interstate 81 and north of Scranton. Snowfall totals generally ranged from 6 to 12 inches. To the west of Interstate 81 snowfall totals dropped off quickly.

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
02/05/01	Heavy Snow	$ -	A coastal storm off the middle Atlantic coast on the morning of the 5th moved north while rapidly intensifying. The storm was off of Long Island, New York on the evening of the 5th. Snow moved north ahead of the storm starting by 6 AM. Snowfall rates went quickly to an inch per hour by noon. Snowfall rates were as high as 2 inches per hour closest to the storm in eastern Pike County. The snow ended during the evening as the storm moved further to the northeast. Snowfall amounts were 4 to 8 inches in Luzerne, Lackawanna, Wyoming, and the eastern half of Susquehanna Counties. Snowfall amounts increased to 5 to 10 inches in Wayne County and 9 to 15 inches in Pike County. The highest amounts were in eastern Pike County.
02/25/01	Ice Storm	$ -	A strengthening low-pressure system in the plains on the 24th moved into the western Great Lakes late that day. The storm moved into southern Ontario province in Canada on the 25th. Precipitation occurred ahead of the low and a warm front. The precipitation started as a period of light snow and sleet the evening of the 24th. The snow and sleet changed to freezing rain between 11 PM and midnight. The freezing rain ended between 10 AM and noon. Water equivalent amounts of the freezing rain were around a quarter of an inch.
03/04/01	Heavy Snow	$ -	A major winter storm moved slowly north along the east coast of the United States. The storm was on the Virginia coast on the afternoon of the 4th. Snow moved north quickly into northeast Pennsylvania that afternoon. Snowfall rates were one inch an hour. The snow continued for the most part continuously for two days. Midday on the 5th, the storm was off the New Jersey coast. The storm then moved very little until late on the 6th when it moved east out to sea. Snowfall totals were 6 to 20 inches. The greatest amounts were in the northern tier.
03/12/01	Ice Storm	$ -	Low pressure moved across the western Great Lakes late on the 12th into eastern Canada on the 13th. Warm moist air moved over colder air at the surface. Precipitation started as rain which cooled the air below freezing. Freezing rain fell most of the overnight before ending the morning of the 13th. Freezing rain amounts were between a quarter and a half of an inch.
12/08/01	Heavy Snow	$ -	Heavy snow spread north ahead of a low-pressure area. The storm moved from West Virginia the afternoon of the 8th to the New Jersey coast early on the 9th. This was the first significant event of the season. Snowfall amounts were in the 4 to 6-inch range across the higher elevations. Lower elevations and areas further south, such as southern Wayne and southern Lackawanna counties had less snow. In these areas the snow was wetter and at times mixed with sleet and rain.
01/06/02	Heavy Snow	$ -	A storm system intensified as it moved north from the gulf coast early on the 6th to the coast of New Jersey that evening. The storm was off of Maine on the 7th. The heaviest snow was during the late afternoon and evening of the 6th. Most locations had 7 to 15 inches of snow. Snow amounts of 1 to 2 feet were from Wilkes-Barre northeast through Scranton and Honesdale to the New York state border. At the peak of the storm snowfall rates were up to 5 inches an hour with thunder and lightning. Mainly light snow lingered through the morning of the 7th as an upper level trough moved through the region.
01/19/02	Heavy Snow	$ -	Low pressure over the southern Mississippi valley, early on the 19th, strengthened and lingered off the middle Atlantic coast during the second half of the day. The moisture with this storm was helped across the northern tier of Pennsylvania by an upper level boundary. Snow amounts were mostly 4 to 7 inches across the area. Snow to water ratios were mostly 15 to 1.

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
01/31/02	Winter Storm	$ -	A strong intensifying storm in the lower Mississippi Valley moved slowly northeast to be in New York late on February 1st. The storm pumped abundant moisture north ahead of it. The precipitation started as snow then changed over to sleet then freezing rain then finally rain. Changes happened from west to east. Most locations had two inches or less of snow. By 10 AM most locations had changed over to freezing rain. Steady freezing rain, at times moderate, fell during the daytime. By evening the Wayne and Pike Counties still had freezing rain but it had lessened in intensity. Across most of the remaining area it was just rain. The freezing rain lessened in coverage and intensity overnight before finally ending late morning on the first. Ice accumulations were up to a quarter of an inch.
05/17/02	Extreme Cold/Wind Chill	$ 2,000	A cold front went through the northern tier of Pennsylvania the morning of May 17th. A surface low pressure area moved east across the Tennessee Valley on the 17th to the mid-Atlantic region early on the 18th. Precipitation in the form of rain was spread east and north ahead of the surface low on the 17th. The rain over northern Pennsylvania changed to wet snow from west to east starting late on the 17th. Accumulations were mostly over 1500 feet in elevation with up to 6 inches above 2000 feet. The highest amount was 6 inches in Sylvania at 2200 feet. 2 inches fell in Montrose.
12/11/02	Winter Weather	$ -	Low pressure on the gulf coast on the 10th moved northeast to be off Cape Hatteras, North Carolina the morning of the 11th. The storm moved north to be off the New Jersey coast that evening then moved northeast off of Cape Cod the morning of the 12th. Precipitation moved into northeast Pennsylvania between 8 and 9 in the morning on the 11th. Precipitation fell in the form of rain but froze to roads and other surfaces with temperatures in the upper 20s. Sleet mixed in with the freezing rain at times at the beginning of the event. In southern parts of Pike and Luzerne Counties temperatures rose above freezing for most of the afternoon. The rain and freezing rain was heavy at times during the afternoon. Rainfall amounts were up to an inch. Freezing rain accretions were up to half an inch. The freezing rain caused numerous accidents which closed most of the major thoroughfares including, Interstates 81, 80, and 84. Several counties declared states of emergencies. The freezing rain also brought down trees and power lines. This was especially true across the higher elevations. The freezing rain changed to snow on the evening of the 11th. The wet snow then continued heavy at times into the next morning. Snowfall amounts for Pike and Luzerne Counties were up to two inches. The remainder of the counties further north received 2 to 8 inches of snow. The heaviest snow of 6 to 8 inches was from Wyoming County eastward across southern Susquehanna, northern Lackawanna, into northern Wayne Counties. Total water equivalents for the entire storm were mostly between an inch and an inch and a half. The freezing rain and the heavy wet snow caused hundreds of customers to lose power.
12/25/02	Heavy Snow	$ -	Low pressure formed off the middle Atlantic coast Christmas evening. This storm intensified as it moved north to be off Long Island, New York Christmas night. Light snow moved into northeast Pennsylvania around midnight on the 25th. This snow remained light through the early morning accumulating little. In many locations the snow changed to sleet and freezing rain around sunrise. The precipitation remained light in most places until afternoon, During the afternoon precipitation changed back to snow and became heavy. In Bradford County precipitation was mostly snow for the entire event. A band of heavy snow lifted north through the region during the afternoon and early evening. Snowfall rates were several inches an hour. The snow ended around midnight on the 26th. In Bradford County snowfall amounts were mostly 7 to 10 inches. In Luzerne County snow totals were 9 to 14 inches. Elsewhere amounts were 10 to 20 inches with some amounts up to 2 feet closer to the New York border and at higher elevations. Due to the interstates being closed due to accidents from time to time many counties declared states of emergencies. The heavy snow caused isolated power outages.

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
01/01/03	Ice Storm	$ 30,000	A low-pressure system in Mississippi, New Year's Eve, moved northeast to the Tennessee/North Carolina border the morning of the 1st. The storm then picked up speed to be in northeast Pennsylvania the evening of New Year's Day. The next morning it was off the coast of Maine. A cold front with rain passed southeast of the area New Year's Eve. This allowed a north to northeast surface wind to set up which brought in cold air during most of the 1st. Precipitation well ahead of the storm started around 10 AM on the 1st. Precipitation started as mostly rain but as colder air moved in the rain began to freeze. The freezing rain was heavy at times in the evening before ending in the early morning of the 2nd. Ice amounts were the thickest at the higher elevations with mostly a quarter to a half inch. Above 1500 feet elevation an inch or more of ice was coating surfaces in Bradford County. Melted precipitation amounts were an inch or more. The ice caused trees and wires to come down. Around 3,000 customers lost power in the area. The hardest hit area with 1000 customers without power was around Canton in Bradford County. The ice remained on the trees and wires through the January 3rd snowstorm causing more wires to come down.
01/03/03	Heavy Snow	$ 500,000	A slow-moving nor'easter moved from the southeast United States early on the 3rd to the Delmarva peninsula that evening. The storm then moved to the southeast New England coast the morning of the 4th. Snow spread well ahead of the storm into central New York the evening of the 2nd. The snow was heavy at times on the 3rd during the day into the evening. Snow spread well ahead of the storm into northeast Pennsylvania the evening of the 2nd. The snow was heavy at times on the 3rd during the day into the evening. Snowfall amounts were 4 to 9 inches in Lackawanna and Luzerne Counties. Elsewhere amounts were mostly between 8 and 14 inches. A few higher amounts up to 20 inches were in Susquehanna and northern Wayne Counties. Water equivalents were mostly half an inch to an inch. The weight of the snow combined with the weight of ice from the New Year's Day storm caused additional power outages. A few thousand customers lost power across the northern tier. All of the major roads had motor vehicle accidents. Some were serious enough to close the interstate highways.
02/17/03	Heavy Snow	$ 50,000	A coastal storm moved slowly up the east coast on the 16th and early on the 17th. Late on the 17th the storm picked up speed to be well off the northeast coast. Snow spread into northeast Pennsylvania during the evening of the 16th. The snow was heavy at times especially the first half of the 17th before ending during the evening. Snowfall rates were several inches an hour. Snowfall amounts were a widespread 10 to 20 inches. States of emergency were declared. Accidents were fewer due to the Presidents Day holiday and due to 8 inches of new snow by sunrise.
12/06/03	Heavy Snow	$ 20,000	A surface low pressure system moved northeast out of the lower plains on the 3rd, before slowly dissipating in the Ohio Valley. A new storm developed off the North Carolina coast early on the 5th, then moved slowly up the east coast of the United States. Snow started in northeast Pennsylvania the afternoon of the 5th, then moved slowly north into central New York that night. The snow mostly fell the first half of the 6th. The snow slowly tapered off from southwest to northeast the afternoon and evening of the 6th. Snowfall amounts were 5 to 9 inches. A few 10-inch amounts were in Wayne County and northern Pike County.
12/14/03	Heavy Snow	$ 20,000	A strong storm on the gulf coast moved slowly northeast up the east coast on the 14th to be near the Delmarva peninsula late that day. The storm continued up the coast on the 15th to be in southeast Canada late that evening. Snow started in the early morning hours of the 14th. Snowfall amounts of 6 to 9 inches were across the area. Some 10-inch snow amounts were in Bradford County. Freezing rain and sleet mixed with the snow for a time cutting down the snow amounts. Snowy roads caused automobile accidents.

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
01/10/04	Cold/Wind Chill	$ 5,000	Arctic high pressure over central Ontario province, Canada brought northeast Pennsylvania record cold temperatures with temperatures below zero in most locations. This extreme cold air came in on north winds ahead of the high on the 9th and 10th. Record low temperatures were set at several cooperative observer and ASOS airport sites. Low temperatures the morning of the 10th were generally between zero and 15 below zero.
01/15/04	Cold/Wind Chill	$ 10,000	A deep low-pressure system in southeast Canada combined with a large area of high pressure in the province of Ontario, Canada to create northwest winds of 15 to 25 mph across the area. This high-pressure system also ushered in below zero temperatures. The cold and wind combined to produce wind chill values of 15 to 35 below zero. Many schools were closed due to the extreme cold. The cold air also caused problems with cars and buses starting. In addition, some residences and business had damage from frozen pipes.
01/28/04	Heavy Snow	$ 50,000	A low-pressure system moved northeast into the Ohio Valley early on the 27th. Another low-pressure system developed on the east coast later that day then moved northeast to the New England coast. Snow ahead of the initial low became heavy the afternoon of the 27th. The snow tapered off to snow showers the morning of the 28th. Snowfall amounts were 6 to 8 inches with a few higher amounts.
02/03/04	Heavy Snow	$ 10,000	A low-pressure area in Missouri the morning of the 2nd moved slowly northeast to be in Michigan the morning of the 3rd. Another low-pressure area formed on the North Carolina coast also the morning of the 3rd. This low moved up the east coast of the United States to be off the Maine coast the morning of the 4th. Precipitation, mostly in the form of snow, moved into the area from the west around 10 AM. Snowfall amounts were mostly 6 to 8 inches across much of Bradford, Susquehanna and Northern Wayne Counties. The highest amounts were at the highest elevations. In the valleys snow amounts were reduced by some rain, freezing rain, and sleet. Snow to water ratios were around 10 to 1. During the afternoon and evening, numerous accidents occurred when people tried to return home from work.
03/16/04	Heavy Snow	$ 20,000	Late on the 15th into the 16th, low pressure in the plains moved east as it intensified and became better organized. A stationary front went from this low east to North Carolina. Moisture was spread north into the area where cold air was near the surface. Snow started between 6 and 9 AM on the 16th. The low was off the Delmarva Peninsula the evening of the 16th before moving northeast further off the coast. The snow was at its heaviest from the late morning into the afternoon on the 16th. This snow intensity hindered drivers getting home during the afternoon and early evening. The snow tapered off to scattered snow showers the morning of the 17th. The snow was a widespread 5 to 9 inches.
01/06/05	Winter Weather	$ -	The first significant storm of the winter started with mixed precipitation that changed to snow the morning of the 5th. During the afternoon, there was a lull followed by more snow that night. The snow changed back to freezing rain then rain late that night and during the day on the 6th. Snowfall amounts were mostly 3 to 7 inches with up to a quarter of an inch of ice. Larger amounts of ice were across the higher elevation from eastern Luzerne County to Pike County. This caused widespread power outages of over 100,000 customers. Some residents were out of power for a week due to the severity and another lesser freezing rain event on the 8th. The snow and freezing rain caused numerous traffic accidents and school closings both days. Hard hit with power outages in Luzerne County were Hazleton, Whitehaven, and Bear Creek.

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
01/21/05	Cold/Wind Chill	$ -	Bitter cold arctic air moved into the region on the 20th and 21st, remaining into the 22nd. Winds the night of the 21st to the 22nd were 5 to 10 mph, increasing to 10 to 20 mph around sunrise on the 22nd ahead of an approaching storm. The increased wind also caused temperatures to rise. Low temperatures that night were 10 to 25 below zero Fahrenheit. Wind chill temperatures were mostly in the 25 to 35 below zero range.
01/23/05	Heavy Snow	$ 20,000	A major winter storm moving east from the Ohio Valley transferred to the mid-Atlantic coast then moved northeast up the coast. This brought a widespread snow of 6 to 12 inches that started during the day on the 22nd and continued into the morning of the 23rd. The snow was heaviest the afternoon and evening on Saturday the 22nd. Despite occurring on a weekend, it still caused major travel problems. It was also unusual in that temperatures during the event were between 0 and 20 above zero Fahrenheit.
03/01/05	Heavy Snow	$ 20,000	A strong winter storm brought 8 to 14 inches of snow to all of northeast Pennsylvania. Isolated snow amounts were as much as two feet. A Midwest storm slowly moved east and combined with another storm moving north along the east coast on February 27th to bring copious moisture to the region on February 28th. The snow moved in from the south starting late in the morning of February 28th. The snow continued through the night, heavy at times, before tapering off to light snow and flurries in the morning on March 1st.
03/24/05	Heavy Snow	$ 10,000	An intensifying storm moved north along the east coast on March 23rd and 24th. Light mixed precipitation moved into northeast Pennsylvania the morning of the 23rd before changing over to snow early in the afternoon. The snow became heavy at times late in the afternoon and continued into the evening. Snowfall amounts were 6 to 8 inches with some amounts up to a foot mainly at higher elevations. Water equivalents of the snow were between half an inch and an inch. Hundreds of accidents occurred as people tried to get home after work during the height of the storm in the evening. Both Interstate 80 and 81 in southern Luzerne County were closed for part of the evening. 7500 electric customers lost power in Luzerne County.
10/25/05	Winter Weather	$ -	An early season snowfall hit the higher terrain of northeast Pennsylvania on October 25, 2005. Low pressure developed over Ohio and tracked to off the New Jersey Coast where it intensified into a major early season winter storm. Snow fell over the higher elevations of northeast Pennsylvania and the Poconos, with rain in the valleys. The rain caused minor flooding problems in the low-lying areas near Sayre along the Susquehanna River. The hardest hits areas were from the higher terrain of Bradford County above 1500 feet, east through the higher terrain of western Susquehanna County. Between 4 and 8 inches of snow fell in these areas with up to a foot reported above 2000 feet in southern Bradford County. The snow came down very hard from the late morning into the early and midafternoon hours on the 25th. The snow continued heavy at times until the mid to late evening hours on the 25th. The snow rapidly accumulated on roads and caused major traffic problems, especially in southern Bradford County where dozens of accidents were reported. In addition, the heavy wet snow brought down trees and power lines in these areas. Across the rest of northeast Pennsylvania, including the Poconos, the valleys saw rain with the higher terrain above 2000 feet seeing only a few inches of snow.
12/09/05	Heavy Snow	$ 10,000	A surface low moved northeast out of the Ohio Valley on the 8th to eastern Canada late on the 9th. Cold air across the region ahead of the storm kept all of the precipitation as snow. The snow moved into the area the evening of the 8th. Snowfall amounts were mostly from 6 to 10 inches. In Pike County, amounts were higher, from 9 to 12 inches.

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
12/14/05	Cold/Wind Chill	$ -	A large area of high pressure centered over southeast Canada brought arctic cold air to the area. Morning low temperatures were almost all below zero, with most between 5 below and 10 below zero. Dozens of airports and cooperative stations broke the record low temperature for the day. Calm to light winds and snow cover helped the temperatures get as cold as they did. These were the coldest temperatures of the season up to this point.
02/13/07	Winter Storm*	$ -	A low-pressure system developed over the southern plains on February 12th and intensified rapidly as it neared the East Coast on the night of the 13th. The storm then continued to strengthen as it moved up the Atlantic Seaboard during the day of February 14th. The storm spread snow into northeast Pennsylvania beginning in the afternoon on Tuesday, the 13th. Snow mixed with, and then changed to sleet across all of northeast Pennsylvania, except in Bradford, Wyoming and western Susquehanna counties, during the morning hours of the 14th. The sleet changed back to snow which became very heavy by the afternoon of the 14th. Snowfall rates of 1 to 3 inches per hour were reported. The high snowfall intensity wreaked havoc with snow plowing operations and closed several major interstates in northeast Pennsylvania, stranding hundreds of motorists for hours creating a state of emergency in Lackawanna and Luzerne counties. The interstates that were closed were 80, 81, 380 and the northeast extension of the Pennsylvania Turnpike. At one point Interstate 81 was closed from the Scranton area north to the New York border. The snow gradually tapered off by the 15th as the storm pulled northeast into the Gulf of Maine. Storm total snowfall amounts across much of northeast Pennsylvania ranged generally between 1 and 2 feet. The exception was Pike county where much more sleet occurred holding snow amounts down to between 6 and 12 inches. The heaviest snowfall in northeast Pennsylvania occurred over the higher terrain of northern Lackawanna, western Wayne and southeast Susquehanna counties where between 24 and 30 inches of snow fell. The weight of the snow and sleet caused a few roofs to collapse as well.
03/16/07	Heavy Snow	$ -	Low pressure gathered strength and moisture while tracking northeast over the Carolinas and eastern Virginia during the morning and afternoon of the 16th. This low reached the Delmarva peninsula by the evening of the 16th and intensified further becoming a major late season winter storm. This storm spread snow, heavy at times, to upstate New York during the morning and early afternoon of the 16th. The snow ended by the early morning hours of the 17th as the storm tracked out to sea well away from the region. Total snowfall accumulations range from 10 to 15 inches over the Poconos of northeast PA to between 5 and 10 inches across the rest of northeast PA.
04/15/07	Winter Storm**	$ -	An area of low pressure organized over the southeastern United States during the evening of Saturday April 14th, and tracked northeast along the East Coast Sunday the 15th, to Long Island on Monday the 16th. The low-pressure system grew into a major late season winter storm by the time it reached the New Jersey coast Sunday evening the 15th. The central pressure of this storm dropped to 963 mb just south of Long Island on the 16th. The storm stalled in the vicinity of Long Island and the southern New England coast from the 16th until Tuesday the 17th when it finally drifted to well off the east coast. Most of the precipitation with this storm fell as moderate to heavy rain through the day on the 15th before changing over to a mix of snow and sleet after midnight on the 16th. During that day on the 16th, the higher elevations of northeast Pennsylvania received heavy snow, while the valleys saw a mix of snow and sleet that primarily melted after hitting the ground. The snow ended by the early morning hours on Tuesday the 17th. Total storm accumulations ranged from a slushy inch or two in the Wyoming, Susquehanna and Delaware River valleys to between 10 and 20 inches over the higher terrain including the Poconos. The snow was heavy and wet bringing down many trees and power lines causing scattered power outages over the higher terrain. Snowfall amounts ranged from 10 to 17 inches across the county.

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
12/13/07	Winter Storm	$ -	A low-pressure system tracked from the Southeast United States to off the Middle Atlantic coast. Light snow overspread northeast Pennsylvania and became heavy at times before tapering off by early evening. The snow also mixed with sleet across some areas, especially the Wyoming Valley, which held snow accumulations down. Snowfall amounts ranged generally between 5 and 10 inches. A winter storm brought a mix of snow and sleet to the area. Snowfall accumulations averaged around 8 inches across the county.
12/30/07	Winter Storm	$ -	A low-pressure system tracked northeast from the Carolina coast to east of Cape Cod from the afternoon of the 29th through the morning of the 30th. Snow, mixed with sleet at times, spread into northeast Pennsylvania during the evening on Sunday and continued overnight before tapering off Monday morning. Snowfall amounts ranged around 7 inches in Susquehanna County. Snowfall amounts across the county ranged from 5 to 8 inches.
12/11/08	Winter Storm	$ 25,000	A low-pressure system tracked from the Gulf of Mexico, the evening of the 10th, through the Carolinas on the 11th, to New England on the 12th. This storm brought a variety of wintry precipitation to northeast Pennsylvania from the morning of the 11th to the morning of the 12th. A band of heavy snow developed across north central Pennsylvania where between 5 and 9 inches of snow fell in the western part of Bradford County. In addition, up to .75 inches of ice accumulated across eastern Bradford County and over the higher terrain of Susquehanna County. The weight of the ice brought down trees and power lines. The rest of northeast Pennsylvania saw around one quarter inch of ice with generally less than 1 inch of snowfall. Significant ice accumulations occurred over the higher terrain of Susquehanna County bringing down trees and power lines. Hardest hit areas were around Little Meadows.
12/19/08	Heavy Snow	$ -	A low-pressure system tracked from the southwest United States to the Plains, Mid-West and the middle Atlantic states from late on the 18th to the evening of December 19th. The storm spread snow across all of northeast Pennsylvania, with accumulations of about 5 to 9 inches. Trained spotters reported 5 to 9 inches of snow from this snowstorm.
10/15/09	Winter Weather	$ -	An upper level disturbance, in combination with a low-pressure system moving up the Atlantic coast brought the first snow of the season to northeast Pennsylvania. While mainly rain, or a mixture of rain and snow fell in the valleys, snow fell at the higher elevations, where about 2 to 5 inches of accumulation was common. This storm produced the earliest measurable snow of any winter season on record in many places. One to four inches of snow was reported, especially across the higher elevations in the southern part of the county.
02/10/10	Winter Storm*	$ -	A complex area of low pressure from the Ohio Valley to the Carolinas tracked east and intensified into a major winter storm off the Delmarva Peninsula from Tuesday the 9th to early Wednesday the 10th. The storm then tracked slowly northeast to a position well off the New Jersey Coast by early on Thursday the 11th. Snow spread into northeast Pennsylvania from the evening of the 9th to the early morning of the 10th. The snow became heavy at times across northeast Pennsylvania during the day Wednesday before tapering off by Wednesday evening. Storm total snowfall ranged from 6 to 10 inches. Strong winds behind the storm caused considerable blowing and drifting snow through Wednesday night. Snowfall amounts across the county ranged from 6 to 9 inches.

