Susquehanna County 2023 Hazard Mitigation Plan

Prepared for:

Susquehanna County Emergency Management Agency

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Certification of Annual Review Meetings

YEAR	DATE OF MEETING	PUBLIC OUTREACH ADDRESSED? *	SIGNATURE
2023			
2024			
2025			
2026			
2027			

**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)

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Acronyms

AACT:	American Academy of Clinical Toxicology
ACHA:	American College Health Association
ACMT:	American College of Medical Toxicology
AHJ:	Authority Having Jurisdiction
AMD:	Acid Mine Drainage
ANSI:	American National Standards Institute
ASAM:	American Society of Addiction Medicine
ASHRAE:	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASIRT:	Association for Safe International Road Travel
BFE:	Base Flood Elevation
CBRNE:	Chemical, Biological, Radiological, Nuclear, or Explosive
CDC:	Centers for Disease Control and Prevention
CERT:	Community Emergency Response Team
CFR:	Code of Federal Regulations
CFS:	Commodity Flow Study
CHSN:	College Health Surveillance Network
CCIDRAP:	Center for Infectious Disease Research and Policy
CRS:	Community Rating System
DCNR:	Department of Conservation and Natural Resources
DDAP:	Department of Drug and Alcohol Programs
DEA:	Drug Enforcement Administration
DFIRM:	Digital Flood Insurance Rate Map
DMA:	Disaster Mitigation Act
DPS:	Department of Public Safety
EF:	Enhanced Fujita
EIA:	Energy Information Administration
EMA:	Emergency Management Agency
EMPG:	Emergency Management Performance Grant
EMS:	Emergency Medical Services
EOP:	Emergency Operations Plan

EPA:	Environmental Protection Agency
EPCRA:	Emergency Planning and Community Right-To-Know Act
EPZ:	Emergency Planning Zone
FBI:	Federal Bureau of Investigations
FEMA:	Federal Emergency Management Agency
FMA:	Flood Mitigation Assistance Grant Program
FRA:	Federal Railroad Association
GIS:	Geographic Information Systems/Sciences
HAZUS:	Hazards U.S. Software
HMA:	Hazard Mitigation Assistance
HMEP:	Hazardous Material Emergency Planning Grant
HMGP:	Hazard Mitigation Grant Planning
HMP:	Hazard Mitigation Plan
HMRF:	Hazardous Material Response Fund
HSCA:	Hazardous Sites Cleanup Act
HSGP:	Homeland Security Grant Program
HVE:	Homegrown Violent Extremist
ICC:	International Code Council
IES:	Illuminating Engineering Society
LEPC:	Local Emergency Planning Committee
LGTBQ:	Lesbian, Gay, Bisexual, Trans & Queer
LPT:	Local Planning Team
MAT:	Medication-Assisted Treatment
MPC:	Municipalities Planning Code
NARM:	Notification and Resource Manual
NAS:	Neonatal Abstinence Syndrome
NCDC:	National Climatic Data Center
NCEI:	National Centers for Environmental Information
NFIP:	National Flood Insurance Program
NFPA:	National Fire Protection Association
NIH:	National Institute of Health
NLD:	National Levee Database

NOAA:	National Oceanic and Atmospheric Administration
NTP:	Narcotic Treatment Program
NWS:	National Weather Service
OIH:	Opioid-Induced Hyperalgesia
OUD:	Opioid Use Disorder
PA DCED:	Pennsylvania Department of Community and Economic Development
PA DEP:	Pennsylvania Department of Environmental Protection
PA DOA:	Pennsylvania Department of Agriculture
PA GWIS:	Pennsylvania Groundwater Information System
PA HART:	Pennsylvania Helicopter Aquatic Rescue Team
PAWNVCP:	Pennsylvania West Nile Virus Control Program
PDMP:	Prescription Drug Monitoring Program
PDSI:	Palmer Drought Severity Index
PEMA:	Pennsylvania Emergency Management Agency
PennDOT:	Pennsylvania Department of Transportation
PHMSA:	Pipeline and Hazardous Materials Safety Administration
PISC:	Pennsylvania Invasive Species Council
POD:	Points of Dispensing
PWSA:	Public Water Service Area
RF:	Risk Factor
SARA:	Superfund Amendments and Reauthorization Act
SC:	Steering Committee
SFHA:	Special Flood Hazard Area
TRI:	Toxic Release Inventory
UCC:	Uniform Construction Code
US HHS:	United States Department of Health and Human Services
USACE:	Untied States Army Corp of Engineers
USDA:	United States Department of Agriculture
USDA FS:	United States Department of Agriculture Forest Service
USGS:	United States Geological Survey
WL:	Working Level

WMD: Weapon of Mass Destruction

WUI: Wildland Urban Interface

Executive Summary

Mitigation is the effort to reduce loss of life and property by lessening the impact of disasters. Hazard mitigation focuses attention and resources on county and municipal policies and actions that will produce successive benefits over time. State and local governments engage in hazard mitigation planning to identify risks and vulnerabilities associated with natural as well as human-caused hazards and develop long-term strategies for protecting people and property from future hazard events. Mitigation plans are key to breaking the cycle of disaster damage, reconstruction, and repeated damage. This plan represents the work of citizens, elected and appointed government officials, business leaders, and volunteer and nonprofit groups to protect community assets, preserve the economic viability of the community, and save lives.

In 2022, the Susquehanna County Emergency Management Agency contracted the services of a consulting agency to revise and update the Susquehanna County Hazard Mitigation Plan. The plan was successfully updated in accordance with the requirements set forth by PEMA and FEMA. The updated Susquehanna County Hazard Mitigation Plan was adopted by the Susquehanna County Commissioners in 2023. All forty municipalities adopted the 2018 Susquehanna County Hazard Mitigation Plan as the municipal hazard mitigation plan, and it is anticipated that all participating municipalities will adopt the 2023 Susquehanna County Hazard Mitigation Plan Update.

The Susquehanna County Commissioners secured a grant to complete the 2023 update to the Susquehanna County Hazard Mitigation Plan. MCM Consulting Group, Inc. was hired to assist the county with the update of the plan. The planning kick-off meeting was conducted on November 30th, 2022.

The planning process for the 2023 Susquehanna County Hazard Mitigation Plan Update consisted of the following:

- Identification and prioritization of the hazards that may affect the county and its municipalities.
- Assessment of the county's and municipalities' vulnerability to these hazards.
- Identification of the mitigation actions and projects that can reduce that vulnerability.
- Development of a strategy for implementing the actions and projects, including identifying the agency(ies) responsible for that implementation.

Throughout the planning process, the general public was given the opportunity to comment on the existing HMP and provide suggestions for the updated version. Due to COVID-19, public meetings were conducted via an online survey to provide residents an opportunity to provide input on the HMP. Several meetings were held in person with a virtual option, and participants were invited to submit surveys and other documents via an online survey.

The following hazards were identified by the local planning team as presenting the highest risk to the county and its municipalities:

Natural hazards:

- Drought
- Earthquake
- Flooding, Flash Flooding, Ice Jam Flooding
- Hurricane and Tropical Storm
- Invasive Species
- Landslide
- Pandemic and Infectious Disease
- Radon Exposure
- Subsidence/Sinkhole
- Tornado/Windstorm
- Wildfire
- Winter Storm

Human-caused hazards:

- Civil Disturbance
- Dam Failure
- *Emergency Services
- Environmental Hazards / Hazardous Materials
- Levee Failure
- Mental Health Services
- Nuclear Incident
- Opioid Epidemic
- Terrorism/Cyberterrorism Incidents
- Transportation Accidents
- Utility Interruption

A total of twenty-four hazards have been identified in the 2023 Susquehanna County Hazard Mitigation Plan. A total of twenty identified hazards were listed in the previous 2018 plan update. The new hazards include Extreme Temperatures, Emergency Services Shortages, and Mental Health Service Shortages.

To mitigate against the effects of these hazards, the local planning team identified the following goals for hazard mitigation over the next five years:

- Reduce potential injury/death and damage to existing community assets due to floods, flash floods, and ice jams.
- Reduce potential injury/death and damage to community assets due to all hazards.
- Promote disaster-resistant future development.
- Promote hazard mitigation as a public value in recognition of its importance to the health, safety, and welfare of the population.
- Improve response and recovery capabilities.
- Protect critical infrastructure.

Mitigation actions are specific projects and activities that help achieve goals. A total of forty-eight actions were developed for this plan update as they pertain to hazards identified by the local planning team. The 2018 Susquehanna County Hazard Mitigation Plan consisted of thirty-eight total actions. The individual objectives and actions that will be implemented are shown in Section 6.4. Each municipality was provided the opportunity to submit new project opportunity forms for this update. A total of forty project opportunity forms were submitted during the 2018 HMP update. A total of twenty-seven project opportunities were submitted for this plan update.

The 2023 Susquehanna County Hazard Mitigation Plan is the cornerstone to reducing Susquehanna County's vulnerability to disasters. It is the commitment to reducing risks from hazards and serves as a guide for decision makers as they commit resources to reducing the effects of hazards. Hazard mitigation is the only phase of emergency management specifically dedicated to breaking the cycle of damage, reconstruction, and repeated damage.

The 2023 Susquehanna County Hazard Mitigation Plan is a living document that reflects ongoing hazard mitigation activities and requires monitoring, evaluating, and updating to ensure the mitigation actions are implemented. To facilitate the hazard mitigation planning process and adhere to regulatory requirements, the plan will be reviewed annually, and any major revisions will be incorporated into the five-year update.

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 charges by the County Board of Commissioners to prepare the 2023 plan. The 2018 HMP has been utilized and maintained during the five-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 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 cycles 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 with less interruption.

1.2. Purpose

The purpose of this all-hazard mitigation plan (HMP) is:

- Protect life, safety, and property by reducing the potential for future damages and economic losses that result from hazards.
- Qualify for additional grant funding, in both the pre-disaster and the post-disaster environment.
- Speed recovery and redevelopment following future disaster events.

- Demonstrate a firm local commitment to hazard mitigation principles.
- 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, tornadoes, hurricanes/tropical storms, invasive species, and severe winter weather. Human-caused hazards such as transportation accidents, emergency services shortage, 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 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 References

Authority for this plan originates from the following federal sources:

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

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

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

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. April, 2022, Effective April, 2023
- 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
- FEMA Rehabilitation of High Hazard Potential Dams: Grant Program Guidance, June 2020

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: All-Hazard Mitigation Planning Standard Operating Guide, 2020.

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

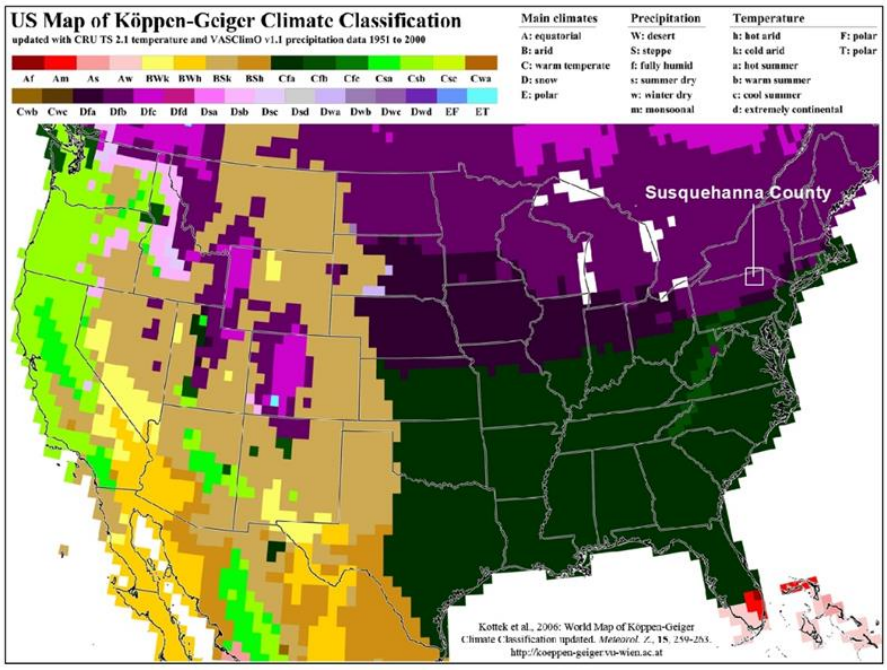
2.1. Geography and Environment

Susquehanna County covers approximately 831.7 square miles and is situated in north-eastern Pennsylvania. The county is bordered by Bradford County in the west, by Broome County, New York to the north, by Tioga County, New York to the northwest, by Wayne County to the east, by Lackawanna County to the southeast, and by Wyoming County to the southwest. Susquehanna County lies within the Appalachian Plateaus physiographic province. The county is the 54th ranked county in terms of population within the Commonwealth of Pennsylvania. There is a total of 823 square miles of land and 8.7 square miles of water.

Susquehanna County presents a wide range of topographic features. The surface ranges from almost level on plateaus and in valleys, to rolling and hilly in other areas. Elevations in the county range from a high of 2,689 feet near Elk Hill in Herrick Township in the southeast of the county to a low of 748 feet along Martins Creek in Lathrop Township in the south central portion of the county.

The Köppen-Geiger Climate Areas map classifies Susquehanna County, and the rest of Pennsylvania, as Humid Continental, which can be seen in *Figure 1 – Köppen-Geiger Climate Map*. While the counties of Pennsylvania share many weather similarities, there are also a few unique characteristics to the area.

Figure 1-Köppen-Geiger Climate Map



According to current data, the climate in Susquehanna County is temperate, characterized by moderately hot summers and moderately severe winters. In winter, the average temperature is 25.38˚F and the average daily minimum temperature is 22.90˚F. In summer, the average temperature is 67.54˚F and the average daily maximum temperature is 82.34˚F. The average amount of snowfall each winter is between 54 inches and 84 inches.

River and stream valleys dominate the landscape of Susquehanna County. The North Branch of the Susquehanna River is the primary feature and runs through the entire county. Its major tributaries in Susquehanna County include Canawacta Creek, Denton Creek, Drinker Creek, Lewis Creek, Mitchell Creek, Salt Lick Creek, and Starucca Creek.

Susquehanna County is comprised of four large watersheds. This information can be seen in *Figure 4 – Susquehanna County Watersheds*:

- Owego-Wappasening
- Upper Susquehanna
- Upper Susquehanna-Lackawanna
- Upper Susquehanna-Tunkhannock

2.2. Community Facts

Susquehanna County was founded on February 21, 1810 from a portion of Luzerne County and was organized in 1812. The county seat of Susquehanna County is located in Montrose Borough and has been since the organization in 1812. Susquehanna County is primarily named for the portion of the Susquehanna River that flows through the northern portion of the county. Bridgewater Township is the most populous municipality in Susquehanna County.

The following cities, 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, and 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, and Thompson.

Table 1- Susquehanna County Historical and Cultural Resources/Places

Historical/Cultural Places in Susquehanna County	
Name:	**Description:**
Bridge in Gibson Township	This Bridge is near South Gibson and was Built between the year 1750 and 1824. This bridge was

Historical/Cultural Places in Susquehanna County	
Name:	**Description:**
	added to the National Register of Historic Places in 1988.
Dennis Farm	Denis Farm is located in Brooklyn Township and was added to the National Register of Historic Places in 2014.
Erie Railroad Station	The Erie Railroad Station was built by the Erie Railway and later was turned in a three-story hotel called the Starrucca House in 1913. This rail station was built in 1863 and was added to the National Register of Historic Places in 1972.
Montrose Historic District	Montrose District is in Montrose PA, and it encompasses 386 buildings. The building of this District started in 1812 and then was added to the National register of Historic Places in 2011.
Sylvanus Mulford House	Sylvanus Mulford House also known as "John Lyons House" was built in 1818 and then was added to the National Register of Historic Places in 1978.
Silver Lake Bank	Silver Lake Bank is in Montrose PA and was built in 1816. This bank was added to the National Register of Historic Places in 1975. This bank is now a headquarters for an Anti-Slavery Studies non-profit organization.
Starrucca Viaduct	Starrucca Viaduct is a stone arch bridge that was built and completed in 1848. This bridge was added to the National Register of Historic Places in 1975.
Susquehanna County Courthouse Complex	Susquehanna Courthouse Complex also known as "Susquehanna County Courthouse and Jail" was built in 1854 and then added to the National Register of Historic Places in 1996.

2.3. Population and Demographics

The total population for Susquehanna County is 38,434 based on 2020 United States Census Bureau. The total change in population for Susquehanna County from 2010 to 2020 was a decrease of 4,942 and a change of negative 10.79%. The most populous municipality is Bridgewater Township. The municipalities in the county that had the largest percentage of

decrease from 2010 to 2020 was Middletown Township with a 25.7% decrease. The municipalities that had the highest percentage of increase for the period from 2010 to 2020 were Thompson Township with a 6.8% increase. *Table 2 – Population Change in Susquehanna County* illustrates the trends and data from United States Census Bureau. These figures are based off data from the United States Census Bureau in 2020. *Figure 5 – Susquehanna County Population Density* illustrates the average population density values per census track in the various municipalities of Susquehanna County.

Table 2-Population Chance in Susquehanna County

Population Change in Susquehanna County from 2010-2020			
Municipality	**2010 Census**	**2020 Census**	**Percent of Change 2010-2020**
Apolacon Township	500	426	**-14.8%**
Ararat Township	583	529	**-9.3%**
Auburn Township	1,939	1,732	**-10.7%**
Bridgewater Township	2,844	2,636	**-7.3%**
Brooklyn Township	963	787	**-18.3%**
Choconut Township	713	679	**-4.8%**
Clifford Township	2,408	2,097	**-12.9%**
Dimock Township	1,497	1,228	**-17.9%**
Forest City Borough	1,911	1,780	**-6.9%**
Forest Lake Township	1,193	1,114	**-6.6%**
Franklin Township	937	833	**-11.1%**
Friendsville Borough	111	101	**-9.0%**
Gibson Township	1,221	1,012	**-17.1%**
Great Bend Borough	734	627	**-14.6%**
Great Bend Township	1,949	1,708	**-12.4%**
Hallstead Borough	1,303	1,174	**-9.9%**
Harford Township	1,430	1,254	**-12.3%**
Harmony Township	528	508	**-3.8%**
Herrick Township	713	710	**-0.4%**
Hop Bottom Borough	337	311	**-7.7%**
Jackson Township	848	856	**+0.95%**
Jessup Township	536	464	**-13.4%**
Lanesboro Borough	506	508	**+0.4%**
Lathrop Township	841	766	**-8.9%**
Lenox Township	1,934	1,603	**-17.1%**
Liberty Township	1,292	1,130	**-12.5%**
Little Meadows Borough	273	245	**-10.3%**
Middletown Township	382	284	**-25.7%**

Population Change in Susquehanna County from 2010-2020			
Municipality	**2010 Census**	**2020 Census**	**Percent of Change 2010-2020**
Montrose Borough	1,617	1,290	**-20.3%**
New Milford Borough	868	812	**-6.5%**
New Milford Township	2,042	1,789	**-12.4%**
Oakland Borough	616	563	**-8.6%**
Oakland Township	564	488	**-13.5%**
Rush Township	1,267	1,133	**-10.6%**
Silver Lake Township	1,716	1,513	**-11.8%**
Springville Township	1,641	1,467	**-10.6%**
Susquehanna Depot Borough	1,643	1,365	**-16.9%**
Thompson Borough	299	254	**-15.1%**
Thompson Township	410	438	**+6.8%**
Union Dale Borough	267	220	**-17.6%**
Source: United States Census Bureau, 2023, 2020 Census Data			

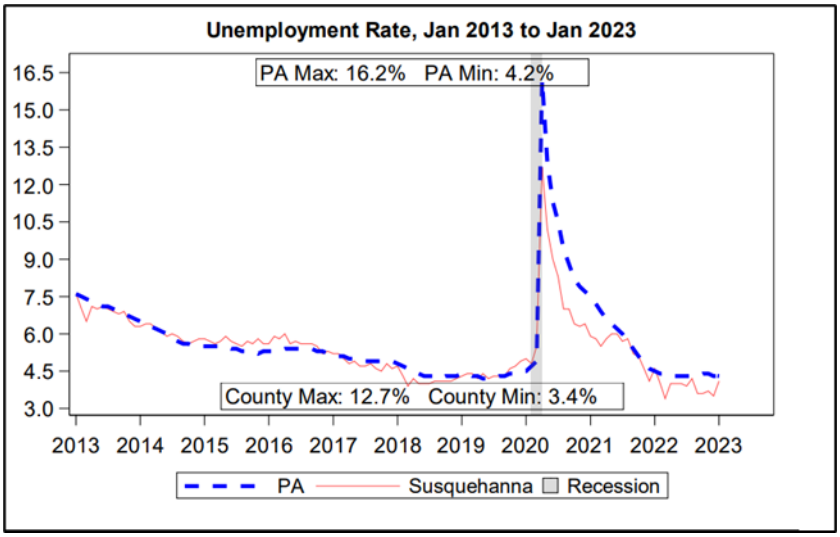
There are approximately 21,342 housing units in Susquehanna County, Pennsylvania. Of these housing units, there are an estimated 15,430 households within the county, with an average size of 2.5 persons. Married couples make up a majority of households in the county 65%, with an average household size of 2.5 persons. The estimated owner-occupied housing rate of Susquehanna County is 78.5%. The median value of the owner-occupied housing units in Susquehanna County from 2017 to 2021 is $176,000.00. The median monthly owner's costs for a structure with a mortgage was $1,319.00 and the median monthly owner's costs for a structure without a mortgage was $497.00. The median gross rent for rental properties in Susquehanna County was $812.00 for the same date range.

The racial composition of the county is 97.3% White, 0.8% Black or African American, 2.0% Hispanic or Latino, 0.3% American Indian and Alaska Native, 0.4% Asian, 0.1% native Hawaiian and other Pacific Islander, and 1.2% two or more races. The median age of Susquehanna County is 48.6 years of age, which is higher than the median age of Pennsylvania at 40.8 and the national median of 38.1 years of age. The percentage of Susquehanna County under the age of 5 years old is 4.7%, between the ages of 18 and 64 years old is 56.6% and aged 65 years old and older is 24.6%.

The median household income for households in Susquehanna County is $59,391.00 and the poverty rate of Susquehanna County is 12.0% of the total population. The poverty rate for the Commonwealth of Pennsylvania is 12.1%. There are approximately 3,074 veterans in Susquehanna County. The median veteran income in Susquehanna County as of 2021 was $39,463.00, with 3.7% of Susquehanna County veterans living below the poverty level. The veteran unemployment rate in the county was approximately 3.7%.

The Covid-19 Pandemic created an increase in unemployment and interruptions in employment throughout the United States, to include Pennsylvania and Susquehanna County. According to Pennsylvania Department of Labor and Industry data, there was a large spike in unemployment both across the Commonwealth and Susquehanna County. At the height of the Covid-19 Pandemic in the spring of 2020, the unemployment rate for Susquehanna County hit 12.7% of the working population of the county. That is lower than the peak unemployment percentage for Pennsylvania, which peaked at 16.5% of the working population of the entire state. *Figure 2 – Unemployment Rate Jan. 2013 to Jan. 2023* illustrates the trend and large spike in unemployment. The unemployment rate for Susquehanna County in March 2023 was 4.1%, which roughly accounted for 800 working age adults (ages 16 to 65). The total estimated workforce for Susquehanna County was 20,300 working age adults (ages 16 to 65) in March 2023.

Figure 2-Unemployment Rate Jan. 2013 to Jan. 2023



Source: Pennsylvania Department of Labor & Industry

Susquehanna County's leading industries are education, healthcare, social services, and retail trade. The primary employment providers within Susquehanna County are displayed below in *Table 3 – Susquehanna County Top Employers*.

Table 3-Susquehanna County Top Employers

Susquehanna County Top Employers	
Ranking	**Company/Organization**
1	Montrose Area School District
2	GasSearch Drilling Services, Corporation
3	Barnes-Kasson County Hospital
4	Susquehanna County

Susquehanna County Top Employers	
Ranking	**Company/Organization**
5	State Government
6	Blue Ridge School District
7	Endless Mountains Health Systems
8	Elk Lake School District
9	Mountain View School District
10	Forest City Regional School District
Source: Pennsylvania Department of Labor & Industry, 2023	

The top employers' data was obtained through the Pennsylvania Department of Labor and Industry, Center for Workforce Information and Analysis. This data only provided a list of employers, their ranking, and North American Industry Classification System (NAICS) descriptions. *Table 4 – Quarterly Census of Employment and Wages, 2021 Annual Averages in Susquehanna County* only calls out how many locations per NAICS description and total number of employees.