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
02/25/10	Winter Storm	$ -	Low pressure organized off the southeast U.S. coast from Wednesday night, the 24th, to early Thursday the 25th. The low moved north along the eastern seaboard and became a major winter storm as it reached the tip of Long Island Thursday evening. The storm then tracked westward into the lower Hudson Valley and into New Jersey by Friday as it weakened. Light snow and flurries spread north into northeast Pennsylvania during the early morning hours Thursday the 25th. The snow became heavy Thursday afternoon and night. In addition to the heavy snows, north winds increased to 20 to 25 mph with gusts to 35 mph, leading to near blizzard conditions and considerable blowing and drifting snow. By the time the snow tapered to flurries, Friday morning the 26th, storm total snowfall ranged from 10 to 20 inches in many areas. Heavy snow fell across the county, with amounts ranging from 16 inches in Silver Lake to 22.5 inches in Hallstead.
03/06/11	Heavy Snow	$ -	A stalled frontal boundary draped along the east coast allowed for a strong surface low pressure system to develop during the daytime hours on Sunday, March 6th. Cold air moved into the area throughout the morning hours on Sunday, changing rain and freezing rain to all snow across Bradford, Susquehanna and Wyoming counties. A band of heavy snow developed during the evening hours of March 6th and remained over central New York and northeast Pennsylvania into the morning of March 7th. Snowfall totals from this storm ranged from 10 to 20 inches with several locations in Bradford county receiving over 2 feet. Snowfall totals across the county ranged generally from 10 to 20 inches.
03/23/11	Winter Storm	$ -	An area of low pressure moved east through the central United States with a warm front stretching across the Ohio Valley. Cold air combined with significant moisture to bring widespread snow to northeast Pennsylvania during the morning hours of March 23rd. Storm total snowfall ranged from 5 to 10 inches, with a foot of snow falling in the higher terrain of western Bradford County in northeast Pennsylvania. Snowfall totals across the county ranged from 5 to 9 inches.
10/29/11	Winter Storm	$ -	An early season winter storm dumped wet snow across northeast Pennsylvania, as deepening low pressure moved up the coast. Snow amounts were very elevation-dependent. Some valleys, especially the Susquehanna, had very little snow at lower elevations, yet the Poconos in some cases had more than a foot of snow at higher elevations. Storm total snowfall accumulations across the county ranged from 6 to 9 inches.
12/26/12	Winter Storm	$ -	A low-pressure system tracked from the Tennessee Valley on Wednesday to just off of the New Jersey coast on Thursday to the Canadian Maritimes on Friday. Northwest flow pulled cold and moist air behind the system with a widespread snow falling across northeast Pennsylvania on Wednesday and Thursday. At times, freezing rain and sleet mixed in across northeast Pennsylvania. Snowfall amounts across the county ranged from 6 to 9 inches. The highest snowfall total of 9 inches fell 7 miles northeast of Friendsville.
12/29/12	Winter Storm	$ -	A low-pressure system tracked from the Midwest on Friday to the mid-Atlantic states on Saturday. Moisture and cold air associated with this system spread snow into the northern tier of Pennsylvania on Saturday. Snowfall amounts across the county ranged from 6 to 7 inches.
02/08/13	Heavy Snow	$ -	As a northern system merged with a coastal storm, a period of heavy snow fell across portions of Northeast Pennsylvania late February 8th into early February 9th. Amounts generally ranged from 5 to 10 inches. A period of heavy snow resulted in 5 to 10 inches accumulation. Highest amounts included 10.3 inches near Thompson, and 10.0 inches in New Milford.

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
12/14/13	Winter Storm	$ -	A low-pressure system developed over the southern Plains on December 13th and intensified as it headed toward the northeast U.S. A coastal low developed along the Atlantic seaboard on December 15th. Warm advection snow developed on the morning of Saturday. December 14th along a stationary boundary stretched across the Mason-Dixon line and dropped an initial 1 to 3 inches of snow. As the low-pressure system intensified, it produced moderate to heavy snowfall across portions of the Poconos and the northern tier of Pennsylvania. The highest snowfall of 10 inches was reported one mile west-southwest of Windfall, Pennsylvania in Bradford County. Widespread amounts of 9 inches fell across all of Susquehanna County.
01/02/14	Winter Storm	$ -	A stalled frontal boundary across central New York resulted in light to moderate snowfall across the northern tier of Pennsylvania after midnight on Thursday, January 2nd. This snow intensified and dropped south into northeast Pennsylvania during the morning hours of Thursday, January 2nd as a low-pressure system tracked through the Ohio Valley and re-developed off of the eastern seaboard. The highest snowfall totals occurred across the northern tier of Pennsylvania with a couple of 12-inch reports in Bradford County. Snowfall amounts ranged from 6-8 inches across the county. Windy conditions resulted in significant blowing snow and cold temperatures.
02/05/14	Winter Storm	$ -	A low-pressure system tracked through the Ohio Valley and re-developed off of the eastern seaboard during the morning hours of Wednesday, February 5th. An intense snow band that developed produced as much as one to three inches of snow per hour during the early morning hours. Widespread snow amounts ranged from 7 to 16 inches, with the highest totals occurring across the northern tier of Pennsylvania. Snowfall amounts ranged from 8-10 inches across the county. The highest amount of 10 inches fell in New Milford.
02/13/14	Winter Storm	$ -	A low-pressure system tracked out of the Gulf of Mexico and along the eastern seaboard on Thursday, February 13th bringing snowfall to the region. Widespread snow amounts ranged from 6 to 20 inches, with the highest totals occurring across the Poconos region. Snowfall amounts ranged from 6-9 inches across the county. The highest amount of 9.1 inches fell two miles southeast of New Milford.
03/30/14	Winter Storm	$ -	A low-pressure system that moved up the eastern seaboard developed an intense narrow band of snow which was centered over the northern tier of Pennsylvania in Susquehanna County. This snow band produced tremendous snowfall rates of up to 3 inches per hour. Storm total snowfalls in a narrow 15-mile band ranged from 6-11 inches. Snowfall amounts in a narrow strip across the central sections of Susquehanna county ranged from 6-11 inches. The highest snowfall total of 11 inches fell five miles west of Montrose.
11/26/14	Winter Storm	$ -	A low-pressure system developed over the northern Gulf of Mexico and intensified as it headed toward the northeast U.S. A coastal low developed along the Atlantic seaboard on November 26th. This system spread snow, heavy at times, into northeast Pennsylvania during the late morning and afternoon hours of Wednesday, November 26th. The highest snowfall total of 10.2 inches was reported in Wyoming County. Snowfall amounts ranged from 7-10 inches across the county. The highest amount of 9.8 inches fell in Susquehanna.
02/01/15	Heavy Snow	$ -	A winter storm tracked from the central Plains on Sunday February 1st to the upper Ohio Valley and western Pennsylvania by Monday morning the 2nd. The storm then moved east off the New Jersey coast and out to sea by Monday evening. This storm spread snow to northeast Pennsylvania during the late evening hours of the 1st. The snow lasted through the overnight and tapered off by Monday afternoon. The winter storm brought a general 6 to 12 inches of snow to northeast Pennsylvania with locally higher amounts. Snowfall of 6 to 12 inches occurred in Susquehanna County with the highest amounts of 12.0 inches occurring in Dimock.

Severe Winter Weather Events (NOAA NCEI, 2017; Knowledge Center, 2017; 2012 HMP)			
Date	**Type**	**Property Damage**	**Description**
11/19/16	Lake-Effect Snow	$ -	A strong cold front crossed Pennsylvania on Saturday afternoon the 19th. Much colder air poured into the Commonwealth behind this front, which was accompanied by several inches of snow, especially over the higher terrain areas. A slow-moving upper air low, which followed this front, slowly tracked across upstate New York into northern New England from Sunday the 20th to Tuesday the 22nd. A northwest flow of cold moist air around this upper level low combined with moisture from the Great Lakes leading to a prolonged period of heavy lake effect snow. The lake effect snow affected an unusually large part of central New York and made it down to extreme northeast Pennsylvania which typically doesn't see heavy lake effect snowfall. The heaviest lake effect snow affected extreme northeast Pennsylvania on Sunday afternoon and night where around a foot or more of snow. Snowfall totals ranged from 8 to 16 inches in the northern half of the county and between 4 and 8 inches in the far south.
02/09/17	Heavy Snow	$ -	Low pressure tracked across Virginia during the morning hours of the 9th and to off the New Jersey Coast by the afternoon while intensifying. This low-pressure system spread snow to northeast Pennsylvania and central New York from the early morning hours of the 9th until midday. Snow accumulation ranged from 6 to 11 inches across northeast Pennsylvania to the Catskills of New York. Snowfall accumulations ranged from 6 to 10 inches with the highest in Gelatt.
03/14/17	Heavy Snow	$ -	A major winter storm developed over eastern North Carolina during the early morning hours of March 14th. The winter storm tracked northeast during the day on the 14th reaching the Gulf of Maine by the late evening of the 14th. This storm spread a heavy record-breaking snowstorm to a large part of central New York and northeast Pennsylvania with blizzard conditions from the Catskills in New York to the Poconos of northeast Pennsylvania and in the greater Scranton Wilkes-Barre area. The snow spread from south to north across northeast Pennsylvania and central New York between midnight and 6 am on the 14th. The snow quickly became very heavy especially east of a Rome, New York to Towanda, Pennsylvania Line. Snowfall rates reached up to 5 inches per hour. The heavy snow continued through the day on the 14th and tapered off by late evening in most of northeast Pennsylvania but continued through the 15th as moisture from Lake Ontario combined with northwest winds behind the storm to prolong snowfall for central New York and the far northern tier of eastern Pennsylvania. Between 30 and 48 inches of snow fell from Bradford, Susquehanna and Wyoming Counties in northeast Pennsylvania through the Greater Binghamton area to Utica and Cooperstown NY, with 1 and 2-day snowfall records broken at many locations. Binghamton and Scranton set their 1-day snowfall records with 32.4 inches and 22.1 inches respectively. There were blizzard conditions from Scranton and Wilkes-Barre areas through the Poconos and Catskills during the late morning and afternoon of the 14th with frequent wind gusts over 35 mph and a peak wind of 61 mph at Monticello. Many other parts of central New York and northeast Pennsylvania had between 1 and 2 feet of snow and all areas had gusty winds and considerable blowing and drifting snow. Many municipalities, and counties declared states of emergencies and/or travel bans. New York state also declared a state of emergency. Pennsylvania reduced speed limits on the interstates. The heavy snow collapsed two roofs and there were two small avalanches that closed roads. There were no storm-related injuries or deaths. Snowfall of 2 to 3 feet fell in Susquehanna County.
*Gubernatorial Disaster Declaration			
**Presidential Disaster Declaration			

4.3.13.4 Future Occurrence

The prospect of climate change brings the future of the climate into uncertainty; however, climate scientists believe that extreme winter storms are expected to occur more

frequently – there have been about twice as many extreme snow events in the United States in the latter half of the 20th century as occurred in the first half (NOAA, 2018). This uptick is caused in part by higher than normal ocean surface temperatures that result in an increased source of moisture for storms that develop over the Atlantic Ocean. Conditions for severe winter storms are particularly heightened in the eastern United States due to changes in atmospheric circulation patterns caused by higher temperatures and melting Arctic sea ice (Francis & Vavrus, 2012). Winters in 2000 and 2001 were mild in Pennsylvania and led to spring-like thunderstorms during the winter months rather than snow storms. Such thunderstorms can be followed by cold fronts and winter storms resulting in temperature drops of 50˚F in a few short hours.

Winter storms are a regular, annual occurrence in Susquehanna County and should be considered highly likely. Approximately thirty-five winter storm events occur across Pennsylvania annually and about five of which are estimated to significantly impact Susquehanna County each year. *Table 45 - Probability of Measurable Snowfall by Snow Station* shows the normal monthly in Susquehanna County and is based on data collected over a thirty-year period (NOAA, 2017).

Table 45 - Probability of Measurable Snowfall by Snow Station

Probability of Measurable Snowfall by Snow Station (NOAA, 2017)		
MONTH	**Normal Monthly Snowfall (inches)**	
	Susquehanna	**Montrose**
January	18.4	21.8
February	13.0	15.9
March	12.1	16.5
April	3.0	4.7
May	0	0.1
June	0	0
July	0	0
August	0	0
September	0	0
October	0.4	0.6
November	3.8	7.3
December	13.0	14.7

4.3.13.5 Vulnerability Assessment

Winter storms are a frequent event in the county. Detrimental impacts of severe winter storms are mitigated by salting, plowing and snow removal by PennDOT and local municipalities. Icy and snow-covered roads often result in increases in traffic incidents.

Swift response to utility outages during winter storms is another significant way to mitigate damages. Residents of the mountainous and more rural areas of the county may be more susceptible during severe storms, especially when emergency medical assistance is required due to the location's potential for isolation. There are rural areas which are susceptible to isolation due to winter storms. Residents in outlying areas often find it beneficial to keep an emergency food and fuel stock in the event of isolation or utility interruption during a winter storm.

Even for communities that are prepared to respond to winter storms, severe events involving snow accumulations that exceed six or more inches in a twelve-hour period can cause a large number of traffic accidents, strand motorists due to snow drifts, interrupt power supply and communications, and cause the failure of inadequately designed and/or maintained roof systems. 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, construction material used and condition of the structure. Unfortunately, no comprehensive database of these variables could be identified for Susquehanna County.

4.3.14. Cyber Attack

4.3.14.1 Location and Extent

Cyber-attacks are maliciously intended actions against a person or organization, often for financial or terror-related reasons. They can take many forms ranging from specifically targeting human operators to a broader computer-based attack on entire systems. Generally, attacks last just minutes but larger events can have lasting impacts on systems and data. Common types of cyber-attacks and vulnerabilities include:

- Phishing and spear-phishing: generally, use e-mail to trick a user into giving a third-party access to a computer system. Spear phishing is a targeted attack on a specific user.
- Viruses, worms and keyloggers: malicious software that can damage or cause unwanted behavior in computer systems.
- Weak password practices making systems easy to exploit.
- Outdated software: companies issues patches to fix security vulnerabilities in their software. Leaving these updates uninstalled can leave a system vulnerable to attacks.
- Unknown devices such as flash drives can be used to implant malicious code to vulnerable systems.

The types of threats that these vulnerabilities include vary depending on the perpetrator's motive. Threats generally include erasure of entire systems, altering files, stealing confidential information and "high jacking" of PC's and systems to attack others. The

spectrum of these attacks is quite wide, and can have extreme effects on individuals, communities, organizations and even national threats.

4.3.14.2 Range of Magnitude

The extent, nature, and timing of cyber incidents are difficult to predict as there may not be any warning. Some cyber incidents take a long time (weeks, months or even years) to be discovered and identified (FEMA 2013). The magnitude of severity of an incident will vary greatly based on the extent and duration of the impact. The extent will also vary based upon which specific system is affected by an attack, the warning time, and the ability to preempt an attack. Currently, there is not an official scale or index used to measure the severity of a cyber-attack. However, the Gibson Index is a ranking system for the relative severity of cyber-attacks (Figure 4.3.14.2 shows the Gibson Index). It ranges from 0 to 7, with 7 being the most severe class of attack (resulting in multiple intentional deaths and/or extreme financial/economic damage).

Table 46 - The Gibson Index for Severity of Cyber Attacks

The Gibson Index for Severity of Cyber Attacks	
Gibson Level	**Description**
0	Causes little or no disruption/damage or is the result of a mitigating circumstance.
1	Some small real-world consequences, but can often have non-malicious explanations; typically, such an event would only target one website or computer network
2	Has a clear malicious intent and can result in longer outages, more significant privacy issues.
3	Minor financial damages and moderate privacy implications, generally stemming from a partial penetration of systems.
4	Major financial damages or privacy implications. Well-defined systems breached by vulnerability, with a clear intention of theft or destruction.
5	Systematic, coordinated, broad penetration of a multitude of networks, likely perpetrated by a well-funded large team or nation-state.
6	Remain mostly theoretical. They consist of attacks that manifest themselves in real-world, targeted, intentional damage.
7	Would result in mass casualties from intentional, targeted efforts.

4.3.14.3 Past Occurrence

To date, there have been no major cyber security breaches to Susquehanna County. There have been significant incidents in Pennsylvania and the United States, however. Some of which may have impacted, directly or indirectly those living in Susquehanna County.

Phishing emails, viruses, Trojans, ransom-ware and all other forms of malicious software are a form of cyber-attack that should not be discredited. While Susquehanna County has been able to protect against the worst impacts of cyber security threats, they remain ever present and they do require a constant vigilance. Successful cyber

security is a partnership between management, IT and an educated and compliant workforce.

4.3.14.4 Future Occurrence

Cyber threats and attacks are often difficult to identify and can include a range of dangers that include: viruses erasing entire systems, intruders breaking into systems and altering files, intruders using one computer or device to attack others, or intruders stealing confidential information. According to FEMA, the spectrum of cyber risks is limitless and threats can have a wide-range of effects on an individual, community, organizational, and national level (FEMA 2016). In 2016, there were 454 data breaches with nearly 12.7 million records exposed (2016 Identity Theft Resource Center Data Breach Category Summary). There are millions of incidents each year in the United States alone; however, a majority of these attacks are other computer security incidents, primarily spyware, adware, phishing and spoofing (U.S. Department of Justice 2008). Based on the number of previous occurrences throughout the United States, cyber-attacks will continue to occur on an annual basis. With the extent of cyberattacks throughout recent history, Susquehanna County and its businesses and residents will be subject to ongoing attacks.

4.3.14.5 Vulnerability Assessment

All assets in the county (population, structures, and critical facilities) are considered vulnerable to cyber security breaches. Because it is difficult to predict any particular target of cyber terrorism, assessing the vulnerability to the hazard is also difficult. All individuals in Susquehanna County are vulnerable, although certain types of attacks would impact specific segments of the population.

If an attack targeted the power and utility grids, individuals with medical needs would be impacted the greatest. These populations are most vulnerable because many of the life-saving systems they rely on require electricity. The next two groups that would be most vulnerable to this type of attack are the county's children and the elderly. If the attack occurs during periods of extreme heat or cold, these populations are the most vulnerable to lack of climate control.

If a facility that stores or manufactures hazardous materials were targeted, people living adjacent or near these facilities would be vulnerable to the repercussions pertaining to the effectiveness of the attack to cause a critical failure.

Any individual has the potential to become a victim to cyber-crimes. These attacks could be targeted to individuals through phishing attempts or malware. But they could also be wide-ranging and affect critical services, like if the 911 system or emergency radio network were rendered inoperable, that could have a devastating effect on emergency

services within the county which may result in injury or loss of life during emergency situations.

A cyber security breach may also affect structures in the county if any critical electronic systems were interrupted. For example, an attack could target cooling systems or pressure regulating systems within critical infrastructure which may result in physical damage to the structure and injuries to those present or nearby.

Economic impacts could also be severe, depending on the nature of the attack. These impacts could range from malware on computer systems that slow them down, in turn causing loss of productivity to retailers losing sensitive information about their customers and causing them to be vulnerable to identity theft.

4.3.15. Dam Failure

See Appendix I for Dam Failure Profile

4.3.16. Environmental Hazards

4.3.16.1 Location and Extent

Environmental hazards in Susquehanna County consists of hazardous materials releases at both fixed facilities and in transit and Marcellus Shale gas well incidents. Activities associated with Marcellus gas well sites can cause fire and pollute streams and drinking water.

Hazardous materials fall into categories such as flammable and combustible materials, compressed gases, explosive and blasting agents, radioactive materials, oxidizing materials, poisons, and corrosive liquids. Most hazardous materials incidents are generally unintentional and are associated with transportation accidents or accidents at fixed facilities. However, hazardous materials can be released as a criminal or terrorist act. Regardless of how a release happens, the result can be injury or death, and contamination to the air, water, and/or soil.

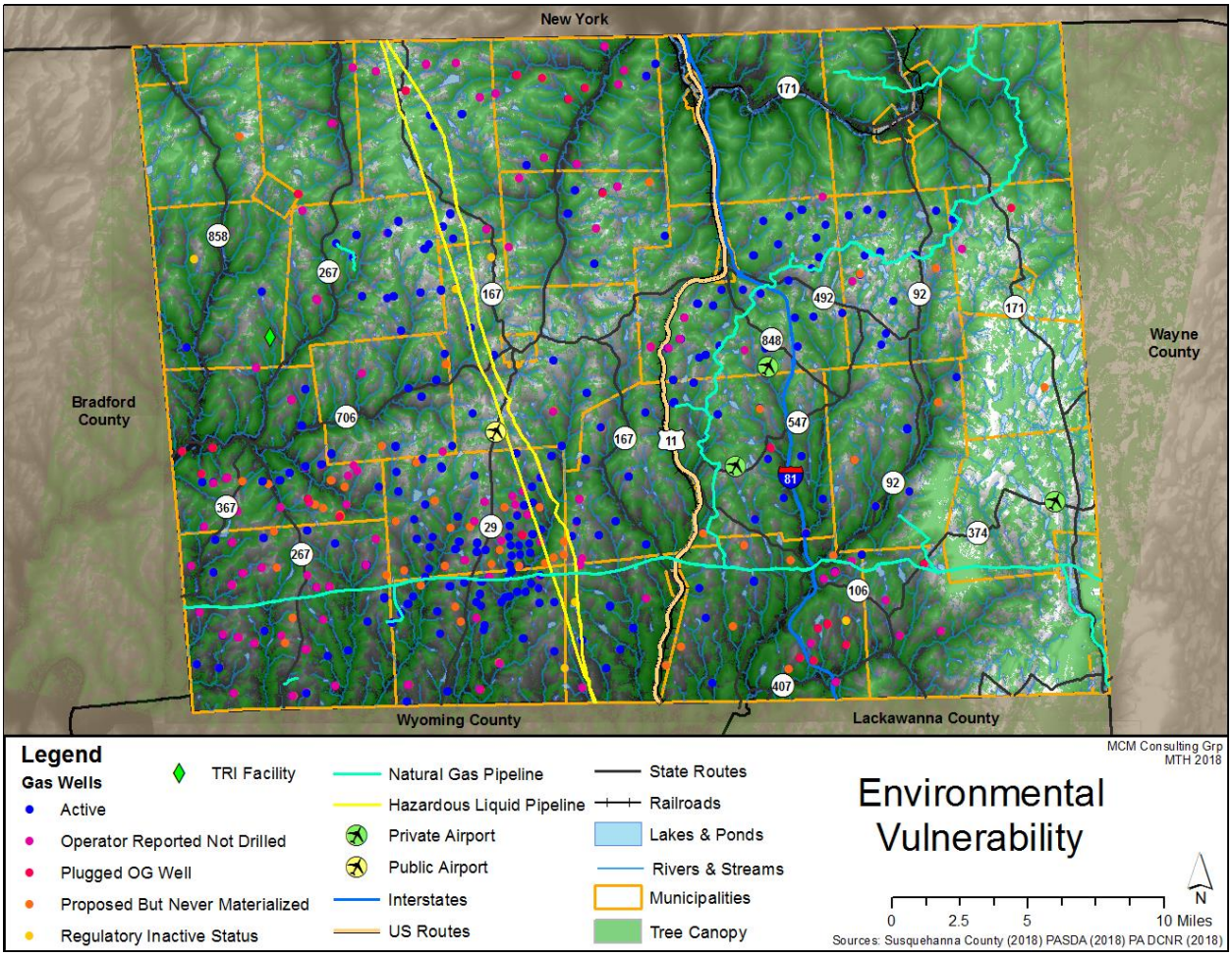
Facilities that use, manufacture, or store hazardous materials in Pennsylvania must comply with both Title III of the federal Superfund Amendments and Reauthorization Act (SARA), also known as the Emergency Planning and Community Right-to-Know Act (EPCRA), and the reporting requirements under the Hazardous Materials Emergency Planning and Response Act (1990-165) as amended for the commonwealth. Communities are kept abreast of the presence and release of chemicals at individual facilities with the community right-to know reporting requirements. The EPCRA was designed to ensure that state and local communities are prepared to respond to potential chemical accidents through local emergency planning committees (LEPCs). LEPCs are charged with developing emergency response plans for SARA Title III facilities; these plans cover

the location and extent of hazardous materials; establish evacuation plans, response procedures, and methods to reduce the magnitude of a materials release; and establish methods and schedules for training and exercises.

There are nine facilities classified as using or storing extremely hazardous substances as defined by the EPA under SARA Title III in Susquehanna County.

Transportation of hazardous materials along highways poses the greatest risk of release to Susquehanna County. Releases from rail transport are also a concern. The most traveled routes in the county are: Interstate 81, U.S. Route 11, PA Route 92, PA Route 171, and PA Route 267. These major roads pass through the more populous areas of Susquehanna County. Similarly, rail lines pass through cities, borough and along major waterways where larger numbers of people could be vulnerable should a hazardous materials accident occur. These major transportation routes are shown in *Figure 25 - Environmental Vulnerability*.

Figure 25 - Environmental Vulnerability



Natural gas extraction from the Marcellus Shale formation exists at a depth of 5,000 to 8,000 feet and is located underneath the entire county. Activities associated with Marcellus Shale gas drilling can cause fires and pollute steams and drinking water. An additional hazard from oil and gas well drilling is stray methane gas in the subsurface, which can migrate into wells and homes. If the methane gas meets an ignition source it will ignite. Transportation of Marcellus Shale gas along pipelines, poses no greater threat to the environment or people as does any other natural gas pipeline. Pipelines are being constructed to connect each compressor station together as a gathering point; while major pipelines are being constructed to transfer the natural gas out of the county.

4.3.16.2 Range of Magnitude

Whether its accidental or intentional, there are several potentially exacerbating circumstances that will affect the severity or impact of a hazardous materials release. Some of these conditions, or characteristics that can enhance or magnify the effects of a hazardous materials release, include the following:

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

There is also concern of hazardous materials releases during a flood event, should the flood compromise the production or storage of chemicals. This type of situation could swiftly move toxic chemicals throughout a water supply and across great distances.

The severity of any given hazardous materials incident is dependent not only on the circumstances described above, but also with the type of materials released and the distance and related response time for emergency response teams. Areas within close proximity to a release are generally at a greater risk, yet depending on the agent, a release can travel great distances or remain present in the environment for a long period of time resulting in extensive impacts on people and the environment.

Any type of drilling can cause stray methane gas in the subsurface; under certain conditions, to migrate to private water supply wells and ultimately into a building. This migration, if left unmitigated, can build up to explosive concentrations. A proper well vent allows methane to vent to the atmosphere rather than build up to explosive levels. The risk of an explosion from stray methane varies from location to location based on site-specific conditions.

Natural gas well fires occur when natural gas is ignited at the well site. Often, these fires erupt during drilling when a spark from machinery or equipment ignites the gas. The

initial explosion and resulting flames have the potential to seriously injure or kill individuals in the immediate area. These fires are often difficult to extinguish due the intensity of the flame and the abundant fuel source. A worst-case scenario for oil and gas well drilling in Susquehanna County occurred on June 18, 2010, when a pipe coupling blue out at a gas well site in Gaines Township, injuring two workers who were airlifted to a hospital.

The potential impacts of oil and natural gas wells range in magnitude and extent to water, land, and air.

4.3.16.3 Past Occurrence

The majority of incidents in the past have involved petroleum product spills along the highways or leaks from a fixed source. Most of these are the result of collisions or leaks that have limited impact on people and the environment. Yearly the number of hazardous materials being produced, stored, and transported continues to increase. *Table 47 - Hazardous Materials and Petroleum Releases.*

Table 47 - Hazardous Materials and Petroleum Releases

Hazardous Materials and Petroleum Releases in Susquehanna County	
Date	**DESCRIPTION**
1960	Accident involving a gas tanker on Grow Avenue and Route 706 in Montrose Borough. The accident caused $3,000 worth of damages.
1964	Accident involving a propane gas tanker on Route 29, five miles south of Montrose, in the Dimock area. The accident required the evacuation of a few families and rerouting of traffic.
1980	A leak in an underground 400-gallon tank at the Vitale Garage in Montrose spilled into the borough's sewer system and required the evacuation of one family.
10-09-99	Fuel spill on I-81, mile marker 207. A truck overturned, spilling approximately 50 gallons of fuel.
11-29-99	Accident on I-81, exit 63. Approximately 300 gallons of fuel spilled from a ruptured fuel tank on one truck.
03-15-00	A milk tanker left the roadway in Jessup Township on SR 3029, and ripped a hole into the fuel tank; spilling approximately 100 gallons of fuel.
12-19-00	A tractor trailer left the interstate and entered the Gas & Goodies in New Milford Township, spilling approximately 50 gallons of fuel.
08-09-01	A flatbed tractor trailer left the roadway, struck the guide rails and a small bridge; coming to rest hanging over the bridge, spilling approximately 50 gallons of diesel fuel into a tributary of the east branch of Wyalusing Creek.
10-14-01	PSP had two reports of mail with a white powder incident.
10-19-01	A tractor trailer traveling northbound on I-81, mile marker 223, had a tire blow out. The tractor trailer crossed through the median, spilling over 50 gallons of a motor oil/transmission fluid mix along with a small amount of diesel fuel.
10-24-01	An accident with a dump truck and car on SR 267, at the New York border, caused over 100 gallons of diesel fuel to leak.
11-17-01	White powder incident in Auburn Township.

Hazardous Materials and Petroleum Releases in Susquehanna County	
Date	**DESCRIPTION**
06-09-03	Vehicle accident on I-81 in Lenox township. A tractor trailer rolled over in the median; both saddle tanks ruptured, spilling fuel.
07-01-03	Truck vs. bridge accident that resulted in the saddle tank being emptied into the creek.
09-18-03	Propane tanks damaged in Gibson Township, Summit Ridge Farms. 270,000 vapor gallons of propane lost. PSP closed road for a half mile.
09-19-03	Tractor trailer overturned in the median, trailer opened and products onboard were leaking. Reported products: paint-related products, batteries wet-filled with acid, corrosive product, a nonlabelled medical product, and individual wrapped foods.
01-01-09	Water well explosion at a residence in Dimock Township. Possibly due to methane gas and active natural gas drilling area.
08-07-09	Oil leak on SR 106, Clifford Township.
08-08-09	A Norfolk Southern rail tank car leaking hydrochloric acid in Kingsley. Voluntary evacuation in immediate area.
08-09-09	Fuel spill in Great Bend Township.
08-11-09	Fuel oil slick on Bel Aire lake.
09-08-09	Severed gas line at New Milford Head Start.
12-02-09	Fuel oil tank leak in Lenox Township.
12-09-09	Tractor trailer roll over on I-81 at mile marker 206.4 Lenox Township. Diesel fuel spilled from the truck and leaked into a nearby storm drain that empties into a creek.
02-08-10	A gas well in Auburn Township reported as venting at high pressure. Gas well personnel shut down the valve.
02-25-10	A fuel truck overturned into Burdick Creek, Dimock Township and leaked fuel into the creek.
02-28-10	Drill mud was flowing down Teel Road, Springville Township.
03-11-10	PSP reported a diesel fuel spill on SR 367, Rush Township for approximately 8 miles to SR 3029.
03-29-10	Accident with approximately 55 gallons of hydraulic fluid spilled into a stream in Rush Township.
07-21-10	A propane leak at a residence on Canada Road, Choconut Township.
07-26-10	Approximately 20 gallons of diesel fuel spilled in the parking lot of the PA Welcome Center off of I-81 in Great Bend Township.
07-29-10	Mineral oil substance spill on roadways throughout Bradford, Wyoming, and Susquehanna counties. Substance caused severe damage to roadways.
08-14-10	A 1,000-gallon underground home heating oil tank caused an oil spill into Bell Aire Lake and in basement sump pumps of nearby residents in Liberty Township.
09-03-10	A tractor trailer with hydraulic fluid leaked approximately 60 gallons on I-81 at mile marker 231.3 in Great Bend Township.
09-04-10	A water truck overturned spilling approximately 5 to 10 gallons of diesel fuel along with 1000 gallons of water in Dimock Township.
12-10-10	A natural gas leak was reported at the Tennessee Pipeline substation in Uniondale Borough.
02-20-11	A pickup truck crashed into a creek in Springville Township. A 100-gallon container with an unknown substance landed in the creek.
03-17-11	An oil drum caught on fire at the Richard Wademan Garage in Thompson Township.
03-23-11	A box truck with fracking supplies (300-gallong totes) rolled over in Springville Township causing a small spill.
04-10-11	There was fuel oil leaking from an abandon residence near a creek that parallels SR 11 in Lathrop Township.

Hazardous Materials and Petroleum Releases in Susquehanna County	
Date	**DESCRIPTION**
08-29-11	Report of a fuel spill in the basement of a business located on Main Street, New Milford Borough. There was a 175-gallon oil tank in the basement, with three feet of water, unknown amount of spill.
09-08-11	Report of an oil sheen on water surrounding a tanker truck at a parking lot in Great Bend Township.
09-10-11	Report of a fuel oil spill on Pennsylvania Avenue, Little Meadows Borough from an unknown source.
10-05-11	Report of 10-15 gallons of diesel fuel spilled in the pump area at the Dandy Mart, Little Meadows Borough, and 20-30 gallons spilled in the dirt.
10-23-11	Accident with a pickup truck with an external diesel fuel cell ruptured, spilling approximately 75-150 gallons of diesel fuel near the intersection of SR 267 and SR 3001 in Auburn Township.
11-04-11	Approximately 20 gallons of produced salt water leaked from a vent at the top of a tank at the Teel Compressor Station, operated by Williams Midstream in Springville Township.
11-26-11	Report of an odor and a hissing sound from the UGI building in Union Dale Borough.
12-17-11	A frack tank spill on the Knosky Pad just off Irish Hill Road, Middletown Township. The spill was contained to the pad.
12-28-11	Report of an unknown amount of fuel spilled from an abandon cottage, spilling into a lake located on Grams Way, Lenox Township.
01-25-12	Report of a small storage shed on fire. A diesel fuel leak was discovered leaking into a water source on the drilling pad in New Milford Township. At time of the fire, there wasn't a drilling rig onsite.
01-30-12	Report liquids spilling from the Carrizo Oil and Gas Baker site located on Turnpike Road, Friendsville, Forest Lake Township.
02-28-12	A truck owned by Cowan Trucking Systems hit something while traveling I-81 and punctured the fuel tank at mile marker 213, Harford Township, spilling approximately 30 gallons of fuel on the road side and storm drain.
03-29-12	Lathrop Compressor Station, Springville Township, reported an explosion with natural gas blow off, and the structure involved with fire. There were no injuries reported.
04-15-12	Report of a yellow discoloration to a pond in Gibson Township with fish dying.
05-13-12	Report of a milky substance with a chemical odor spilling into Tripp Lake, Liberty Township. The substance is coming from the ground.
06-08-12	Report of an unknown substance that was dumped into a drainage creek that flows into Drinker Creek, Susquehanna Depot Borough.
06-27-12	Report of 250 gallons of waste water and glycol spilled at the Zick Compression Station in Lenox Township.
07-11-12	Report of 40 gallons of produce water spilled at the Teel Compressor Station, Springville Township.
08-06-12	Report of two people receiving burns from fracking fluid, due to an equipment failure at the Susan well site, Auburn Township.
08-10-12	A tractor trailer was on fire in New Milford Township, and once fire was extinguished fire crews found fuel leaking from the fuel tank. Approximately 20-30 gallons spilled on the ground.
08-16-12	Report of 50 gallons of triethylene glycol spilled at the Williams Midstream site in Springville Township.
08-21-12	A well site explosion and fire at the Phillips well site for Chief Oil & Gas, Lathrop Township.
08-31-12	Report of 20 gallons of glycol and wastewater spilled at Williams Station in Forest Lake Township

Hazardous Materials and Petroleum Releases in Susquehanna County	
Date	**DESCRIPTION**
09-01-12	A methane detector alerted to an explosive reading at a residence in Dimock Township.
09-04-12	Report of a possible gas leak at the Cole gas pad in Auburn Township.
09-05-12	Report of 20 gallons of tri ethylene glycol ad waste water mixture spilled at the Hawley Field Receipt Point in Forest Lake Township.
09-21-12	Report of a tractor trailer leaking fuel from the 202-mile marker to the 212.9-mile marker on I-81 in Lenox Township.
10-09-12	Vehicle accident in Great Bend Township with oil leaking from a water truck.
10-15-12	Approximately 20-30 gallons of hydraulic fluid was released from the lines of a wood shredder, causing a fire.
10-18-12	A construction vehicle, which was hauling hay, caught fire on an access road to a well site in Forest Lake Township. Approximately 100 gallons of fuel leaked from the vehicle.
10-22-12	Accident between an oil truck and a car occurred in Rush Township. The oil truck leaked over 1,000 gallons of oil.
10-30-12	A tractor trailer struck a tree in Forest Lake Township, spilling approximately 15-20 gallons of motor oil.
11-16-12	Report of oil on a lake in Liberty Township, believed from a fuel tank.
01-22-13	Report of 20 gallons of salt water from a collection tank in Springville Township.
02-04-13	Approximately 1 quart of hydraulic oil spilled into wetlands in Lathrop Township due to equipment failure
03-25-13	A gas line break on Hudson Street, Forest City Borough by construction crews.
04-02-13	Approximately 100 gallons of home heating oil spilled on a parking lot and into a home in New Milford Borough.
04-04-13	An excavator's hydraulic line broke spilling hydraulic fluid on the Horton Pipeline in Lathrop Township.
04-07-13	Report of a kerosene smell and oil substance in a creek in New Milford Borough.
04-08-13	Approximately 25 gallons of triethelean glycol spilled at the Williams Midstream Compressor Station in Forest Lake Township.
06-04-13	Report of a leak from the UGI natural gas control station on SR 2023 in Uniondale Borough, no evacuation needed.
06-18-13	Hydraulic fluid spilled from the Gas Search Drilling Services street sweeper. Approximately 15-20 gallons spilled along a paved roadway in Lathrop Township.
06-28-13	Approximately 15 gallons of hydraulic oil spilled into a lake.
07-09-13	Meth lab in Montrose Borough.
08-16-13	Report of natural gas blowing from a valve at the Teel Compressor Station, Springville Township.
09-04-13	Injury reported at a natural gas release at a meter station in Dimock Township.
10-09-13	Natural gas release at the Teel Compressor Station on Button Road, Springville Township.
10-10-13	Strong odor of gas reported in the area of the UGI regulator station and the Tennessee Gas pipeline.
11-22-13	A tanker truck leaked residual waste and drill cuttings in New Milford Township.
12-21-13	Report of oil running down the road in Silver Lake Township.
12-22-13	Notified by Williams of pressure relief valves activated at two facilities: Snake Creek Compressor; and Shaskas Compressor Station.
12-24-13	Report of a vehicle, parked in the Village of Four Seasons, has been leaking motor oil and gasoline towards a stream and a nearby lake. This has been an ongoing event for years.
01-05-14	Cabot reported an uncontrolled natural gas release at a producing well site in Brooklyn Township.

Hazardous Materials and Petroleum Releases in Susquehanna County	
Date	**DESCRIPTION**
01-06-14	Report of a fire and release of natural gas from the Snake Creek Compressor Station in Liberty Township.
02-02-14	A gas well fire occurred at the Nickolyn Well site in Auburn Township.
02-13-14	A heating oil tank leaked 200-250 gallons of fuel in a basement of a duplex. Two families were displaced.
02-18-14	A propane tank damaged by ice falling from a roof, leaked propane into a residence in Susquehanna Depot Borough.
02-20-14	UGI Penn Natural Gas Company reported a leaking regulator at a residence.
03-20-14	A tractor trailer leaked fuel from its saddle tanks in Auburn Township.
03-27-14	Cabot reported a pinhole leak in a valve on a producing wellhead.
04-12-14	Natural gas released from a WPX well site in Middletown Township.
05-23-14	A parked vehicle rolled into a 500-gallon propane tank causing a leak, this occurred in Choconut Township.
06-30-14	Fuel oil and water leak in a basement.
07-18-14	A release valve at the Fraser Compressor Station, Forest Lake Township, malfunctioned.
08-30-14	High pressure and high flow alarm activation at the Tennessee Pipeline Station, Uniondale Borough.
09-29-14	A skid mounted pumping unit, hauled by a tractor trailer, leaked diesel fuel as it traveled on SR 167 through Hop Bottom Borough and Lathrop Township.
11-24-14	A 55-gallong drum tipped over in the back of a pick-up truck in a parking lot and spilled approximately 25-gallons of diesel fuel.
11-27-14	A faulty valve at the Williams' Northeast Compressor, Great Bend Township, caused a leak of natural gas.
01-07-15	Gas leak at the UGI gas transfer station.
01-08-15	Gas leak at the UGI gas transfer station.
01-30-15	Structure fire believed to have been started by a meth lab in Great Bend Borough.
02-13-15	A motor home parked at the fill station in the Flying J parking lot leaked approximately 5-gallons of propane out of an 8-gallon tank.
03-15-15	Meth lab in Clifford Township.
03-17-15	An unplanned emergency shut down of the DTE CDP3 station on Lakeview Road, Jackson Township.
04-01-15	Approximately 230 gallons of fuel oil spilled in a basement of a residence in Hallstead Borough.
05-06-15	Vehicle accident spilled approximately 50-100 gallons of diesel fuel from a fuel tank in the back of the truck. This occurred in Franklin Township.
05-15-15	A 1-ton pickup truck rolled over into Cork Hill Creek, Apolacon Township, spilling diesel fuel into the creek.

Hazardous Materials and Petroleum Releases in Susquehanna County	
Date	**DESCRIPTION**
06-27-15	Approximately 15-gallons of gasoline leaked from a pickup's fuel tank at a rest stop off of I-81.
10-23-15	Natural gas leak at a residence in Auburn Township.
11-04-15	Natural gas release at the Phelps Pad in Lathrop Township.
01-13-16	Natural gas was building pressure in the wellhead at the Southwestern Buckhorn Pad, Oakland Township.
05-12-16	Smell of gas and a hissing noise reported in the area of the UGI/Kinder Morgan interface in Uniondale Borough.
10-02-16	Reported natural gas leak at a compressor station.
01-30-17	Gasoline spilled into a storm drain from a fuel tank leak while being filled. This occurred at the intersection of SR 106 and SR 374.
04-28-17	An overturned truck spilled diesel fuel into a pond in Brooklyn Township.
07-19-17	Carbon dioxide vented from a leaking valve on a tank truck.
12-06-17	Report of a fuel spill from a tractor trailer pulled off the side of I-81 southbound at mile marker 229.1)

Starting in 2009, Susquehanna County utilized the reporting tool of Knowledge Center™ to track events. Reports to 911 of hazardous materials spills, to include Marcellus Shale drilling and pipeline emergencies, are tracked on Knowledge Center.

A total of 288 unconventional well drilling permits were issued by PA DEP in Susquehanna County in 2015; with 152 of these wells actually drilled. In Susquehanna these wells were drilled into the Marcellus shale. Throughout the state, there were twenty-three Utica shale and thirty-two Point Pleasant shale wells drilled in 2015.

4.3.16.4 Future Occurrence

Between 2009 and 2017 there has been an average of 12.33 environmental hazard events in Susquehanna County per year. In 2012 there were twenty-four events and only three events in 2016. Future occurrence of an environmental hazard occurring in Susquehanna County is likely, however it is difficult to predict. Traffic accidents involving hazardous materials can be caused by many different facets, such as weather conditions or drivers' errors.

As natural gas drilling and pipe line activities continue to grow in Susquehanna County the inherent dangers persist. In the "2015 Oil and Gas Annual Report" [most current issue available] produced by the Pennsylvania Department of Environmental Protection,

the state is identified as the second largest supplier of natural gas in the nation. Pennsylvania is second only to the state of Texas. The natural gas production has increased dramatically in Pennsylvania since 2008. This has resulted in an increase to energy security, due to less dependence on fossil fuels from other parts of the world. In 2015 almost 4.5 trillion cubic feet of natural gas was generated from the Marcellus shale formation.

The Marcellus shale has been the predominant shale play in Pennsylvania, however, there is interest in the exploration and production of the Utica shale and Point Pleasant shale plays that are located well below the Marcellus shale play. The term "shale play" is used by the oil and gas exploration and development industry to identify areas of shale basins that appear to be suitable for shale gas development. According to the "2015 Oil and Gas Annual Report", there are more than a dozen geologic formations below the state's land surface that contain rich deposits of natural gas. As technology progresses, and oil and gas drilling companies are able to extract the natural gas from the multiple natural gas shales, the potential for environmental hazards due to this process exists.

4.3.16.5 Vulnerability Assessment

There are 1,884 miles of roadways within Susquehanna County, of which 812 miles are owned and maintained by PennDOT. There are approximately twenty-one miles of Interstate 81 that cross north to south throughout the county. Interstate 81 is a major route that traverses the Commonwealth of Pennsylvania and crosses into New York. Various materials and substances, to include hazardous materials are transported over the interstate highway and other highways through the county. The railway network also is vulnerable to hazardous materials incidents.

Jurisdictions where one or more TRI (EPA's Toxic Release Inventory) fixed facilities are in operation should be considered vulnerable to a release of hazardous material(s). These releases could be the result of severe weather conditions, power outages, acts of criminal activities or terrorism, and/or human error.

All communities in Susquehanna County are vulnerable, on some level to environmental hazards resulting form oil and gas well activity; to include drilling, pipeline construction, and distribution. Susquehanna County has previously taken steps to protect residents and reduce the county's overall vulnerability to oil/gas well drilling emergencies, with the development of procedures for handling emergencies at Marcellus well sites. Individual gas well drilling operators should have an Emergency Response Plan for their wells in place, however, the county's plan can substitute in an emergency. The Well Control Emergency Plan defines a well control emergency as uncontrolled flow of oil, gas, condensate, brine, sand, gravel, rock, and/or steam from a wellbore. The emergency

plan lists procedures on how to deal with a blowout or control incident with or without fire, environmental release, injury on a rig, or other miscellaneous incidents.

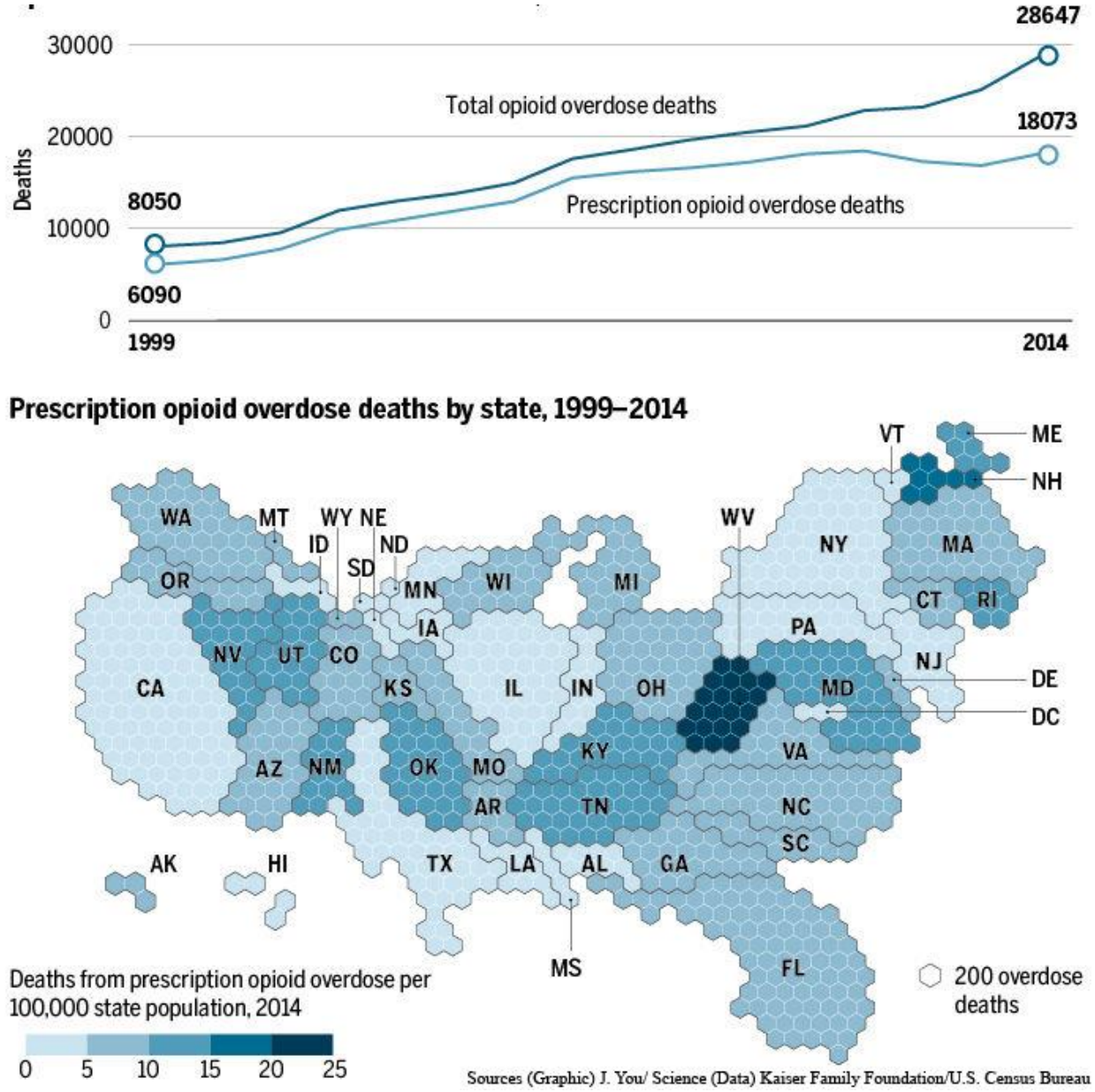
4.3.17. Opioid Epidemic

4.3.17.1 Location and Extent

Opioids are a class of drugs that interact with receptors on nerve cells in the body and brain, producing euphoria and pain relief. (NIH, 2017) Opioid drugs are highly addictive, and the Commonwealth and country at large have been experiencing an epidemic of opioid addiction and abuse, resulting in increasing numbers of overdose deaths from both prescribed (e.g. fentanyl) and illicit (e.g. heroine) opioids (see *Figure 26 - US Opioid Deaths 1999-2014* (Science, 2016)). Overdose deaths from opioids occur when a large dose slows breathing, which can be especially likely when opioids are combined with alcohol or antianxiety drugs. While generally prescribed with good intentions, opioids can often be over-prescribed, resulting in addiction due to their highly addictive nature.

The opioid crisis was declared to be a public health emergency October 26, 2017. While the declaration provides validation for the scope and severity of the problem, it was not accompanied by any release of funding for mitigating actions. On January 10, 2018, Governor Wolf declared the Opioid Epidemic to be a statewide public health disaster emergency for Pennsylvania. The declaration is intended to enhance response, increase access to treatment.

Figure 26 - US Opioid Deaths 1999-2014 (Science, 2016)



4.3.17.2 Range of Magnitude

According to the CDC, more than one hundred forty Americans die every day from an opioid overdose. In 2015, 3,383 overdose deaths were reported in Pennsylvania, compared to 2014, when there were 2,742 overdose deaths in PA – an increase of 23.4 percent (DEA, 2015). Pennsylvania ranked 8th in the country for overdose deaths in 2014 at 21.9 deaths per 100,000 people (DEA, 2015).