Table 4-Quarterly Census of Employment and Wages, 2021 Annual Averages in Susquehanna County

Quarterly Census of Employment and Wages, 2021 Annual Averages in Susquehanna County					
NAICS	**Description**	**Number of Locations**	**Number of Employees**	**Employment Percentage**	**Average Wages**
11	Agriculture, Forestry, Fishing, and Hunting	18	54	0.6%	$34,565
21	Mining, Quarrying, and Oil & Gas	70	728	8.2%	$75,679
22	Utilities	11	157	1.8%	$134,233
23	Construction	93	555	4.6%	$60,025
31-33	Manufacturing	54	561	6.3%	$47,694
42	Wholesale Trade	33	267	3.0%	$58,455
44-45	Retail Trade	130	1,211	13.6	$34,079
48-49	Transportation and Warehousing	72	404	4.5%	$49,912
51	Information	13	84	0.9%	$54,871
52	Finance and Insurance	28	201	2.3%	$56,533
53	Real Estate, Rental, and Leasing	16	62	0.7%	$74,811

Quarterly Census of Employment and Wages, 2021 Annual Averages in Susquehanna County					
NAICS	**Description**	**Number of Locations**	**Number of Employees**	**Employment Percentage**	**Average Wages**
54	Professional and Technical Services	63	480	5.4%	$125,172
55	Management of Companies and Enterprises	8	63	0.7%	$72,577
56	Administrative and Waste Services	34	152	1.7%	$59,463
61	Educational Services	25	ND	ND	ND
62	Healthcare and Social Assistance	100	1,088	12.3%	$39,635
71	Arts, Entertainment, and Recreation	12	ND	ND	ND
72	Accommodation and Food Services	86	813	9.2%	$18,649
81	Other Services (Except Public Administration)	82	339	3.8%	$31,573
92	Public Administration	49	476	5.4%	$41,124
-	**Total, All Industries**	**997**	**8,880**	**100%**	**$51,605**
Source: PA DLI, NAICS (North American Industry Classification System)					

2.4. Land Use and Development

Susquehanna County is composed of forty municipalities, which include:

- Twenty-seven townships
- Thirteen boroughs

The majority of acreage in Susquehanna County is forested, while approximately 46% of the acreage is agriculture. Susquehanna County is very mountainous, with a large number of mountains in the east and hill-like mountains to the west. Susquehanna County largest mountain is North Knob which is west of Union Dale. Mostly all individuals that live in Susquehanna County live in long and narrow valley which are very good for farming.

Susquehanna County has approximately 532,000 acres of total land area, and 5,568 acres of water area, with a population per square mile of forty-six persons based on 2020 data estimates. Forested areas make up 29% of the county, while Agriculture makes up approximately 46% of the total land area in Susquehanna County, and high density urban, low density urban, water, transitional, resource extraction, quarries, and wetlands each account for 9% of the land area.

2.5. Data Source and Limitations

The following data sources were used during the update process:

- United States Census Bureau.
- National Climatic Data Center (NCDC).
- National Oceanic and Atmospheric Administration (NOAA).
- Pennsylvania Department of Conservation and Natural Resources (PA DCNR).
- Pennsylvania Department of Environmental Protection (PA DEP).
- Pennsylvania Department of Labor and Industry (PA DLI).
- Pennsylvania Groundwater Information System (PaGWIS).
- Pennsylvania Emergency Incident Reporting System. (PEIRS)
- Pennsylvania Emergency Management Agency (PEMA).
- Susquehanna County Comprehensive Plan 2023.

The countywide Digital Flood Insurance Rate Maps (DFIRM) were used for all flood risk analysis and estimation of loss. The Susquehanna County DFIRMs were approved and effective in 2013. The DFIRM database provides flood frequency and elevation information used in the flood hazard risk assessment. Other Susquehanna County GIS datasets including road centerlines, structures, and municipalities were utilized in conjunction with the DFIRM data.

In order to assess the vulnerability of different jurisdictions to the hazards, data on past occurrences of damaging weather events was compiled. A large number of natural-hazard events were gathered from the National Climatic Data Center (NCDC) database. The NCDC is a division of the United States Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). Information on hazard events is compiled by the NCDC from data gathered by the National Weather Service (NWS), another division of NOAA. The data is then presented by the NCDC as tabular data that can be queried in the United States Storm Events database, which "documents the occurrences of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce" (NOAA, 2006). The classification of storm events in the database is based off of data collected from around the United States and the Commonwealth of Pennsylvania, so the data may not be filed under the correct storm category due to user input error. The reason for this data issue results from some storm events falling under multiple categories, including but not limited to winter storm, ice storm, tornado, hurricane / tropical storm, flooding, and flash flooding. Many of the events listed in the United States Storm Events database can fall under multiple of these categories. In an effort to include a comprehensive list of prior storm events for Susquehanna County, search queries with multiple storm classifications were conducted for each hazard.

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

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

This hazard mitigation plan evaluates the vulnerability of the county's community lifelines. For the purposes of this plan, critical infrastructure facilities are those entities that are essential to the health, welfare, and safety of the community. This includes but is not limited to airports, emergency medical service (EMS) stations, communication facilities and towers, day care centers and preschools, fire departments, hospitals and medical facilities, police departments, schools, and senior living facilities. The locations of these facilities were provided by the Susquehanna County GIS Department.

Geographic Information Systems (GIS) Data

GIS data was utilized in risk assessment, estimation of loss and the development of map products for the hazard mitigation plan update. A foundation of data was available from the Susquehanna County GIS Department. Some of the utilized data was downloaded from the Pennsylvania Spatial Data Access (PASDA). A large portion of the plan utilizes census data from the United States Census Bureau, but the 2020 census data collection and dissemination was disrupted due to the Covid-19 Pandemic in 2020 and 2021. The 2020 census was delayed, and the information received during the census was spread out due to social distancing and the limiting of census takers going door to door to gather information.

The Susquehanna County GIS Department provided the following layers for use in the development of hazard profiles and hazard profile mapping for the 2023 Hazard Mitigation Plan Update:

- Susquehanna County address points
- Susquehanna County EMS stations
- Susquehanna County fire stations
- Susquehanna County law enforcement locations
- Susquehanna County municipal boundaries
- Susquehanna County roads
- Susquehanna County SARA sites

The following GIS Data layers were developed for use in the 2023 Hazard Mitigation Plan Update:

- Susquehanna County airports
- Susquehanna County airport vulnerabilities
- Susquehanna County community lifelines
- Susquehanna County drug take back box locations
- Susquehanna County electric transmission lines
- Susquehanna County national risk inventory data
- Susquehanna County natural gas pipelines
- Susquehanna County oil and gas locations

- Susquehanna County population density
- Susquehanna County public water supply areas
- Susquehanna County rivers
- Susquehanna County slope data
- Susquehanna County slope vulnerable locations
- Susquehanna County state parks
- Susquehanna County tornado impacted municipalities
- Susquehanna County traffic information
- Susquehanna County toxic release inventory (TRI) facilities
- Susquehanna County wildland urban interface
- Susquehanna County zip codes

Figure 3-Susquehanna County Basemap

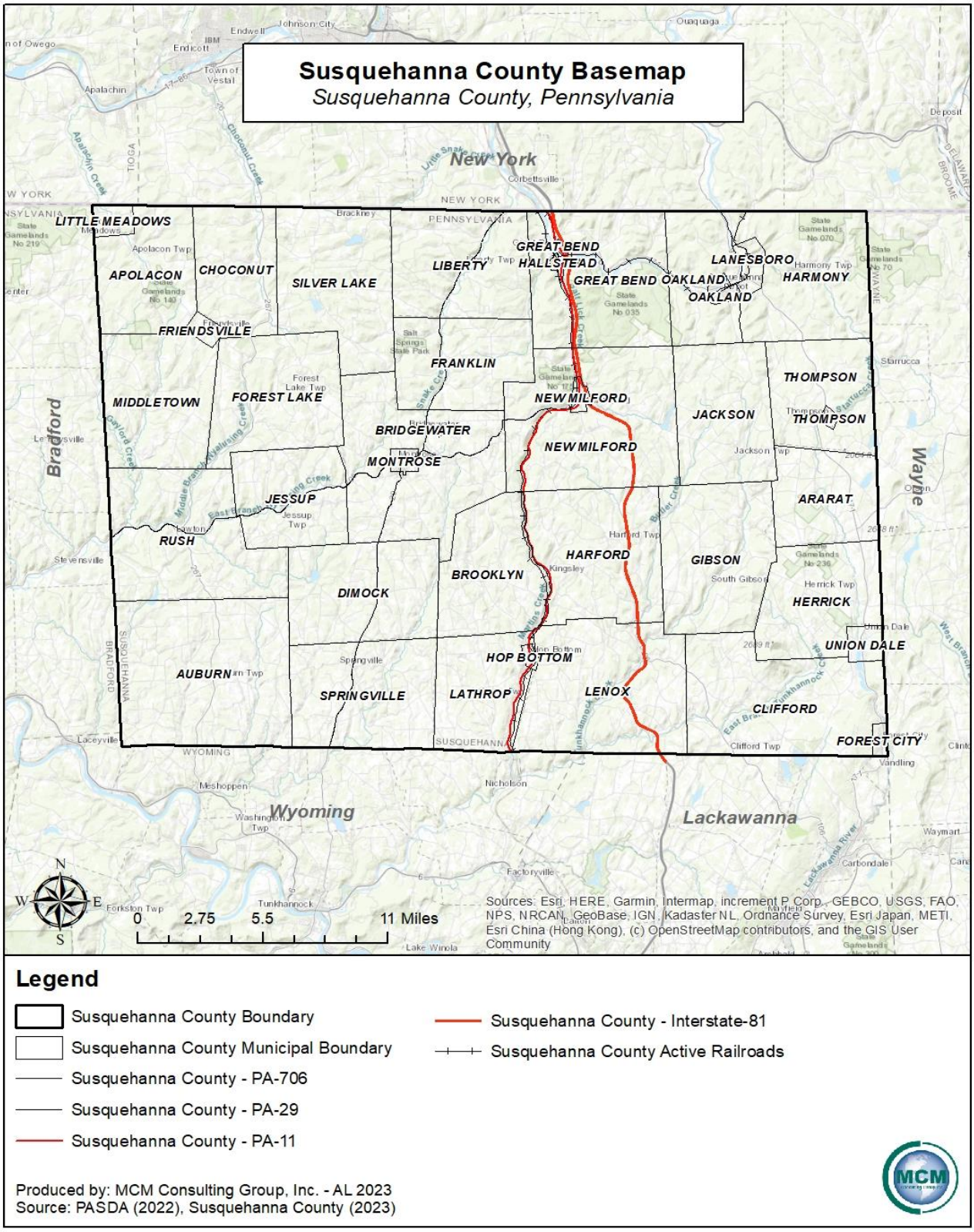


Figure 4-Susquehanna County Watersheds

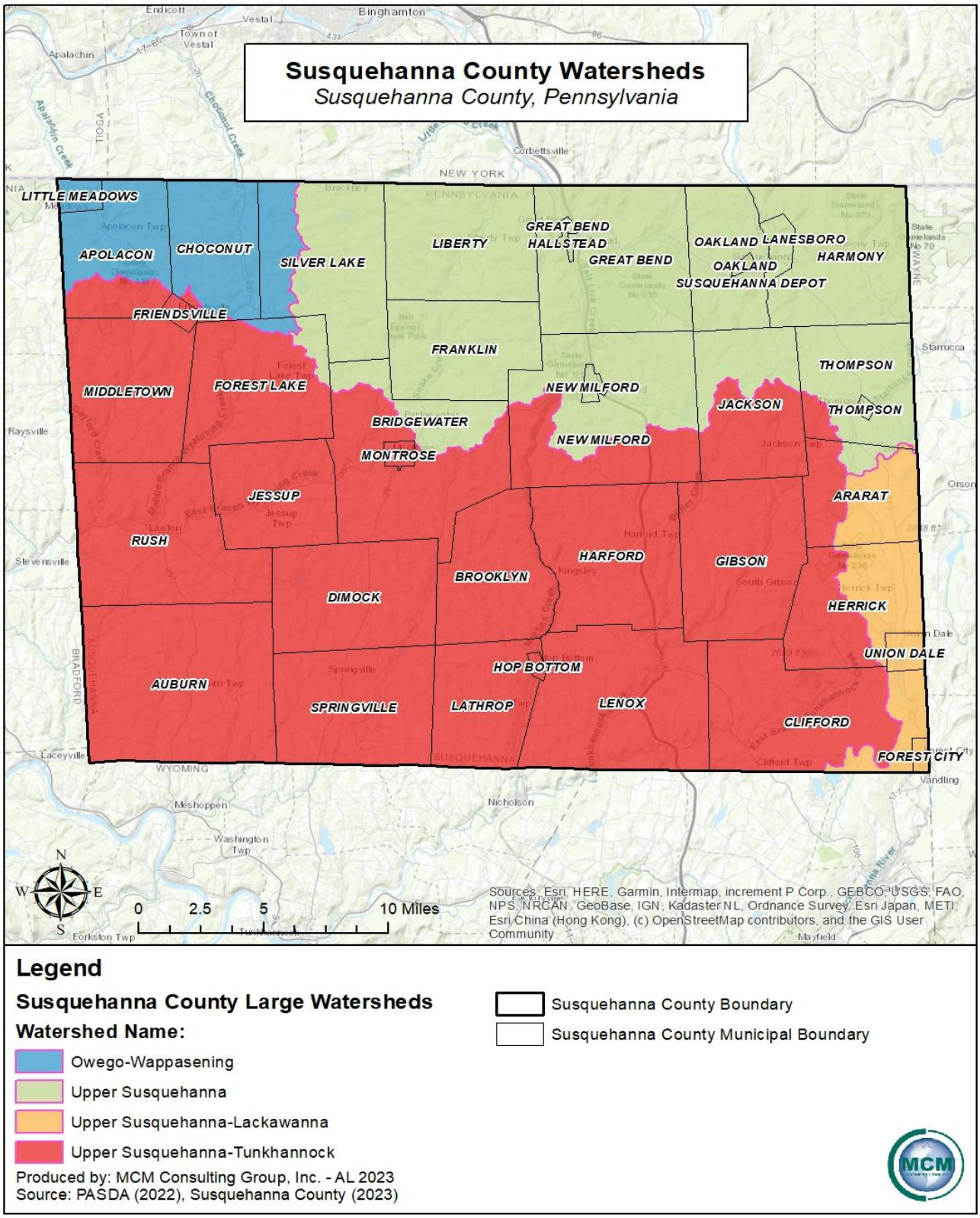


Figure 5-Susquehanna County Population Density

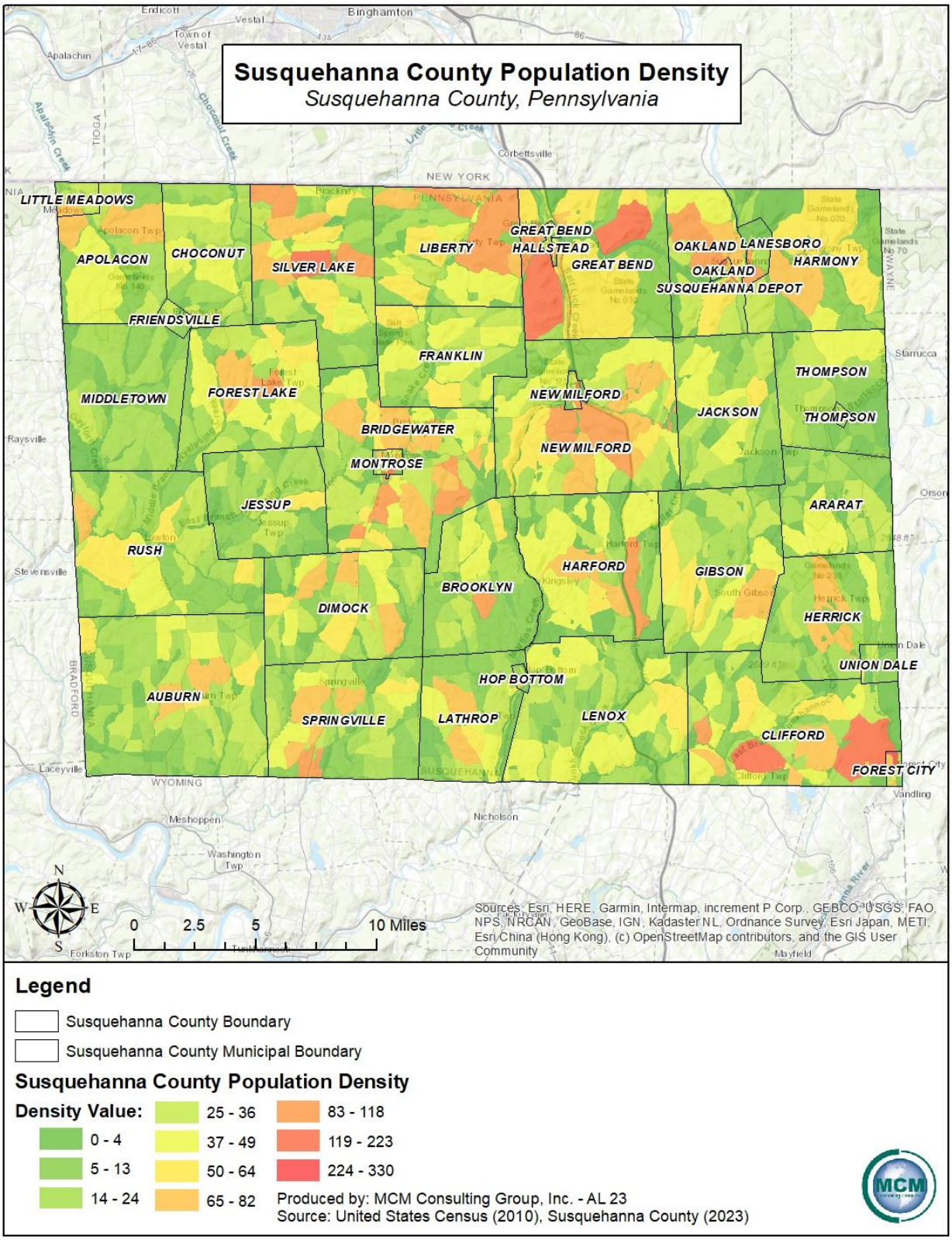
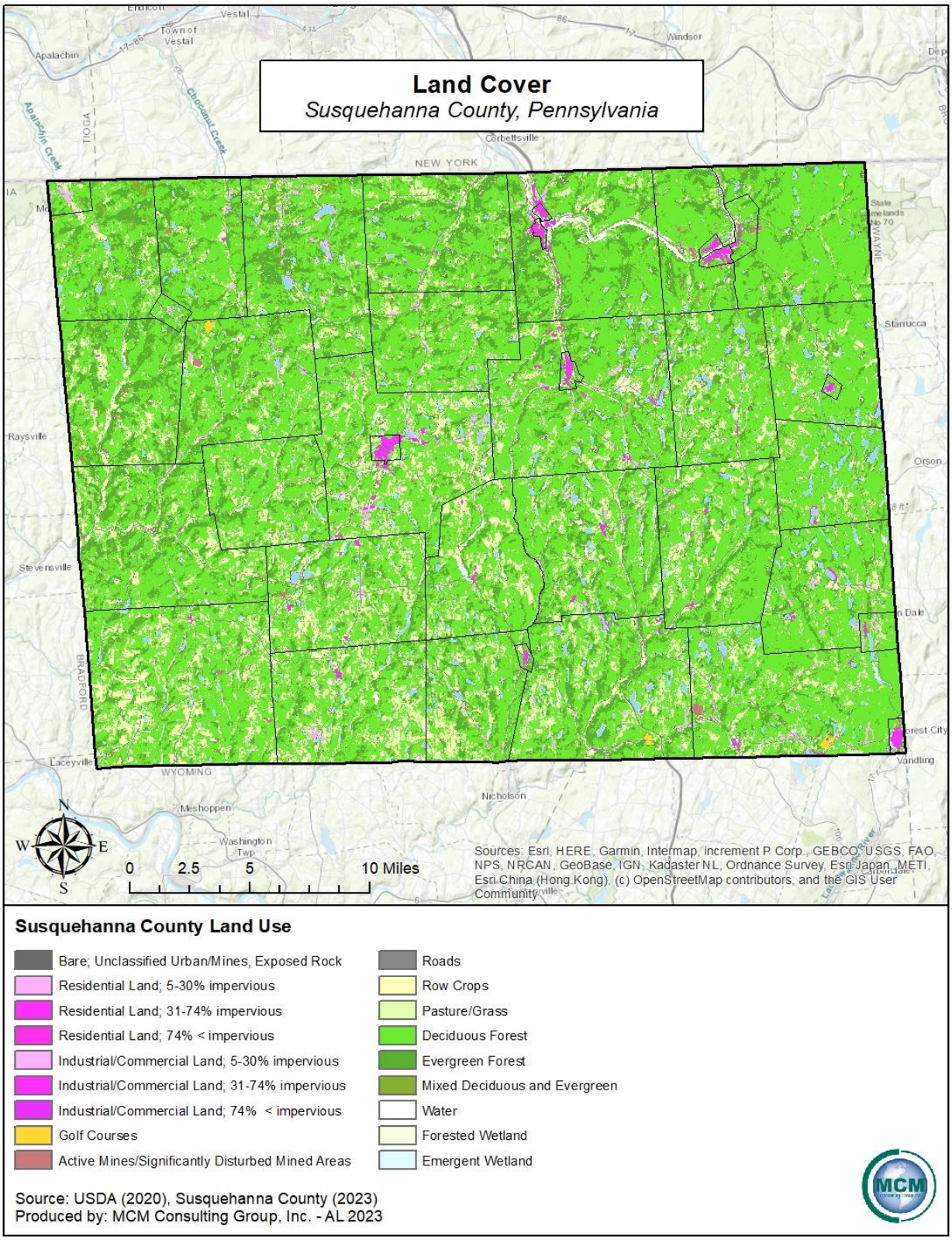


Figure 6-Susquehanna County Land Cover



3. Planning Process

3.1. Update Process and Participation Summary

The Susquehanna County Hazard Mitigation Plan update began October 20, 2022. 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 steering committee, included officials from the Susquehanna County Emergency Management Agency 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 Susquehanna County Emergency Management Agency in coordinating and leading public involvement meetings, local planning team meetings, analysis, and the writing of the updated HMP. The Susquehanna County Local Planning Team (LPT) worked closely with MCM in the writing and review of the HMP. MCM conducted project meetings and local planning team meetings throughout the update process. Due to COVID-19, meetings were held with the option to attend virtually. 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 capability's 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 building resilient infrastructure and communities grant (BRIC) 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 2023 Susquehanna County HMP was completed September 30, 2023. The 2023 plan follows an outline developed by PEMA which provides a standardized format for all local HMPs in the Commonwealth of Pennsylvania. The 2023 HMP format is consistent with the PEMA recommended format. The 2023 Susquehanna County HMP has added additional hazard profiles to the HMP, and these additional profiles increased the subsections in section 4.3 of the HMP.

3.2. The Planning Team

The 2023 Susquehanna County Hazard Mitigation Plan update was led by the Susquehanna County Steering Committee. The Susquehanna County Steering Committee provided guidance and leadership for the overall project. The steering committee assisted MCM Consulting Group, Inc. with dissemination of information and administrative tasks. *Table 5 – Steering Committee* outlines the individuals that comprised this team.