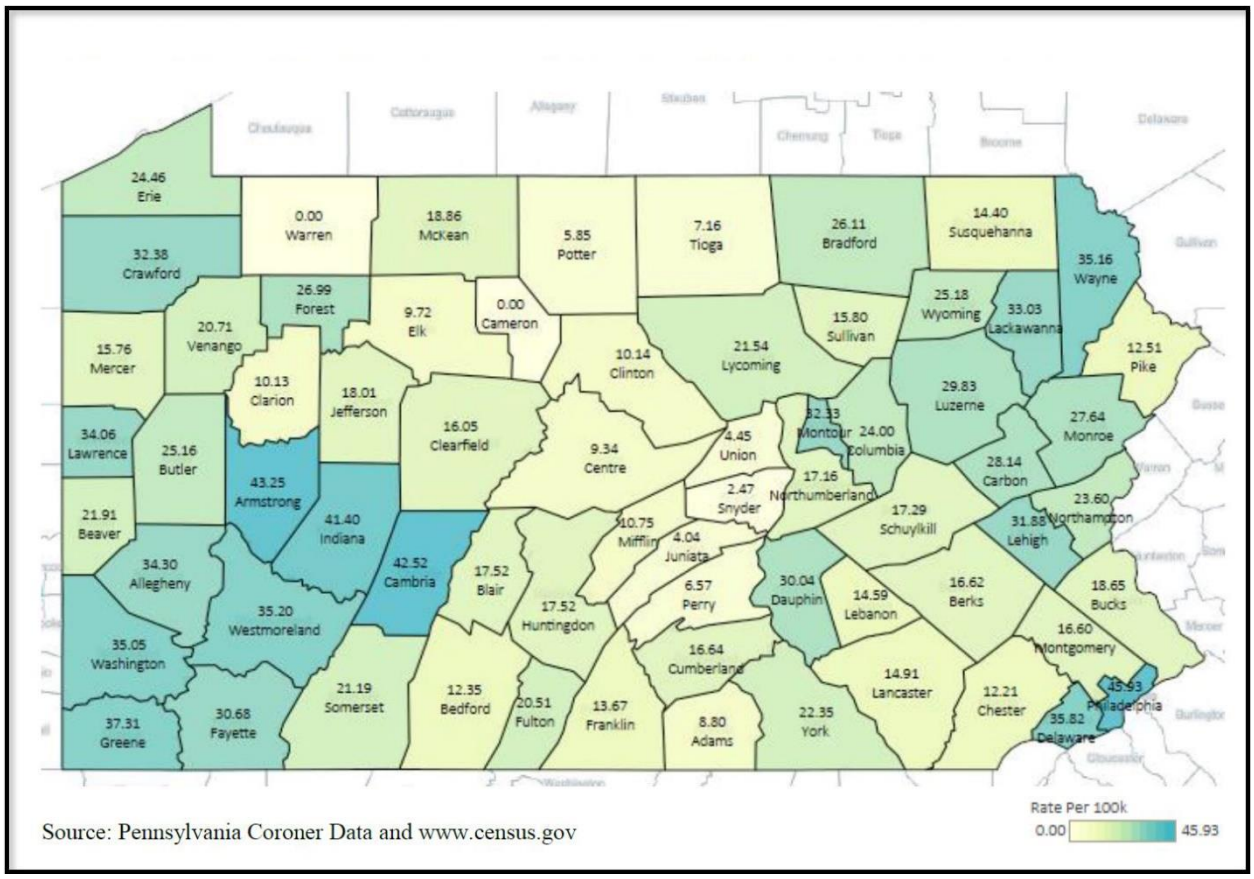
4.3.17.3 Past Occurrence

For the year of 2015, Susquehanna County had 14.4 overdose deaths per 100,000 people, with 6 recorded overdose deaths occurring in the county (see Figure 27 - PA Opioid Overdose Deaths 2015 (DEA, 2016)Figure 27 - PA Opioid Overdose Deaths 2015 (DEA, 2016)), compared to 2014, where the county had 28.8 overdose deaths per 100,000 people with fourteen recorded overdose deaths (DEA, 2015). Table 48 - Overdose Death History shows recorded overdose deaths in Susquehanna County from Overdose Free PA database, as data from the Susquehanna County Coroner about the specific presence of Fentanyl or Heroin in those overdose deaths. There are two overdose deaths that occurred in December 2017 that do not have full toxicology reports yet.

Table 48 - Overdose Death History

Overdose Death History (Overdose Free PA, 2018; Susquehanna County Coroner, 2018)			
Year	**Overdose Deaths**	**Fentanyl present**	**Heroin present**
2010	6	1	2
2011	6	1	3
2012	5	1	0
2013	6	1	5
2014	14	5	6
2015	6	1	0
2016	9	6	7
2017	3*	2	1
Total	**55**	**18**	**24**

Figure 27 - PA Opioid Overdose Deaths 2015 (DEA, 2016)



4.3.17.4 Future Occurrence

According to recent research, in states where medical marijuana has been permitted, overdose deaths from opioids have decreased about twenty-five percent, and the effect was even stronger five to six years after medical marijuana was allowed (Bachhuber et al., 2014). In those states where medical marijuana is permitted, each physician prescribed an average of 1826 fewer doses of pain medication each year (Bradford & Bradford, 2016), suggesting that medical marijuana could help prevent patients from ever being exposed to addicting opioids (Miller, 2016). Another possible alternative pain treatment comes from hemp extracted cannabidiol, or CBD. Unlike THC (the psychoactive constituent of marijuana) CBD in non-psychoactive and does not have the same intoxicating effect as THC, however CBD and can provide relief from pain (Lynch & Campbell, 2011) inflammation (Burstein, 2015), anxiety (Scuderi et al., 2009) and even psychosis (Iseger & Bossong, 2015).

Rather than reduce pain, in some cases high doses of opioid painkillers can actually increase pain due to a phenomenon known as opioid-induced hyperalgesia (OIH). However, it is difficult to know how much of an influence OIH has on the opioid epidemic. Some researchers think that OIH could be increasing patients' pain and in turn, increasing their dosages and dependence on opioid drugs, suggesting that patients should work with lower dosages of opioids (Servick, 2016). However, other researchers are unsure of the importance of OIH for opioid users (Servick, 2016).

In the event of an opioid overdose, death can sometimes be prevented with the use of the drug naloxone. Emergency medical responders have access to the treatment, and as of 2015, naloxone is available without a prescription in Pennsylvania. Furthermore, with the January 10, 2018 Disaster Declaration, Emergency Medical Technicians (EMTs) are now allowed to leave naloxone behind at a scene, further increasing distribution and accessibility of this lifesaving medication.

4.3.17.5 Vulnerability Assessment

Deaths from prescription opioid drugs like oxycodone, hydrocodone, and methadone have increased by more than four-fold since 1999. While opioid addiction is often viewed as a criminal problem, a more productive way to view the epidemic can be to view opioid addiction as a chronic disease. This paradigm shift moves away from faulting the abuser and incentivizing quick cures, to viewing the abuser as a patient and working towards long-term management of the disease (ASAM, 2014).

In general, it is important to consider alternative approaches to pain treatment in order to avoid beginning a dependence on highly addictive prescribed opioids. CBD and medical marijuana appear to be promising alternatives in some contexts. CBD is legal to purchase and use without a prescription, making it much more accessible for Pennsylvanian residents compared to medical marijuana.

The January 10, 2018 gubernatorial disaster declaration was accompanied by thirteen initiatives in three areas of focus which illustrate the current status of the opioid crisis in the Commonwealth as of January 2018:

Enhancing Coordination and Data Collection to Bolster State and Local Response

- **Establishes and Opioid Command Center located at the Pennsylvania Emergency Management Agency (PEMA)**, which will house the Unified Opioid Coordination Group that will meet weekly during the disaster declaration to monitor implementation and progress of the initiatives in the declaration.
- **Expands Access to Prescription Drug Monitoring Program (PDMP) to Other Commonwealth Entities for Clinical Decision-Making Purposes** to improve treatment outcomes and better monitor compliance among prescribers. Since 2016, 90,000 physicians have conducted more than 1 million searches on the PDMP.

- **Adds Overdoses and Neonatal Abstinence Syndrome (NAS) as Reportable Conditions in Title 28, Chapter 27** to the DOH in order to increase data collection and improve outcomes in both areas.
- **Authorizes Emergency Purchase Under Procurement Code for Hotline Contract with Current Vendor,** giving DDAP further emergency purchase authorization to allow the department to enter into a contract with the current drug and alcohol hotline vendor to ensure uninterrupted services. To date, the 24/7 helpline, 1-800-662-HELP, has received more than 18,000 calls to connect those suffering from substance use disorder with treatment.

Improving Tools for Families, First Responders, and Others to Save Lives

- **Enables Emergency Medical Services providers to leave behind naloxone** by amending the current Standing Order to include dispensing by first responders, including Emergency Medical Technicians (EMTs). The existing naloxone standing order and funding for naloxone to first responders has allowed for more than 5,000 lives to be saved so sufferers can be linked to treatment for substance use disorder.
- **Allows Pharmacists to Partner with Other Organizations to Increase Access to Naloxone** by waiving regulations to allow pharmacists to partner with other organizations, including prisons and treatment programs to make naloxone available to at-risk individuals upon discharge from these facilities.
- Allows for the immediate temporary rescheduling of all fentanyl derivatives to align with the federal DEA schedule while working toward permanent rescheduling.
- **Authorizes emergency purchasing under Section 516 of the Procurement Code** to allow for an emergency contract to expand the advanced body scanner pilot program currently in place at Wernersville that is used on re-entrants returning to the facility. This would prevent the program from lapsing.

Speeding Up and Expanding Access to Treatment

- **Waive the face-to-face physician requirement for Narcotic Treatment Program (NTP) admissions** to allow initial intake review by a Certified Registered Nurse Practitioner (CRNP) or Physician Assistant (PA) to expedite initial intakes and streamline coordination of care when an individual is most in need of immediate attention.
- **Expand access to medication-assisted treatment (MAT)** by waiving the regulatory provision to permit dosing at satellite facilities even though counseling remains at the base NTP. This allows more people to receive necessary treatments at the same location, increasing their access to all the care and chances for recovery.
- **Waive annual licensing requirements for high-performing drug and alcohol treatment facilities** to allow for bi-annual licensure process which streamlines licensing functions and better allocates staff time. DDAP will request that facilities seek a waiver by filing exception requests to the annual licensing requirement.
- **Waive the fee provided for in statute for birth certificates** for individuals who request a good-cause waiver by attesting that they are affected by OUD. This is of

particular importance to individuals experiencing homelessness and other vulnerable populations who often cannot obtain copies of their birth certificates in order to access treatment and other benefits due to the financial requirements.

- **Waive separate licensing requirements for hospitals and emergency departments to expand access to drug and alcohol treatment** to allow physicians to administer short-term MAT consistent with DEA regulations without requiring separate notice to DDAP.

4.3.18. Terrorism

4.3.18.1 Location and Extent

Following several serious international and domestic terrorist incidents during the 1990's and early 2000's, citizens across the United States paid increased attention to the potential for deliberate, harmful actions of individuals or groups. The term "terrorism" refers to intentional, criminal, malicious acts. The functional definition of terrorism can be interpreted in many ways. Officially, terrorism is defined in the Code of Federal Regulations as "…*the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives*." (28 CFR §0.85)

The Federal Bureau of Investigation (FBI) further characterizes terrorism as either domestic or international, depending on the origin, base, and objectives of the terrorist organization. However, the origin of the terrorist or person causing the hazard is far less relevant to mitigation planning than the hazard itself and its consequences.

Critical facilities are either in the public or private sector that provide essential products and/or services to the general public. Critical facilities are often necessary to preserve the welfare and quality of life in the County, or fulfill 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, those that are traveling through the county on any of the interstate or major highways and marginalized groups such as LGBTQ persons and racial minorities. Potential targets for attack include:

- Commercial facilities
- Abortion or Family Planning Clinics and other organizations associated with controversial issues.
- Education facilities

- Events attracting large amounts of people
- Places of worship
- Industrial facilities, especially those utilizing large quantities of hazardous materials
- Transportation Infrastructure
- Historical sites
- Government Facilities

4.3.18.2 Range of Magnitude

Terrorism refers to the use of Weapons of Mass Destruction (WMD) (including, biological, chemical, nuclear, and radiological weapons) arson, incendiary, explosive, armed attacks, industrial sabotage, 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:

- Active Shooter
- 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

Cyber terrorism is becoming increasingly prevalent. 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 are the main goals for a safe cyber environment. 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. 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.

4.3.18.3 Past Occurrence

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. One of the more recent high-profile shootings occurred at the Pulse Nightclub in Orlando, Florida on June 12, 2016 where the LGBTQ community was targeted – forty-nine people were killed and fifty-three were wounded. A few other significant active shooter events include those that occurred at Virginia Tech (April 2007), Sandy Hook elementary School (December 2012), San Bernardino CA (December 2015), an Aurora CO movie theater (July 2012) and a church in Charleston SC (June 2015). A 2014 study by the FBI concluded that there has been a significant recent increase in frequency of active shooter incidents, and the vast majority (154 of 160 shooters between 2000 and 2013) were male (FBI, 2014). Of these 160 incidents, 45.6% took place in commercial environments, 24.3% took place in an educational environment, and the remaining 30.1% took place at other locations such as open spaces, military and other government properties, residential locations, houses of worship, and health care facilities (FBI, 2014). *Figure 28 - Active Shooter Incidents 2000-2013 (FBI, 2014)* summarizes the FBI's findings in the study.

Significant international terrorism incidents in the USA include: the World Trade Center bombing in 1993, the bombing of the Murrow Building in Oklahoma City in 1995, and the September 11, 2001 attack on the World Trade Center. Susquehanna County has not been directly impacted by any significant international terrorist incidents.

While the largest scale terrorist incidents have largely had international stimulus, many other incidents are caused by home grown actors who may have become radicalized through hate groups either in real life or online, and who may have mental health struggles. Hate groups such as the Ku Klux Klan (KKK), Aryan Nation and, more recently, the Alt-Reich have in one way or another been a part of domestic terrorism in different forms.

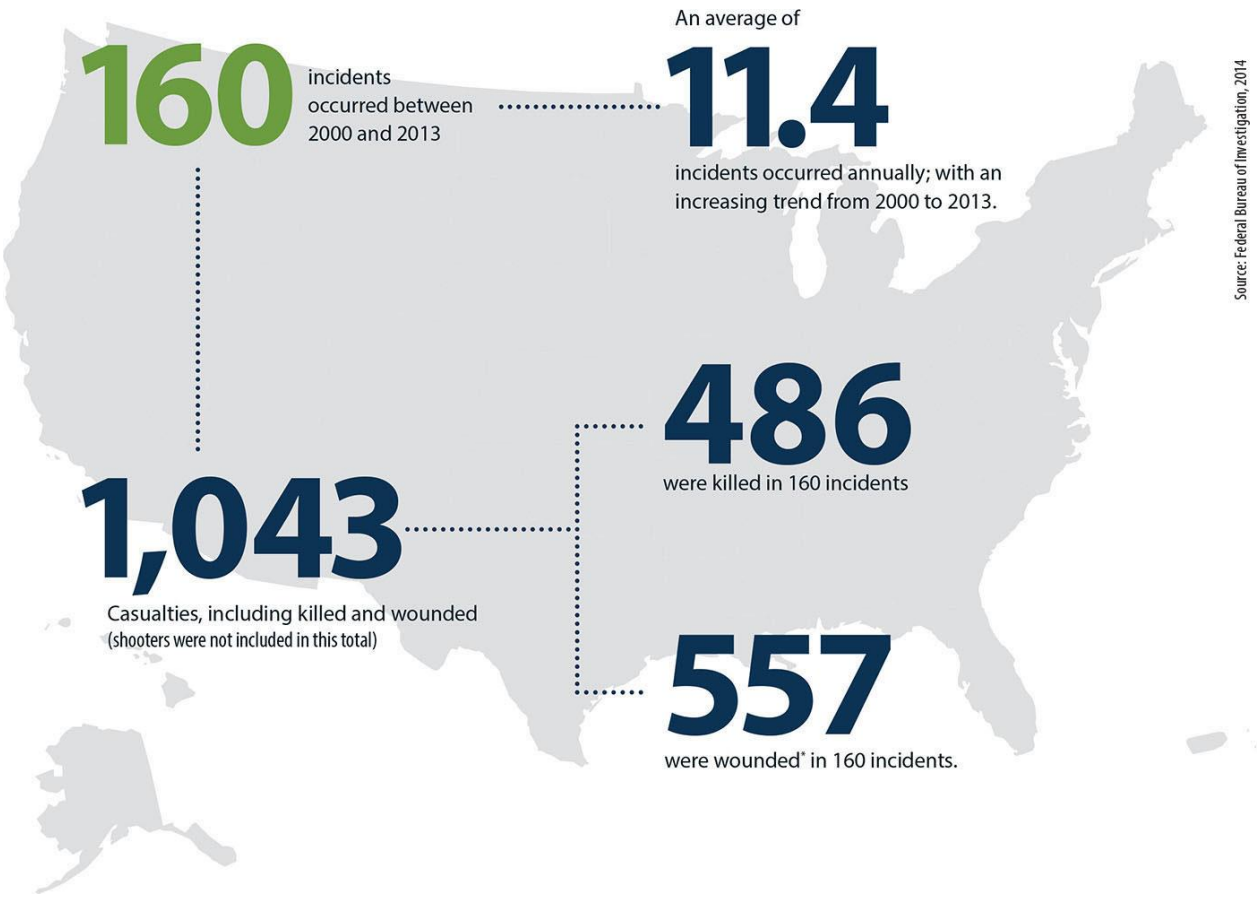
The high-volume interstate highway I-81 traverses Susquehanna County running north-south. The sheer number of people traveling on this route makes it a potential target.

Knowledge Center reports of terrorist activity in Susquehanna County from 2010 to late 2017 can be found in *Table 49 - Knowledge Center™ Incidents*.

Table 49 - Knowledge Center™ Incidents

Knowledge Center™ Incidents (Knowledge Center, 2017)		
Description	**Location**	**Date**
Theft	Great Bend Township	06/09/10
Rowdy Group	Springville Township	06/09/10
Gas Drilling Protests (Exercise)	Dimock Township	06/29/10
Cabot Depaola 1	Dimock Township	06/30/10
Cabot C Rose 3H	Dimock Township	06/30/10
Cabot J Blaisure	Dimock Township	06/30/10
Cabot Elk Lake School	Dimock Township	06/30/10
Well Site Trespassing	Dimock Township	09/29/12
Gas Protesters	Susquehanna County	07/04/13
Disturbance at polling station	Susquehanna County	05/19/15
Montrose Area School District Strike	Montrose Borough	03/28/16

Figure 28 - Active Shooter Incidents 2000-2013 (FBI, 2014)



4.3.18.4 Future Occurrence

The likelihood of Susquehanna County being a primary target for a major international terrorist attack is somewhat small. More likely terrorist activity in Susquehanna County are bomb threats or incidents at schools. The Local Planning Team gave this hazard a risk factor of 1.5.

4.3.18.5 Vulnerability Assessment

The probability of terrorist activity is more difficult to quantify than some other hazards. Instead of considering likelihood of occurrence, 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. Planning should work towards identifying potentially at-risk critical facilities and systems in the community, prioritizing those assets and locations, and identify their vulnerabilities relative to known potential threats.

All communities in Susquehanna County are vulnerable on some level, directly or indirectly, to a terrorist attack. However, communities where critical facilities 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?
- Fire Protection Engineering – Are the building's water supply and fire suppression systems adequate, code-compliant, and protected? Are on-site personnel trained appropriately? Are local first responders aware of the nature of the operations at the facility?
- Electronic and Organized Security – Are systems and personnel in place to monitor and protect the facility?

4.3.19. Transportation Accidents

4.3.19.1 Location and Extent

The present transportation system in Susquehanna County grew out of "farm-to-market" roads as well as "turnpikes" that provided links between more urban area. These turnpikes are Milford-Owego Turnpike, Bridgewater-Wilkes-Barre Turnpike, Great Bend-Cochecton Turnpike, and Philadelphia-Great Bend Turnpike (Susquehanna County Comprehensive Plan, 2003).

Small one- or two-vehicle accidents would not significantly impact a larger community. However, certain accidents could have secondary regional impacts such as hazardous materials release or disruption in critical supply/access routes, especially if vital transportation corridors or junctions are affected.

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.

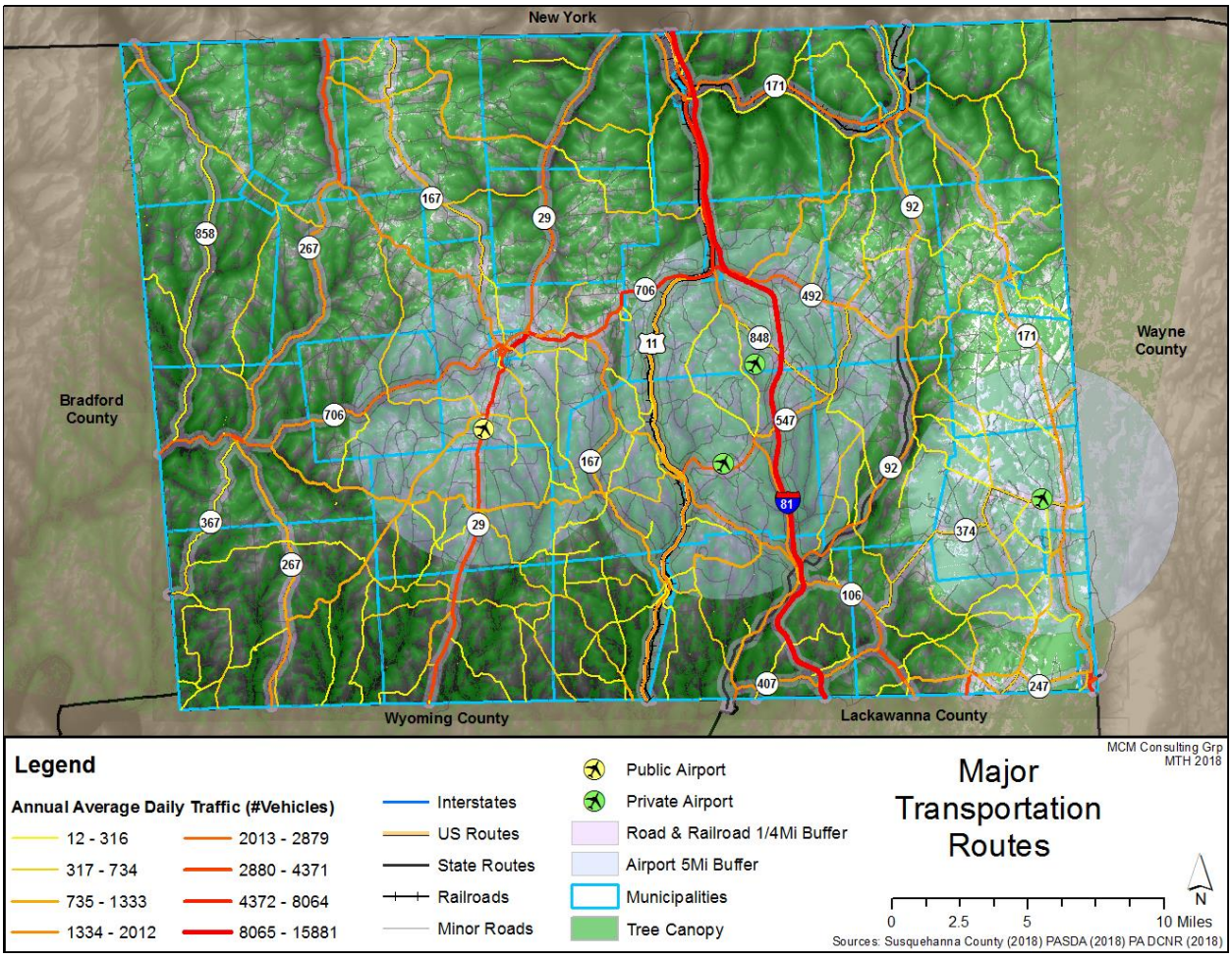
Penn DOT owns and maintains 812 of the 1,884 miles of road within the county's borders; with the remaining 1,072 miles owned and maintained by townships and boroughs. Interstate 81 traverses Susquehanna County in a north-south direction offering easy access through this mountainous region.

There are two railroad lines in Susquehanna County. Norfolk-Southern's southern tier main line travels east-west along the Susquehanna River in the northeastern portion of the county as well as through Susquehanna Depot Borough and Lanesboro Borough. The second rail line is owned by Canadian Pacific and runs north-south along the Route 11 corridor.

There are no commercial airports. Almost no goods are shipped or received in Susquehanna County by marine transport.

A map of Susquehanna County's transportation system is shown in *Figure 29 - Major Transportation Routes*

Figure 29 - Major Transportation Routes



4.3.19.2 Range of Magnitude

Significant transportation accidents can result in death, serious injury, or extensive property loss or damage. Road and railway accidents have the potential to result in hazardous materials release. Transportation accidents are routine emergencies. However, the recent increase in Marcellus Shale gas well drilling and pipeline development has caused a significant increase in the volume of traffic and roadway incidents in Susquehanna County. With the increase of heavy truck traffic there has been an acceleration on the ware-and-tear on many roadways, rending them unsafe, and at times in some cases, impassable.

4.3.19.3 Past Occurrence

The Center for highway Safety of the Pennsylvania Department of Transportation (PennDOT) issues an annual report of reportable motor vehicle traffic accidents within the

Commonwealth of Pennsylvania. Some of the data within these annual reports includes the total number of accidents, fatal accidents, accidents with injuries and fatal pedestrian versus vehicle accidents per county within Pennsylvania. Accident statistics between 1985 and 2016 for Susquehanna are in *Table 50 - Traffic Accident Statistics.* No data for 2017 was available at the development of this profile.