Table 5-Steering Committee

Susquehanna County Hazard Mitigation Plan Update Steering Committee		
Name	**Organization**	**Position**
Scott Aylesworth	Susquehanna County Emergency Management Agency	EMA Coordinator
Nathanial Wallace	Susquehanna County Emergency Management Agency	EMA Deputy Coordinator
Alan Hall	Susquehanna County Board of Commissioners	Commissioner
Don Hibbard	Susquehanna County Conservation District	Program Coordinator
Duane Naugle	Susquehanna County Planning Department	Planning Director

Susquehanna County Hazard Mitigation Plan Update Steering Committee		
Name	**Organization**	**Position**
Michael Rearick	MCM Consulting Group, Inc.	Director of Operations
Adam Leister	MCM Consulting Group, Inc.	Senior GIS Consultant
Daniel Becker	MCM Consulting Group, Inc.	Consultant

In order to represent the county, the Susquehanna County Steering Committee developed a diversified list of potential local planning team (LPT) members. Members that participated in the 2018 hazard mitigation plan were highly encouraged to join the 2023 team. The steering committee then provided invitations to the prospective members and provided a description of duties to serve on the LPT. The invitations for members 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 6 – Local Planning Team* served on the 2023 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 6-Local Planning Team

Susquehanna County Hazard Mitigation Plan Local Planning Team		
Name	**Organization**	**Position**
Jeff Burman	Pennsylvania State Police	Corporal
Mikyle Fabrizio	Susquehanna County GIS	GIS Technician
Mike Felsman	Pennsylvania State Police	Sergeant
Stephen Janoski	Susquehanna County IT	County IT Director
Chris McComb	Montrose Area School District	Superintendent
Matt Nebzydoski	Blue Ridge School District	Administrator
Craig Owens	Montrose Area School District	Administrator
Ben Pratt	Susquehanna River Basin	Engineer
Bobbi Jo Turner	Susquehanna County Housing / Redevelopment Authority	Administrator
Joseph Ulozas	PA DCNR Bureau of Forestry	Associate District Manager
Chad Wallace	Jackson Township	Local EMC/FD

Underserved, unserved, and socially vulnerable populations were indirectly invited to participate in the 2023 HMP update via news articles, the county website listing of the HMP update, and their respective municipal authority being aware of the ongoing process. In the future, underserved, unserved, and socially vulnerable populations will be directly invited to participate

in the maintenance and update of the 2023 hazard mitigation plan in accordance with the May 2023 FEMA local mitigation planning guidelines. The specified populations will be invited to participate via email, or any other communication items deemed appropriate by the local planning team.

Although local dam owners were not directly invited to participate during this update process, outreach was achieved to those individuals, and the public, via news articles, the updates to the county website, and the updates to the county social media pages during the hazard mitigation update process. In the future, those dam owners and state representatives for dam safety will be invited to the local planning team for the Susquehanna County Hazard Mitigation Planning Program to foster greater collaboration and community involvement regarding dam safety.

3.3. Meetings and Documentation

Meetings with local elected officials and the local planning team were held as needed. At each of the meetings, municipal officials were strongly encouraged to submit hazard mitigation project opportunity forms, complete their respective portions of the capability assessment, review and eventually adopt the multi-jurisdictional HMP. *Table 7 – 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, and other documentation is in Appendix C.

The draft plan was made available for public review on June 28th, 2023. The draft was advertised on Susquehanna County's social media page and was made available digitally on the Susquehanna County website at:

https://www.surveymonkey.com/

The public comment period remained open until July 28th, 2023. All public comments were submitted via an online survey or in writing to the Susquehanna County Emergency Management Agency. Public commenting was available during the public comment period via a Survey Monkey link that was advertised on the county website and social media pages. No public comments were received for this planning period, so no comments are included in Appendix C of this hazard mitigation plan update.

Table 7-HMP Process Timeline

Susquehanna County HMP Process Timeline		
Date	**Meeting**	**Description**
10/20/2022	Susquehanna Municipal Convention Meeting	Municipal meeting
11/30/2022	Local Planning Team	Planning team meeting

Susquehanna County HMP Process Timeline		
Date	**Meeting**	**Description**
11/30/2022	Municipalities project meeting	Go over project details with municipalities
1/4/2023	Local Planning Team Meeting Onsite	Go over risk factor assessments and selections of hazards for 2023 HMP.
2/2/2023	Local Planning Team Meeting	Start mitigation strategy. Go over goals and objectives.
2/21/2023	Local Planning Team Meeting	Finalize goals and objectives. Start the action development process.
2/22/2023	Municipality Mitigation Opportunity Form Development	Development of opportunity forms.
2/22/2023	Public Meeting	Go over risk assessment section
3/14/2023	Local Planning Team Meeting	Mitigation action plan draft review and update
3/28/2023	Local Planning Team Meeting	Mitigation action plan finalize
4/4/2023	THIRA Steering Committee	Threat and Hazard Identification Risk Assessment meeting
6/28/2023	Public Meeting	Draft plan presentation

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 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 for completion and return to the Susquehanna County Emergency Management Agency or at meetings to solicit information, data, and comments from both local municipalities and other key stakeholders. Responses to these worksheets and surveys are available for review at the Susquehanna County Emergency Management Agency.

1. **Risk Assessment Hazard Identification and Risk Evaluation Worksheet**: Capitalizes on local knowledge to evaluate the change in the frequency of occurrence, magnitude, or

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 2018 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 G. The previous mitigation actions were provided and reviewed at update meetings. New 2023 municipal project opportunity forms are included as well, located in Appendix G.

In an effort to capture public input, the Susquehanna County LPT held in person meetings and offered on-line surveys. Members of the public were also encouraged to contact Susquehanna County Emergency Management Agency or MCM Consulting Group, Inc. with any comments or questions regarding this update. 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 2023 draft hazard mitigation plan. A letter was sent to the emergency management coordinator in Bradford, Lackawanna, Wayne, and Wyoming counties in Pennsylvania. 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 risk 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 8 – Municipality Worksheets, Surveys, and Forms Participation* reflects the municipalities participation by completing worksheets, surveys, and forms.

Table 8-Municipality Worksheets, Surveys, and Forms Participation

Susquehanna County HMP Worksheets, Surveys, and Forms Participation					
Municipality	**Capability Assessment Survey**	**Risk Assessment Hazard Identification and Risk Evaluation Worksheet**	**NFIP**	**Hazard Mitigation Opportunity Form Review and Updates**	**Risk Factor Analysis**
Apolacon Township	X	X	X		
Ararat Township	X	X	X		
Auburn Township	X	X	X		
Bridgewater Township	X	X	X		X
Brooklyn Township	X				
Choconut Township	X	X	X		
Clifford Township	X	X	X		X
Dimock Township	X	X	X		X
Forrest City Borough	X	X	X		
Forrest Lake Township	X	X	X		
Franklin Township	X	X			X
Friendsville Borough					
Gibson Township	X	X	X		X
Great Bend Borough					
Great Bend Township					
Hallstead Borough	X	X	X		X
Harford Township	X	X	X		X
Harmony Township	X	X	X	X	X
Herrick Township	X	X	X		
Hop Bottom Borough	X	X	X		
Jackson Township	X	X	X		
Jessup Township		X	X		X
Lanesboro Borough	X	X	X	X	
Lathrop Township	X	X	X	X	X
Lenox Township					X
Liberty Township	X	X	X		
Little Meadows Borough	X	X	X		
Middletown Township	X	X	X	X	X
Montrose Borough		X	X		X

Susquehanna County HMP Worksheets, Surveys, and Forms Participation					
Municipality	**Capability Assessment Survey**	**Risk Assessment Hazard Identification and Risk Evaluation Worksheet**	**NFIP**	**Hazard Mitigation Opportunity Form Review and Updates**	**Risk Factor Analysis**
New Milford Borough	X	X			X
New Milford Township	X	X	X		X
Oakland Borough	X	X	X		X
Oakland Township	X	X	X		
Rush Township					X
Silver Lake Township					
Springville Township	X	X	X	X	X
Susquehanna Depot Borough	X	X	X	X	X
Thompson Borough	X	X	X	X	X
Thompson Township	X	X	X		
Union Dale Borough					

All forty municipalities within Susquehanna County adopted the 2018 Susquehanna County Hazard Mitigation Plan as the municipal hazard mitigation plan. The goal of the Susquehanna County Local Planning Team is to have 100% participation by municipalities in adopting the 2023 Susquehanna County Hazard Mitigation.

The table above was completed with the most accurate information available at the time of the writing of this Hazard Mitigation Plan Update. Since the writing of this plan, some of the municipalities listed above have provided information to Susquehanna County which updates their participation status.

4. Risk Assessment

4.1. Update Process Summary

A key component to reducing future loss 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 a 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 human-caused 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 (LPT) reviewed and assessed the change in risk for all natural and human-caused hazards identified in the 2023 hazard mitigation plan. The mitigation planning team then identified hazards that were outlined within the Pennsylvania Hazard Mitigation Plan but not included in the 2023 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 Steering Committee met with municipalities and provided guidance on how to complete the municipal hazard identification and risk evaluation worksheet. Thirty-three municipalities in Susquehanna County 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 human-caused 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 of the twenty-two hazards 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 9 – Presidential & Gubernatorial Disaster Declaration contains a list of all Presidential and Gubernatorial disaster declarations that have affected Susquehanna County and its municipalities from 1955 through 2023, according to the Pennsylvania Emergency Management Agency.

Table 9-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 mudslides	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

Presidential Disaster Declarations and Gubernatorial Declarations and Proclamations		
Date	**Hazard Event**	**Action**
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
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
January, 2018	Opioid Epidemic	Gubernatorial Disaster Declaration
January, 2019	Winter Weather	Gubernatorial Disaster Declaration
March, 2020	Covid-19 Pandemic	Gubernatorial Disaster Declaration
March, 2020	Covid-19 Pandemic	Presidential Declaration
December, 2020	Winter Weather	Gubernatorial Disaster Declaration
February, 2021	Winter Weather	Gubernatorial Disaster Declaration
Source: Pennsylvania Emergency Management Agency (2023) and Federal Emergency Management Agency (2023)		

4.2.2. Summary of Hazards

The Susquehanna County LPT was provided the Pennsylvania Standard List of Hazards to be considered for evaluation in the 2023 HMP Update. Following a review of the hazards considered in the 2018 HMP and the standard list of hazards, the local planning team decided that the 2023 plan should identify, profile, and analyze twenty-two hazards. These twenty-two hazards include all of the hazards profiled in the 2023 plan and newly selected hazards. The list below contains the hazards that have the potential to impact Susquehanna County as identified through previous risk assessments, the Susquehanna County Hazard Vulnerability Analysis and input from those who 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 defined as a deficiency of precipitation experienced over an extended period of time, usually a season or more. Droughts increase the risk of other hazards, like wildfires, flash floods, and landslides or debris flows. This hazard is of particular concern in Pennsylvania due to the prevalence of farming and other water-dependent industries, water dependent recreation uses, and residents who depend on wells for drinking water.

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.

Extreme Temperature

Extreme heat often results in the highest number of annual deaths of all weather-related hazards. In most of the United States, extreme heat is defined as a long period (2 to 3 days) of high heat and humidity with temperatures above 90 degrees. Extremely cold air comes every winter in at least part of the country and affects millions of people across the United States. The arctic air, together with brisk winds, can lead to dangerously cold wind chill values. People exposed to extreme cold are susceptible to frostbite and hypothermia in a matter of minutes.

Flooding, Flash Flooding, and Ice Jam Flooding

Flooding is the temporary condition of partial or complete inundation of normally dry land, and it is the most frequent and costly of all-natural hazards in Pennsylvania. 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. 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.

Hailstorm

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. Hailstorms can cause significant damage to homes, vehicles, livestock, and people.

Hurricane/Tropical Storm

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 counterclockwise (in the Northern Hemisphere) and whose diameter averages 10-30 miles across. Potential threats from hurricanes include powerful winds, heavy rainfall, storm surges, coastal and inland flooding, rip currents, tornadoes, and landslides. The Atlantic hurricane season runs from June 1 to November 30.

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, environmental, or human harm. These species can be any type of organism: plant, fish, invertebrate, mammal, bird, disease, or pathogen.

Landslide

In a landslide, masses of rock, earth or debris move down a slope. Landslides can be caused by a variety of factors, including earthquakes, storms, fire, and human modification of land. Areas that are prone to landslide hazards include previous landslide areas, areas on or at the base of slopes, areas in or at the base of drainage hollows, developed hillsides with leach field septic systems, and areas recently burned by forest or brush fires.

Lightning Strike

Lightning is a giant spark of electricity resulting from the build-up of positive and negative charges within a thunderstorm. The flash or "bolt" of light can occur within the thunderstorm

cloud or between the cloud and the ground. Lightning is a leading cause of injury and death from weather-related hazards. Although most lightning victims survive, people struck by lightning often report a variety of long-term, debilitating symptoms.

Pandemic and Infectious Disease

A pandemic is a global outbreak of disease that occurs when a new virus emerges in the human population, spreading easily in a sustained manner, and causing serious illness. An epidemic describes a smaller scale infectious outbreak, within a region or population, that emerges at a disproportionate rate. Infectious disease outbreaks may be widely dispersed geographically, impact large numbers of the population, and could arrive in waves lasting several months at a time.

Radon Exposure

Radon is a radioactive gas produced by the breakdown of uranium in soil and rock that can lead to lung cancer in people exposed over a long period of time. Most exposure comes from breathing in radon gas that enters homes and buildings through foundation cracks and other openings. According to the DEP, approximately 40% of Pennsylvania homes have elevated radon levels.

Tornadoes/Windstorm

A tornado is a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground. About 1,250 tornadoes hit the U.S. each year, with about sixteen hitting Pennsylvania. Damaging winds exceeding 50-60 miles per hour can occur during tornadoes, severe thunderstorms, winter storms, or coastal storms. These winds can have severe impacts on buildings, pulling off the roof covering, roof deck, or wall siding and pushing or pulling off the windows.

Wildfire

A wildfire is an unplanned fire that burnt in a natural area. Wildfires can cause injuries or death and can ruin homes in their path. Wildfires can be caused by humans or lightning, and can happen anytime, though the risk increases in period of little rain. In Pennsylvania, 98% of wildfires are caused by people.

Winter Storm

A winter storm is a storm in which the main types of precipitation are snow, sleet, or freezing rain. 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. Most deaths from winter storms are not directly related to the storm itself, but result from traffic accidents on icy

roads, medical emergencies while shoveling snow, or hypothermia from prolonged exposure to cold.

Identified Human Caused Hazards

Civil Disturbance

A civil disturbance is defined by FEMA as a civil unrest activity (such as a demonstration, riot, or strike) that disrupts a community and requires intervention to maintain public safety.

Dam Failure

Dam failure is the uncontrolled release of water (and any associated wastes) from a dam. This hazard often results from a combination of natural and human causes, and can follow other hazards such as hurricanes, earthquakes, and landslides. The consequences of dam failures can include property and environmental damage and loss of life.

Emergency Services

Emergency medical services (EMS) and fire department services play a crucial role in the emergency response system, and the functionality of these emergency services directly impacts many of the other hazard profiles in this report. Both EMS and fire services face challenges from lack of funding and lower rates of volunteerism.

Environmental Hazards/Hazardous Materials

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

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

Hazardous material releases can contaminate air, water, and soils and have the potential to cause injury or death. Dispersion can take place rapidly when transported by water and wind. While often accidental, releases can occur as a result of human carelessness, intentional acts, or natural hazards. When caused by natural hazards, these incidents are known as secondary events.

Mental Health Services

Mental health services play a crucial role in the emergency response system, and the functionality of these mental health services directly impacts many of the other hazard profiles in this report. The mental health services face challenges from lack of funding, training, and additional institutional challenges.

Opioid Epidemic

An 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, de-spite their high risk of addiction and overdose, have made them popular both as for-mal 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 enact-ed 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/Cyberterrorism Incidents

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. Cyber-attacks have become an increasingly pressing concern. Cyberterrorism refers to acts of terrorism committed using computers, networks, and the internet. The most widely cited definition comes from Denning's Testimony before the Special Oversight Panel on Terrorism: "Cyberterrorism…is generally understood to mean unlawful attacks and threats of attack against computers, networks, and the information stored therein when done to intimidate or coerce a government or its people in furtherance of political or social objectives. Further, to qualify as cyberterrorism, an attack should result in violence against persons or property, or at least cause enough harm to generate fear".

Transportation Accidents

Transportation accidents are technological hazards involving the nation's system of land, sea, and air transportation infrastructure. A flaw or breakdown in any component of this system can and often does result in a major disaster involving loss of life, injuries, property and environmental damage, and economic consequences.

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.
- 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 (Unit-ed 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 de-forestation 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 are expected to intensify over time as temperatures continue to rise, so it is prudent to be aware of how climate change is impacting natural hazards.

The most obvious change is in regard to extreme temperature. As average atmospheric temperatures rise, extreme high temperatures become more threatening, with record high temperatures outnumbering record low temperatures 2:1 in recent years. 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. Some studies show increased insect activities during a similar rapid warming event in Earth's history. 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, potentially increasing the risk of infectious disease.

Climate change is likely to increase the risk of droughts (Section 4.3.1). Higher average temperatures mean that more precipitation will fall as rain rather than snow, snow will melt earlier in the spring, and evaporation and transpiration will increase. Along with the prospect of decreased annual precipitation, the risk of hydrological and agricultural drought is expected to increase (Sheffield & Wood, 2008). Correspondingly this will impact wildfires. 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.

While it may seem counterintuitive considering the increased risk of drought, there is also an increased risk of flooding associated with climate change (Section 4.3.4). Warmer temperatures mean more precipitation will fall as rain rather than snow. Combined with the fact that warmer air holds more moisture, the result is heavier and more intense rainfalls and dam and levee failures. Similarly, winter storms are expected to become more intense, if possibly less frequent. Climate change is also expected to result in more intense hurricanes and tropical storms. With the rise of atmospheric temperatures, ocean surface temperatures are rising, resulting in warmer

and more moist conditions where tropical storms develop (Stott et al., 2010). A warmer ocean stores more energy and is capable of fueling stronger storms. It is projected that the Atlantic hurricane season is elongating, and there will be more category 4 and 5 hurricanes than before (Trenberth, 2010).

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

This type of sudden global change is novel to humanity. Despite the myriad of well thought out research, there is still much uncertainty surrounding the future of the Earth. All signs point to the intensification of the hazards mentioned above, especially if human society and individuals do not make swift and significant changes combat 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 experience drought conditions intermittently throughout the calendar year. 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 droughts:

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 without rainfall that has an adverse effect on streams, lakes, and groundwater levels, potentially impacting agriculture.

Droughts are often the leading contributing factor to wildfires, as they leave areas with little to no moisture. Droughts can have adverse effects on farms and other water-dependent industries resulting in local economic loss. Areas of extensive agriculture use are particularly vulnerable to drought; 154,409 acres of Susquehanna County, or roughly 29.3% of the 526,720 total land acreage, make up farmland (United States Department of Agriculture [USDA], 2017 Census). The total number of farms for Susquehanna County is 909 and the average acreage for farms in Susquehanna County is 170 acres. Susquehanna County ranks 35th of sixty-seven counties in the commonwealth for agricultural production, totaling over $49.8 million annually. Agricultural production from crops, including nursery and greenhouse crops, accounts for more than $14.8 million in commerce annually. Production from livestock, poultry, and their products accounts for $35 million annually. Acreage for farming has decreased slightly since the 2012 USDA Census when there was a reported total of 154,416 farming and drought vulnerable acres.

4.3.1.2. Range of Magnitude

The average annual precipitation of 45,41” (rain) occurs primarily during the spring and summer months. This value is derived from averaging twenty-three (2000-2022) years of mean annual

precipitation data for Susquehanna County. Rural farming areas of Susquehanna County are most at risk when a drought occurs. A drought can create a significant financial burden for the community. Approximately 10.7% of Susquehanna County farms are family-owned and operated. Additionally 46% of the county farmland use is devoted to crop cultivation and 15% to livestock and poultry. Wildfires are often the most severe secondary effect associated with drought. Wildfires can devastate wooded and agricultural areas, structures near high wildfire loads, and farm production facilities, and threaten natural resources. Prolonged drought conditions can have a lasting impact on the economy and can cause major ecological changes, such as increases in scrub growth, flash flooding, and soil erosion.

Long-term water shortages during severe drought conditions can have a significant impact on agribusiness, public utilities, and other industries reliant on water for production services. Susquehanna County also has a growing agritourism business that would be threatened by long-term drought.

Local municipalities may, with the approval of the Pennsylvania Emergency Management Council, implement local water rationing. 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 mandatory water usage restrictions imposed by the commonwealth and/or local municipalities, procedures are provided for granting of variances to consider individual hardships and economic dislocations. *Table 10 – Drought Preparation Phases* shows the FEMA-defined levels of drought severity along with suggested actions, requests, and goals.

Table 10 - Drought Preparation Phases

Drought Preparation Phases				
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 Preparation Phases				
Phase	**General Activity**	**Actions**	**Request**	**Goal**
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.	Reduced water use by 15%.
Source: Pennsylvania Department of Environmental Protection, 2017				

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 records)
- Soil moisture via the Palmer Drought Index as seen in *Table 11 – Palmer Drought Severity Index*, which is a soil moisture algorithm calibrated for relatively homogenous regions which measures dryness based on recent precipitation and temperature.

Table 11 - Palmer Drought Severity Index

Palmer Drought Severity Index (PDSI)	
Severity Category	**PDSI Value**
Extremely Wet	4.0 or more
Very Wet	3.0 to 3.99
Moderately Wet	2.0 to 2.99
Slightly Wet	1.0 to 1.99
Incipient Dry Spell	0.5 to 0.99
Near Normal	0.49 to -0.49
Incipient Dry Spell	-0.5 to -0.99

Palmer Drought Severity Index (PDSI)	
Severity Category	**PDSI Value**
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

The effects of a drought can be far-reaching both economically and environmentally. Economic impacts include reduced productivity of aquatic resources, mandatory water use restrictions, well failures, cutbacks in industrial production, agricultural losses, and limited recreational opportunities. Environmental impacts of drought include the following: *Table 12 – Economic and Environmental Impacts of Drought Events* qualifies the potential economic and environmental impacts from a drought event.

Table 12 - Economic and Environmental Impacts of Drought Events

Economic and Environmental Impacts of Drought Events	
Economic	**Environmental**
- Reduced productivity of aquatic resources - Mandatory water use restrictions - Well failures - Cutbacks in industrial production - Agricultural losses - Limited recreational opportunities	- Hydrologic effects - Adverse effects on animal populations - Damage to plant communities - Increased number and severity of fires - Reduced soil quality - Air quality effects - Loss of quality in landscape

4.3.1.3. Past Occurrence

The Pennsylvania Department of Environmental Protection (PA DEP) maintains the most comprehensive data on drought occurrences across the commonwealth. Descriptions of drought status categories (i.e., watch, warning, and emergency) are included in the "Range of Magnitude" section above. The declared drought status from 1980 to 2022 is shown in *Table 13 – Past Drought Events in Susquehanna County*.

The National Oceanic and Atmospheric Administration (NOAA) has archived records showing extreme droughts for the commonwealth in 1931 and a prolonged event in the 1960s as seen in *Figure 7 – Pennsylvania Palmer Drought Index 1900 – 1999*.

Based on the county's more recent disaster history and other drought occurrence data, the worst drought event in Susquehanna County occurred in the summer of 1999. Extended dry weather spurred Governor Thomas Ridge to declare a drought emergency in fifty-five counties. During this event, precipitation deficits for that summer averaged five to seven inches below normal; the Susquehanna River hit record low flows, streams were dry, and many wells were depleted. Crop

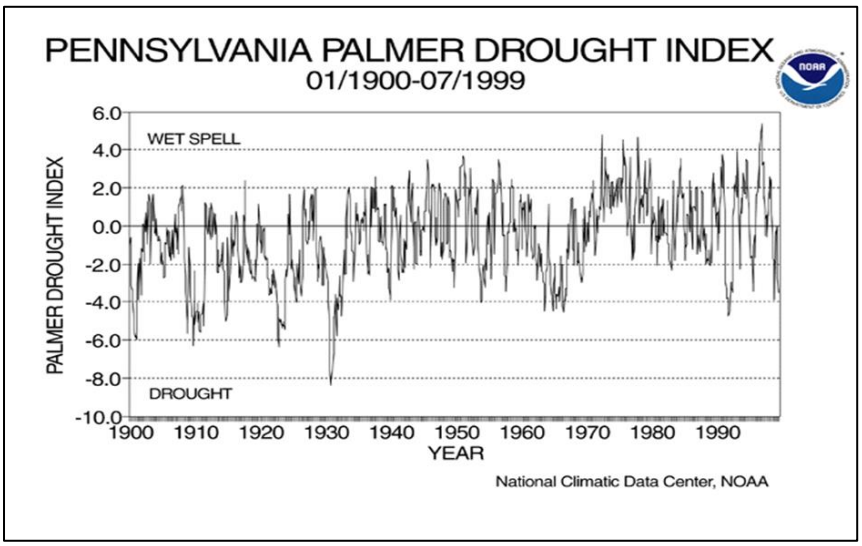
damage losses totaled over $500 million statewide, and those losses equated to 70% to 100% of crop production. There were additional losses from the decline of milk production. Also, the state asked municipal and private water suppliers to restrict local water use.