Table 50 - Traffic Accident Statistics

Traffic Accident Statistics for Susquehanna County				
Year	**Accidents with fatalities**	**Accidents with injuries**	**Total auto accidents**	**Deaths from pedestrian/auto accidents**
1985	4	284	431	0
1986	10	265	420	0
1987	13	281	461	0
1988	11	302	476	2
1989	13	281	467	2
1990	10	289	445	1
1991	10	288	445	0
1992	8	280	467	0
1993	9	283	469	0
1994	11	248	443	0
1995	8	262	459	0
1996	8	307	537	0
1997	9	354	602	1
1998	10	264	505	1
1999	11	295	553	1
2000	8	288	550	0
2001	9	281	504	0
2002	NO DATA AVAILABLE			
2003	14	287	551	0
2004	7	271	532	1
2005	12	292	574	0
2006	8	270	527	0
2007	11	250	507	0
2008	10	248	515	0
2009	6	222	503	0
2010	11	223	471	0
2011	10	229	514	0
2012	13	252	511	2
2013	8	288	533	0
2014	10	204	523	2
2015	10	206	467	1
2016	10	202	493	0

Susquehanna County has been logging traffic accident and other events into Knowledge Center™ since June 2009. Details of traffic accidents from Knowledge Center™ are listed in *Table 51 - Traffic Accidents in Susquehanna County.*

Table 51 - Traffic Accidents in Susquehanna County

Traffic Accidents in Susquehanna County		
Date	**Location**	**Event**
09-12-09	Silver Lake Township	Motorcycle vs. truck
09-27-09	Rush Township	Multi-vehicle accident with road closure
11-03-09	Liberty Township	Multi-vehicle accident
12-05-09	Lenox Township	Multi-vehicle accident on I-81 South
01-12-10	New Milford Township	Multi-vehicle accident on I-81 North
01-28-10	Bridgewater Township	Multi-vehicle accident on SR 706
04-29-10	Harford Township	Vehicle accident with rollover
04-29-10	Montrose Borough	Multi-vehicle accident
05-24-10	Springville Township	Drilling rig transport rollover
06-09-10	Great Bend Township	Two cars and a tractor-trailer accident
06-25-10	Dimock Township	Vehicle accident
07-06-10	Ararat Township	Bus accident
07-14-10	Lenox Township	Multi-vehicle accident involving PSP
08-12-10	Lenox Township	Potato truck turned over
09-18-10	Great Bend Township	Motor vehicle accident
09-22-10	New Milford Township	Tractor-trailer accident
10-02-10	Clifford Township	Multi-vehicle accident
10-04-10	Brooklyn Township	Dump-truck rollover with fluids spilled
10-06-10	Gibson Township	Multi-vehicle accident
11-30-10	Lathrop Township	Emergency vehicle accident with injuries
02-15-11	New Milford Township	Accident involving PSP (08:42 hours)
02-25-11	New Milford Township	Accident involving a State Trooper (17:09 hours)
03-06-11	Harford Township	Tractor-trailer rollover vs. a car
03-10-11	Auburn Township	Vehicle accident due to flooding
04-15-11	Forest City Borough	Tractor-trailer into a building
05-13-11	Lenox Township	Vehicle accident with a fuel spill
05-13-11	Bridgewater Township	Vehicle accident with injuries
06-18-11	Harford Township	Vehicle accident
07-10-11	New Milford Township	Tractor-trailer rollover on I-81 N at mile 224
07-19-11	Clifford Township	Vehicle accident with EMS vehicle
07-20-11	Lenox Township	Vehicle accident
07-29-11	Liberty Township	Tanker rollover with entrapment and HazMat
08-20-11	New Milford Township	Person struck by a vehicle
09-01-11	Bridgewater Township	Vehicle accident
09-07-11	New Milford Township	Vehicle accident
09-17-11	Lenox Township	Truck rollover
09-29-11	Little Meadows Borough	Vehicle accident into a creek
10-04-11	Hallstead Borough	Vehicle accident on SR 11

Traffic Accidents in Susquehanna County		
Date	**Location**	**Event**
10-30-11	Lenox Township	Vehicle accident with a fuel spill
11-04-11	New Milford Township	Vehicle accident with a small fuel spill
11-06-11	Bridgewater Township	Vehicle accident
11-07-11	Bridgewater Township	Vehicle accident
11-07-11	New Milford Township	Vehicle accident
12-31-11	Dimock Township	Vehicle accident on SR 29
12-31-11	New Milford Borough	Vehicle accident involving a police vehicle
01-21-12	Forest Lake Township	Vehicle accident on North Road
02-09-12	Dimock Township	Two-vehicle accident
02-25-12	New Milford Township	Accident – truck vs. pedestrians
02-29-12	Lenox Township	Accident with heavy entrapment on I-81
02-29-12	Silver Lake Township	Vehicle accident with entrapment
05-07-12	Dimock Township	Dump-truck rollover
05-09-12	Jessup Township	Vehicle accident
05-10-12	Great Bend Township	Vehicle accident with injuries
05-11-12	Auburn Township	Vehicle accident on SR 3004
05-17-12	Forest Lake Township	Truck rollover
05-27-12	Silver Lake Township	Vehicle accident
06-08-12	Lenox Township	Vehicle accident
07-07-12	Rush Township	Vehicle accident
07-10-12	Dimock Township	Vehicle accident
07-13-12	Rush Township	Vehicle accident
08-05-12	Oakland Township	Vehicle accident
10-14-12	Harford Township	Vehicle accident on I-81 S
10-25-12	Lenox Township	Fire apparatus struck, no injuries
11-27-12	Countywide	Vehicle accidents with road closures
12-29-12	Countywide	Multiple vehicle accidents
02-11-13	Forest Lake Township	Vehicle accident
02-20-13	New Milford Township	Vehicle accident
02-24-13	Choconut Township	Vehicle accident on Hawleyton Turnpike
03-11-13	Hop Bottom Borough	Vehicle accident
03-30-13	New Milford Township	Vehicle accident
04-14-13	Rush Township	Sand truck rollover
04-25-13	Unknown	Vehicle accident with ejection
08-16-13	Harford Township	Pedestrian struck
10-14-13	Unknown	Accident involving an ambulance
10-14-13	Unknown	Vehicle accident
10-25-13	Unknown	Vehicle accident
11-18-13	Unknown	Water truck rollover
11-25-13	Unknown	Vehicle accident
11-26-13	Forest Lake Township	Crane roll over
12-05-13	Unknown	Vehicle accident
01-15-14	Unknown	Vehicle accident with road closure
02-03-14	Lenox Township	Multiple vehicle accidents

Traffic Accidents in Susquehanna County		
Date	**Location**	**Event**
02-03-14	Lathrop Township	Fatal vehicle accident with road closure
02-13-14	Clifford Township	Emergency response vehicle accident
02-25-14	Unknown	Vehicle accident with road issues
03-04-14	Unknown	Vehicle accident
03-25-14	New Milford Township	Vehicle accident on I-81
03-30-14	New Milford Township	Accident involving a fire apparatus, no injuries
04-01-14	Unknown	Vehicle accident
04-21-14	Great Bend Township	Vehicle accident
05-10-14	Unknown	Vehicle accident on I-81 North
05-15-14	Unknown	Vehicle accident
05-17-14	Unknown	Vehicle accident
06-18-14	Unknown	Vehicle accident
06-19-14	Unknown	Vehicle accident involving livestock
06-19-14	Unknown	Vehicle accident
07-03-14	Hallstead Borough	Vehicle accident
07-17-14	Lenox Township	Vehicle accident
07-23-14	Liberty Township	Vehicle accident in a construction zone
09-01-14	Unknown	Fatal vehicle accident
09-23-14	Unknown	Water truck rollover
11-07-14	Unknown	Water truck rollover
11-10-14	Unknown	Vehicle accident
11-15-14	Unknown	Vehicle accident with wires down
11-17-14	Jackson Township	Wide load vs. water tanker with fuel spill
11-22-14	Montrose Borough	Vehicle accident involving a PennDOT truck
11-22-14	Unknown	Vehicle accident on I-81 with road closure
11-26-14	New Milford Township	Vehicle accident on I-81 involving a PSP car
12-02-14	Unknown	Vehicle accident
12-10-14	Springville Township	Fatal water truck accident
01-02-15	Springville Township	Multi-vehicle accident
01-03-15	Lenox Township	Multi-vehicle accident on I-81 SB
01-16-15	Unknown	Fatal vehicle accident
01-17-15	Unknown	Truck into a tree
01-27-15	Unknown	Vehicle accident
02-07-15	Unknown	Gas tanker rollover
03-02-15	Clifford Township	Vehicle accident involving two school buses
03-18-15	Unknown	Vehicle accident
04-11-15	Unknown	Vehicle accident on I-81
04-14-15	Unknown	Commercial vehicle accident on SR 267
05-04-15	Unknown	Vehicle accident with road closure
05-10-15	Unknown	Vehicle accident involving a large crane
06-05-15	New Milford Township	Vehicle accident
06-15-15	Unknown	Tractor-trailer rollover
06-30-15	Lenox Township	Overturned tractor-trailer
07-26-15	Unknown	Vehicle rollover

Traffic Accidents in Susquehanna County		
Date	**Location**	**Event**
08-15-15	Unknown	Multi-vehicle accident
10-08-15	Bridgewater Township	Pedestrian struck by a vehicle
11-09-15	Bridgewater Township	Accident in a construction zone on SR 29
11-18-15	Dimock Township	Vehicle accident
12-11-15	Unknown	Vehicle accident with wires down
12-19-15	Unknown	Fatal vehicle accident
12-22-15	Great Bend Township	Vehicle accident
01-20-16	Lenox Township	Tractor-trailer accident on I-81 South
01-24-16	Bridgewater Township	One-vehicle rollover
01-24-16	Montrose Borough	Vehicle accident involving a firefighter's POV
02-19-16	Unknown	Fatal vehicle accident
02-21-16	Unknown	Vehicle rollover requiring a water rescue
03-27-16	Unknown	One-vehicle accident on SR 267
05-07-16	Unknown	Vehicle accident on I-81 South
05-23-16	Unknown	Vehicle accident with road closure
06-27-16	Choconut Township	Vehicle accident on SR 267 with road closure
07-02-16	Unknown	Vehicle accident on SR 492
07-18-16	Unknown	Vehicle accident
07-27-16	Unknown	Vehicle accident
08-11-16	Unknown	Vehicle accident involving fire, and a road closure
08-29-16	Unknown	Vehicle accident
08-30-16	Ararat Township	Vehicle accident with a road closure
09-13-16	Lenox Township	Fatal vehicle accident with a road closure
10-14-16	Great Bend Township	Vehicle accident involving a PennDOT truck
10-22-16	Unknown	Fatal vehicle accident, a tractor-trailer vs. a car
11-11-16	Liberty Township	Vehicle accident
12-01-16	Harford Township	Vehicle accident with a road closure
12-19-16	Harford Township	Vehicle accident on I-81 South
01-10-17	Unknown	Tractor trailer accident with a fuel spill
01-14-17	Unknown	Fatal vehicle accident
02-09-17	Unknown	Vehicle accident on I-81 South
02-09-17	Unknown	Vehicle accident with road closure at mile 206.2 N
02-21-17	Unknown	Vehicle accident on North Road
03-24-17	Thompson Township	Home heating oil truck rollover
03-29-17	Unknown	Vehicle accident
04-17-17	Unknown	Vehicle accident with road closure
06-03-17	Unknown	Mass casualty motor vehicle accident
06-27-17	Bridgewater Township	Vehicle accident
06-29-17	Unknown	Vehicle accident on Kingsley Road
06-30-17	Lenox Township	Fatal vehicle accident with a road closure
07-11-17	Unknown	Vehicle accident
07-12-17	Unknown	Vehicle accident on North Road
07-14-17	Unknown	Vehicle accident
08-31-17	Unknown	Vehicle accident with a road closure

Traffic Accidents in Susquehanna County		
Date	**Location**	**Event**
09-13-17	Lenox Township	Vehicle accident in a construction zone
10-03-17	Lenox Township	Accident with a truck carrying HazMat

Accidents involving trains; to include derailments and train vs. automobile accidents, that have been logged into Knowledge Center™ between June 2009 and October 2017, are listed in *Table 52 - Railroad Accidents in Susquehanna County.*

Table 52 - Railroad Accidents in Susquehanna County

Railroad Accidents in Susquehanna County		
Date	**Location**	**Event**
06-30-10	Hallstead Borough	Train derailment
12-11-12	New Milford Township	Train vs. pedestrian
06-05-14	Unknown	Train derailment
06-19-14	Unknown	Railroad car derailment
07-13-15	Unknown	Train emergency

Although there are no commercial airports in Susquehanna County, there have been aircraft crashes and alert notices recorded on Knowledge Center™. These events are listed in *Table 53 - Aircraft Incidents in Susquehanna County.*

Table 53 - Aircraft Incidents in Susquehanna County

Aircraft Incidents in Susquehanna County		
Date	**Location**	**Event**
09-06-13	Harford Township	Aircraft alert notice
11-28-13	Bridgewater Township	Plane crash
06-19-14	Countywide	ELT activated, Air Force
08-07-15	Bridgewater Township	Small plane crash

4.3.19.4 Future Occurrence

Based on past occurrences, it is highly likely transportation accidents along roadways will continue to occur in Susquehanna County. In the past thirty-one years (1985 – 2016 minus 2002 due to no data) there has been an average of 498.6 accidents a year. In 1997 Susquehanna County had a high of 602 accidents for the entire year; with a high of 354 accidents with injuries the same year. The highest amount of fatal accidents occurred in 2003 with fourteen, and the lowest amount of fatal accidents occurred in 1985 with four.

4.3.19.5 Vulnerability Assessment

A transportation-related accident can occur on any stretch of road or railway in Susquehanna County. However, severe accidents are more likely along major highways such as Interstate 81. This is due to high traffic volumes that include heavy freight vehicles. Those that are most likely to be affected by a traffic accident, especially one involving trucks transporting hazardous materials, are those that live within a quarter-mile radius of the accident. Addressable structures and critical facilities that are vulnerable to transportation incidents via rail and major roads are identified by municipality in *Table 54 - Vulnerable Addressable Structures and Critical Facilities*.

Table 54 - Vulnerable Addressable Structures and Critical Facilities

Vulnerable Addressable Structures and Critical Facilities				
Municipality	**Within ¼ Mile of Major Roads & Railroads**		**Within 5 Miles of an Airport**	
	Addressable Structures	**Critical Facilities**	**Addressable Structures**	**Critical Facilities**
Apolacon Township	67	-	-	-
Ararat Township	92	2	302	4
Auburn Township	182	6	-	-
Bridgewater Township	798	23	1091	22
Brooklyn Township	196	5	429	6
Choconut Township	185	4	-	-
Clifford Township	659	14	191	1
Dimock Township	127	5	683	16
Forest City Borough	789	13	-	-
Forest Lake Township	131	2	27	-
Franklin Township	119	5	-	-
Friendsville Borough	-	-	-	-
Gibson Township	212	4	358	2
Great Bend Borough	295	11	-	-
Great Bend Township	739	10	-	-
Hallstead Borough	468	7	-	-
Harford Township	358	11	840	14
Harmony Township	98	3	-	-
Herrick Township	337	2	880	11
Hop Bottom Borough	144	6	113	5
Jackson Township	213	7	126	-
Jessup Township	91	3	209	4
Lanesboro Borough	161	7	-	-
Lathrop Township	119	-	23	-
Lenox Township	459	12	357	4
Liberty Township	184	6	-	-
Little Meadows Borough	110	3	-	-
Middletown Township	57	1	-	-
Montrose Borough	788	25	886	28
New Milford Borough	431	15	431	15
New Milford Township	469	15	1088	18
Oakland Borough	246	3	-	-
Oakland Township	197	4	-	-
Rush Township	338	10	20	-

Vulnerable Addressable Structures and Critical Facilities				
Municipality	Within ¼ Mile of Major Roads & Railroads		Within 5 Miles of an Airport	
	Addressable Structures	Critical Facilities	Addressable Structures	Critical Facilities
Silver Lake Township	197	3	-	-
Springville Township	208	6	-	-
Susquehanna Depot Borough	709	10	-	-
Thompson Borough	131	7	-	-
Thompson Township	71	2	-	-
Union Dale Borough	80	3	186	5
Total	**11255**	**275**	**8240**	**155**

4.3.20. Utility Interruptions

4.3.20.1 Location and Extent

Utility interruptions include disruptions in fuel, water, electric and telecommunications capabilities in Susquehanna County. Fuel is described as oil or natural gas, and a shortage occurs when the supply of energy resources doesn't meet the demand. Fuel shortages are mostly caused by localized imbalances such as weather-related issues, breaks in the supply lines, or a localized utility employee strike. A worst-case scenario would be a nationwide shortage, i.e., oil embargo. These shortages have been experienced in the United States in the past and have had the effect of leaving homes and industry without the needed fuels.

Utility interruptions are most often a secondary impact of another hazard. Traffic accidents or wind damage can cause localized outages, while severe thunderstorms, windstorms, tornadoes, and wither storms can also lead to more regional utility interruptions. Heat waves may also result in rolling blackouts where power may not be available for extended periods of time. Utility interruptions have the potential to affect the entire county.

Solar flares are concentrated releases of magnetic energy that emanate from sunspots, and can last for minutes or hours. Solar flares can also cause coronal mass ejections (CME) from the outer solar atmosphere which are large clouds of plasma and magnetic field which induce geomagnetic currents when they reach the surface of Earth. A combination of these events can be referred to as solar storms or solar weather. Solar weather only impacts Earth when it occurs on the side of the sun that is actively facing Earth. A severe solar storm can have a geographically wide-ranging impact that can last for days or weeks (NASA, 2016).

4.3.20.2 Range of Magnitude

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

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

The degree of damage or harm from utility interruptions depends on the population affected and the severity of the outage. For example, loss of heating and cooling capabilities is more dangerous in the winter and summer months, when heat sensitive populations, like the elderly, count on utilities and fuel to maintain safe temperatures. A worst-case scenario for fuel shortages in Susquehanna County would be if there was a fuel-oil shortage in the county during the winter months, leaving many homes without a source of heat.

Minor solar flares have no negative impacts on Earth thanks to the protection afforded by Earth's magnetic field and atmosphere, but cause beautiful visual displays known as the Northern Lights or Aurora Borealis. However, severe solar storms can cause an electromagnetic pulse (EMP) that is able to break through Earth's magnetic field and send current to Earth's surface, inducing geomagnetic currents. Geomagnetically induced currents (GICs) impact the electrical grid and can cause transformers to burn and fail, potentially knocking out wide swatches of electricity infrastructure resulting in blackouts (Phillips, 2009). Electricity blackouts have many secondary effects, including limited water distribution capabilities, losing perishable foods and medicines, heating and air conditioning as well as communication services. A solar EMP would also contribute to corrosion of oil and gas pipelines, disrupt high-frequency signals from global positioning system (GPS) satellites, and require aircrafts to avoid polar-routes to avoid communication malfunctions (Baker et al., 2008). Industries that are most impacted by severe space weather are: electric power, spacecraft, aviation, and other industries relying on GPS.

4.3.20.3 Past Occurrence

Susquehanna County, and the rest of the nation, experienced utility interruptions in the form of energy shortages during the fuel crises of 1972-73 and 1976-77. There was also the truckers strike in 1974 that prompted a gubernatorial disaster declaration. Susquehanna County indicates that there haven't been any serious or regional interruptions, aside from the gas shortages experienced in the 1970s.

Prior to 2009 there wasn't a complete list of utility interruption events. Since July 2009, utility events have been logged onto the Knowledge Center™ database utilized by Susquehanna County as an emergency management tool, a list of these events is located in Table x: Utility Interruptions for Susquehanna County. This information has been separated by utility: communications, electricity, fuel, and water.

From August 28 to September 4 of 1859, two severe solar storms resulted in widespread auroral displays in North and South America, Europe, Asia, Australia, and as far south as Hawaii and Cuba (Baker et al., 2008). The event is known as the Carrington Event, and resulted in the widespread disruption of telegraph lines, even setting fire to some telegraph offices (Phillips, 2014). The Carrington Event is estimated to be one of the strongest recorded geomagnetic storm events.

In March of 1989, a severe geomagnetic storm caused a widespread blackout (occurring within 90 seconds) in northeastern Canada's Hydro-Quebec power grid, resulting in millions being without electricity for 9 hours (Baker et al., 2008). Currents from this event are estimated to be ten times less than those induced in the May 1921 event.

On May 14 of 1921, a geomagnetic storm produced ground currents that are estimated to be half as strong as the Carrington event, but ten times stronger than the 1989 event.

In July of 2012, a powerful solar storm produced an intense coronal mass ejection, estimated to be possibly stronger than the Carrington Event (Baker et al., 2013). Fortunately, due to the position of the event and the location of Earth in its orbit, the event missed Earth by as little as a week (Phillips, 2014). The STEREO-A spacecraft was however was in the line of fire, and was able to record valuable data on the event (Baker et al., 2013).

Table 55 - Utility Interruptions

Utility Interruptions for Susquehanna County		
Date	**Location**	**Event**
Communications		
07/31/09	Countywide	Phone outage
10/27/09	Rush Township	Phone outage
01/02/10	Herrick Township	Phone line trouble
01/15/10	Countywide	Phone problems

Utility Interruptions for Susquehanna County		
Date	**Location**	**Event**
08/19/10	Harford Township	Mass phone outage
12/02/10	County courthouse	Phone issues
05/27/11	Little Meadows Borough	Phone outage
10/06/11	Countywide	Phone outage
11/15/11	Countywide	Phone outage
12/10/11	Rush Township	911 phone outage
05/13/12	Forest Lake Township	Phone outage
07/07/12	Montrose Borough	Communications center outage
07/13/12	Susquehanna Depot Borough	Cell, landline and cable service outage
07/18/12	Countywide	911 Center microwave outage
08/14/12	Montrose Borough	Court house phone lines down
11/19/12	Countywide	NEP phone outage
03/22/13	Dimock Township	Phone outage
04/16/13	Montrose Borough	911 phone outage
04/27/13	Montrose Borough	Phone outage
08/25/13	Countywide	911 phone outage
09/25/13	Little Meadows Borough	911 phone outage
11/04/13	Countywide	Phone outage
11/05/13	Lathrop Township	Phone outage
01/03/14	Countywide	Phone outage
03/12/14	West-central part of county	Phone outage
03/20/14	Countywide	911 phone outage
04/16/14	East Rush area	Frontier phone outage
05/22/14	Dimock Township	Phone outage
06/05/14	Countywide	Verizon outage affecting 911
06/19/14	Southern part of the county	Frontier phone outage
07/15/14	Brooklyn Township	Frontier phone outage
08/18/14	Jessup Township	Phone outage
08/30/14	Brooklyn Township	Frontier phone outage
11/02/14	Montrose Borough	Phone outage
03/13/15	Countywide	Phone outage
03/18/15	Countywide	Frontier utility issue
03/25/15	Countywide	Frontier phone outage
06/08/15	Forest Lake Township	Phone outage
07/14/15	Countywide	Phone outage
09/18/15	Countywide	Phone outage
08/08/15	Countywide	Frontier phone outage
09/05/15	Countywide	Frontier phone outage
09/22/15	Countywide	Frontier phone outage
10/07/15	Countywide	Frontier phone outage
10/18/15	Countywide	Phone outage
10/19/15	Countywide	Phone outage
10/30/15	Countywide	Communications outage
11/13/15	Montrose Borough	Verizon cell outage
12/29/15	Countywide	Phone outage
01/13/16	Countywide	Cable/VOIP outage

Utility Interruptions for Susquehanna County		
Date	**Location**	**Event**
01/29/16	Countywide	Phone outage
04/03/16	Countywide	Phone outage
07/15/16	Countywide	Phone outage
08/12/16	Countywide	911 phone outage
05/04/17	Countywide	Frontier outage
10/30/17	Countywide	Communications outage
11/08/17	Countywide	911 phone system technical issue
Electricity		
07/23/09	Montrose Borough	Power outage
02/02/11	Countywide	Power outage
08/28/11	Auburn Township	Generator provided
08/29/11	Silver Lake Township	Generator provided
09/07/11	Countywide	West Central Power outage
09/08/11	Bridgewater Township	Power outage – oxygen dependent resident
10/27/11	Great Bend Borough	Power outage
03/31/12	Bridgewater Township	Widespread power outage
10/29/12	Countywide	Power outages
12/13/12	Montrose Borough	Power outages
04/16/13	Montrose Borough	Power outages at the courthouse
01/04/14	New Milford Borough	Power outage
02/05/14	Great Bend Township	Power outage at Green Valley Mobile Home Park
03/12/14	Montrose Borough	Power outage
03/13/14	Montrose Borough	Power outage
03/13/14	New Milford Borough	Power outage
03/18/14	East-central part of county	Power outage
06/13/14	Susquehanna & Lanesboro	Power outage
02/27/15	Auburn & Springville twps.	Power outage
03/26/15	Little Meadows Borough	Power outage
04/06/15	Countywide	Power outage
06/17/15	Countywide	Power outage
08/05/15	Countywide	Outage
08/11/15	Clifford and West Clifford	Power outage
09/22/15	Forest City Borough	Power outage
09/30/15	Bridgewater Township	Power outage with a road closure
10/19/15	Montrose Borough	Power outage at EMHS
11/14/15	Countywide	Power outage
01/10/16	Countywide	Power outage
02/02/16	Countywide	Outage
02/06/16	Countywide	Outage
02/12/16	Forest Lake Township	Power outage due to a pole fire
03/02/16	Countywide	Power outages
05/12/16	Countywide	Outages
10/26/16	Countywide	Outages
05/01/17	Countywide	Outages
05/05/17	Countywide	Major outages
07/17/17	Bridgewater Township	Outages