Table 13 - Past Drought Events in Susquehanna County

Susquehanna County Droughts			
Start	**End**	**Number of Days**	**Description**
11/18/1980	04/20/1982	518	Emergency
04/26/1985	12/19/1985	237	Watch
07/07/1988	08/24/1988	48	Watch
08/24/1988	12/12/1988	110	Warning
03/03/1989	05/15/1989	73	Watch
06/28/1991	07/24/1991	26	Warning
07/24/1991	04/20/1992	271	Emergency
04/20/1992	06/23/1992	64	Warning
09/01/1995	09/20/1995	19	Warning
09/20/1995	11/08/1995	49	Emergency
11/08/1995	12/18/1995	40	Warning
07/17/1997	01/16/1998	183	Watch
12/03/1998	12/14/1998	11	Watch
12/14/1998	03/15/1999	91	Warning
03/15/1999	06/10/1999	87	Watch
06/10/1999	07/20/1999	40	Warning
07/20/1999	09/30/1999	72	Emergency**
09/30/1999	05/05/2000	218	Watch
12/05/2001	06/14/2002	191	Watch
09/05/2002	11/07/2002	63	Watch
04/11/2006	06/30/2006	80	Watch
08/06/2007	09/05/2007	30	Watch
10/05/2007	01/11/2008	98	Watch
09/16/2010	11/10/2010	55	Watch
03/24/2015	06/17/2015	85	Watch
08/31/2022	10/17/2022	47	Watch

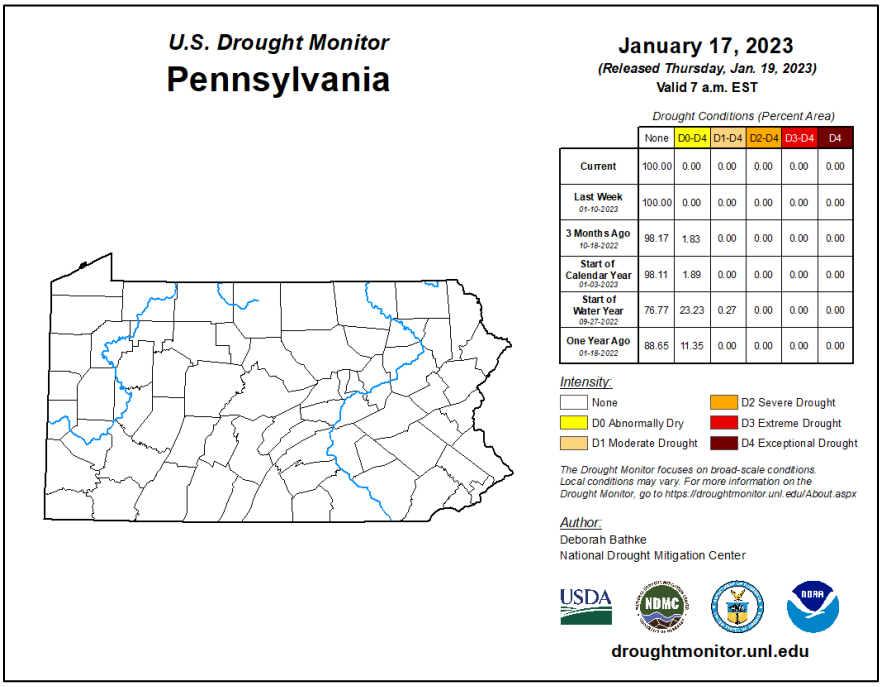
Source: Pennsylvania Department of Environmental Protection, 2023
**Gubernatorial Disaster Declaration

Figure 7-Pennsylvania Palmer Drought Index 1900 – 1999



The warmest July on record in Pennsylvania occurred in 2020, and sixteen counties entered Drought Watch status on August 21 of that year. In June 2021, dry conditions were again affecting the commonwealth. By 2022, most of Pennsylvania was experiencing normal conditions, with intermittent drought watches. *Figure 8 – U.S. Drought Monitor, Pennsylvania* illustrates the conditions of drought in Pennsylvania at the time of the report. Currently, Pennsylvania is under normal drought conditions.

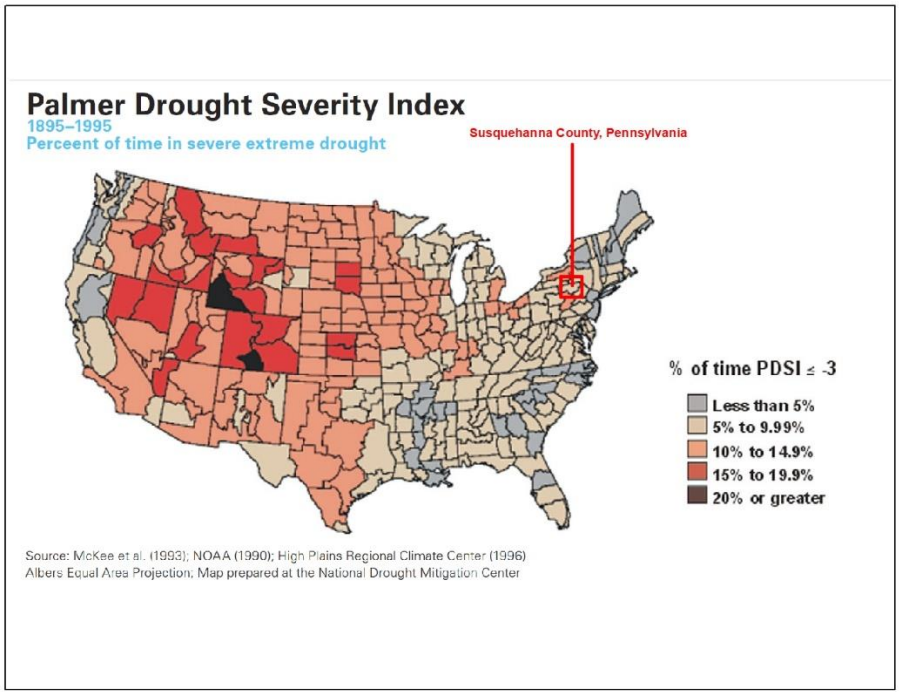
Figure 8-U.S. Drought Monitor, Pennsylvania



4.3.1.4. Future Occurrence

It is difficult to forecast the exact severity and frequency of future drought events. Climate change will lead to increased uncertainty and extremity of climate events. Susquehanna County has experienced severe drought between 5% to 10% of the time between 1895 and 1995 as seen in *Figure 9 – Palmer Drought Severity Index*. This report can be used to make a rough estimate of the future probability of drought in Susquehanna County, although it does not account for changes introduced by climate change. Drought conditions are expected to become more severe with climate change, as evaporation and transpiration will increase with higher temperatures.

Figure 9-Palmer Drought Severity Index



The potential for a drought to occur in Susquehanna County is high. Given the frequency of drought watches issued for Susquehanna County and its municipalities, the county can reasonably expect to be under a drought watch at least once every three years. While some form of drought condition frequently exists in Susquehanna County, the impact depends on the duration of the event, severity of conditions, and area affected. The map above shows that Susquehanna County, and most of Pennsylvania, is currently (and most often) in normal (non-drought) conditions.

4.3.1.5. Vulnerability Assessment

The magnitude of drought vulnerability depends on the duration and area of impact. However, other factors contribute to the severity of a drought. Unseasonably high temperatures, prolonged winds, and low humidity can heighten the impact of a drought.

Extended periods of drought can lead to lowered stream levels, altering the delicate balance of riverine ecosystems. Certain tree species are susceptible to fungal infections during prolonged periods of soil moisture deficit. Fall droughts pose a particular threat because groundwater levels are typically at their lowest following height of the summer growing season.

There are many hazards that can be considered cascading hazards related to drought events. Wildfire is the most severe cascading hazard effect associated with drought. Wildfires can devastate wooded and agricultural areas, threatening natural resources and farm production facilities. With drought events, water infiltration into the ground becomes more difficult. This lack of infiltration can result in flash flooding events in areas of steep slopes, canyons, and rolling hills. A loss of vegetation from a drought can also increase the occurrence of landslides in areas of steep slopes with loose packed soil profiles. A discussion on the county's vulnerability to wildfire, flash floods, and landslides can be found in Section 4.3.13.5, 4.3.4.5, and 4.3.8.5 respectively.

Within Susquehanna County, the amount of crop acreage varies by township and by borough. There is no dataset that relates directly to acreage in Susquehanna County used for agriculture. However, a GIS analysis and conversion of land use data from PASDA can illustrate the amount of row crops per municipality in Susquehanna County. This data is not considered authoritative but can be used to see what the potential vulnerability is for each municipality in Susquehanna County. This table is below:

Row Crop Acreage by Municipality in Susquehanna County	
Municipality	**Acreage of Row Crops**
Apolacon Township	320.68
Ararat Township	222.0
Auburn Township	1,849.64
Bridgewater Township	1,034.19
Brooklyn Township	893.92
Choconut Township	106.91
Clifford Township	495.75
Dimock Township	806.76
Forest City Borough	0
Forest Lake Township	339.61
Franklin Township	209.04
Friendsville Borough	2.39
Gibson Township	455.44
Great Bend Borough	0.44
Great Bend Township	200.79
Hallstead Borough	0.44
Harford Township	473.19
Harmony Township	59.15
Herrick Township	275.87

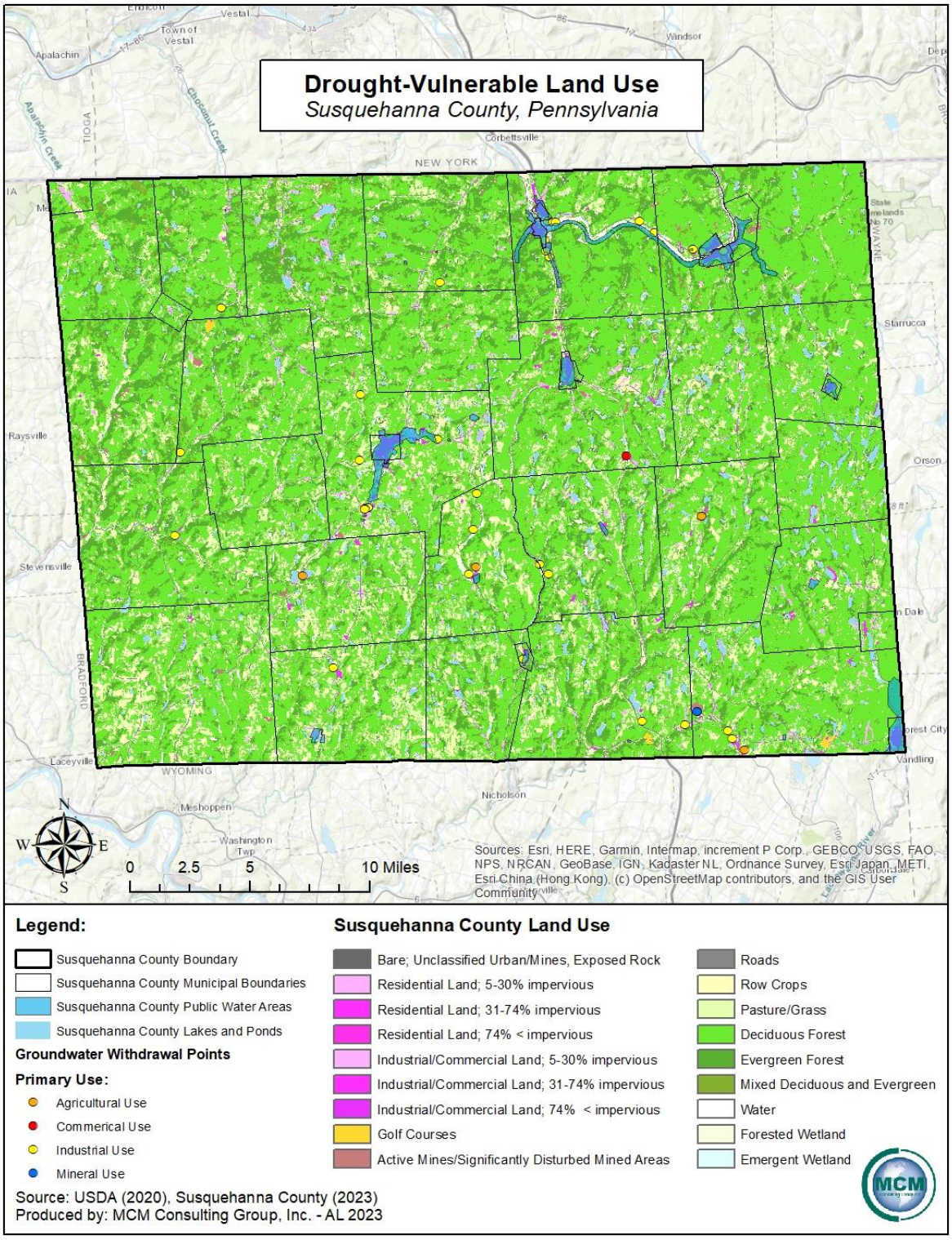
Row Crop Acreage by Municipality in Susquehanna County	
Municipality	**Acreage of Row Crops**
Hop Bottom Borough	16.61
Jackson Township	611.28
Jessup Township	340.06
Lanesboro Borough	4.82
Lathrop Township	519.55
Lenox Township	785.87
Liberty Township	294.27
Little Meadows Borough	50.58
Middletown Township	659.86
Montrose Borough	19.93
New Milford Borough	2.29
New Milford Township	589.62
Oakland Borough	0
Oakland Township	95.93
Rush Township	745.70
Silver Lake Township	269.40
Springville Township	641.02
Susquehanna Depot Borough	0
Thompson Borough	0.22
Thompson Township	443.63
Union Dale Borough	5.65
Total:	**13,842.5**
Source: PA Land Use Statistics (PASDA), 2023	

Based on the information in the table above, the largest amount of row crops can be found in the townships in Susquehanna County. This information does not cover land used for animal husbandry and animal agriculture, and is only part of the agricultural vulnerability.

Additionally, emergency services can be adversely impacted by drought as a cascading hazard. Local fire departments often utilize ponds, creeks, and streams for water onboard fire apparatus. With low water levels in waterbodies, responders may be unable to draft enough water to efficiently respond to and extinguish a fire. Also, with an increased number of potential wildfires due to drought conditions, agencies may not have the personnel to efficiently respond to all fires in a timely manner.

A map of the tillable agricultural land use, forestry, and other land in the county vulnerable to drought is shown below in *Figure 10 – Drought-Vulnerable Land Use and Public Water Supply*.

Figure 10-Drought-Vulnerable Land Use and Public Water Supply

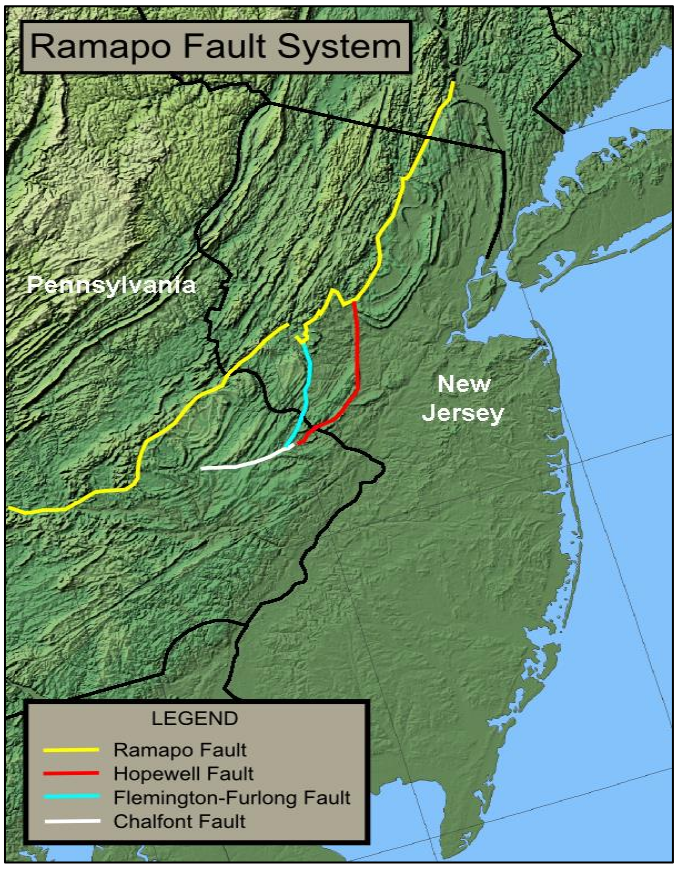


4.3.2. Earthquake

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 62 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, PA, is far from the nearest plate boundary. That plate boundary is the Mid-Atlantic Ridge and is approximately 2,000 miles to the east, under the Atlantic Ocean. The Ramapo Fault System runs through New York, New Jersey, and eastern Pennsylvania (See *Figure 11 – Ramapo Fault System*). This fault system is associated with some small earthquakes, and it is thought unlikely to produce significant disruption.

Figure 11-Ramapo Fault System



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

ideal 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 12 – Pennsylvania Earthquake Hazard Zones*). Nevertheless, the United States Geological Survey (USGS) indicates that Susquehanna County has a low earthquake risk, and there is one earthquake epicenter located in Susquehanna County.

Natural gas extraction of the Marcellus/Utica Shale formation (see *Figure 13 - Pennsylvania Oil and Gas Geology*) has occurred in many regions of the commonwealth, but eastern and southeastern Pennsylvania are not among them. Hydraulic fracturing, or fracking, is used to extract the gas, and the process is thought to lead to an increase in seismic activity (Meyer, 2016).

However, fracking does not appear to be linked to the increased rate of magnitude three and larger earthquakes (USGS 2014). In recent years, permits for extraction of the natural gas and oil in the commonwealth have been issued by the Pennsylvania Department of Environmental Protection, but no records of requested permits for gas extraction or injection wells were found for Susquehanna County at the writing of this plan.

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 14 – Richter Scale* summarizes Richter Scale magnitudes as they relate to the spatial extent of impacted areas. The Modified Mercalli Intensity Scale (*Table 15 – Modified Mercalli Intensity Scale*) is an alternative measure of earthquake intensity that is scaled 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 14 - Richter Scale

Richter Scale	
Richter Magnitude	**Earthquake Effects**
Less than 3.5	Not generally 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.

Richter Scale	
Richter Magnitude	**Earthquake Effects**
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 15 - Modified Mercalli Intensity Scale

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

4.3.2.3. Past Occurrence

According to USGS, one known earthquake has had an epicenter within Susquehanna County since 1724, before which local seismology cannot be known. That earthquake occurred on August 14th, 1982 and was registered as a 1.8 magnitude. However, several seismic events that occurred outside the county boundary may have been felt in the region.

On August 23, 2011, a 5.9 earthquake occurred in Virginia, and a 2.2 earthquake shook Reading, Pennsylvania (Berks County), on July 19, 2019. Further, a 3.4 earthquake struck Mifflintown (Juniata County) on June 13, 2019, and Bolivar (Westmoreland County) experienced a 2.9 event on October 6, 2020. Parts of the county may have experienced some of the shock waves from these minor earthquakes and others that have occurred around the region, most notably New Jersey. The strongest recorded earthquake in Pennsylvania history (5.2) occurred on September 25, 1998 in northwestern Pennsylvania and is known as the Pymatuning Earthquake for its epicenter near Pymatuning Lake. The effects of the earthquake were felt across the commonwealth and were blamed for many wells in the epicentral region drying up, while new springs and old wells began to flow. A three-month date range revealed 120 dry household-supply wells on the ridge of Jamestown and Greenville, Pennsylvania. Declines of up to 100 feet were observed on a ridge where at least eighty of the wells resided. The degree of the damage varied. Some of the wells lost all power or could barely hold their yields and some of the water in wells turned black or began to smell of sulfur.

The most likely cause of the wells drying was because of the increase in hydraulic conductivity or "fracking" of shale rock under this area caused by the earthquake. The quake affected the existing faults and created new faults in the shale. This created more permeability for the water to leak down from the hilltops on the ridge down to the valleys following the contours of the Meadville shale.

Because the effects of large earthquakes can be felt hundreds of miles away, the historical earthquake epicenters *near* Susquehanna County are shown below at *Figure 14 – Pennsylvania Earthquake Activity*. A wider depiction of earthquake occurrences in the northeastern United States may be found here: *https://earthquake.usgs.gov/earthquakes/map/?extent=14.26438,-141.32813&extent=56.51102,-48.60352*

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 12 – Pennsylvania Earthquake Hazard Zones* shows that Susquehanna County is in a low hazard zone for earthquake activity according to the USGS (2014), suggesting a low probability of earthquake occurrence. However, according to the USGS, there has been a recent trend increasing the

frequency of magnitude three and larger earthquakes in the central and eastern U.S. (*Table 16 – Recent Earthquake Trends in Northeastern United States*). This uptick in seismicity is due to hydraulic fracturing activities, and specifically occurs as a result of wastewater 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). It is important to note that seismicity can occur even after wells become inactive and injection rates decline (Shirzaei et al., 2016).

Isostatic Rebound is a hypothesis for earthquake occurrence that has been conceptualized for many years, according to Charles Scharnberger, a retired professor of geology at Millersville University, who monitors the seismic station there. Scharnberger said Pennsylvania earthquakes are somewhat of a mystery, but they could have something to do with the westward shift of the North American tectonic plate. Though the plates meet in California, where most of the seismic activity occurs, that movement still causes stress, squeezing and pressure along the entire length of the plate, reverberating as far back as the East Coast. A 3.4 earthquake like the one in Mifflintown, Juniata County in 2019 is in the medium range for Pennsylvania and may occur every couple of years. According to the USGS, this was the strongest earthquake felt or originating in Pennsylvania that year. It was followed by a 1.3 aftershock.

The chances of a devastating earthquake are low, but do exist, according to Scharnberger, His calculations on the probability of a severe earthquake based on the historic record indicate it is about a one in 200 chance in any given year.

Table 16 - Recent Earthquake Trends in Northeastern United States

Earthquake Trends in Northeastern U.S.	
Year	**Number of Magnitude 3+ Earthquakes**
2015	0
2016	3
2017	4
2018	0
2019	5
2020	3
2021	0
2022	1
Source: USGS, 2020	

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, dried up or rejuvenated water wells, 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 and proximity 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. Infrastructure is more at risk on the east coast than the west coast because its buildings are older.

Climate change and its relationship with earthquakes is hard to identify. According to the U.S Geological Survey, climate change and earthquakes correlation occurs when there is a large change in atmospheric pressure that can be caused by major storms which then could cause slow, small earthquakes. With the release of energy from small earthquakes, over time that energy can lead to ground shaking earthquakes that can cause damage more severe damage. This theory is not yet proven and is still subject to change, but can provide some context to climate change's impact.

Figure 12-Pennsylvania Earthquake Hazard Zones

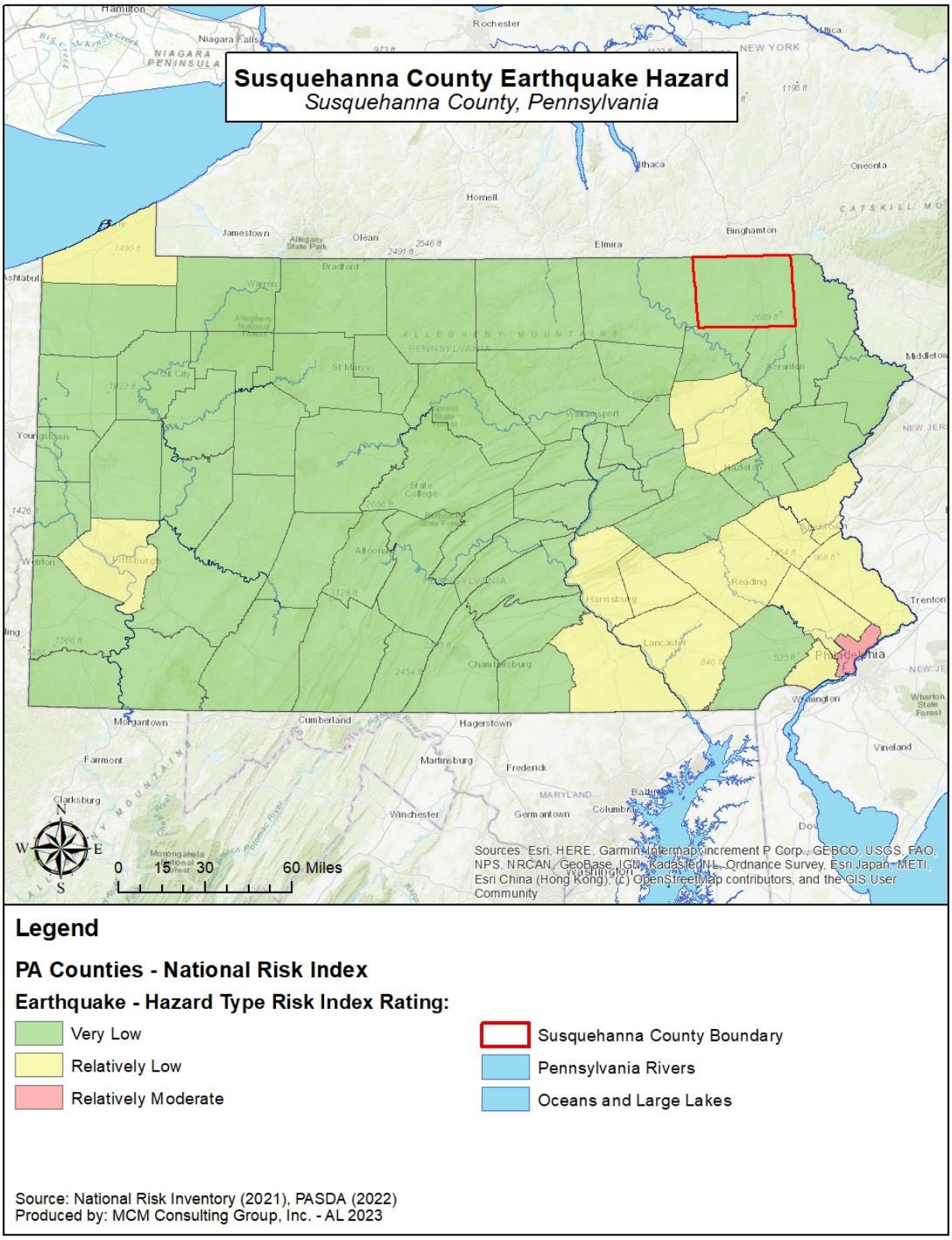


Figure 13-Pennsylvania Oil and Gas Geology

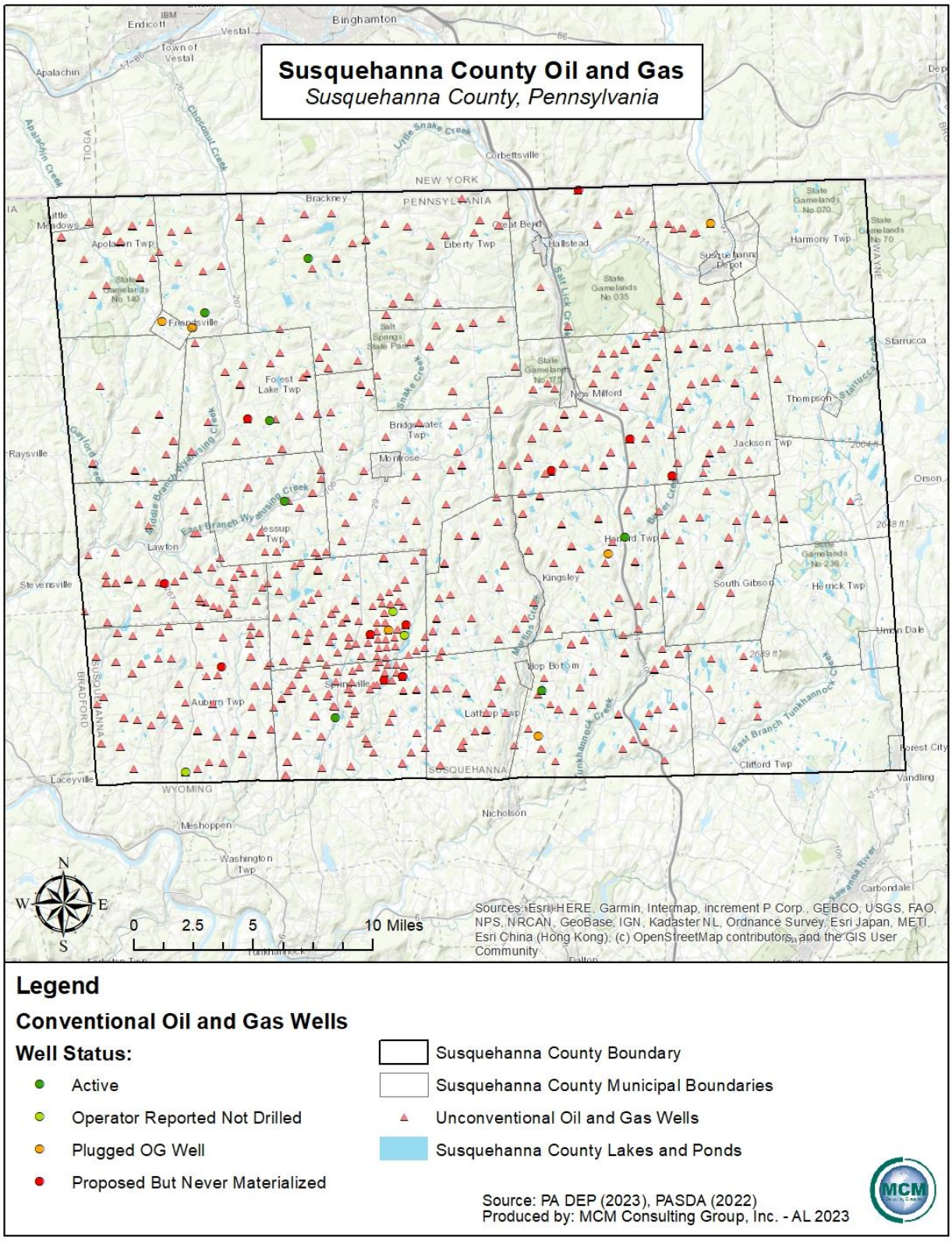
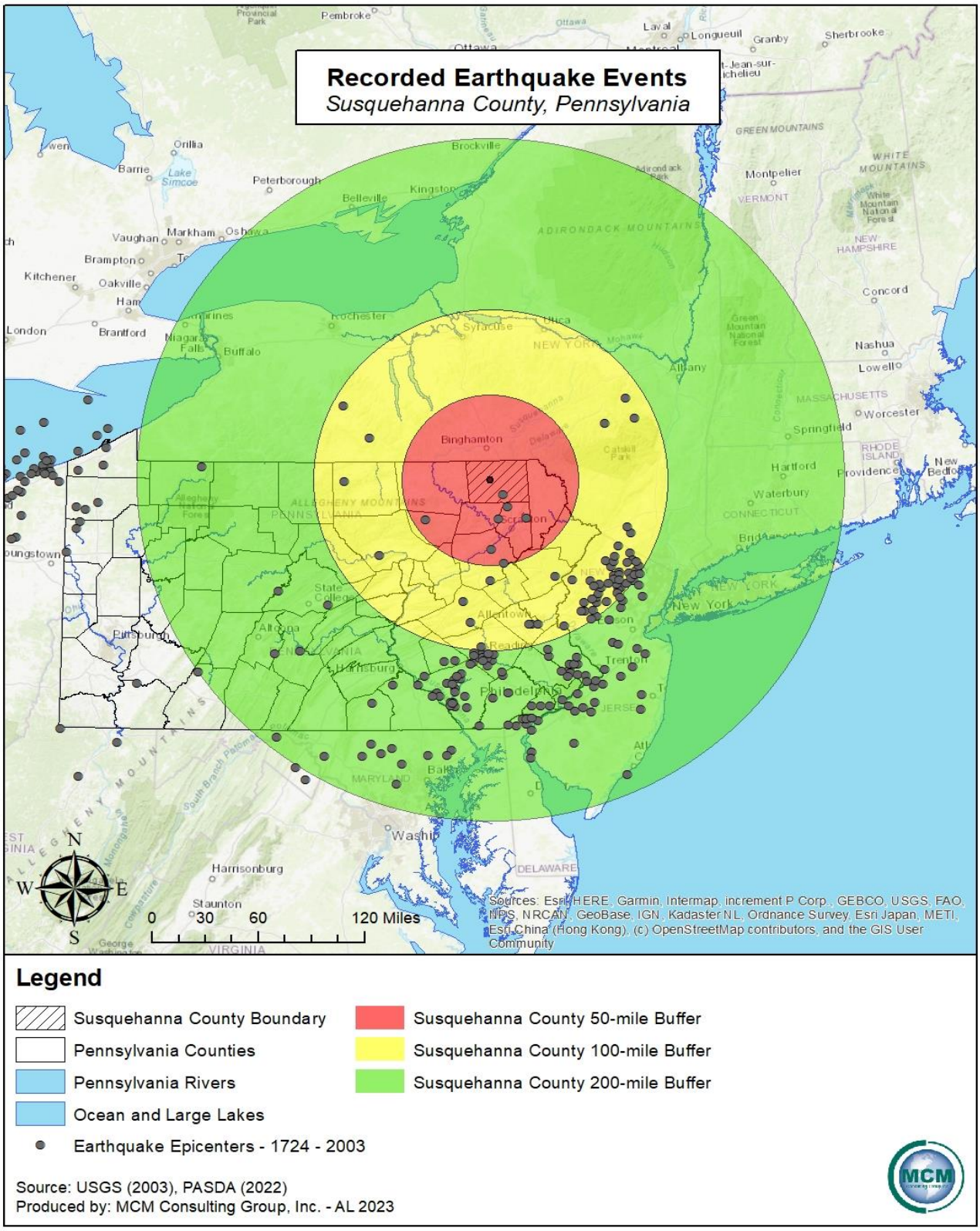


Figure 14-Pennsylvania Earthquake Activity



4.3.3. Extreme Temperatures

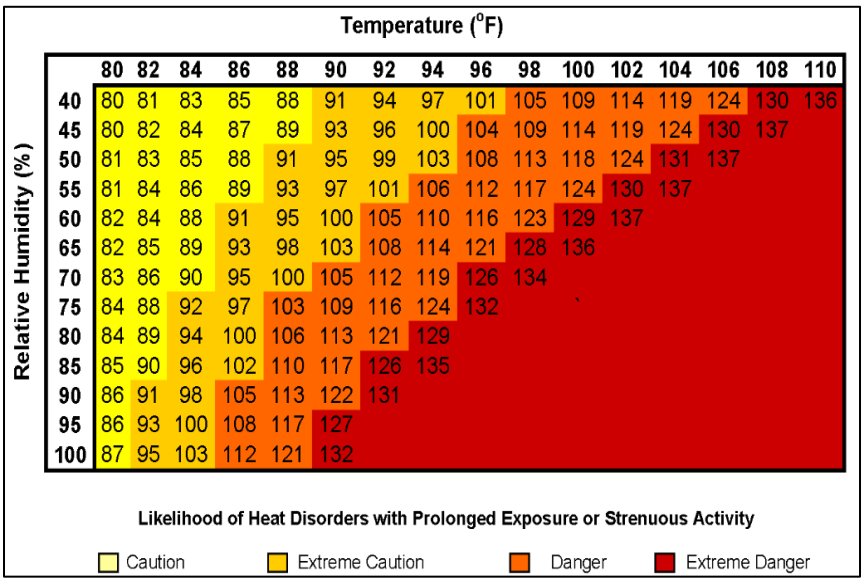
4.3.3.1. Location and Extent

Pennsylvania, and more specifically, Susquehanna County can experience many different temperature extremes. High temperatures occur about ten days per year at any location in Pennsylvania, however, southern parts of the state, experiences more than twice this number. Freezing temperatures occur on an average of 100 or more days per year with longest freeze-free period at near sea level locations such as northwest Pennsylvania (adjacent to Lake Erie). Extreme temperatures can be devastating – extreme heat can cause sunburn, heat cramps, heat exhaustion, heat stroke, and dehydration, while extreme cold can cause hypothermia and frostbite. Both can potentially cause long-lasting disabilities. January is typically the coldest month for Susquehanna County, with average temperatures of 22.6°F. *Figure 17 - Average Minimum Temperature Trends for Pennsylvania* shows the average minimum temperatures in Pennsylvania with Susquehanna County identified. July has typically been the warmest month for Susquehanna County, with an average temperature of 69.5°F. *Figure 18 - Average Maximum Temperature Trends for Pennsylvania* shows the average maximum temperatures in Pennsylvania with Susquehanna County identified. Temperatures can vary across Susquehanna County due to elevation changes in topography.

4.3.3.2. Range of Magnitude

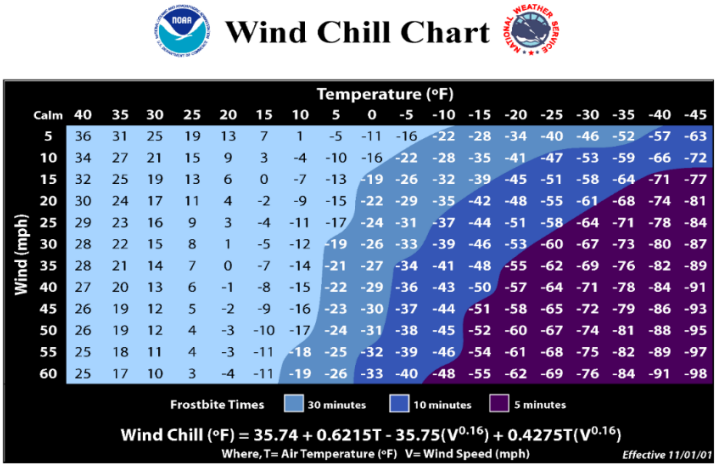
When extreme temperature events occur, they typically impact the entirety of Susquehanna County, including the surrounding region. Extreme heat is described as temperatures that hover at least 10ºF above the average high temperature for a region during the summer months. Extreme heat is responsible for more deaths in Pennsylvania than all other natural disasters combined. Temperature advisories, watches, and warnings are issued by the National Weather Service relating impacts to the range of temperatures typically experienced in Pennsylvania. Heat advisories are issued when the heat index temperature is expected to be equal to 100°F, but less than 105°F. Excessive heat warnings are issued when heat indices will attain or exceed 105°F and are issued within twelve hours of the onset. Excessive heat watches are issued when there is a possibility that excessive heat warning criteria may be experienced within twenty-four to seventy-two hours, but their occurrence and timing are still uncertain. A potential worst-case extreme temperature scenario would be widespread areas of the Commonwealth experiencing 90°F or higher temperatures for an extended number of days. The heat could overwhelm the power grid and cause widespread blackouts, cutting off vital HVAC services for residents. It could create crisis management issues for senior citizens on fixed incomes, the homeless, and other vulnerable populations. The heat index is a measurement that takes into account both the temperature and relative humidity, and it is calculated as shown in *Figure 15 - National Weather Service's Heat Index Matrix*.

Figure 15-National Weather Service's Heat Index Matrix



Extreme cold temperatures drop well below typical temperatures and are often associated with winter storm events. Wind can make the apparent temperature drop further, and exposure to such extreme cold temperatures can cause hypothermia, frost bite and death. Wind chill warnings are issued when wind chills drop to -25°F or lower. While this threshold applies to the entire state, the threshold for advisories varies based on regions. Wind chill advisories are issued in the south and western sections of Pennsylvania, when wind chill values drop to -10°F to -24°F. Wind chill advisories are issued in the southern-central to northern sections of the Commonwealth when wind chills drop to -15°F to -24°F. The National Weather Service created a wind chill chart which shows the time frostbite takes to set in depending on temperature and wind speed as shown in *Figure 16 - National Weather Service's Wind Chill Matrix*.

Figure 16-National Weather Service's Wind Chill Matrix



Source: (NOAA NWS, 2001)

4.3.3.3. Past Occurrence

Susquehanna County has had more past occurrences of extreme cold incidents than extreme heat due to the geographic location of the county. *Table 17 - Past Extreme Temperature Occurrences for Susquehanna County* shows the past occurrence events associated with extreme temperature (hot and cold) that have occurred in Susquehanna County. The data in the table was reported from early 2000s to the year 2022. Due to the source used, no further events have been documented since 2022, however, events most likely have occurred without being documented. With a total of eight different extreme temperature events that have occurred, seven of the events were extreme cold related while the remaining event was extreme heat related. There were no reports of death or injury related to the occurrences. However, numerous sources have provided information regarding past occurrences and losses associated with extreme temperature in Susquehanna County and the Commonwealth as a whole. Due to the number of sources available with information, number of events and losses could vary slightly in number.

Data from the National Climatic Data Center reports that there have been 755 extreme temperature episodes in Pennsylvania from 2000 to present, resulting in a total of ninety-five deaths and 103 injuries. Out of the 755 events, 493 of them were extreme cold related with two deaths. The other 262 events were extreme heat related with ninety-three deaths and 103 injuries across the state. The biggest event was on July 12th, 2011, which had a total of twenty-two deaths and forty-eight injuries. Record-breaking heat temperatures were experienced in numerous counties across the Commonwealth of Pennsylvania. All of these events are regional and are difficult to specify where the event begins and ends in terms of extent.

Table 17 - Past Extreme Temperature Occurrences for Susquehanna County

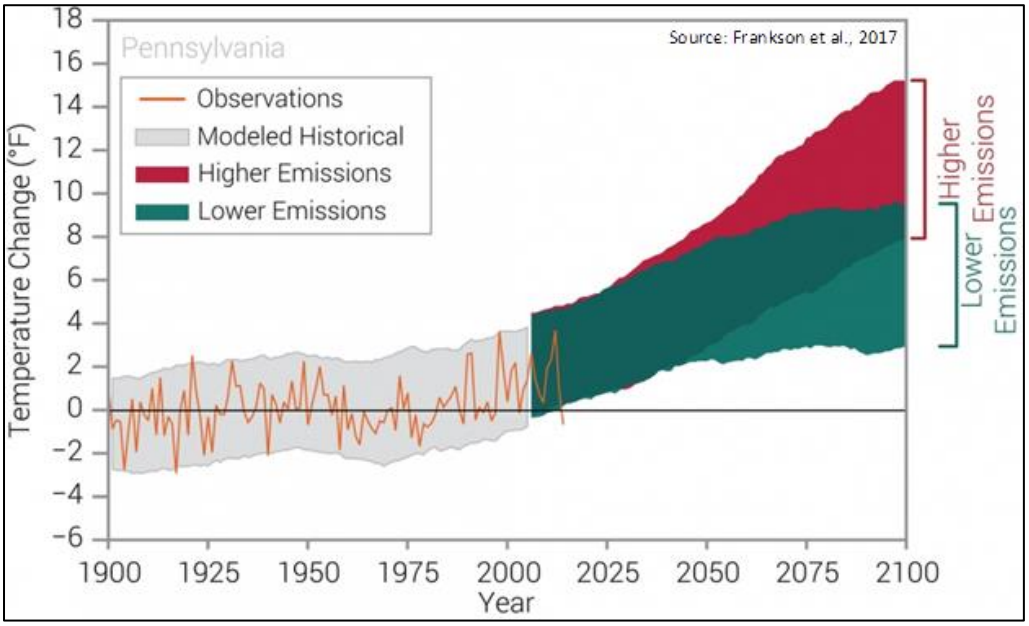
Past Extreme Temperature Occurrences for Susquehanna County		
Location	**Date**	**Type**
Susquehanna County (Entire County)	09/28/2000	Extreme Cold/Wind Chill
Susquehanna County (Entire County)	05/17/2002	Extreme Cold/Wind Chill
Susquehanna County (Entire County)	01/10/2004	Cold/Wind Chill
Susquehanna County (Entire County)	01/15/2004	Cold/Wind Chill
Susquehanna County (Entire County)	01/21/2005	Cold/Wind Chill
Susquehanna County (Entire County)	12/14/2005	Cold/Wind Chill
Susquehanna County (Entire County)	07/21/2011	Excessive Heat
Susquehanna County (Entire County)	01/15/2022	Extreme Cold/Wind Chill
Source: NOAA, 2023		

4.3.3.4. Future Occurrence

Extreme temperatures will continue to impact Susquehanna County in the future. Anthropogenic climate change is causing extreme climatic events to occur more frequently, suggesting that extreme temperatures are becoming a more threatening hazard as the impacts of climate change intensify. The annual average temperature has increased by 1.2˚F across the continental United

States during the years 1986 to present compared to the time period 1901 to 1960 and temperatures are expected to continue rising. *Figure 18 – Observed and Projected Temperature Change for Pennsylvania* shows these projected changes in temperature for Pennsylvania based on climate models considering the possibilities of increased and decreased levels of greenhouse gas emissions. In recent years, record high temperatures have outnumbered record low temperatures 2:1 so it is expected that the risk of extreme heat will be amplified whereas the risk of extreme cold will be attenuated. The Northeastern United States is expected to experience twenty to thirty more days with temperatures above 90˚F, and twenty to thirty fewer days below freezing by approximately 2050. While there may be fewer extreme cold events, those that do occur are expected to reach record-setting low temperatures more often. Historically, Susquehanna County has had more extreme cold events than extreme heat events due to the geographic location of the county; however, this balance is expected to shift somewhat in the coming years to include a greater proportion of extreme heat events.

Table 18 - Observed and Projected Temperature Change for Pennsylvania



Source: (Frankson et al., 2017)

4.3.3.5. Vulnerability Assessment

Extreme temperatures are usually a regional hazard when they occur. The very old (sixty-five years or older, accounting for 24.6% of Susquehanna County population) and the very young (five years or younger, accounting for 4.7% of Susquehanna County population) are most vulnerable to extreme temperatures due to risk factors, mobility challenges, and disabilities. Extreme temperatures can increase the demand for utility services, often resulting in an increased cost which some consumers may be unable to afford. The increased demand for services may

cause a decrease in availability of these services or failure of the system. A decrease or failure of the utility system during extreme temperature events would put a large population at great risk. Extreme temperature events can also drastically increase the volume of emergency calls, potentially overwhelming the public safety communications center. Extreme heat events can also contribute to drought conditions, which in turn increase the risk of wildfire, as discussed in Section 4.3.1.

The table below illustrates the vulnerable populations that would be at increased vulnerability to extreme temperatures in Susquehanna County.