Utility Interruptions for Susquehanna County		
Date	**Location**	**Event**
Fuel		
02/26/13	Unknown	Gas main damaged
02/27/14	Unknown	Residential gas leak
03/06/14	Clifford Township	Residential gas leak
09/20/14	Montrose Borough	Natural gas line leak into sewer main
11/03/15	Forest City Borough	Heat outages at 2nd Ward Polling
Water/sewage		
09/10/09	New Milford Borough	Water main break
11/15/09	Montrose Borough	Water main break
07/30/10	Montrose Borough	Water main break
06/20/11	Harford Township	Water shortage
09/08/11	Bridgewater Township	Raw sewage
09/09/11	Oakland Borough	Boil water advisory
11/14/11	Susquehanna Depot Borough	Water outage
06/19/13	Thompson Township	Well contamination
02/17/14	Susquehanna Depot Borough	Water main break
03/10/14	Susquehanna Depot Borough	Frozen water main
04/02/14	Lenox Township	Partial breach of dam bulkhead
07/29/14	Bridgewater Township	Water main break affecting EMHS
07/31/14	Bridgewater Township	Water main breaks
01/06/15	Bridgewater Township	Water main break
02/01/15	Oakland Township	Water main break
02/21/15	Hallstead Borough	Fire hydrant leak
02/25/15	Forest City Borough	Frozen water mains
02/27/15	Montrose Borough	Water outage at District Court 34-3-01
03/02/15	Thompson Borough	Frozen water service – Thompson Fire Station
03/02/15	Countywide	Frozen water services
03/03/15	Susquehanna Depot Borough	Water main break
03/04/15	Hallstead Borough	Frozen water main
03/12/15	Susquehanna Depot Borough	Frozen water services
04/02/15	Hallstead Borough	Water main break
06/05/15	Hallstead Borough	Water main break
09/12/16	Susquehanna Depot Borough	Water main break at Barnes Kasson Hospital

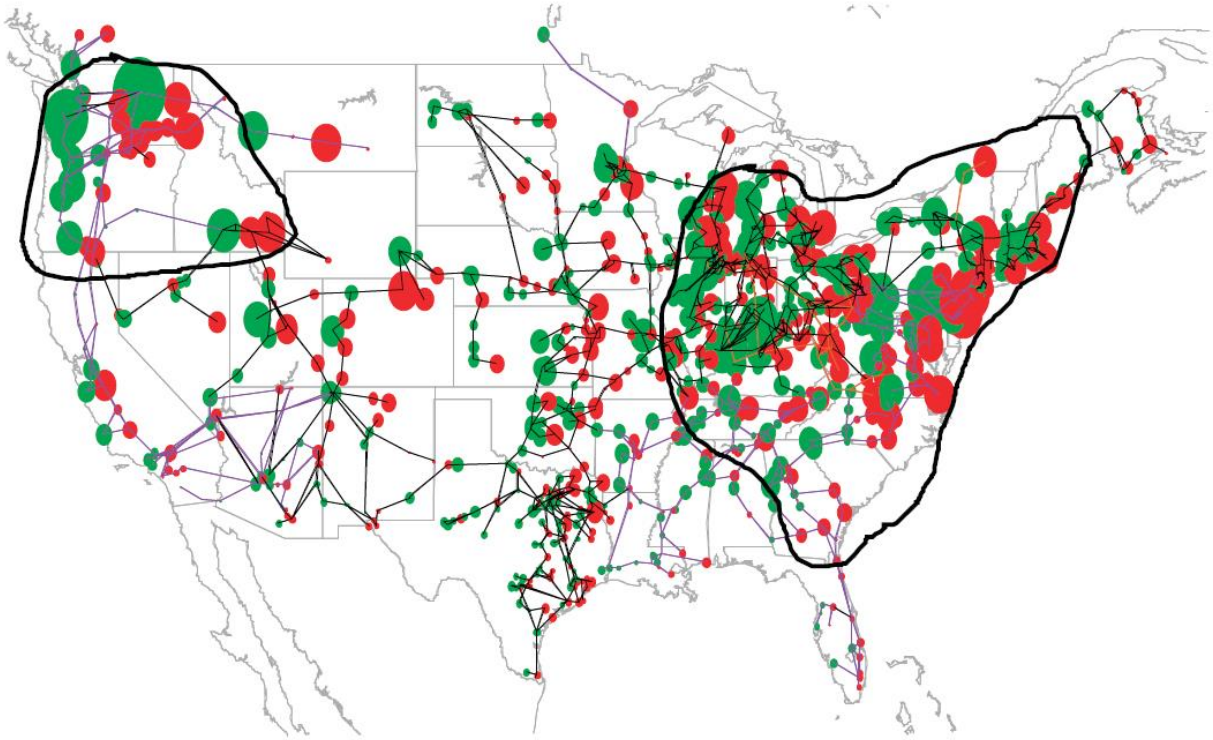
4.3.20.4 Future Occurrence

Minor, short-term utility interruptions may occur several times a year in any given area within Susquehanna County. Major, long-term events may take place once every few years. Difficult to predict, utility interruptions can be by-products of severe weather events. The future occurrence of utility interruptions and fuel shortages should be considered possible.

It is estimated that the probability of occurrence in the next ten years of an extreme space weather event at the scale of the Carrington Event is twelve percent (Riley, 2012).

If a solar storm on the scale of the 1921 event impacted our modern electricity infrastructure, it could permanently damage an estimated 350 transformers, and cause blackouts for 130 million people (*Figure 30 - Potential Electricity Grid Failure*) (Baker et al., 2008).

Figure 30 - Potential Electricity Grid Failure



Scenario showing effects of a 4800 nT/min geomagnetic field disturbance at 50° geomagnetic latitude scenario. The regions outlined are susceptible to system collapse due to the effects of the GIC disturbance; the impacts would be of unprecedented scale and involve populations in excess of 130 million. SOURCE: J. Kappenman, Metatech Corp., "The Future: Solutions or Vulnerabilities?," presentation to the space weather workshop, May 23, 2008.

4.3.20.5 Vulnerability Assessment

Since most utility interruptions are due to severe weather events, citizens should prepare for them during storms. Residents of Susquehanna County are generally prepared for utility interruptions that occur as a result of severe weather. Most residents, especially those residing in rural areas, have alternate heat sources installed.

Hospitals, long-term care facilities, retirement homes, and senior centers are particularly vulnerable to fuel shortages and utility interruptions as elderly populations are susceptible to extreme temperatures. Back-up power generators are often used at these

facilities, but the population will become particularly vulnerable if a fuel shortage or utility outage lasts longer than the back-up power supply.

The National Oceanic and Atmospheric Administration (NOAA) monitors solar activity from the Space Weather Prediction Center (SWPC), and is able to alert power grid operators of the impending geomagnetic storm so they may make efforts to protect the grid from GICs (Baker et al., 2008). Events such as the 1989 Hydro-Quebec blackout have illuminated the hazard that solar storms pose to electricity infrastructure, however modern power grids are more vulnerable than ever. Power grids have become increasingly interconnected which improves efficiency in many ways but makes them more vulnerable to wide ranging rolling failures as seen in *Figure 30 - Potential Electricity Grid Failure* (Baker et al., 2008).

Geomagnetic storms can cause permanent damage to transformers that could result in much longer restoration times than experienced in the 1989 Hydro-Quebec outage. Transformer damage occurs when GICs cause excessive internal heating resulting in melting and burning of many large-amperage copper windings and leads. Such damage cannot be repaired, and the damaged transformer must be replaced. Transformers are extremely large and heavy apparatuses, and replacement can be a long process, suggesting that efforts should be taken to protect resident transformers from GICs. A workshop held by the Committee on the Societal and Economic Impacts of Severe Space Weather Events offered solutions to mitigating negative impacts of GICs, suggesting that supplemental transformer neutral ground resistors should be installed because they are relatively inexpensive, have low engineering trade-offs, and can produce 60-70 percent reduction of GIC levels during severe solar storms (Baker et al., 2008).

The Department of Homeland Security (DHS) has a Solar Storm Mitigation effort, which "aims to provide owners and operators of the electricity grid with advanced and actionable information about anticipated GCI current levels in the event of a solar storm" (US GAO, 2017). According to the DHS, when provided with accurate solar storm warnings, utility operators can "make operational decisions to mitigate the impacts from solar storms. This can range from canceling maintenance work to temporarily shutting down vulnerable grid components and preventing permanent damage" (DHS, 2015).

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 56 - 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:

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

Table 56 - 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.

Table 56 - 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**	
PROBABILITY *What is the likelihood of a hazard event occurring in a given year?*	**UNLIKELY**	LESS THAN 1% ANNUAL PROBABILITY		1	30%
	POSSIBLE	BETWEEN 1 & 10% ANNUAL PROBABILITY		2	
	LIKELY	BETWEEN 10 &100% ANNUAL PROBABILITY		3	
	HIGHLY LIKELY	100% ANNUAL PROBABILTY		4	
IMPACT *In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?*	**MINOR**	VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF CRITICAL FACILITIES.		1	30%
	LIMITED	MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE DAY.		2	
	CRITICAL	MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE WEEK.		3	
	CATASTROPHIC	HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR 30 DAYS OR MORE.		4	
SPATIAL EXTENT *How large of an area could be impacted by a hazard event? Are impacts localized or regional?*	**NEGLIGIBLE**	LESS THAN 1% OF AREA AFFECTED		1	20%
	SMALL	BETWEEN 1 & 10% OF AREA AFFECTED		2	
	MODERATE	BETWEEN 10 & 50% OF AREA AFFECTED		3	
	LARGE	BETWEEN 50 & 100% OF AREA AFFECTED		4	
WARNING TIME *Is there usually some lead time associated with the hazard event? Have warning measures been implemented?*	**MORE THAN 24 HRS**	SELF-DEFINED	*(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)*	1	10%
	12 TO 24 HRS	SELF-DEFINED		2	
	6 TO 12 HRS	SELF-DEFINED		3	
	LESS THAN 6 HRS	SELF-DEFINED		4	

Summary of Risk Factor Approach Used to Rank Hazard Risk.					
RISK ASSESSMENT CATEGORY	**DEGREE OF RISK**				**WEIGHT VALUE**
	LEVEL	**CRITERIA**		**INDEX**	
DURATION *How long does the hazard event usually last?*	**LESS THAN 6 HRS**	SELF-DEFINED	*(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)*	1	10%
	LESS THAN 24 HRS	SELF-DEFINED		2	
	LESS THAN 1 WEEK	SELF-DEFINED		3	
	MORE THAN 1 WEEK	SELF-DEFINED		4	

4.4.2. Ranking Results

Using the methodology described in Section 4.4.1, *Table 57 - Risk Factor Assessment* lists the Risk Factor calculated for each of the twenty-four potential hazards identified in the 2018 HMP. *It should be noted that the tornado hazard and windstorm hazard were ranked individually instead of together.* 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 57 - Risk Factor Assessment

Susquehanna County Hazard Ranking Based on RF Methodology.							
HAZARD RISK	**HAZARD NATURAL (N) OR MANMADE (M)**	**RISK ASSESSMENT CATEGORY**					**RISK FACTOR (RF)**
		PROBABILITY	**ECONOMIC IMPACT**	**SPATIAL EXTENT**	**WARNING TIME**	**DURATION**	
HIGH	Flash Flood	4	4	3	4	4	**3.8**
	Environmental Hazards	4	3	4	4	4	**3.7**
	Utility Interruptions	4	3	4	4	3	**3.6**
	Cyber Crime Attack (NEW)	3	3	4	4	4	**3.4**
	Tornado	3	4	3	4	3	**3.4**
	Windstorm	4	3	3	4	3	**3.4**
	Winterstorm	4	3	4	2	2	**3.3**
	Flood	3	3	3	1	4	**2.9**
	Nor'Easter (NEW)	3	3	4	2	3	**3.1**
	Opioid Epidemic (NEW)	4	2	4	4	1	**3.1**
	Pandemic, Epidemic and Infectious Disease (NEW)	3	3	4	1	4	**3.1**
	Transportation Accidents	4	3	2	4	2	**3.1**
	Hurricane, Tropical Storm (NEW)	3	3	4	1	3	**3**
	Invasive Species (NEW)	4	1	4	1	4	**2.8**
	Dam Failure	3	2	2	4	4	**2.7**

Susquehanna County Hazard Ranking Based on RF Methodology.							
HAZARD RISK	HAZARD NATURAL (N) OR MANMADE (M)	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
		PROBABILITY	ECONOMIC IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
	Drought	2	2	4	1	4	2.5
	Radon Exposure	3	1	4	1	4	2.5
	Wildfire	4	1	2	4	2	2.5
MODERATE	Lightning Strike	3	2	1	4	1	2.2
	Ice Jam Flood	2	2	2	2	3	2.1
	Earthquake	1	1	4	4	1	1.9
	Landslides	2	1	1	4	2	1.7
LOW	Hailstorm	2	1	1	4	1	1.6
	Terrorism (NEW)	1	1	2	4	1	1.5

Based on these results, there are eighteen *high* risk hazards, two *moderate* risk hazards and four *low* risk hazards in Susquehanna 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 58 - Countywide Risk Factor by Hazard* shows the different municipalities in Susquehanna 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 4.3.20.

Table 58 - Countywide Risk Factor by Hazard

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk											
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR											
Municipality	**Flash Flood**	**Environmental Hazards**	**Utility Interruptions**	**Cyber Crime Attack**	**Tornado**	**Windstorm**	**Winter storm**	**Nor'easter**	**Opioid Epidemic**	**Pandemic, Epidemic, and Infectious**	**Transportation Accidents**
	3.8	***3.7***	***3.6***	***3.4***	***3.4***	***3.4***	***3.3***	***3.1***	***3.1***	***3.1***	***3.1***
Apolacon Township	=	=	=	=	=	=	=	=	=	=	=
Ararat Township	<	<	=	=	=	=	=	=	>	=	=
Auburn Township	=	=	<	<	=	=	=	=	=	<	=
Bridgewater Township	=	=	=	=	=	=	=	=	=	=	=
Brooklyn Township	=	=	=	=	=	=	=	=	=	=	=
Choconut Township	>	<	>	<	<	>	>	>	<	<	>
Clifford Township	=	<	=	<	<	=	=	<	<	=	=
Dimock Township	<	=	=	<	<	=	=	=	=	=	=
Forest City Borough	<	=	=	=	<	=	=	=	=	=	=
Forest Lake Township	<	<	=	<	<	<	<	<	>	=	<
Franklin Township	=	=	=	=	=	=	=	=	=	=	=
Friendsville Borough	<	<	=	<	<	<	<	=	<	<	<
Gibson Township	<	<	=	=	<	=	=	=	=	=	<
Great Bend Borough	=	<	=	=	=	=	=	=	=	=	=
Great Bend Township	=	=	=	=	<	=	=	=	=	=	=
Hallstead Borough	<	<	<	<	<	<	<	<	<	<	<
Harford Township	<	<	=	<	=	=	=	=	=	<	=
Harmony Township	=	=	<	>	>	=	=	=	=	=	>
Herrick Township	=	=	=	=	=	=	=	=	=	=	=
Hop Bottom Borough	=	=	=	<	=	=	=	=	=	<	<
Jackson Township	<	<	=	<	=	=	=	=	=	=	=
Jessup Township	<	<	<	=	=	=	=	=	=	=	<
Lanesboro Borough	>	=	>	>	=	=	=	=	=	=	>
Lathrop Township	<	=	=	<	=	=	=	=	=	=	>
Lenox Township	=	=	=	=	=	=	=	=	=	=	=
Liberty Township	=	=	>	=	=	>	=	>	>	=	>
Little Meadows Borough	=	=	=	=	=	=	=	=	=	=	<

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk											
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR											
Municipality	**Flash Flood**	**Environmental Hazards**	**Utility Interruptions**	**Cyber Crime Attack**	**Tornado**	**Windstorm**	**Winter storm**	**Nor'easter**	**Opioid Epidemic**	**Pandemic, Epidemic, and Infectious**	**Transportation Accidents**
	3.8	***3.7***	***3.6***	***3.4***	***3.4***	***3.4***	***3.3***	***3.1***	***3.1***	***3.1***	***3.1***
Middletown Township	=	=	=	<	<	=	=	=	<	<	<
Montrose Borough	=	=	<	<	<	=	=	=	>	<	=
New Milford Borough	<	=	=	=	<	=	=	=	=	=	>
New Milford Township	<	=	=	=	=	=	=	=	=	=	>
Oakland Borough	=	=	=	=	<	>	=	=	=	=	=
Oakland Township	>	>	=	>	=	>	>	=	=	=	=
Rush Township	=	=	=	=	=	=	=	=	=	=	=
Silver Lake Township	=	=	=	=	=	=	=	=	=	=	=
Springville Township	=	=	<	<	=	<	=	<	<	=	=
Susquehanna Depot Borough	=	<	>	=	<	=	>	=	>	<	=
Thompson Borough	=	=	=	=	<	=	=	=	=	<	=
Thompson Township	<	=	=	<	=	=	=	=	=	<	=
Union Dale Borough	<	<	=	<	=	=	=	=	=	<	<

Municipality	**Hurricane, Tropical Storm**	**Flood**	**Invasive Species**	**Dam Failure**	**Drought**	**Radon Exposure**	**Wildfire**	**Lightning Strike**	**Ice Jam Flood**	**Earthquake**	**Landslides**	**Hailstorm**	**Terrorism**
	3	***2.9***	***2.8***	***2.7***	***2.5***	***2.5***	***2.5***	***2.2***	***2.1***	***1.9***	***1.7***	***1.6***	***1.5***
Apolacon Township	=	=	=	=	=	=	=	=	=	=	=	=	=
Ararat Township	=	1	>	=	=	>	=	>	<	=	<	=	=
Auburn Township	<	3.8	=	<	=	=	=	=	<	=	=	=	=
Bridgewater Township	=	3.3	=	=	=	=	=	=	=	=	=	=	=
Brooklyn Township	=	=	=	=	=	=	=	=	=	=	=	=	=

Municipality	Hurricane, Tropical Storm	Flood	Invasive Species	Dam Failure	Drought	Radon Exposure	Wildfire	Lightning Strike	Ice Jam Flood	Earthquake	Landslides	Hailstorm	Terrorism
	3	*2.9*	*2.8*	*2.7*	*2.5*	*2.5*	*2.5*	*2.2*	*2.1*	*1.9*	*1.7*	*1.6*	*1.5*
Choconut Township	<	=	>	<	<	<	>	>	<	<	<	>	<
Clifford Township	=	3.8	>	=	=	=	=	=	>	=	=	=	=
Dimock Township	=	1.8	=	=	=	=	=	=	<	=	<	=	<
Forest City Borough	<	1.4	=	<	<	=	<	=	<	=	=	=	=
Forest Lake Township	<	2.9	>	<	=	=	<	<	<	=	<	>	>
Franklin Township	=	=	=	=	=	=	=	=	=	=	=	=	=
Friendsville Borough	<	=	<	<	n/a	<	<	n/a	<	<	<	=	<
Gibson Township	=	1.7	=	<	=	=	<	=	=	=	<	=	=
Great Bend Borough	=	3.2	=	<	=	=	<	=	=	=	=	=	=
Great Bend Township	<	3.2	<	<	=	=	=	=	>	=	=	=	=
Hallstead Borough	<	2.7	<	<	<	<	<	=	>	>	>	>	>
Harford Township	<	1.6	<	<	<	=	=	=	<	<	=	=	=
Harmony Township	=	2.8	=	<	=	=	=	=	<	=	=	<	=
Herrick Township	=	=	=	=	=	=	=	=	=	=	=	=	=
Hop Bottom Borough	=	3.8	<	=	=	=	=	=	=	=	=	=	=
Jackson Township	=	1.8	n/a	<	=	=	=	=	<	=	<	=	=
Jessup Township	=	2.6	=	<	=	=	=	=	<	=	=	=	=
Lanesboro Borough	=	3.4	=	>	=	=	=	=	>	=	>	=	>
Lathrop Township	=	2.2	=	=	=	=	=	=	>	=	<	=	=
Lenox Township	=	1.3	>	=	=	=	=	=	=	=	=	=	=
Liberty Township	=	2.3	>	>	>	>	=	=	>	=	=	>	=
Little Meadows Borough	=	3.2	=	<	=	=	<	=	=	=	=	=	=
Middletown Township	<	=	>	<	<	=	=	=	<	<	<	=	=
Montrose Borough	<	=	<	<	<	<	<	=	<	=	<	<	=
New Milford Borough	=	2.4	=	=	=	=	<	=	=	=	<	=	=
New Milford Township	=	2.5	=	>	=	=	=	=	=	=	=	=	=
Oakland Borough	=	2.4	=	>	=	=	=	=	=	=	>	=	=
Oakland Township	=	=	=	<	>	=	>	>	>	=	=	>	<
Rush Township	=	=	=	=	=	=	=	=	=	=	=	=	=
Silver Lake Township	=	=	=	=	=	=	=	=	=	=	=	=	=
Springville Township	=	2	=	=	=	=	=	=	=	=	=	=	=
Susquehanna Depot Borough	<	=	>	>	=	>	<	>	>	=	>	=	=
Thompson Borough	<	2.3	<	>	=	=	=	=	>	<	<	>	=
Thompson Township	<	1	<	<	<	=	=	=	<	<	<	=	<
Union Dale Borough	=	2	=	=	=	=	=	=	<	=	<	>	=

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 high-risk natural hazard in Susquehanna 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 quantity of commercial and residential structures in each Susquehanna County municipality is outlined in section 4.3.3 of the flooding hazard profile.

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 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 Susquehanna County are estimated to equal $63,070,000. Residential occupancies make up 51.42% of the total estimated building-related losses. Total economic loss, including replacement value, content loss, functional loss and displacement cost, from a countywide 1%-annual-chance flood are estimated to equal $117,450,000.

4.4.4. Future Development and Vulnerability

Total population in Susquehanna County increased 2.6% between 2000 and 2010 from 42,238 to 43,356. However, all municipalities within the county have seen population decreases in the period between 2000 and 2016 with an overall county population loss of -5.7%, as seen in *Table 59 - 2000-2016 Population Change*. At the same time, the boroughs of Great Bend, Hallstead, Montrose, New Milford and Susquehanna Depot have (and will continue to have) the highest population densities in the county, meaning that hazard vulnerability and loss estimates will most be relatively higher in those municipalities. The 2016 estimated population for Susquehanna County is 40,862 which is 2,494 less than the 2010 census. There was an overall decrease of 5.7% in population based on the estimate. There were no municipalities that had an estimated increase with the 2016 estimate as identified in *Table 59 - 2000-2016 Population Change*.

Table 59 - 2000-2016 Population Change

Population Change in Susquehanna County from 2000-2016				
Municipality	**2000 Population**	**2010 Population**	**2016 Population (Estimated)**	**Percent of Change**
Apolacon Township	507	500	484	-3.2%
Ararat Township	531	563	533	-5.3%
Auburn Township	1816	1939	1866	-3.8%
Bridgewater Township	2668	2844	2754	-3.2%
Brooklyn Township	889	963	917	-4.8%
Choconut Township	797	713	668	-6.3%
Clifford Township	2381	2408	2301	-4.4%
Dimock Township	1398	1497	1418	-5.3%
Forest City Borough	1855	1911	1765	-7.6%
Forest Lake Township	1194	1193	1112	-6.8%
Franklin Township	938	937	883	-5.8%
Friendsville Borough	91	111	106	-4.5%
Gibson Township	1129	1221	1177	-3.6%
Great Bend Borough	700	734	678	-7.6%
Great Bend Township	1890	1949	1829	-6.2%
Hallstead Borough	1216	1303	1219	-6.4%
Harford Township	1301	1430	1348	-5.7%
Harmony Township	558	528	492	-6.8%
Herrick Township	599	713	688	-3.5%
Hop Bottom Borough	333	337	306	-9.2%
Jackson Township	788	848	791	-6.7%
Jessup Township	564	536	509	-5.0%

Population Change in Susquehanna County from 2000-2016				
Municipality	**2000 Population**	**2010 Population**	**2016 Population (Estimated)**	**Percent of Change**
Lanesboro Borough	588	506	468	-7.5%
Lathrop Township	835	841	798	-5.1%
Lenox Township	1832	1934	1820	-5.9%
Liberty Township	1266	1292	1214	-6.0%
Little Meadows Borough	290	273	258	-5.5%
Middletown Township	340	382	351	-8.1%
Montrose Borough	1664	1617	1491	-7.8%
New Milford Borough	878	868	850	-2.1%
New Milford Township	1859	2042	1904	-6.8%
Oakland Borough	622	616	567	-8.0%
Oakland Township	550	564	519	-8.0%
Rush Township	1290	1267	1202	-5.1%
Silver Lake Township	1729	1716	1620	-5.6%
Springville Township	1555	1641	1533	-6.6%
Susquehanna Depot Borough	1690	1643	1525	-7.2%
Thompson Borough	299	299	269	-10.0%
Thompson Township	440	410	389	-5.1%
Union Dale Borough	368	267	240	-10.1%
TOTAL	**42,238**	**43,356**	**40,862**	

5. Capability Assessment

5.1. Update Process Summary

The capability assessment is an evaluation of Susquehanna 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. 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 survey was provided to the county and municipalities during the planning process held with Susquehanna 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 forty 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 following categories – 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 Susquehanna County and its municipalities have the capacity to do and provides an understanding of what must be changed to mitigate loss.