Population per Municipality by Age				
Municipality	**Number of People 65 years or older**	**Percent of Population (%)**	**Number of People under 5 years old**	**Percent of Population (%)**
Apolacon Township	109	29.9	6	1.6
Ararat Township	128	26.3	28	5.7
Auburn Township	423	28.7	39	2.6
Bridgewater Township	717	27.3	84	3.2
Brooklyn Township	268	35.5	18	2.4
Choconut Township	192	29.6	33	5.1
Clifford Township	649	26.4	50	2.0
Dimock Township	171	13.8	64	5.1
Forest City Borough	466	28.9	102	6.3
Forest Lake Township	265	23.3	49	4.3
Franklin Township	154	22.5	22	3.2
Friendsville Borough	25	15.2	9	5.5
Gibson Township	229	18.3	67	5.4
Great Bend Borough	175	26.0	14	2.1
Great Bend Township	406	28.5	32	2.2
Hallstead Borough	216	16.1	144	10.7
Harford Township	303	20.5	61	4.1
Harmony Township	99	28.2	20	5.7
Herrick Township	195	35.2	17	3.1
Hop Bottom Borough	68	22.9	11	3.7
Jackson Township	233	27.3	63	7.4
Jessup Township	119	29.8	23	5.8
Lanesboro Borough	170	28.7	59	9.9

Population per Municipality by Age				
Municipality	**Number of People 65 years or older**	**Percent of Population (%)**	**Number of People under 5 years old**	**Percent of Population (%)**
Lathrop Township	164	21.3	41	5.3
Lenox Township	490	30.7	81	5.1
Liberty Township	271	23.8	105	9.2
Little Meadows Borough	49	23.8	14	6.8
Middletown Township	78	31.0	7	2.8
Montrose Borough	319	22.9	45	3.2
New Milford Borough	124	18.3	29	4.3
New Milford Township	456	27.2	59	3.5
Oakland Borough	83	15.5	39	7.3
Oakland Township	87	15.0	71	12.2
Rush Township	264	21.1	41	3.3
Silver Lake Township	380	21.5	32	1.8
Springville Township	392	24.6	64	4.0
Susquehanna Depot Borough	200	14.3	90	6.5
Thompson Borough	29	10.0	51	17.5
Thompson Township	102	27.0	17	4.5
Union Dale Borough	49	30.6	2	1.3
Total:	**9,317**	**-**	**1,803**	**-**
Source: American Community Survey, United States Census Bureau, 2022				

Figure 17-Average Minimum Temperature Trends for Pennsylvania

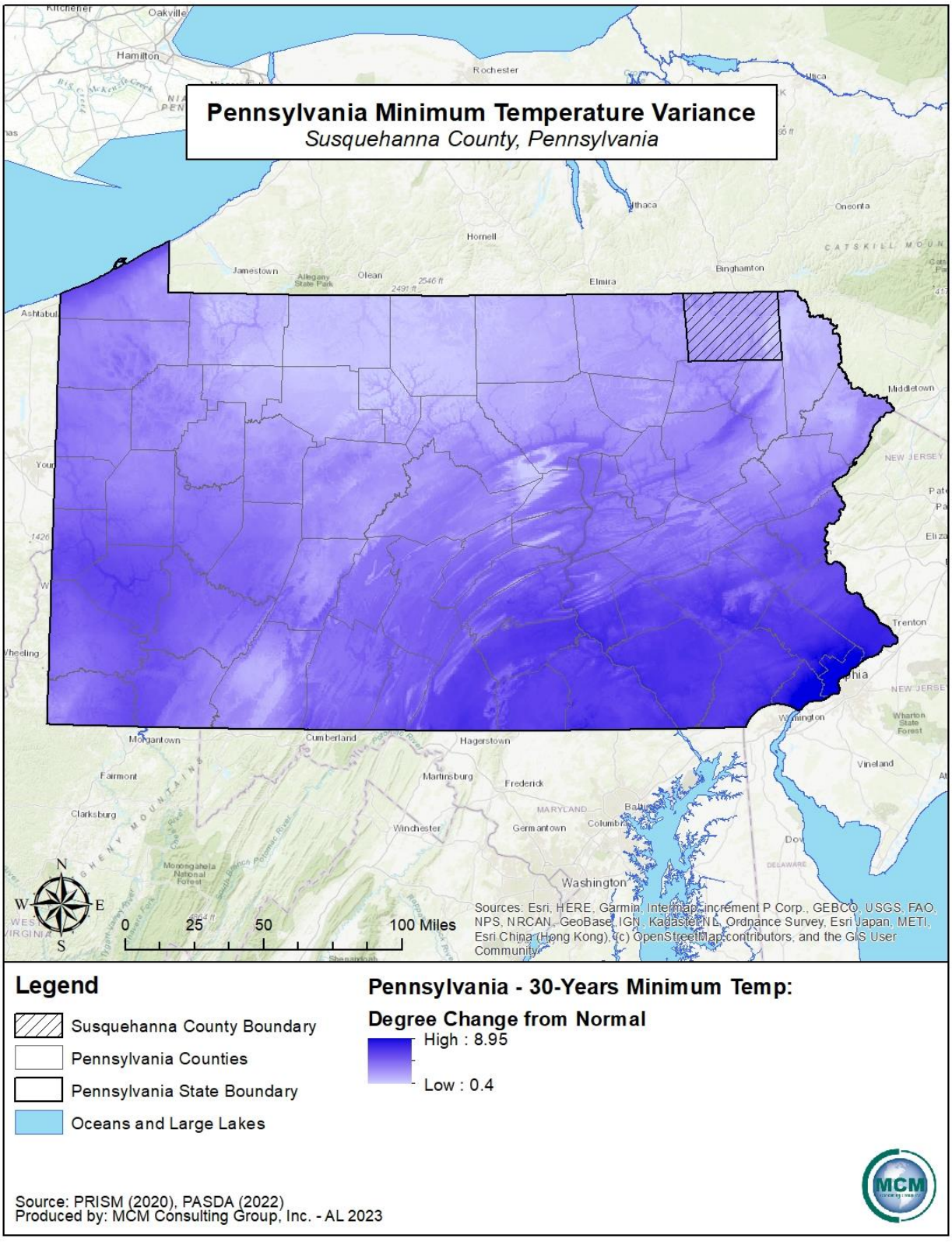
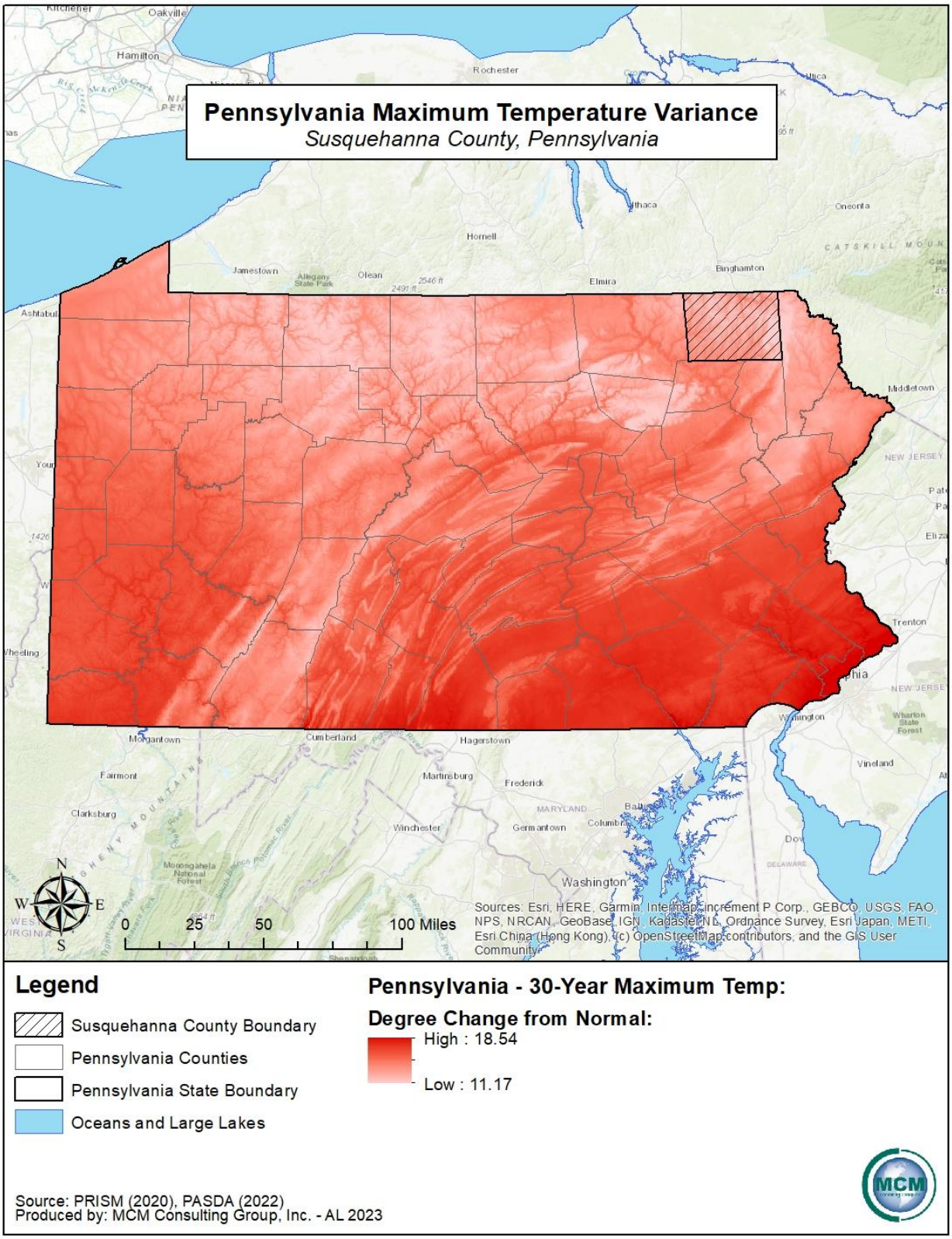


Figure 18-Average Maximum Temperature Trends for Pennsylvania



4.3.4. Flooding, Flash Flooding, and Ice Jam Flooding

4.3.4.1. Location and Extent

Flooding is the temporary condition of partial or complete inundation on normally dry land and it is the most frequent and costly of all hazards in Pennsylvania. Flooding events are generally the result of excessive precipitation. General flooding is typically experienced when precipitation occurs over a given river basin for an extended period. Flash flooding is usually the result of heavy, localized precipitation falling in a short period of time over a given location, often in mountain streams and mountainous regions, and in urban areas where much of the ground is covered in impervious surfaces. Flash floods are relatively common in Susquehanna County and the severity of those flood events is dependent upon a combination of creek, stream, and river basin topography and physiography, hydrology, precipitation, and weather patterns. Present soil conditions, the degree of vegetative clearing, and the presence of impervious cover must also be considered when determining the severity of a flood or flood event.

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.

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 event. Flood recurrence intervals are explained in more detail in section 4.3.4.4. However, in assessing the potential spatial extent of flooding, it is important to know that a floodplain associated with a flood that has a 10% chance of occurring in a given year is smaller than a floodplain associated with a flood that has a 0.2% 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. The special flood hazard area (SFHA) and base flood elevations (BFE) are developed from the 1% annual chance flood event as seen in *Figure 19 – Flooding and Floodplain Diagram*. Structure located within 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 the Susquehanna County local government. Federal floodplain management regulations and mandatory flood insurance purchase requirements apply to the following high-risk special flood hazard areas in *Table 19 – 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 community lifeline facilities identified using the most current DFIRM data for Susquehanna County.

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 community lifeline 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, or store hazardous materials. A flood could potentially release and transport hazardous materials throughout the area. Most flood damage to a property and structure located in the floodplain is caused by water exposure to the interior, high velocity water, and debris flow.

Figure 19-Flooding and Floodplain Diagram

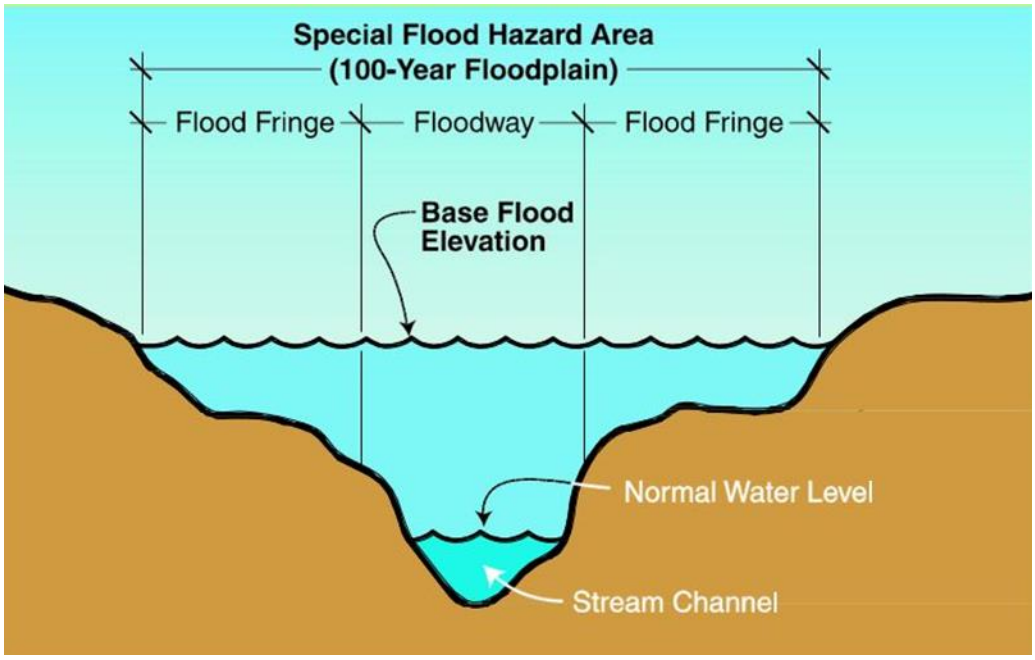


Table 19-Flood Hazard High Risk Zones

Flood Hazard High Risk Zones	
Zone	**Description**
A	Areas subject to inundation by the 1% annual chance flood event. Because detailed hydraulic analysis has 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.

Flood Hazard High Risk Zones	
Zone	**Description**
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.
Source: FEMA, 2017	

4.3.4.2. Range of Magnitude

The Susquehanna River basin has caused significant flooding in Susquehanna County, specifically on the following streams, creeks, and their tributaries:

- Susquehanna River
    - Drinker Creek
    - East Branch Wyalusing Creek
    - Snake Creek
    - Starrucca Creek

Several factors determine the severity of floods, including rainfall intensity and duration, topography, ground cover, and the 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. The is of particular concern for areas along steep slopes and on the edges of valleys throughout Susquehanna County.

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 flood events. Flash floods can occur very quickly and with little warning. A flash flood can also be deadly because of the rapid rise in water levels and devastating flow velocities. The more developed areas in the county can be easily susceptible to flash floods because of the significant presence of impervious surfaces, such as streets, sidewalks, parking lots, and driveways. Additionally, small amounts of rain can cause floods in locations where the soil is still frozen, saturated from a previous wet period or if the areas is largely covered in impermeable surfaces such as parking lots, paved roadways, and other developed areas. The county occasionally experiences intense rainfall from tropical storms in later summer and early fall, which can potentially cause flooding as well.

Severe flooding can cause injuries and deaths and can have long-term impacts on the health and safety of citizens. Severe flooding can also result in significant property damage, potentially disrupting the regular function of community lifeline facilities and can have widespread negative effects on local economies. Industrial, commercial, and public infrastructure facilities can become inundated with flood waters, threatening the continuity of government and business. The

vulnerable populations must be identified and located in flooding situations, as they are often home bound. Mobile homes and manufactured structures are especially vulnerable to high water levels. Flooding can have significant environmental impacts when the flood water release and/or transport hazardous materials.

The most severe flooding in Central Pennsylvania Northeastern, and South-Central Pennsylvania has been associated with the Susquehanna River Basin. The greatest magnitude of county wide flooding impacts was reported as a result of Hurricane Agnes in 1972. Hurricane Agnes deposited a large amount of rain on Ohio, western Pennsylvania, northern West Virginia, and southwestern New York, with an average of 8 ½ inches of rain reported over most areas. This large amount of rain contributed to widespread and record setting flooding across the Commonwealth of Pennsylvania. Pennsylvania experienced an estimated $2.1 billion in damage and forty-eight deaths.

Severe flooding also comes with secondary effects that could have long lasting impacts on the population, economy, and infrastructure within 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. Community lifelines, such as sewage and water treatment facilities, can fail, causing sewage overflows and the contamination of 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 for Susquehanna County is estimated by looking at the potential loss data and repetitive loss data, both analyzed in the risk assessment section of the hazard mitigation plan. In these cases, the severity and frequency of damage can result in permanent population displacement, and business may close if they are unable to recover from the disaster.

Estimation of potential loss is completed through FEMA's HAZUS software, A level two HAZUS scenario was performed for the entirety of Susquehanna County. The FEMA Global Flood Risk Report and other reports generated by the software at the end of the scenario were utilized to estimate the amount of damage and loss from a flood. The total building loss for a 100-year flood based on a HAZUS level two scenario is displayed in *Table 20 – HAZUS Building Economic Loss Figures*. The total business interruption vales occurring from a proposed 100-year flood based on FEMA HAZUS data is illustrated in *Table 21 – HAZUS Business Interruption Economic Loss Figures*. *Figure 20 – Loss by Occupancy Type* illustrates the breakdown of economic losses by either residential, commercial, industrial, or other use type.

Table 20-HAZUS Building Loss Figures

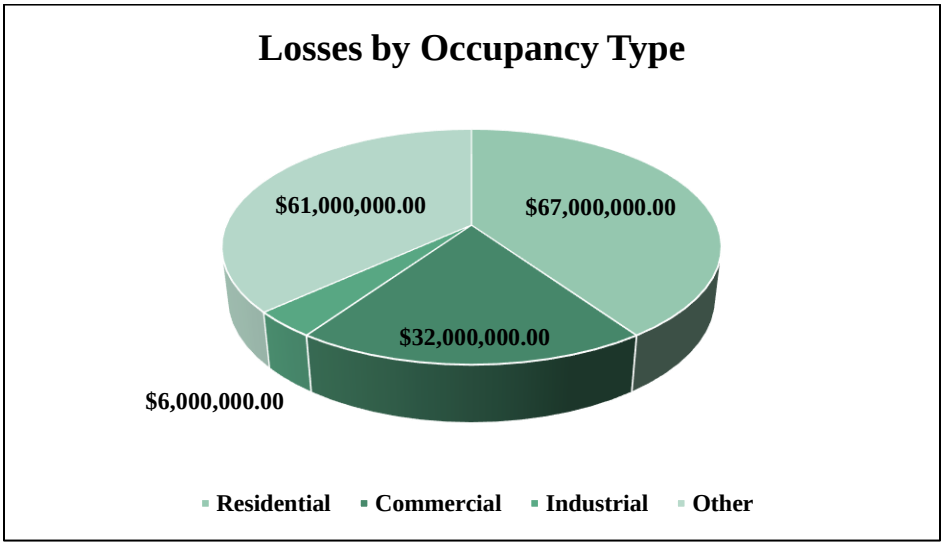
HAZUS Building Economic Loss Figures					
	Residential	**Commercial**	**Industrial**	**Other**	**Total**
Building:	$34,150,000.00	$2,910,000.00	$1,530,000.00	$880,000.00	$39,470,000.00

HAZUS Building Economic Loss Figures					
	Residential	**Commercial**	**Industrial**	**Other**	**Total**
Content:	$15,830,000.00	$10,420,000.00	$3,690,000.00	$4,830,000.00	$34,770,000.00
Inventory:	$0.00	$190,000.00	$420,000.00	$40,000.00	$650,000.00
Subtotal:	**$49,980,000.00**	**$13,520,000.00**	**$5,640,000.00**	**$5,750,000.00**	**$74,890,000.00**
Source: HAZUS, 2023					

Table 21-HAZUS Business Interruption Economic Loss Figures

HAZUS Business Interruption Economic Loss Figures					
	Residential	**Commercial**	**Industrial**	**Other**	**Total**
Income:	$780,000.00	$7,320,000.00	$80,000.00	$1,670,000.00	$9,850,000.00
Relocation:	$10,540,000.00	$1,680,000.00	$90,000.00	$1,080,000.00	$13,390,000.00
Rental Income:	$4,250,000.00	$1,110,000.00	$10,000.00	$80,000.00	$5,450,000.00
Wage:	$1,830,000.00	$8,690,000.00	$120,000.00	$52,620,000.00	$63,260,000.00
Subtotal:	**$17,400,000.00**	**$18,800,000.00**	**$300,000.00**	**$55,450,000.00**	**$91,950,000.00**
Source: HAZUS, 2023					

Figure 20-Loss by Occupancy Type



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 sediments which improve 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 and can contaminate habitats after flood events.

4.3.4.3. Past Occurrence

Susquehanna County has experienced numerous flooding, flash flooding, and ice jam events in the past. The flooding and flash flooding were caused by a variety of heavy storms, inclement weather, tropical storms, and other issues. A summary of recent flood event history for Susquehanna County from January 2000 to April 2023 is found in *Table 22 – Past Flood and Flash Flood Events*. Details of each event can be found in NOAA's National Center for Environmental Information (NCEI) database.

Table 22-Past Flood and Flash Flood Events

Past Flood and Flash Flood Events			
Event Location	**Event Date**	**Event Type**	**Property Damage Estimate**
Susquehanna County (Entire County)	02/27/2000	Flood	$0.00
Montrose Borough	03/26/2002	Flash Flood	$0.00
Susquehanna County (Entire County)	03/27/2002	Flood	$0.00
Auburn Township	09/04/2003	Flash Flood	$100,000.00
Susquehanna County (Entire County)	12/11/2003	Flash Flood	$50,000.00
Harford Township	07/17/2004	Flash Flood	$10,000.00
Montrose Borough	07/17/2004	Flash Flood	$10,000.00
New Milford Township	08/30/2004	Flash Flood	$5,000.00
Susquehanna County (Entire County)	09/17/2004	Flash Flood	$10,000,000.00
Susquehanna County (Entire County)	11/28/2004	Flash Flood	$10,000.00
Susquehanna County (Entire County)	04/01/2005	Flood	$200,000.00
Susquehanna County (Entire County)	04/02/2005	Flash Flood	$250,000.00
Great Bend Township	01/18/2006	Flash Flood	$50,000.00
Little Meadows Borough	06/27/2006	Flash Flood	$50,000.00
Susquehanna County (Entire County)	06/27/2006	Flash Flood	$100,000,000.00
Little Meadows Borough	11/16/2006	Flash Flood	$0.00
Susquehanna County (Entire County)	11/16/2006	Flash Flood	$0.00
Friendsville Borough	11/16/2006	Flash Flood	$0.00
Harford Township	03/08/2008	Flash Flood	$0.00
Little Meadows Borough	07/23/2008	Flash Flood	$5,000.00
Little Meadows Borough	06/20/2009	Flash Flood	$75,000.00
Little Meadows Borough	01/25/2010	Flash Flood	$0.00
Auburn Township	01/25/2010	Flash Flood	$10,000.00
Montrose Borough	01/25/2010	Flash Flood	$10,000.00
Little Meadows Borough	09/30/2010	Flash Flood	$5,000.00
Brooklyn Township	07/08/2011	Flash Flood	$0.00
Hallstead Borough	08/28/2011	Flash Flood	$75,000.00
New Milford Township	08/28/2011	Flash Flood	$150,000.00

Past Flood and Flash Flood Events			
Event Location	**Event Date**	**Event Type**	**Property Damage Estimate**
Little Meadows Borough	09/07/2011	Flash Flood	$1,000,000.00
Rush Township	09/07/2011	Flash Flood	$250,000.00
Brooklyn Township	09/28/2011	Flash Flood	$0.00
Little Meadows Borough	09/29/2011	Flash Flood	$0.00
Hallstead Township	09/29/2011	Flash Flood	$0.00
Ararat Township	06/28/2013	Flash Flood	$100,000.00
Harmony Township	06/28/2013	Flash Flood	$150,000.00
Forest Lake Township	08/21/2014	Flash Flood	$200,000.00
Silver Lake Township	08/21/2014	Flash Flood	$50,000.00
Montrose Borough	08/21/2014	Flash Flood	$100,000.00
Friendsville Borough	08/21/2014	Flash Flood	$250,000.00
Hallstead Borough	07/17/2017	Flash Flood	$15,000.00
Susquehanna Depot Borough	07/17/2017	Flash Flood	$15,000.00
Little Meadows Borough	07/24/2017	Flash Flood	$467,000.00
Silver Lake Township	07/24/2017	Flash Flood	$467,000.00
Friendsville Borough	07/24/2017	Flash Flood	$467,000.00
New Milford Township	08/03/2018	Flash Flood	$20,000.00
Little Meadows Borough	08/08/2018	Flash Flood	$8,000.00
Rush Township	08/11/2018	Flash Flood	$30,000.00
Dimock Township	08/11/2018	Flash Flood	$5,000.00
Lenox Township	08/13/2018	Flash Flood	$20,000.00
Liberty Township	08/14/2018	Flash Flood	$510,000.00
Montrose Borough	08/14/2018	Flash Flood	$250,000.00
Franklin Township	08/14/2018	Flash Flood	$10,000.00
Hallstead Borough	08/14/2018	Flash Flood	$5,000.00
Hop Bottom Borough	08/14/2018	Flash Flood	$10,000.00
Springville Township	06/18/2019	Flash Flood	$7,000.00
Lenox Township	06/18/2019	Flash Flood	$10,000.00
Little Meadows Borough	07/17/2019	Flash Flood	$5,000.00
Rush Township	04/30/2020	Flood	$5,000.00
Forest Lake Township	08/07/2020	Flash Flood	$15,000.00
Hallstead Borough	08/07/2020	Flash Flood	$50,000.00
Choconut Township	12/25/2020	Flash Flood	$30,000.00
Silver Lake Township	07/12/2021	Flash Flood	$10,000.00
Ararat Township	10/26/2021	Flash Flood	$2,000.00
Herrick Township	10/26/2021	Flash Flood	$1,000.00
		Total:	**$115,599,000.00**
Source: NCEI NOAA, 2023			

Past Flood and Flash Flood Events			
Event Location	**Event Date**	**Event Type**	**Property Damage Estimate**
*Property Damage Values are estimated and are not exact figures.			

The National Flood Insurance Program (NFIP) 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 repair, on average, equaled or exceeded 25% 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 increased cost of compliance coverage. *Table 23 – Repetitive Loss Properties* illustrates the communities that have repetitive loss properties, the total building payments, the contents payments, and the number of losses and properties. There are eighty-one repetitive loss properties in Susquehanna County. *Table 24 – Summary of Type of Repetitive Loss Properties by Municipality* illustrates the breakdown of type of repetitive loss properties in Susquehanna County.

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. *Table 25 – Severe Repetitive Loss Properties* illustrates the communities within Susquehanna County that have severe repetitive loss properties, the total building payments, the contents payments, and the number of losses and properties. The data used in the table is based on data provided by PEMA.

Table 23-Repetitive Loss Properties

Repetitive Loss Properties						
Community Name	**Community Number**	**Cumulative Building Payment**	**Cumulative Contents Payment**	**Sum of Total Paid**	**Losses**	**Properties**
Apolacon Township	422072	$14,582.00	$740.66	$15,322.66	3	1
Bridgewater Township	422585	$71,313.72	$9,548.11	$80,861.83	4	2
Brooklyn Township	422075	$19,431.68	$0.00	$19,431.68	2	1
Choconut Township	422076	$55,736.76	$0.00	$55,736.76	2	1
Franklin Township	422079	$202,793.25	$69,147.90	$271,941.05	8	3

Repetitive Loss Properties						
Community Name	**Community Number**	**Cumulative Building Payment**	**Cumulative Contents Payment**	**Sum of Total Paid**	**Losses**	**Properties**
Gibson Township	422080	$33,487.86	$0.00	$33,487.86	2	1
Great Bend Borough	422068	$210,766.02	$1,516.70	$212,282.72	4	2
Great Bend Township	421212	$969,268.85	$1,110,677.45	$2,079,946.30	30	14
Hallstead Borough	422069	$231,087.30	$33,203.76	$264,291.06	10	4
Harmony Township	422082	$250,611.36	$49,115.44	$299,726.80	29	10
Hop Bottom Borough	420812	$91,455.79	$0.00	$91,455.79	6	2
Jessup Township	422084	$98,630.19	$19,289.65	$115,919.84	2	1
Lanesboro Borough	420813	$929,288.24	$148,294.09	$1,077,582.33	48	22
Liberty Township	422087	$227,415.90	$25,780.44	$253,196.34	7	3
Little Meadows Borough	420814	$46,949.33	$4,755.62	$51,704.95	2	1
New Milford Borough	420815	$348,607.33	$50,000.00	$398,607.33	14	6
New Milford Township	422089	$143,691.55	$10,662.96	$154,354.51	2	1
Oakland Township	422581	$128,031.10	$11,269.61	$139,300.71	2	1
Rush Township	422090	$121,948.57	$0.00	$121,948.57	5	2
Springville Township	422092	$26,657.28	$13,031.67	$39,688.95	3	1
Susquehanna Depot Borough	420816	$3,751.56	$818.97	$4,570.53	2	1
	Total:	**$4,225,505.64**	**$1,557,853.03**	**$5,781,358.57**	**185**	**79**
Source: FEMA, 2023						

Table 24-Summary of Type of Repetitive Loss Properties by Municipality

Summary of Type of Repetitive Loss Properties by Municipality					
Municipality	Type				
	Non-Residential	2-4 Family	Single Family	Condo	Other Residential
Apolacon Township	0	0	1	0	0
Bridgewater Township	0	0	2	0	0
Brooklyn Township	0	0	1	0	0
Choconut Township	0	0	1	0	0
Franklin Township	0	0	3	0	0
Gibson Township	0	0	1	0	0
Great Bend Borough	1	0	1	0	0
Great Bend Township	3	1	10	0	0
Hallstead Borough	0	0	4	0	0
Harmony Township	0	0	10	0	0
Hop Bottom Borough	0	0	2	0	0
Jessup Township	0	0	1	0	0
Lanesboro Borough	1	1	20	0	0
Liberty Township	1	0	2	0	0
Little Meadows Borough	0	0	1	0	0
New Milford Borough	1	0	5	0	0
New Milford Township	0	0	1	0	0
Oakland Township	0	0	1	0	0
Rush Township	1	0	1	0	0
Springville Township	0	0	1	0	0
Susquehanna Depot Borough	0	0	1	0	0
Source: FEMA, 2023					

Table 25-Severe Repetitive Loss Properties

Severe Repetitive Loss Properties						
Community Name	Community Number	Cumulative Building Payments	Cumulative Contents Payments	Sum of Total Paid	Losses	Properties
Great Bend Township	421212	$59,921.80	$0.00	$59,921.80	4	1
Hallstead Borough	422069	$158,901.40	$28,540.35	$187,442.19	2	1
Harmony Township	422082	$28,766.34	$17,965.29	$46,731.63	5	1

Severe Repetitive Loss Properties						
Community Name	**Community Number**	**Cumulative Building Payments**	**Cumulative Contents Payments**	**Sum of Total Paid**	**Losses**	**Properties**
Harmony Township	422082	$14,391.04	$0.00	$14,391.04	2	1
Lanesboro Borough	420813	$145,135.33	$38,514.77	$183,650.10	3	1
Lanesboro Borough	420813	$96,000.00	$19,886.20	$115,886.20	2	1
Liberty Township	422087	$111,792.90	$25,780.44	$137,573.34	2	1
	Total:	**$614,908.81**	**$130,687.05**	**$745,596.30**	**20**	**7**

Source: PEMA, 2023
Information provided by PEMA, 2023.

4.3.4.4. Future Occurrence

Flooding is a frequent problem throughout the Commonwealth of Pennsylvania. Susquehanna County will certainly be impacted by flooding events in the future, as Susquehanna County experiences some degree of flooding annually. The threat of flooding is compounded in the late winter and early spring months, as melting snow can overflow streams, creeks, and tributaries, increasing the amount of groundwater, clogging stormwater culverts and bridge openings. The NFIP recognizes the 1% annual chance flood, also known as the base flood of a 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 in a given year or is likely once every one-hundred years. The digital flood insurance maps (DFIRMs) are used to identify areas subject to the 1% annual chance of 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 has a 10% chance of being flooded every year. However, this label does not mean that this area cannot flood more than once every ten years. This label simply 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 2%. A summary of flood probability is shown in *Table 26 – Flood Probability Summary*.

Table 26-Flood Probability Summary

Flood Probability Summary	
Flood Recurrence Intervals	**Annual Chance of Occurrence**
10-year	10.00%
50-year	2.00%
100-year	1.00%
500-year	0.20%
Source: FEMA, 2009	

4.3.4.5. Vulnerability Assessment

Riverine and Stream Flooding

Susquehanna County is vulnerable to stream and river flooding on an annual basis. Flooding puts the entire population at some level of risk, whether through flooding of homes, businesses, places of employment, roadways, sewers, and water infrastructure. Flooding can cause significant power outages and poor road conditions that can lead to heightened transportation accident risk.

County community lifelines are the most vulnerable buildings and services when riverine and stream flooding is considered. Community lifeline facilities are facilities that, if damaged, would present an immediate threat to life, public health, and safety. Facilities that use and store hazardous materials pose a potential threat to the environment during flooding events if flooding causes a leak, inundation, or equipment failure. Appendix D of this hazard mitigation plan includes a flooding vulnerability map for each municipality in Susquehanna County, with vulnerable structures and community lifeline facilities that are located within the special flood hazard area.

Table 27 – Expected Damage to Essential Facilities (HAZUS) illustrates the estimated damage levels to certain essential facilities based on classifications in the HAZUS General Building Stock. There are four facilities that are estimated to be at least moderately damaged by a 100-year flooding event in the HAZUS Level Two scenario that was completed for Susquehanna County. Of those four facilities that are estimated to be moderately damaged by the scenario, all of those facilities will undergo a loss of use. No police stations, hospitals, or schools will be damaged by the HAZUS scenario. All four essential facilities that will experience a loss of use are fire stations within the county. Plans for such an event, and the damage that would result to essential facilities, must be put in place to successfully mitigate the potential disruption to community lifeline facilities.

Table 27-Expected Damage to Essential Facilities (HAZUS)

Expected Damage to Essential Facilities				
Classification	**Number of Facilities**			
	Total:	**At Least Moderate:**	**At Least Substantial:**	**Loss of Use:**
Emergency Operations Center	1	0	0	0
Fire Stations	20	4	0	4
Hospitals	2	0	0	0
Police Stations	10	0	0	0
Schools	18	0	0	0
Source: FEMA, 2023				

Table 28 - County Structures Within Special Flood Hazard Area shows the number of site structure address points within the Special Flood Hazard Area as well as the community lifeline facilities. This information was compiled using the Special Flood Hazard Area and GIS data provided by the Susquehanna County GIS Department.

Table 28-County Structures Within Special Flood Hazard Area

County Structures Within Special Flood Hazard Area		
Municipality	**Site Structure Address Points Within Flood Area**	**Community Lifelines within Flood Area**
Apolacon Township	26	0
Ararat Township	4	0
Auburn Township	25	0
Bridgewater Township	43	0
Brooklyn Township	18	0
Choconut Township	23	1
Clifford Township	78	0
Dimock Township	14	0
Forest City Borough	0	0
Forest Lake Township	21	0
Franklin Township	29	0
Friendsville Borough	0	0
Gibson Township	29	0
Great Bend Borough	15	1
Great Bend Township	359	1
Hallstead Borough	49	0
Harford Township	42	0

County Structures Within Special Flood Hazard Area		
Municipality	**Site Structure Address Points Within Flood Area**	**Community Lifelines within Flood Area**
Harmony Township	66	0
Herrick Township	12	0
Hop Bottom Borough	37	1
Jackson Township	5	0
Jessup Township	17	0
Lanesboro Borough	88	0
Lathrop Township	22	0
Lenox Township	85	1
Liberty Township	39	0
Little Meadows Borough	11	0
Middletown Township	14	0
Montrose Borough	4	1
New Milford Borough	181	1
New Milford Township	22	0
Oakland Borough	4	1
Oakland Township	44	0
Rush Township	53	0
Silver Lake Township	31	0
Springville Township	30	0
Susquehanna Depot Borough	10	0
Thompson Borough	5	0
Thompson Township	28	0
Union Dale Borough	3	0
Totals:	**1,586**	**8**
Source: Susquehanna County, 2023		

Table 29 – Community Lifeline Facilities Additional Information illustrates the additional information including name, the municipality, and the type of facility for each community lifeline facility that falls within the Special Flood Hazard Area for Susquehanna County. This information was compiled using Susquehanna County's GIS information with the assistance of the Susquehanna County GIS Department. Community lifelines included in this assessment include fire departments, police department, EMS stations, emergency operation centers, hospitals, clinics, nursing homes, schools, electric substations, power plants, sewer and water authorities, community assistance resources, and grocery stores.

Table 29-Community Lifeline Facilities Additional Information

Community Lifeline Facilities Additional Information		
Type of Facility:	**Facility Name:**	**Municipality:**
Community Lifelines		
Fire Department	Hop Bottom Volunteer Fire Department	Hop Bottom Borough
	New Milford Volunteer Fire Department	New Milford Borough
	Silver Lake Station 2	Choconut Township
Grocery Store	Rob's Market	Great Bend Township
Utility	Hallstead-Great Bend Sewer Authority	Great Bend Borough
Utility – Electric Substation	Unknown 124173	Lenox Township
	Unknown 173022	Montrose Borough
Utility – Power Plant	Oakland Dam Hydroelectric Power	Oakland Borough

Flash Flooding

Flash flooding is a common occurrence in Susquehanna County and can occur anywhere in the county. A large portion of flash flooding occurs in populated areas that have increased impervious ground cover. During the risk assessment process, numerous resources were utilized to determine flash flooding locations in Susquehanna County. Municipalities were asked to identify locations within the municipality that were prone to frequent flash flooding. The National Climatic Data Center was also queried to determine flash flood vulnerable areas. This data reflected in *Table 22 – Past Flood and Flash Flood Events* above.

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

- Friendsville Borough
- Hallstead Borough
- Little Meadows Borough
- Montrose Borough
- Silver Lake Township

Although the above locations were identified as vulnerable areas in Susquehanna County, they are not the only locations that are vulnerable to flash flooding. The Susquehanna County Hazard

Mitigation Team will continue to work with municipalities to identify vulnerable flash flooding locations and identify vulnerable populations and community lifelines.

4.3.5. Hailstorm

4.3.5.1. 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.

4.3.5.2. 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 30 - Size of hail in related terms.* Hail should only be measured when it is safe to do so.

Table 30 - 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"

Size of hail in related terms	
Related item	**Size of hail**
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.

4.3.5.3. 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 31 – National Weather Service Hail Reports*.

Table 31 - National Weather Service Hail Reports

National Weather Service Hail Reports		
Date	**Location**	**Size (inches)**
05/09/2000	Harford Township	0.75
06/11/2001	Silver Lake Township	0.75
05/23/2004	Great Bend Township	0.88
06/06/2005	Oakland Township	1.75
07/09/2005	New Milford Township	0.75
05/10/2007	Auburn Township	2.75
05/10/2007	Montrose Borough	0.75
06/21/2007	Clifford Township	1.00
06/16/2008	Oakland Township	1.25

National Weather Service Hail Reports		
Date	**Location**	**Size (inches)**
06/16/2008	Montrose Borough	0.75
06/16/2008	Harford Township	0.88
08/02/2008	Hallstead Borough	0.88
08/02/2008	Oakland Township	1.00
08/02/2008	Oakland Township	0.75
08/02/2008	Jackson Township	0.75
08/10/2008	Gibson Township	1.00
08/10/2008	New Milford Township	0.88
08/10/2008	Thompson Borough	1.00
08/10/2008	Montrose Borough	0.88
05/04/2010	Gibson Township	1.00
05/04/2010	Thompson Township	0.75
07/21/2010	Hallstead Borough	0.88
09/13/2010	Silver Lake Township	1.00
09/13/2010	Gibson Township	1.00
09/13/2010	New Milford Borough	0.88
09/13/2010	Franklin Township	1.00
09/13/2010	Thompson Borough	0.75
09/13/2010	Auburn Township	0.88
09/13/2010	Springville Township	1.00
04/25/2011	Silver Lake Township	0.75
04/25/2011	Montrose Borough	0.75
04/25/2011	New Milford Borough	1.75
04/26/2011	Montrose Borough	0.75
04/26/2011	Dimock Township	1.00
06/09/2011	Little Meadows Borough	1.00
06/09/2011	Montrose Borough	1.00
08/19/2011	Springville Township	1.50
07/23/2012	New Milford Township	1.00
07/23/2012	Clifford Township	1.25
07/23/2012	Montrose Borough	1.00

National Weather Service Hail Reports		
Date	**Location**	**Size (inches)**
07/26/2012	Montrose Borough	1.00
09/06/2012	Friendsville Borough	1.00
06/24/2013	Ararat Township	1.00
09/11/2013	Brooklyn Township	1.75
05/22/2014	Friendsville Borough	1.00
05/22/2014	Middletown Township	0.75
07/02/2014	Friendsville Borough	1.75
07/02/2014	Forest Lake Township	1.75
07/02/2014	Montrose Borough	0.88
07/02/2014	Brooklyn Township	2.00
07/03/2014	Thompson Borough	0.75
05/31/2017	Auburn Township	0.75
06/27/2017	Silver Lake Township	1.50
05/15/2018	Dimock Township	1.00
05/15/2018	Gibson Township	1.00
05/15/2018	Harford Township	2.75
06/24/2018	Clifford Township	1.00
06/29/2019	Lenox Township	1.00
06/29/2019	Lathrop Township	0.88
05/11/2020	Clifford Township	1.00
07/22/2022	Middletown Township	0.75

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.

4.3.5.4. Future Occurrence

Hailstorms are associated with thunderstorms and should be considered highly likely for Susquehanna County. While death and severe injury are rarely attributed to hailstorms, they still pose a threat to unsheltered peoples, vehicles, livestock, crops, and even structures, so vulnerability to the hazard should continue to be monitored. Susquehanna County should expect to see moderate hailstorm weather events, and the hazards which they entail, perpetuate.

4.3.5.5. Vulnerability Assessment

Automobiles, aircraft, skylights, livestock, and farmers' crops can all be seriously damaged by hail. That National Weather Service estimates that large hailstorms events cause over one-billion USD in damages to agriculture every year. Susquehanna County's farmland can be negatively impacted by hail and hailstorm events. With a total of 909 farms located in Susquehanna County as reported in the 2017 Census of Agriculture, and with a total market value of $49,775,000.00, hail damage could cause economic strain on the county, the local municipalities, and the residents. A hail event has the potential to impact 154,409 acres of land in Susquehanna County that is held in farms, or approximately 29% of the total land area of the county. Crop yields that could be negatively impacted by a potential hail event are worth approximately $14,678,000.00 based on 2017 information. The most common crop products that would be impacted are hay and haylage, corn for silage or greenchop, and corn for grain. Susquehanna County is ranked 42nd in terms of crop production in the Commonwealth of Pennsylvania.

Acreage used for agriculture in Susquehanna County is at an increased vulnerability to hail and hailstorms. There are no records that allow for breakdown of number of farms per municipality, but by utilizing a GIS analysis and conversion of land use data from PASDA, the number of row crop acres per municipality can be examined. This information is not considered authoritative but does provide basic information on row crop vulnerability. This information can be found in the table below:

Row Crop Acreage by Municipality in Susquehanna County	
Municipality	**Acreage of Row Crops**
Apolacon Township	320.68
Ararat Township	222.0
Auburn Township	1,849.64
Bridgewater Township	1,034.19
Brooklyn Township	893.92
Choconut Township	106.91
Clifford Township	495.75
Dimock Township	806.76
Forest City Borough	0
Forest Lake Township	339.61
Franklin Township	209.04
Friendsville Borough	2.39
Gibson Township	455.44
Great Bend Borough	0.44
Great Bend Township	200.79
Hallstead Borough	0.44
Harford Township	473.19
Harmony Township	59.15
Herrick Township	275.87

Row Crop Acreage by Municipality in Susquehanna County	
Municipality	**Acreage of Row Crops**
Hop Bottom Borough	16.61
Jackson Township	611.28
Jessup Township	340.06
Lanesboro Borough	4.82
Lathrop Township	519.55
Lenox Township	785.87
Liberty Township	294.27
Little Meadows Borough	50.58
Middletown Township	659.86
Montrose Borough	19.93
New Milford Borough	2.29
New Milford Township	589.62
Oakland Borough	0
Oakland Township	95.93
Rush Township	745.70
Silver Lake Township	269.40
Springville Township	641.02
Susquehanna Depot Borough	0
Thompson Borough	0.22
Thompson Township	443.63
Union Dale Borough	5.65
Total:	**13,842.5**
Source: PA Land Use Statistics (PASDA), 2023	

The damage that a hail event could cause to cars, trucks, and transportation systems in Susquehanna County must also be examined. The Pennsylvania Department of Transportation (PennDOT) Bureau of Vehicles Summary of Vehicle Registrations for Susquehanna County lists a total of 49,639 vehicles registered in the county in 2022. Of those 49,639 vehicles, 24,216 vehicles are passenger cars, or 49% of the total. There are also 10,115 trailers registered in Susquehanna County. All of these vehicles, if they are not under cover, would be vulnerable to a hail event. There are no records of how many housing units have garages in Susquehanna County, but all of the vehicles in garages would be secure from damage from 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.

4.3.6. Hurricane and Tropical Storm

4.3.6.1. Location and Extent

Susquehanna County does not have any open-ocean coastline areas. However, the impacts from coastal storms such as tropical storms and hurricanes can expand inland. 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 and 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, Caribbean Sea, or Gulf of Mexico. Another type of tropical storms is the nor'easter, which is a large cyclone that rotates clockwise and is 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.

While Susquehanna County is located about 212 miles inland of the East Coast of the United States, tropical storms can track inland and cause heavy rainfall and strong winds. Susquehanna County is located inland of the East Coast region, designated by FEMA, as being Hurricane-Susceptible (see *Figure 21 – Pennsylvania Wind Zones*). Susquehanna County falls within wind zone III as shown in *Figure 21 – Pennsylvania Wind Zones*. Zone III for Susquehanna County suggests that shelters and critical facilities should be able to withstand winds that range up to 200 MPH. Tropical storms and hurricanes are regional and seasonal events that can impact very large areas that are hundreds to thousands of miles across over the life of the storm. Hurricane and tropical storm seasons are typically from June to November. 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.

4.3.6.2. Range of Magnitude

Table 32-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. Flood damage results from intense precipitation and wind, typically from coastal storms, which impact L. Expected damage from hurricane force winds is measured using the Saffir-Simpson Scale (Table X – Saffir-Simpson Scale). The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential. Categories three, four, and five are classified as "major" hurricanes, but category one and two storms can contain potential significant storm surge. Category one storms result in very dangerous winds with some damage, while category two storms results in extremely dangerous winds with extensive damage. Category three storms result in devastating damage and category four/five storms result in catastrophic damage. Although major hurricanes comprise only 20% of all tropical cyclones making landfall, they account for over 70% 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. In Susquehanna County wind impacts from tropical events include downed trees and utility poles to cause utility interruptions. Mobile home, because they may not be well-anchored, have a greater potential to be impacted by high winds. Additionally, these storms can produce high volumes of rainfall that cause flash flooding which can be followed by stream and riverine flooding. The risk assessment and associated impact for flooding events is included in Section 4.3.4.

4.3.6.3. Past Occurrence

Table 33 – History of Coastal Storms Impacting Susquehanna County lists all coastal storms that have impacted Susquehanna County from 1878 to 2021 *Figure 22 – Historic Tropical Storms/Hurricanes in Pennsylvania* identifies some past hurricanes that had an inland path through Pennsylvania. Hurricane Agnes was a severe coastal storm event in June 1972 that impacted Susquehanna County after making first landfall as a hurricane near Florida, Agnes

weakened and exited back into the Atlantic off the North Carolina coast. The storm moved along the coast and made a second landfall near New York City as a tropical storm and merged with an extra-tropical low-pressure system over Pennsylvania. This brought extremely heavy rains to Pennsylvania that caused major flooding. Pennsylvania incurred $2.8 billion in damages. There were fifty storm related deaths statewide. However, in Susquehanna County, the most significant effects of Hurricane Agnes were due to utilities outages**.** Agnes was only a category one hurricane but dropped more than fifteen inches of rain in the northeastern United States. Pennsylvania received the greatest amount of flood damage.

Hurricane Irene and Tropical Storm Lee impacted and caused damage to Susquehanna County Although they were separate events, Hurricane Irene and Tropical Storm Lee together caused significant rainfall in Susquehanna County due to how close the events took place. First, Tropical Storm Lee caused significant flooding in the central and eastern counties in Pennsylvania with wind damage that caused utility outages for one to two days. Then, Hurricane Irene caused additional flooding with utility interruptions from five to eight days. Many flooding events took place in the county during this time.

Hurricane Sandy was another coastal storm event that caused no significant damage to Susquehanna County. Sandy caused significant wind damage and utility interruptions for numerous days to weeks in certain counties. Hurricane Sandy ranks among the most damaging coastal storms to ever impact Susquehanna County. In Susquehanna County more than 20,000 people, or more than 50% of the county's population, were without power for an extended period. Susquehanna County had assessed thousands of structures, including mobile and single-family homes/businesses, for property damage. There was no information on the estimated storm-recovery costs total which includes all labor, housing, materials/equipment, and feeding expanded 24/7 staffing for longer than a week.

Table 33-History of Coastal Storms Impacting Susquehanna County

Year	Name
1949	Unnamed Hurricane
1972	Tropical Storm Agnes
1979	Hurricane David
1979	Hurricane Frederic
1994	Tropical Storm Beryl
1999	Hurricane Dennis
2003	Hurricane Isabel
2004	Tropical Depression Frances
2005	Hurricane Katrina

Year	Name
1949	Unnamed Hurricane
2006	Hurricane Ernesto
2012	Hurricane Sandy
2018	Hurricane Florence
2020	Tropical Strom Fay
2020	Hurricane Isaias
2021	Tropical Storm Fred
2021	Hurricane Henri

4.3.6.4. 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 34 – 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. According to FEMA, once every five years there is a probability of 10% and 20% that Susquehanna County will experience winds from coastal storms that could cause minimal to moderate damages (*Table 34 – Annual Probability of Wind Speeds*). The potential future impacts from a tropical storm or hurricane will be approximately 91.59%. The probability of winds exceeding 118 mph is less than .1% annually.