Susquehanna County has multiple 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. 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 forty municipalities within Susquehanna County and Susquehanna County completed and submitted a capability assessment survey. The results of the survey were collected, aggregated and analyzed.

5.2.1. 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 storm-water 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 Susquehanna 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.

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.

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 2003 International Codes issued by the International Code Council (ICC). Supplements to the 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 Susquehanna County adhere to the standards of the Pennsylvania Uniform Construction Code (Act 45). Of the municipalities who submitted a capability assessment, thirty-four have opted in on building code enforcement.

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. Six municipalities in Susquehanna County have adopted and enforce a zoning ordinance.

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 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. Susquehanna County has a subdivision and land development ordinance that governs thirty-two of the forty municipalities. The remaining eight municipalities have their own subdivision and land development ordinance.

Storm-water Management Plan/Storm-water Ordinance

The proper management of storm-water 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 storm-water 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 storm-water management plan by amending or adopting laws and regulation for land use and development. The implementation of storm-water 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 storm-water 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 storm-water 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 twenty-one watersheds in Susquehanna County. Susquehanna County and other local municipalities have general (non-Act 167 compliant) storm-water management regulations as part of either the county or local subdivision and land development plan. No municipalities in Susquehanna County have their own stormwater management plans.

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 examines 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 ten 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 considers 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.

Susquehanna County has a county comprehensive plan that was adopted on November 12, 2003.

Article III of the Municipality Planning Code (MPC) enables municipalities to prepare a comprehensive plan however, development of a comprehensive plan is voluntary. Five municipalities in the Eastern section of Susquehanna County have joined forces to create a multi-municipal comprehensive plan. This multi-municipal plan is known as the Eastern Susquehanna County Partnership Multi-Municipal Comprehensive Plan and includes Ararat Township, Herrick Township, Thompson Borough, Thompson Township and Union Dale Borough. This plan was adopted in November 2005. A second multi-municipal plan is also in existence for the Northern section of the county. This plan is known as the Northern Tier Coalition Multi-Municipal Plan and includes Apolacon Township, Bridgewater Township, Choconut Township, Forest Lake Township, Franklin Township, Friendsville Borough, Jessup Township, Liberty Township, Little Meadows Borough, Montrose Borough, Middletown Township, Rush Township and Silver Lake Township. This plan was adopted in January 2005.

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, storm-water 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 Susquehanna County that have an identified capital improvement plan.

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:

1. Prohibiting manufactured homes in the floodway.
2. Prohibiting manufactured homes within the area measured 50 feet landward from the top-of bank of any watercourse within a special flood hazard area.
3. Special requirements for recreational vehicles within the special flood hazard area.
4. Special requirement for accessory structures.
5. 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.
6. Providing the Susquehanna 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:

1. Reduce flood losses
2. Protect public health and safety
3. Reduce damage to property
4. Prevent increases in flood damage from new construction
5. Reduce the risk of erosion damage
6. Protect natural and beneficial floodplain functions
7. Facilitate accurate insurance rating
8. Promote the awareness of flood insurance

There are ten 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 forty-five 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.

Of the municipalities who completed the capability assessment survey, thirty-seven indicated that they participate in the NFIP. Currently, no municipalities have completed or started to complete the CRS program. Additional research will be conducted on the CRS program and mitigation actions will be developed in support of the CRS. Informational classes that provide general information about the CRS for municipal elected officials will be conducted during the next five-year period.

5.2.2. Administrative and Technical Capability

There are twenty-seven townships, and thirteen boroughs within Susquehanna 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.

County Planning Department

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. The Susquehanna County Department of Planning assists all municipalities in the county as needed. The county employs a county planner on an annual basis.

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 in Susquehanna County subcontract a municipal engineer as needed.

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 utilized by a majority of the Susquehanna County Departments and Offices. GIS data is managed, maintained and developed by the Department of Economic Development for Susquehanna County. Additional GIS data layers that will assist with future hazard mitigation planning and vulnerability assessments are needed. There are no employees that have completed Basic HAZUS-MH.

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.

A municipal emergency management coordinator is responsible for emergency management – preparedness, response, recovery and mitigation within the 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 Susquehanna County and its municipalities to have an emergency management coordinator.

The Susquehanna County Emergency Management Agency coordinates countywide emergency management efforts. Each municipality has a designated local emergency management coordinator who possesses a unique knowledge of the impact hazard events have on their community.

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. Currently, thirty-seven municipalities have adopted the county EOP. The notification and resource section of the plan was developed individually by each municipality. The Susquehanna County Emergency Management Agency updates their EOP on a yearly basis.

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, the average response was a three, moderately willing.

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 60 - Capability Self-Assessment Matrix* summarizes the results of the self-assessment survey. Thirty eight out of forty municipalities returned this section of the assessment completed.

Table 60 - Capability Self-Assessment Matrix

Susquehanna County Capability Self-Assessment Matrix				
Municipality Name	**Capability Category**			
	Planning and Regulatory Capability	**Administrative and Technical Capability**	**Fiscal Capability**	**Community Political Capability**
Apolacon Township	M	M	H	M
Ararat Township	M	M	M	M
Auburn Township	L	L	M	M
Bridgewater Township	L	L	M	L
Brooklyn Township	M	M	M	M
Choconut Township	L	L	L	L
Clifford Township	M	L	L	L
Dimock Township	M	M	M	M
Forest City Borough	M	L	L	L
Forest Lake Township	L	L	L	L
Franklin Township	L	L	M	M
Friendsville Borough	L	L	L	L
Gibson Township	L	L	L	L
Great Bend Borough	M	M	L	M
Great Bend Township	M	M	L	M
Hallstead Borough	L	L	L	L
Harford Township	M	M	M	L
Harmony Township	M	M	L	M
Herrick Township	M	M	M	M
Hop Bottom Borough	H	H	H	H
Jackson Township	M	M	M	M

Susquehanna County Capability Self-Assessment Matrix				
Municipality Name	Capability Category			
	Planning and Regulatory Capability	Administrative and Technical Capability	Fiscal Capability	Community Political Capability
Jessup Township	M	M	M	M
Lanesboro Borough	M	M	L	L
Lathrop Township	L	L	L	L
Lenox Township	L	L	M	H
Liberty Township	L	L	L	L
Little Meadows Borough	M	M	L	L
Middletown Township	L	L	L	L
Montrose Borough	M	L	L	M
New Milford Borough	M	M	L	M
New Milford Township	M	M	M	M
Oakland Borough	L	L	L	L
Oakland Township	Not completed by municipality			
Rush Township	Not completed by municipality			
Silver Lake Township	M	M	L	M
Springville Township	L	L	L	L
Susquehanna Depot Borough	M	M	L	L
Thompson Borough	M	M	M	M
Thompson Township	L	L	L	L
Union Dale Borough	L	L	L	L

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.

5.2.3. Financial 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; lease-purchase, authorities and special district; current revenue (pay-as-you-go); reserve funds; and tax increment financing. Most municipalities have very limited local tax funds for capital projects. Grants and other funding is always a priority.

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.

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.

5.2.4. Education and Outreach

Susquehanna County has a limited education and outreach program. The Susquehanna County Emergency Management Agency conducts some public outreach at public events to update the citizens and visitors of the county on natural and human-caused hazards. The county conservation district also conducts outreach on various activities and projects in the county. Many of these projects are related to or directly impact hazard mitigation projects.

Educational activities that directly impact hazard mitigation in Susquehanna County predominantly revolve around the first responders. Providing fire, medical and search and rescue training and education enhances the response and recovery capabilities of response agencies in the county. Additional training is always a goal within Susquehanna County.

Education and outreach on the NFIP is necessary. With new regulations in floodplain management, updated digital flood insurance rate maps and new rate for insurance policies, education and outreach on the NFIP would assist the program. The Susquehanna County Local Planning Team will identify actions necessary to complete this.

5.2.5. Plan Integration

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 Susquehanna County Comprehensive Plan, Susquehanna County Emergency Operations Plan, local emergency operation plans, local zoning ordinances, local subdivision and land development ordinances.

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 Susquehanna 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).

The Susquehanna County Comprehensive Plan, the Susquehanna County Emergency Operations Plan, and various municipal regulatory tools identified in the capability assessment section of this plan require alignment with this updated hazard mitigation plan. The county comprehensive plan has not been updated since August 2008. This plan is very limited on the amount of hazard mitigation principals that are incorporated into the plan. Discussions on specific hazard areas within municipalities that may be used for future development must be addressed. Municipalities should also identify mitigation projects that could decrease the impact of hazards in these specific areas in the annual municipal capital improvement plan.

Storm-water management plans have not been implemented in the county and should strongly be considered and encouraged in the future. In the event that these plans are implemented, Susquehanna County officials will ensure that hazard mitigation data and principals are implemented as appropriate.

Susquehanna County is a small county with a limited population and a limited amount of resources to appropriately ensure and implement hazard mitigation principals into all regulatory tools. Susquehanna County will continue to explore options to further enhance the implementation of these principals utilizing already multi-tasked staff and

resources. Susquehanna County will review other local and state plans that could be impacted with hazard mitigation principals over the next five-year planning period.

Pennsylvania All-Hazard Mitigation Plan - 2013

The Pennsylvania All-Hazard Mitigation Plan (PAHMP) is the baseline document for all county hazard mitigation plans in the Commonwealth of Pennsylvania. During the 2018 Susquehanna County HMP update, the local planning team and steering committee reviewed and utilized the various sections of the PAHMP to provide information specific to the same sections of the Susquehanna County HMP. As an example, the PAHMP Risk Assessment section provided copious amounts of past occurrence and vulnerability data for every hazard profile that was updated or developed new in the 2018 Susquehanna County HMP. The PAHMP also provided information and data on contiguous counties to Susquehanna County within the Commonwealth. Contiguous counties to Susquehanna County within Pennsylvania are Bradford, Wyoming, Lackawanna and Wayne Counties. Information on past occurrences of hazards and mitigation actions and opportunities were utilized.

The PAHMP was also utilized to ensure that the updated Susquehanna County mitigation strategy was aligned with the PAHMP mitigation strategy. High priority mitigation strategies in the PAHMP (like removal of repetitive loss and severe repetitive loss properties from the floodplain) were considered with the Susquehanna County HMP mitigation strategy development. The local planning team consulted the PAHMP as they developed new actions and project opportunities.

National Flood Insurance Program and Municipal Floodplain Ordinance

The National Flood Insurance Program provided specific information that was incorporated into the Flooding Profile (section 4.3.3) and the Capability Assessment Findings (section 5.2). Specifically, the amount of active insurance policies per municipality, repetitive loss properties and severe repetitive loss properties were used in the vulnerability assessment section of the flooding profile. This afforded the local planning team specific vulnerability information that was then used to develop mitigation actions and municipal mitigation project opportunity forms. Numerous municipalities identified flooding, flash flooding and ice jam flooding project opportunities that would decrease the loss of life and property damage when completed. These opportunities are identified in Appendix G.

A GIS dataset of the 1% annual chance floodplain as identified by FEMA Digital Flood Insurance Rate Maps (DFIRM) from 2015 was used to identify structures and critical facilities that fall within the floodplain in Susquehanna County for the vulnerability assessment of the Flooding Profiles (section 4.3.3). While DFIRM maps are a useful tool and important to integrate into this planning process, it should also be noted that these

are not completely accurate, and are estimates and models of vulnerability. A map of these floodplains for each municipality in Susquehanna County can be found in Appendix D.

In the future, Susquehanna County should ensure that all floodplain ordinance updates have integrated hazard mitigation principles by participation in NFIP programs and integrating the NFIP program data into any applicable hazard mitigation sections. Susquehanna will utilize the National Flood Insurance Program (NFIP) Survey document to ensure that flood insurance outreach, floodplain map dissemination and floodplain ordinance enforcement is accurately completed.

Susquehanna 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 ten years. The Susquehanna County Commissioners adopted the updated Susquehanna County Comprehensive Plan on November 12, 2003.

The Susquehanna County Department of Planning is responsible for maintaining and updating the Susquehanna County Comprehensive Plan and many other regulatory tools. Technical assistance on community planning matters is provided to the Susquehanna County Board of Commissioners through the Susquehanna County Department of Planning. The department of planning administers the Susquehanna County Comprehensive Plan. The department of planning also performs technical reviews of municipal subdivision and land development plans, municipal floodplain ordinances and other community planning and development matters.

Susquehanna 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). Susquehanna County Office of Emergency Services 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 annually. 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.

The complete risk assessment section, mitigation actions and mitigation project opportunities identified in the Susquehanna 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.

The EMA will consider the Susquehanna County Hazard Mitigation Plan during its annual review of the county EOP. Recommended changes to the HMP will then be coordinated with the hazard mitigation local planning team.

Other Resources and Interconnectivity

Other resources utilized in the planning process include the PA DEP 2015 Oil and Gas Annual Report, which provided valuable information about Pennsylvania and Susquehanna County in the Environmental Hazards Profile (section 4.3.16). The USDA 2012 Census of Agriculture was referenced in the Drought Profile (section 4.3.1) to provide community information about Susquehanna County. The PA West Nile Control Program, a collaboration between the PA DEP, PA DOH & the PA DOA, was a valuable resource for the Pandemic and Infectious Diseases Profile (4.3.9), providing background information and detailed past occurrence data for West Nile Virus in Susquehanna County. All references utilized to update all sections of this 2018 hazard mitigation plan have been included in appendix A. Specifically, references used for the hazard identification and risk assessment are noted in appendix A as well.

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, Susquehanna 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. Susquehanna 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.

6. Mitigation Strategy

6.1. Update Process Summary

Mitigation goals are general guidelines that explain what the county wants to achieve. Goals are usually expressed as broad policy statements representing desired long-term results. Mitigation objectives describe strategies or implementation steps to attain the identified goals. Objectives are more specific statements than goals; the described steps are usually measurable and can have a defined completion date. There were four goals and twenty-one objectives identified in the 2012 hazard mitigation plan. The 2018 Susquehanna County Hazard Mitigation Plan Update has four goals and fourteen objectives. Objectives have been added and arranged in order to associate them with the most appropriate goal. These changes are noted in *Table 61 - 2012 Mitigation Goals and* Objectives. 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 61 - 2012 Mitigation Goals and Objectives.* 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 mitigation strategy update meeting. Copies of these meetings and all documentation associated with the meetings are located in Appendix C.

Actions provide more detailed descriptions of specific work tasks to help the county and its municipalities achieve prescribed goals and objectives. There were sixteen actions identified in the 2012 mitigation strategy. A review of the 2012 mitigation actions was completed by the local planning team. The results of this review are identified in *Table 61 - 2012 Mitigation Goals and Objectives.* Actions were evaluated by the local planning team with the intent of carrying over any actions that were not started or continuous for the next five years.

Table 61 - 2012 Mitigation Goals and Objectives

Susquehanna County 2012 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
GOAL 1	**Protect Life and Property**	Protect life and property from all natural and human-caused hazards. Flooding should be separate.

Susquehanna County 2012 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
Objective 1.1	Implement mitigation activities that will assist in protecting lives and property by making homes, businesses, infrastructure, and critical facilities more resistant to hazards.	No change.
Objective 1.2	Encourage property owners to take preventive actions in areas that are especially vulnerable to hazards.	No change
Objective 1.3	Review existing local laws and ordinances, building codes, safety inspection procedures, and applicable rules to help ensure that they employ the most recent and generally accepted standards for the protection of buildings and environmental resources.	Review and Recommend existing laws
Objective 1.4	Ensure that public and private facilities and infrastructure meet established building codes and immediately enforce the codes to address any identified deficiencies.	This is an action that ties back to objective 1.3.
Objective 1.5	Incorporate hazard considerations into land-use planning and natural resource management.	This is an action that ties back to objective 1.3.
Objective 1.6	Encourage homeowners, renters, and businesses to purchase insurance coverage for potential damages caused by hazards.	No change (Possibly public awareness)
Objective 1.7	Integrate the recommendations of this plan into existing local and County programs.	Integrate hazard mitigation principals from the 2018 plan into local and county plans and programs.
Objective 1.8	Implement mitigation activities that encourage environmental stewardship and protection of the environment.	
GOAL 2	**Increase Public Awareness**	Increase education and risk awareness regarding natural and human-caused hazards.
Objective 2.1	Develop and implement additional education and outreach programs to increase public awareness of the risks associated with significant hazards present in the County and educate the public on specific, individual preparedness activities.	Develop and implement additional education and outreach programs to increase public awareness of the risks associated with all hazards and educate the public on specific, individual preparedness activities.

Susquehanna County 2012 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
Objective 2.2	Provide information on tools, partnership opportunities, funding resources, and current government initiatives to assist in implementing mitigation activities.	Research and identify information
Objective 2.3	Implement mitigation activities that enhance the technological capabilities of municipalities and agencies in the County to better profile and assess exposure of hazards.	Implement mitigation activities that enhance the capabilities of municipalities and agencies in the county to better profile and assess risk of hazards. Move to Goal #1, Objective 1.4
Objective 2.4	Provide comprehensive information online to local emergency service providers, municipalities, the media and the public during and immediately following disaster and hazard events regarding emergency traffic routes, road closures, shelter locations, traffic restrictions, etc.	Removal word on-line. Remove "regarding emergency traffic routes, road closures, shelter locations, traffic restrictions, etc." Now reads, "Provide comprehensive information to local emergency service providers, municipalities, the media and the public during and immediately following disaster and hazard events"
Objective 2.5	Formalize hazard mitigation as a factor in all facets of community planning and development activities	No change
GOAL 3	**Encourage Partnerships**	Encourage and develop local, state, regional and federal partnerships to improve coordination, planning and regulation development and enforcement.
Objective 3.1	Strengthen inter-jurisdictional and inter-agency communication, coordination and partnerships to foster hazard mitigation strategies and/or projects designed to benefit multiple jurisdictions or municipalities.	Encourage and develop inter-jurisdictional and inter-agency partnerships to foster hazard mitigation strategies and/or projects
Objective 3.2	Identify and implement ways to engage public agencies with individual citizens, non-profit organizations, business, and industry to implement mitigation activities more effectively.	No change
Objective 3.3	Encourage shared services in acquiring, maintaining, and providing emergency services and equipment.	Encourage mutual aid relationships in acquiring, maintaining and providing emergency resources.

Susquehanna County 2012 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
GOAL 4	**Provide for Emergency Services**	Enhance and improve emergency preparedness, warning and response procedures and capabilities.
Objective 4.1	Encourage the establishment of policies at the County and local level to help ensure the prioritization and implementation of mitigation measures essential to the physical integrity and operations of facilities, services, and infrastructure.	Encourage the establishment of policies at the County and local level to help ensure the prioritization and implementation of mitigation measures.
Objective 4.2	Where appropriate, coordinate and integrate hazard mitigation activities with existing local emergency operations plans.	Remove. No longer applicable.
Objective 4.3	Identify the need for, and acquire, any special emergency services, training, and equipment needed to enhance response capabilities for specific hazards.	Identify and acquire, any emergency services, training, and equipment needed to enhance response capabilities for specific hazards.
Objective 4.4	Review and improve, if necessary, emergency traffic routes; communicate such routes to the public and communities.	Review and improve emergency traffic routes and communicate such routes to the public and communities.
Objective 4.5	Ensure continuity of governmental operations, emergency services, and essential facilities at the County and local level during and immediately after disaster and hazard events.	Move to Goal #1, Objective 1.5

Table 62 - 2012 Mitigation Actions Review

2012 Susquehanna County Mitigation Actions Review						
Existing Mitigation Actions	***Status***					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION 1: Monitor, remove stream debris, stabilize streambanks and restore streams needed.			**X**			All municipalities. Most municipalities identified this as a continuous project as they do this annually as needed. Objective 1.1 Action 1.1.1 or 1.7.1
ACTION 2: Install new pipe/culvert or increase size of pipe/culvert to reduce runoff and flooding at identified problem areas. (Community specific information is located in Appendix C)			**X**			All Municipalities. Most municipalities identified this as a continuous project as they do this annually as needed. Project Opportunity Form. Objective 1.1 Action 1.1.2
ACTION 3: Elevate or repair Identified roadways to reduce flooding and/or snow drifting			**X**			All Municipalities. Most municipalities identified this as a continuous project as they do this annually as needed. Project Opportunity Form.
ACTION 4: Replace/Rebuild identified bridges to accommodate increased water flow.			**X**			All Municipalities. Most municipalities identified this as a continuous project as they do this annually as needed. Project Opportunity Form.
ACTION 5: Monitor and remove restrictive streambanks and or/debris from Alford and Brooklyn Dam outflows as needed.	**X**					Brooklyn Township Project Opportunity Form.
ACTION 6: Develop a flood control plan with the Choconut Creek Watershed Association.	**X**					Choconut Township Objective 1.3.1

2012 Susquehanna County Mitigation Actions Review						
Existing Mitigation Actions	***Status***					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION 7: Stormwater upgrade in association with Boroughwide sewer main replacement.			**X**			Forest City Borough. The borough states this action is continuous. They anticipate completing their current project by June 2018 but will endeavor additional projects to further upgrade the system.
ACTION 8: Place snow fence where drifting is expected			**X**			Gibson Township states this is continuous., Herrick Township. Ararat Township states no progress also.
ACTION 9: Burn ban during drought to prevent wildfires			**X**			Gibson Township. This is completed countywide as needed when conditions are at a high vulnerability for wildfires. Objective 1.7.1
ACTION 10: Continue code enforcement for land use, building codes and floodplain			**X**			Gibson Township, Great Bend Borough. Great Bend Borough identified this as a continuous action. Objective 1.3.2
ACTION 11: Build 1,100' x 5' levee behind houses and parallel to Main Street.	**X**					Lanesboro Borough
ACTION 12: Investigate risk potential of Buckey Pumping Station on SR 2002 and aging pipelines.				**X**		Lathrop Township advised that this project was completed.
ACTION 13: Seek guidance on risk potential of natural gas exploration and drilling.			**X**			Lathrop Township advised that this action is continuous and that the railroad parallels route 11 and that an increase for derailment is present. Objective 2.3.1
ACTION 14: Stabilize/repair roadside affecting Route 29				**X**		Liberty Township advised that this project is complete.

2012 Susquehanna County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					**Review Comments**
	No Progress / Unknown	In Progress / Not Yet Complete	Continuous	Completed	Discontinued	
ACTION 15: Stabilize landslides on Route 29 and Liberty Park Road				X		Liberty Township advised that this project is complete.
ACTION 16: Raise wellheads and electric box to protect from flooding on Route 92	X					Oakland Borough
ACTION 17: Conduct engineering study to determine necessary modifications to drainage system at State, High and East High Streets.	X					Oakland Borough Objective 2.2.1
ACTION 18: Construct berm at Sewer Authority to prevent flooding from Drinker Creek				X		Susquehanna Depot Borough reported that this was completed since the last hazard mitigation plan update. No completion date provided.
ACTION 19: Replace Front Street retaining wall					X	Susquehanna Depot Borough advised this action should be discontinued.
ACTION 20: Inspect and maintain Thompson Mill Pond Dam			X			Thompson Borough. The municipality identified that this is a continuous action that is completed annually. Action 1.1.3
ACTION 21: Identify and implement structural and property protection projects to reduce the impacts from flooding including floodproofing, acquisition, elevation and relocation projects.		X				All Municipalities. Will need to add demolition/reconstruction to this action. Hop Bottom Borough stated that many residents are moving their furnace, electric box and water heater to higher locations in the building. Objective 1.1.4
ACTION 22: Maintain, update, and enhance Mutual Aid Agreements at all levels of government			X			Susquehanna County Objective 3.3.1 Agreements with Wyoming County PA and Broome County NY

2012 Susquehanna County Mitigation Actions Review						
Existing Mitigation Actions	***Status***					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION 23: Review, update and enhance early warning and notification systems			**X**			Susquehanna County Objective 4.2.1 Text paging to FR. Code Red. SMART 911
ACTION 24: Publicize/release shelter information during an emergency with special attention to facilities that accommodate pets.			**X**			Susquehanna County Objective 2.3.2 Use social media to assist with.
ACTION 25: Where necessary, obtain funding for back-up generators and other redundant systems and utilities necessary for nursing homes, personal care facilities, and other critical assets vital to safety and the delivery of government services.			**X**			Susquehanna County Objective 1.1.5 All county facilities have gensets. Critical facilities have as well. Both hospitals.
ACTION 26: Develop, promote, and adopt model ordinances to reduce vulnerabilities to hazards			**X**			Susquehanna County Objective 1.3.3 Update to say floodplain
ACTION 27: Encourage continued compliance and greater participation in the NFIP			**X**			Susquehanna County Objective 1.3.4
ACTION 28: Actively integrate recommendations and principles of this plan into existing local and County programs and initiatives			**X**			Susquehanna County. Expand this some. Determine specific plans that this could occur with. Objective 2.4.1

2012 Susquehanna County Mitigation Actions Review						
Existing Mitigation Actions	***Status***					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION 29: Secure and facilitate training in all aspects of damage prevention, emergency management, and disaster recovery, with emphasis on grant programs and maximizing federal and state resources			**X**			Susquehanna County Objective 2.1.1
ACTION 30: Support remapping of floodplain within Susquehanna County and the development of better floodplain management tools			**X**			Susquehanna County Objective 1.3.5
ACTION 31: Actively pursue funding on annual basis, outside disaster assistance programs, for flood mitigation activities that target repetitive loss properties and improve public safety.			**X**			Susquehanna County Objective 2.2.2
ACTION 32: Prioritize and target RL and SRL properties (Tables 4.3.3-2 and 4.3.3-3) for structural and property protection projects to reduce the impacts from flooding including floodproofing, acquisition, elevation and relocation projects.			**X**			All Municipalities. Add demolition/reconstruction. No progress munis: Jessup Twp. Objective 1.2.1

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 four goals and eighteen corresponding objectives was developed. *Table 63 - 2018 Goals and Objectives* details the mitigation goals and objectives established for the 2018 Susquehanna County Hazard Mitigation Plan.

Table 63 - 2018 Goals and Objectives

2018 Susquehanna County Goals and Objectives	
GOAL 1	***Protect life and property from all natural and human-caused hazards.***
Objective 1.1	*Implement mitigation activities that will assist in protecting lives and property by making homes, businesses, infrastructure, and critical facilities more resistant to hazards.*
Objective 1.2	*Encourage property owners to take preventive actions in areas that are especially vulnerable to hazards.*
Objective 1.3	*Review and recommend existing local laws and ordinances, building codes, safety inspection procedures, and applicable rules to help ensure that they employ the most recent and generally accepted stands for the protection of buildings and environmental resources.*
Objective 1.4	*Implement mitigation activities that enhance the capabilities of municipalities and agencies in the county to better profile and assess risk of hazards.*
Objective 1.5	*Ensure continuity of governmental operations, emergency services, and essential facilities at the county and local level during and immediately after disaster and hazard events.*
Objective 1.6	*Integrate hazard mitigation principals from the 2018 plan into local and county plans and programs.*
Objective 1.7	*Implement mitigation activities that encourage environmental stewardship and protection of the environment.*
GOAL 2	***Increase education and risk awareness regarding natural and human-caused hazards.***
Objective 2.1	*Develop and implement additional education and outreach programs to increase public awareness of the risks associated with all hazards and educate the public on specific, individual preparedness activities.*
Objective 2.2	*Research and identify information on tools, partnership opportunities, funding resources, and current government initiatives to assist in implementing mitigation activities.*
Objective 2.3	*Provide comprehensive information to local emergency service providers, municipalities, the media and the public during and immediately following disaster and hazard events*
Objective 2.4	*Formalize hazard mitigation as a factor in all facets of community planning and development activities*

2018 Susquehanna County Goals and Objectives	
Objective 2.5	*Encourage homeowners, renters, and businesses to purchase insurance coverage for potential damages caused by hazards.*
GOAL 3	***Encourage and develop local, state, regional and federal partnerships to improve coordination, planning and regulation development and enforcement.***
Objective 3.1	*Encourage and develop inter-jurisdictional and inter-agency partnerships to foster hazard mitigation strategies and/or projects*
Objective 3.2	*Identify and implement ways to engage public agencies with individual citizens, non-profit organizations, business, and industry to implement mitigation activities more effectively.*
Objective 3.3	*Encourage mutual aid relationships in acquiring, maintaining and providing emergency resources.*
GOAL 4	***Enhance and improve emergency preparedness, warning and response procedures and capabilities.***
Objective 4.1	*Encourage the establishment of policies at the county and local level to help ensure the prioritization and implementation of mitigation measures.*
Objective 4.2	*Identify and acquire, any emergency services, training, and equipment needed to enhance response capabilities for specific hazards.*
Objective 4.3	*Review and improve emergency traffic routes and communicate such routes to the public and communities.*

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

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
- 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 64 - 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 65 - 2018 Mitigation Action Plan*.

Table 64 - Mitigation Strategy Technique Matrix

Susquehanna County Mitigation Strategy Technique Matrix				
HAZARD	**MITIGATION TECHNIQUE**			
	Local Plans and Regulations	**Structural and Infra-structure**	**Natural Systems Protection**	**Education and Awareness**
Drought	X		X	X
Earthquake	X	X		X
Flood, Flash Flood, Ice Jam Flooding	X	X	X	X
Hailstorm	X	X		X
Hurricane, Tropical Storm, Nor'easter	X	X	X	X
Invasive Species	X		X	X
Landslides	X	X	X	X
Lightning Strike	X	X		X
Pandemic, Epidemic and Infectious Disease	X		X	X
Radon Exposure	X	X		X
Tornado	X	X		X
Windstorm	X	X		X
Cyber Crime Attack	X			X
Dam Failure	X	X		X
Environmental Hazards	X	X		X
Opioid Epidemic	X			X
Terrorism	X			X
Transportation Accidents	X	X		X
Utility Interruptions	X	X		X

6.4. Mitigation Action Plan

The Susquehanna County Hazard Mitigation Local Planning Team (LPT) immediately began work on the mitigation strategy section of the 2018 hazard mitigation plan (HMP) update after the risk assessment section was completed. The LPT started this section by reviewing the 2012 HMP mitigation strategy section. A review of the previous goals, objectives, actions and project opportunities documented in the 2012 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.

MCM Consulting Group, Inc. completed municipality meetings at various time periods at the Susquehanna County Emergency Management Agency. 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 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 opportunity forms 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 2018 Susquehanna County HMP are listed in the mitigation action plan. *Table 65 - 2018 Mitigation Action Plan* is the 2018 Susquehanna County Mitigation Action Plan. This plan outlines mitigation actions and projects that comprise a strategy for Susquehanna 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 and an estimated cost. All benefit and cost analysis were completed using the Pennsylvania Emergency Management Agency recommended analysis tool. The completed analysis is located in Appendix H. *Table 66 - 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.

Table 65 - 2018 Mitigation Action Plan

Susquehanna County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
1.1.1	Structural and Infrastructure	Monitor, remove stream debris, stabilize streambanks and restore streams as needed.	Flooding		**X**		Ongoing	Local, HMGP, PDM and FMA Grants	Susquehanna Municipalities
1.1.2	Structural and Infrastructure	Install new pipe/culvert or increase size of pipe/culvert to reduce runoff and flooding at identified problem areas.	Flooding		**X**		Ongoing	Local, HMGP, PDM and FMA Grants	Susquehanna Municipalities
1.1.3	Structural and Infrastructure	Inspect and maintain Thompson Mill Pond Dam	Dam Failure			**X**	Ongoing	Local	Thompson Borough
1.1.4	Structural and Infrastructure	Identify and implement structural and property protection projects to reduce the impacts from flooding including flood proofing, acquisition, elevation, relocation and demolition and reconstruction projects.	All Hazards	**X**			Ongoing	Local	Susquehanna Municipalities
1.1.5	Structural and Infrastructure	Where necessary, obtain funding for back-up generators and other redundant systems and utilities necessary for nursing homes, personal care facilities, and other critical assets vital to safety and the delivery of government services.	Utility Interruptions	**X**			Ongoing	Local and HSGP	Susquehanna County EMA and all Municipal EMA
1.2.1	Structural and Infrastructure	Prioritize and target repetitive loss and severe repetitive loss for structural and property protection projects to reduce the impacts from flooding including flood proofing, acquisition, elevation, relocation and demolition/reconstruction projects.	Flooding	**X**			Ongoing	Local, HMGP, PDM and FMA Grants	Susquehanna County EMA and all Municipal EMA
1.2.2	Local Plans and Regulations	Conduct educational sessions on the community rating system offered by the National Flood Insurance Program for all municipalities	Flooding			**X**	2018-2022	Local and FMA	Susquehanna County EMA and Planning, PSATS

Susquehanna County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
1.3.1	Local Plans and Regulations	Develop a flood control plan with the Choconut Creek Watershed Association.	Flooding			**X**	2018-2022	Local	Susquehanna County Planning and Choconut Township
1.3.2	Local Plans and Regulations	Continue code enforcement for land use, building codes and floodplain	All Hazards		**X**		Ongoing	Local	Susquehanna Municipalities
1.3.3	Local Plans and Regulations	Develop, promote, and adopt model floodplain ordinances to reduce vulnerabilities to flooding	Flooding		**X**		Ongoing	Local	Susquehanna County Planning and Susquehanna Municipalities
1.3.4	Local Plans and Regulations	Encourage continued compliance and greater participation in the NFIP	Flooding			**X**	Ongoing	Local	Susquehanna County Planning and Susquehanna Municipalities
1.3.5	Local Plans and Regulations	Support remapping of floodplain within Susquehanna County and the development of better floodplain management tools	Flooding			**X**	Ongoing	Local, HMGP, PDM and FMA	Susquehanna County Planning and Susquehanna Municipalities
1.4.1	Local Plans and Regulations	Conduct a county wide hazardous material commodity flow study.	Environmental Hazards		**X**		2019	Act 165 and HMEP	Susquehanna County EMA and LEPC
1.4.2	Local Plans and Regulations	Susquehanna County GIS will develop layers for future hazard mitigation planning and vulnerability assessments.	All Hazards		**X**		Ongoing	Local	Susquehanna County GIS
1.4.3	Local Plans and Regulations	Susquehanna County GIS will complete HAZUS loss estimation software training.	All Hazards			**X**	2018-2022	Local	Susquehanna County GIS
1.5.1	Structural and Infrastructure	Susquehanna County to implement new fire walls to decrease the impact of cyber-attacks.	Cyber Attack		**X**		2018	Local and Act 12 Funds	Susquehanna County IT, 911 and EMA

Susquehanna County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
1.5.2	Education and Awareness	Susquehanna County will exercise the county continuity of government plan and update with information from the after action report.	All Hazards			**X**	Ongoing	Local, HSGP and EMPG	Susquehanna County
1.5.3	Education and Awareness	Outreach to businesses will be completed to encourage the development of a continuity of operations plan to ensure the survivability of business post disaster.	All Hazards		**X**		Ongoing	Local and EMPG	Susquehanna County EMA
1.6.1	Local Plans and Regulations	Integrate 2018 hazard mitigation principals into the next county comprehensive plan update.	All Hazards		**X**		2018-2019	Local and MAP funds	Susquehanna County Commissioners and Planning
1.6.2	Local Plans and Regulations	Update the municipal regional comprehensive plans and integrate hazard mitigation principals.	All Hazards		**X**		Ongoing	Local and EMPG	Susquehanna County EMA and Municipalities
1.7.1	Local Plans and Regulations	Enact a county burn ban during drought to prevent wildfires	Wildfire		**X**		Ongoing	Local	Susquehanna County EMA County Fire Chiefs
2.1.1	Education and Awareness	Secure and facilitate training in all aspects of damage prevention, emergency management, and disaster recovery, with emphasis on grant programs and maximizing federal and state resources	All Hazards		**X**		Ongoing	Local and EMPG	Susquehanna County EMA
2.1.2	Education and Awareness	Develop a training program on household hazardous materials and conduct various sessions across the county.	Environmental Hazards			**X**	Ongoing	Local and Act 165	Susquehanna County Commissioners, EMA and LEPC
2.1.3	Education and Awareness	Conduct a Narcan training program for all first responders and secondary responders of the county.	Opioid Epidemic	**X**			Ongoing	Local and PCCD	Susquehanna County Coroner
2.1.4	Education and Awareness	Conduct first responder training on transportation and fixed facility HazMat emergencies.	Environmental Hazards	**X**			Ongoing	Local and Act 165	Susquehanna County EMA and LEPC

Susquehanna County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
2.1.5	Education and Awareness	Conduct public education and outreach so the residents of the county are aware of the threat level of radon in the county per municipality.	Radon			**x**	Ongoing	Local and Act 165	Susquehanna County EMA
2.1.6	Education and Awareness	Conduct public education and outreach so the residents of the county are aware of the location radon test kits can be acquired and the process for completing radon tests on their homes.	Radon			**x**	Ongoing	Local and Act 165	Susquehanna County EMA
2.2.1	Local Plans and Regulations	Conduct engineering study to determine necessary modifications for drainage systems at: State, High and East High Streets.	Flooding and Transportation Accidents			**x**	Ongoing	Local, HMGP, PDM and FMA	Oakland Borough
2.2.2	Local Plans and Regulations	Actively pursue funding on annual basis, outside disaster assistance programs, for flood mitigation activities that target repetitive loss properties and improve public safety.	Flooding		**x**		Ongoing	Local, HMGP, PDM and FMA	Susquehanna County Municipalities
2.2.3	Education and Awareness	Research and identify funding to purchase a fire prevention trailer to be used to educate children on what to do when a fire occurs and how to navigate a smoke-filled room.	Structure Fires		**x**		2018-2020	Local and Act 13	Susquehanna County Commissioners
2.2.4	Education and Awareness	Drug and Alcohol Task Force activities to decrease the impact of opioid epidemic	Opioid Epidemic		**x**		Ongoing	Local and PCCD	Susquehanna County DA
2.3.1	Education and Awareness	Seek guidance on risk potential of natural gas exploration and drilling.	Environmental Hazards			**x**	Ongoing	Local	Lathrop Township
2.3.2	Education and Awareness	Publicize/release shelter information during an emergency with special attention to facilities that accommodate pets.	All Hazards			**x**	Ongoing	Local, HSGP and EMPG	Susquehanna County 911, EMA and Red Cross

Susquehanna County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
2.4.1	Local Plans and Regulations	Actively integrate recommendations and principles of the 2018 hazard mitigation plan into existing local and county emergency operations plans	All Hazards		X		Ongoing	Local and EMPG	Susquehanna County EMA and Municipal EMA
2.5.1	Education and Awareness	Encourage citizens to purchase flood insurance for properties located in the special flood hazard area or known flooding areas.	Flooding		X		Ongoing	Local	Susquehanna County Planning
3.2.1	Education and Awareness	Dropbox locations throughout the county to return prescription drugs to ensure that abuse is decreased	Opioid Epidemic		X		Ongoing	Local and PCCD	Susquehanna Law Enforcement Agencies
3.3.1	Local Plans and Regulations	Maintain, update, and enhance Mutual Aid Agreements at all levels of government	All Hazards	X			Ongoing	Local	Susquehanna County and Municipalities
4.2.1	Local Plans and Regulations	Review, update and enhance early warning and notification systems	All Hazards	X			Ongoing	Local HSGP and Act 12 Funds	Susquehanna County 911 and EMA

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

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

Table 66 - Municipal Hazard Mitigation Actions Checklist

Municipal Hazard Mitigation Actions Checklist										
Municipality	**1.1.1**	**1.1.2**	**1.1.3**	**1.1.4**	**1.1.5**	**1.2.1**	**1.2.2**	**1.3.1**	**1.3.2**	**1.3.3**
Apolacon Township	X	X		X	X	X			X	X
Ararat Township	X	X		X	X	X			X	X
Auburn Township	X	X		X	X	X			X	X
Bridgewater Township	X	X		X	X	X			X	X
Brooklyn Township	X	X		X	X	X			X	X
Choconut Township	X	X		X	X	X		X	X	X
Clifford Township	X	X		X	X	X			X	X
Dimock Township	X	X		X	X	X			X	X
Forest City Borough	X	X		X	X	X			X	X
Forest Lake Township	X	X		X	X	X			X	X
Franklin Township	X	X		X	X	X			X	X
Friendsville Borough	X	X		X	X	X			X	X
Gibson Township	X	X		X	X	X			X	X
Great Bend Borough	X	X		X	X	X			X	X
Great Bend Township	X	X		X	X	X			X	X
Hallstead Borough	X	X		X	X	X			X	X
Harford Township	X	X		X	X	X			X	X
Harmony Township	X	X		X	X	X			X	X
Herrick Township	X	X		X	X	X			X	X
Hop Bottom Borough	X	X		X	X	X			X	X
Jackson Township	X	X		X	X	X			X	X
Jessup Township	X	X		X	X	X			X	X
Lanesboro Borough	X	X		X	X	X			X	X
Lathrop Township	X	X		X	X	X			X	X
Lenox Township	X	X		X	X	X			X	X
Liberty Township	X	X		X	X	X			X	X
Little Meadows Borough	X	X		X	X	X			X	X
Middletown Township	X	X		X	X	X			X	X
Montrose Borough	X	X		X	X	X			X	X
New Milford Borough	X	X		X	X	X			X	X
New Milford Township	X	X		X	X	X			X	X
Oakland Borough	X	X		X	X	X			X	X

Municipal Hazard Mitigation Actions Checklist										
Municipality	**1.1.1**	**1.1.2**	**1.1.3**	**1.1.4**	**1.1.5**	**1.2.1**	**1.2.2**	**1.3.1**	**1.3.2**	**1.3.3**
Oakland Township	X	X		X	X	X			X	X
Rush Township	X	X		X	X	X			X	X
Silver Lake Township	X	X		X	X	X			X	X
Springville Township	X	X		X	X	X			X	X
Susquehanna Depot Borough	X	X		X	X	X			X	X
Thompson Borough	X	X	X	X	X	X			X	X
Thompson Township	X	X		X	X	X			X	X
Union Dale Borough	X	X		X	X	X			X	X
Susquehanna County				X	X	X	X	X	X	X

Municipal Hazard Mitigation Actions Checklist										
Municipality	**1.3.4**	**1.3.5**	**1.4.1**	**1.4.2**	**1.4.3**	**1.5.1**	**1.5.2**	**1.5.3**	**1.6.1**	**1.6.2**
Apolacon Township	X	X								X
Ararat Township	X	X								X
Auburn Township	X	X								X
Bridgewater Township	X	X								X
Brooklyn Township	X	X								X
Choconut Township	X	X								X
Clifford Township	X	X								X
Dimock Township	X	X								X
Forest City Borough	X	X								X
Forest Lake Township	X	X								X
Franklin Township	X	X								X
Friendsville Borough	X	X								X
Gibson Township	X	X								X
Great Bend Borough	X	X								X
Great Bend Township	X	X								X
Hallstead Borough	X	X								X
Harford Township	X	X								X
Harmony Township	X	X								X
Herrick Township	X	X								X
Hop Bottom Borough	X	X								X
Jackson Township	X	X								X
Jessup Township	X	X								X

Municipal Hazard Mitigation Actions Checklist										
Municipality	**1.3.4**	**1.3.5**	**1.4.1**	**1.4.2**	**1.4.3**	**1.5.1**	**1.5.2**	**1.5.3**	**1.6.1**	**1.6.2**
Lanesboro Borough	X	X								X
Lathrop Township	X	X								X
Lenox Township	X	X								X
Liberty Township	X	X								X
Little Meadows Borough	X	X								X
Middletown Township	X	X								X
Montrose Borough	X	X								X
New Milford Borough	X	X								X
New Milford Township	X	X								X
Oakland Borough	X	X								X
Oakland Township	X	X								X
Rush Township	X	X								X
Silver Lake Township	X	X								X
Springville Township	X	X								X
Susquehanna Depot Borough	X	X								X
Thompson Borough	X	X								X
Thompson Township	X	X								X
Union Dale Borough	X	X								X
Susquehanna County	X	X	X	X	X	X	X	X	X	X

Municipal Hazard Mitigation Actions Checklist										
Municipality	**1.7.1**	**2.1.1**	**2.1.2**	**2.1.3**	**2.1.4**	**2.1.5**	**2.1.6**	**2.2.1**	**2.2.2**	**2.2.3**
Apolacon Township									X	
Ararat Township									X	
Auburn Township									X	
Bridgewater Township									X	
Brooklyn Township									X	
Choconut Township									X	
Clifford Township									X	
Dimock Township									X	
Forest City Borough									X	
Forest Lake Township									X	
Franklin Township									X	
Friendsville Borough									X	

Municipal Hazard Mitigation Actions Checklist										
Municipality	**1.7.1**	**2.1.1**	**2.1.2**	**2.1.3**	**2.1.4**	**2.1.5**	**2.1.6**	**2.2.1**	**2.2.2**	**2.2.3**
Gibson Township									x	
Great Bend Borough									x	
Great Bend Township									x	
Hallstead Borough									x	
Harford Township									x	
Harmony Township									x	
Herrick Township									x	
Hop Bottom Borough									x	
Jackson Township									x	
Jessup Township									x	
Lanesboro Borough									x	
Lathrop Township									x	
Lenox Township									x	
Liberty Township									x	
Little Meadows Borough									x	
Middletown Township									x	
Montrose Borough									x	
New Milford Borough									x	
New Milford Township									x	
Oakland Borough								x	x	
Oakland Township									x	
Rush Township									x	
Silver Lake Township									x	
Springville Township									x	
Susquehanna Depot Borough									x	
Thompson Borough									x	
Thompson Township									x	
Union Dale Borough									x	
Susquehanna County	x	x	x	x	x	x	x			x

Municipal Hazard Mitigation Actions Checklist								
Municipality	**2.2.4**	**2.3.1**	**2.3.2**	**2.4.1**	**2.5.1**	**3.2.1**	**3.3.1**	**4.2.1**
Apolacon Township				x			x	
Ararat Township				x			x	

Municipal Hazard Mitigation Actions Checklist								
Municipality	**2.2.4**	**2.3.1**	**2.3.2**	**2.4.1**	**2.5.1**	**3.2.1**	**3.3.1**	**4.2.1**
Auburn Township				x			x	
Bridgewater Township				x			x	
Brooklyn Township				x			x	
Choconut Township				x			x	
Clifford Township				x			x	
Dimock Township				x			x	
Forest City Borough				x			x	
Forest Lake Township				x			x	
Franklin Township				x			x	
Friendsville Borough				x			x	
Gibson Township				x			x	
Great Bend Borough				x			x	
Great Bend Township				x			x	
Hallstead Borough				x			x	
Harford Township				x			x	
Harmony Township				x			x	
Herrick Township				x			x	
Hop Bottom Borough				x			x	
Jackson Township				x			x	
Jessup Township				x			x	
Lanesboro Borough				x			x	
Lathrop Township		x		x			x	
Lenox Township				x			x	
Liberty Township				x			x	
Little Meadows Borough				x			x	
Middletown Township				x			x	
Montrose Borough				x			x	
New Milford Borough				x			x	
New Milford Township				x			x	
Oakland Borough				x			x	
Oakland Township				x			x	
Rush Township				x			x	
Silver Lake Township				x			x	
Springville Township				x			x	
Susquehanna Depot Borough				x			x	
Thompson Borough				x			x	

Municipal Hazard Mitigation Actions Checklist								
Municipality	**2.2.4**	**2.3.1**	**2.3.2**	**2.4.1**	**2.5.1**	**3.2.1**	**3.3.1**	**4.2.1**
Thompson Township				X			X	
Union Dale Borough				X			X	
Susquehanna County	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 1.2.1; 1.3.3; 1.3.4; 1.3.5 and 2.2.2 comply for Susquehanna County and all its municipalities.

Evaluate and Prioritize Mitigation Actions

Mitigation Action Evaluation:

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.
- 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 H 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 Susquehanna 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 Susquehanna County HMP Local Planning Team decided to alter the current maintenance procedures. The 2018 HMP update establishes a review of the plan within ninety 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 2018 HMP update encourages continued public involvement and how this plan may be integrated into other planning mechanisms in the county.

7.2. Monitoring, Evaluating and Updating the Plan

Hazard mitigation planning in Susquehanna County is a responsibility of all levels of government (i.e., county and local), as well as the citizens of the county. The Susquehanna 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 be afforded the opportunity to provide information for the annual review and 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. Each year during the annual review, all sections of the plan, all project opportunities and mitigation actions will be reviewed by both the county and the municipalities. The review will assist with determining any areas that require additional update, research or addition mitigation actions and projects to decrease the future hazard vulnerability. In the event that any significant changes to the hazard mitigation plan are needed, the county will submit an update for approval by PEMA and FEMA. The annual reviews and post disaster reviews will ensure that this plan is accurately reflecting the mission of hazard mitigation in Susquehanna County. The HMP must be updated on a five-year cycle 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 Planning Team meetings.

The Susquehanna 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 Susquehanna County Emergency Management Agency will maintain a copy of these records and place them in Appendix J of this plan. Susquehanna 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. Continued Public Involvement

The Susquehanna County Emergency Management Agency will ensure that the 2018 Susquehanna County Hazard Mitigation Plan is posted and maintained on the Susquehanna County website and will continue to encourage public review and comment on the plan. The Susquehanna County website that the plan will be located at is as follows: http://susqco.com/county-government/emergency-management/hazard-mitigation-plan/

The public will have access to the 2018 HMP through their local municipal office, the Susquehanna County Planning Department, or the Susquehanna County Emergency Management Agency. Information on upcoming events related to the HMP or solicitation for comments will be announced via newsletters, newspapers, mailings, and the county website.

The citizens of Susquehanna County are encouraged to submit their comments to elected officials and/or members of the Susquehanna County HMP Local Planning Team. To promote public participation, the Susquehanna 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 Susquehanna 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 2018 Susquehanna 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.

9. Appendices

APPENDIX A: References

APPENDIX B: FEMA Local Mitigation Review Tool

APPENDIX C: Meetings and Support Documents

APPENDIX D: Municipal Flood Maps

APPENDIX E: Critical and Special Needs Facilities

APPENDIX F: 2018 HAZUS Reports

APPENDIX G: 2018 Mitigation Project Opportunities

APPENDIX H: 2018 Mitigation Action Evaluation & Prioritization

APPENDIX I: Dam Failure Profile

APPENDIX J: Annual Review Documentation

APPENDIX K: Susquehanna County & Municipal Adoption Resolutions