Table 34-Annual Probability of Wind Speeds

Annual Probability of Wind Speeds		
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
Source: FEMA, 2000		

There has been an increase in North Atlantic hurricane activity since the 1970s with locations of peak intensity tropical cyclones migrating poleward coinciding with tropics expansion. An index potential hurricane destructiveness suggests an increase over the past thirty years. Variability in

tropical cyclone activity in the Atlantic is due to natural variability in ocean circulation, volcanic eruptions, and Saharan dust, as well as climate change resulting from greenhouse gases and sulfate aerosols.

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. However, the relationship between climate change and hurricanes can be complex due to the many other factors that are associated with hurricane development which include wind shear and air pollution. 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. The storms associated with the tropical storms/hurricanes can also linger around for a longer period of time in a given place due to the climate change which enhances destructive impacts in the future. Other possible connections of hurricanes in near future related to climate change are the length of hurricane season and seeing more hurricanes earlier or later than usual hurricane season. There are expected to be more category four and five hurricanes in the Atlantic and the hurricane season may be elongated, all which impact the future of Susquehanna County

4.3.6.5. Vulnerability Assessment

The impacts of climate change are tangible and hazardous realities. Tropical storms tracking nearby Susquehanna County can not only cause high winds, but also heavy rains to occur. A vulnerability assessment for hurricanes and tropical storms focusses on the impacts of flooding and severe winds. Flooding associated with hurricanes/tropical storms can occur in areas throughout Susquehanna County which can cause damage to buildings and infrastructure. The assessment for flood-related vulnerability is addressed in Section 4.3.4 and a discussion of wind related vulnerability is addressed in Section 4.3.12. Due to the impact of hurricanes and tropical storms, the vulnerability for Susquehanna County is moderate. Potential economic losses could include direct building loss and business interruption. Direct building loss is direct damage to any building or structure. Business interruption includes relocation, employee wage loss, expenses, income loss, etc. Susquehanna County vulnerability level is high for direct building loss. The total direct building loss amount for Susquehanna County equates to $74 million dollars. The total business interruption value for Susquehanna County equates to $91 million dollars. Therefore, the vulnerability of direct building loss and business interruption is high.

Figure 21-Pennsylvania Wind Zones

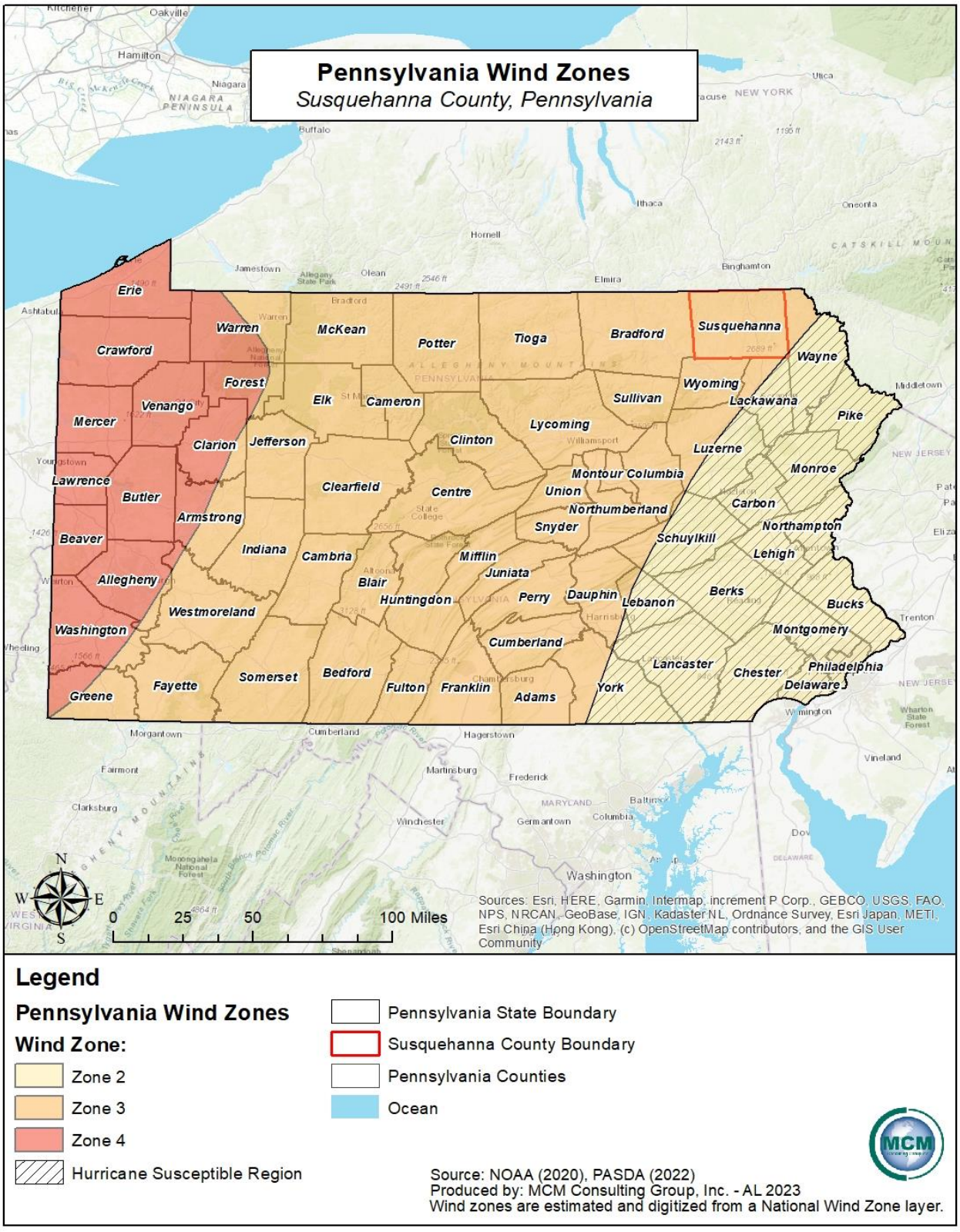
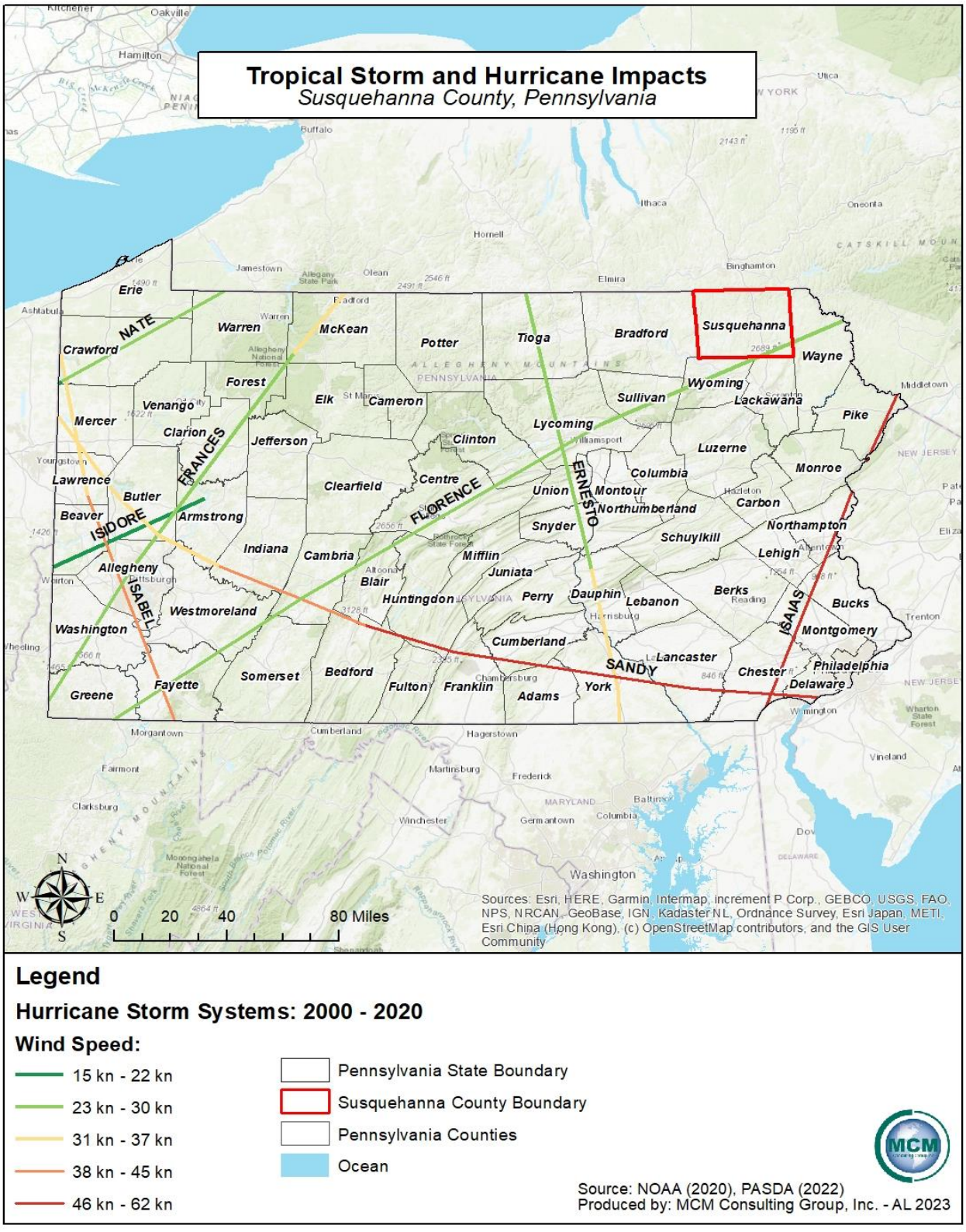


Figure 22-Historic Tropical Storms/Hurricanes in Pennsylvania



4.3.7. Invasive Species

4.3.7.1. 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. Often, an invasive species spreads and reproduces quickly. Invasive species are not limited to organisms that come from a foreign country. Invasive species can come from a different region in the United States. The main instigator of invasive species is human activity. 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 but are not limited to:

- 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

The Governor's Invasive Species Council of Pennsylvania (PISC), the lead organization for invasive species threats, recognizes two types of invasive species: Aquatic and Terrestrial.

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 instead of in an aquatic environment and whose introduction does or is likely to cause economic/environmental damage or harm to human health.

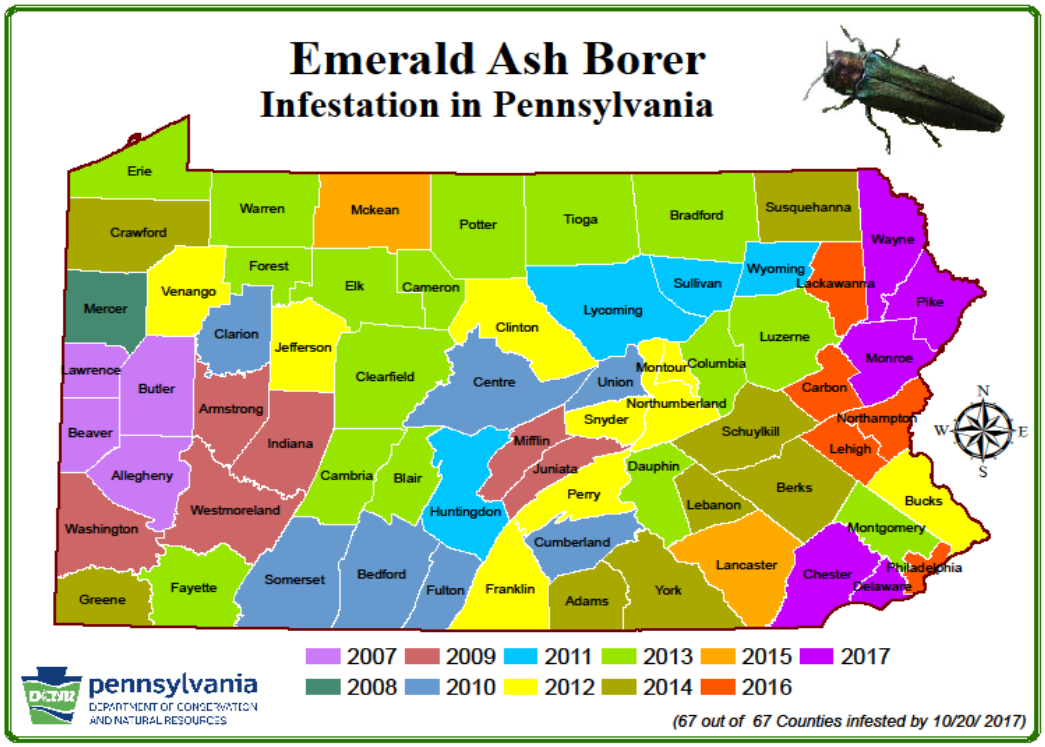
The location and extent of invasive threats is dependent on the preferred habitat of the species, as well as the species' ease of movement and establishment. For example, kudzu vine is an aggressive vascular plant. With wide ecological parameters and ease of spread, the vine is a more widespread invasive species threat. Other species' spread, such as the spotted lantern fly, has

been limited by state agency activity. First discovered in Berks County in 2014, the spotted lantern fly was placed under a quarantine by the Pennsylvania Department of Agriculture in thirteen counties. *Table 35 - Prevalent Invasive Species* lists invasive species that have been found in Susquehanna County.

4.3.7.2. Range of Magnitude

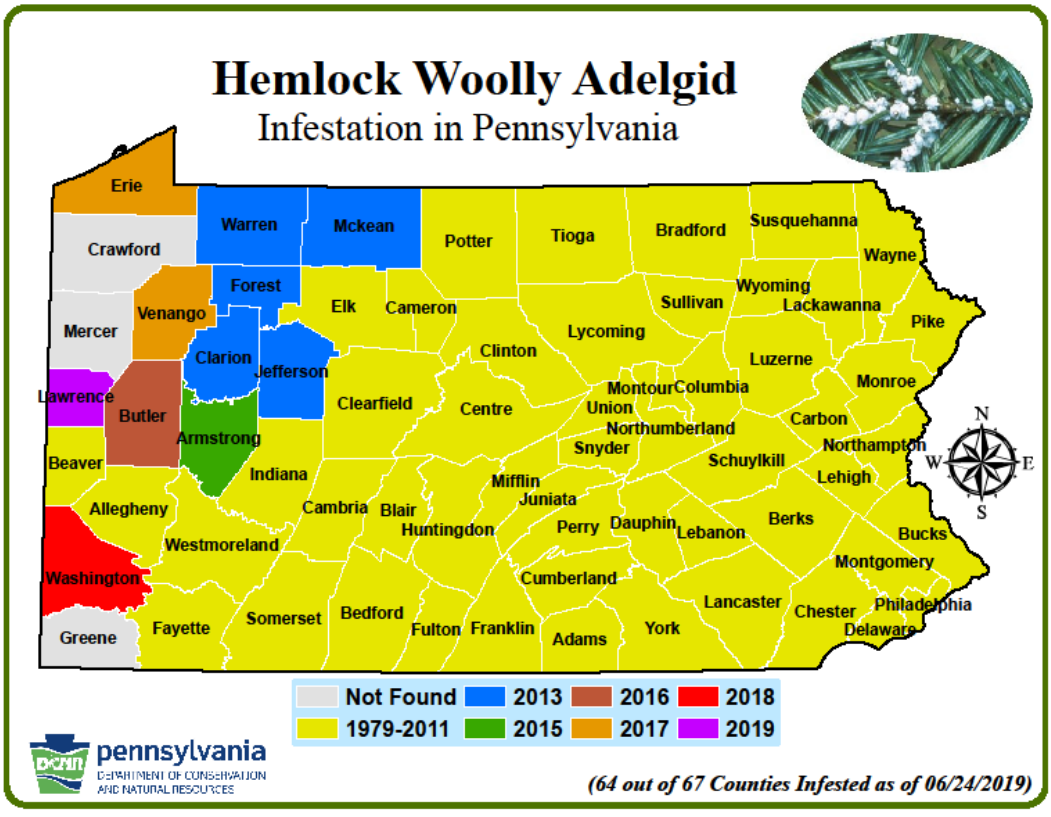
The magnitude of invasive species threats ranges from nuisance to widespread killer. Some invasive species are not considered agricultural pests, and do not harm humans or cause significant ecological problems. For example, Brown Marmorated Stink Bugs are not considered to be an agricultural pest and do not harm humans. Other invasive species can have many negative impacts and cause significant changes in the composition of ecosystems. For example, the Emerald Ash Borer creates a 99% mortality rate in any ash tree it infects. 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 in Pennsylvania is the Emerald Ash Borer in Susquehanna County and the surrounding region (see *Figure 23 - Emerald Ash Borer Infestation in Pennsylvania*).

Figure 23-Emerald Ash Borer Infestation in Pennsylvania



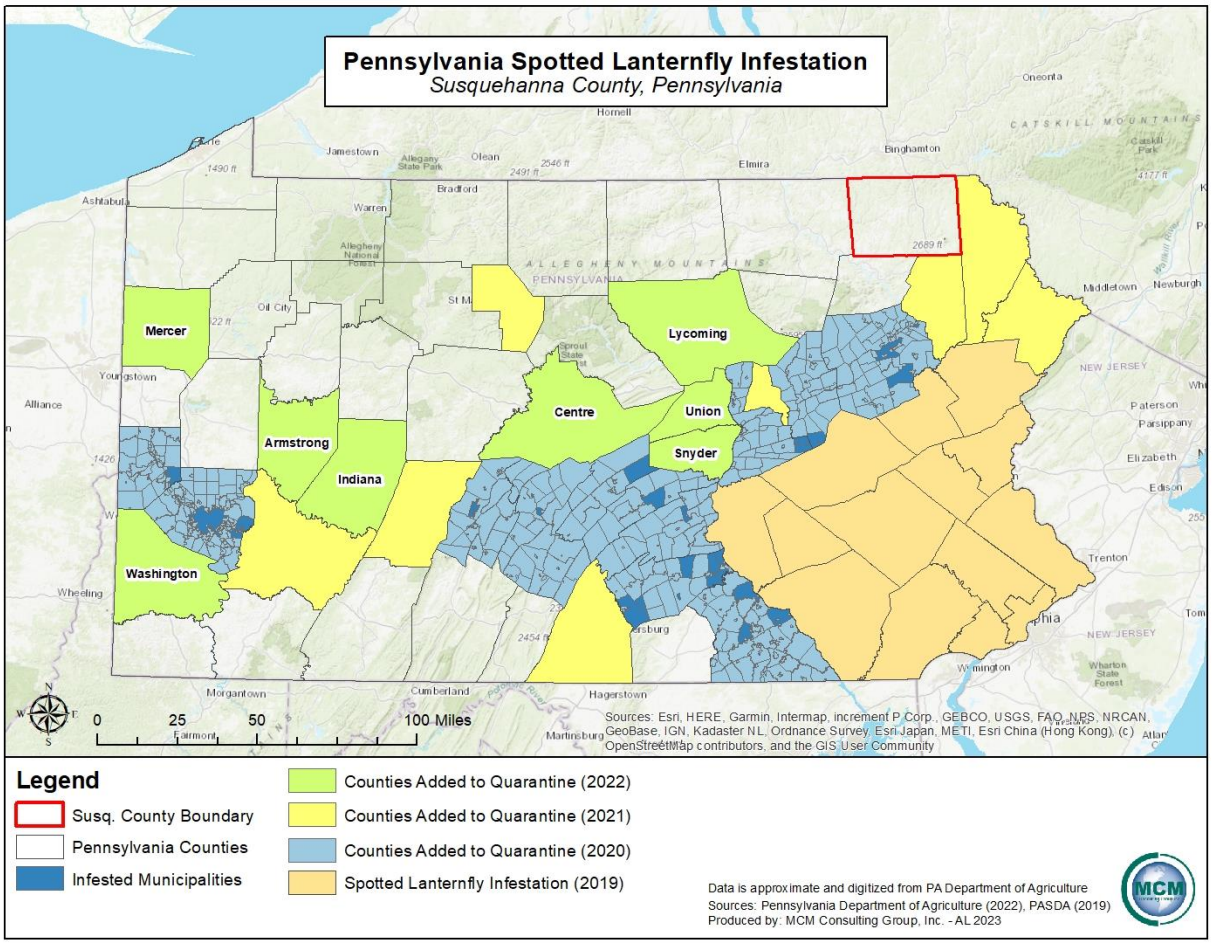
Another example of an invasive pest is the hemlock woolly adelgid. Hemlock woolly adelgid is a fluid-feeding insect that feeds on hemlock trees throughout eastern North America, including Pennsylvania. The egg sacs of these insects look like the tips of cotton swabs clinging to the undersides of hemlock branches. Hemlock woolly adelgid was introduced from Asia into the Pacific Northwest in 1924. It is likely to have been introduced into the northeastern United States in the 1950s, and it was first discovered in Pennsylvania in 1967. To date, sixty-four counties in Pennsylvania, including Susquehanna County, have been infested with this insect. See *Figure 24 - Hemlock Woolly Adelgid Infestation in Pennsylvania*. Currently, Crawford, Mercer, and Greene counties are the three counties in the commonwealth not reporting an infestation. Eastern hemlock (Pennsylvania's state tree) and Carolina hemlocks (found further south in the Smoky Mountain sections of the Appalachians) are more susceptible to hemlock woolly adelgid damage than Asian and western hemlock trees due to feeding tolerance and predators that protect the latter species. Hemlock woolly adelgid sucks fluid from the base of hemlock needles. It may also inject toxins into the tree as it feeds, accelerating needle drop and branch dieback. Although some trees die within four years, trees often persist in a weakened state for many years. Hemlocks that have been affected by hemlock woolly adelgid often have a grayish-green appearance (hemlocks naturally have a shiny, dark green color).

Figure 24-Hemlock Woolly Adelgid Infestation in Pennsylvania



A final example of an invasive species is the Spotted Lanternfly. The Spotted Lanternfly is a harmful invasive species which feeds on plants, damaging or destroying them. This can negatively impact the areas of Pennsylvania known for outdoor scenery and activities. According to the Penn State Extension, the Spotted Lanternfly is a significant threat to Pennsylvania agriculture, landscapes, and natural ecosystems, including grape, tree-fruit, hardwood, and nursery industries, which collectively are worth nearly $18 billion to the state's economy, outdoor recreation, and biodiversity. The Spotted Lanternfly has not yet been confirmed in Susquehanna County, though adjacent counties have been added to the quarantine. However, the Spotted Lanternfly is undoubtedly continuing to spread. The State Department of Agriculture gives the total number of infected counties as forty-five, as of 2022. *Figure 25 – Pennsylvania Spotted Lanternfly Infestation* illustrates the counties in Pennsylvania that are considered to be in the quarantine zone for this pest.

Figure 25-Pennsylvania Spotted Lanternfly Infestation



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 succumb to an infestation more easily. A worst-case example could be the Hemlock Woolly Adelgid causing reduced biodiversity, increased wildfire potential, and thermal harm to small stream cold water fisheries and habitats.

4.3.7.3. Past Occurrence

Invasive species have been entering Pennsylvania since the arrival of European settlers, but not all occurrences required government action. Susquehanna County is known for its great number of geographic features. There are various state game lands within the area which include state game lands numbers 35 and 299. Susquehanna County is home to Salt Spring State Park, Shore Forrest Campground, Pinchot State Forest, Susquehanna County Forest Land, Manny Gordon Recreation area and other well-known areas in the county that have significant amounts of forest land and lakes which species may invade. Due to the vast area of forests, there are many invasive terrestrial species that have been widespread in Susquehanna County that are common problems throughout the Commonwealth.

Many of the extreme problematic species have been around for many years. However, the most recent problematic species are the Emerald Ash Borer, Hemlock Wooly Adelgid, and the Spotted Lanternfly. In 2007, both the Emerald Ash Borer and Hemlock Wooly Adelgid were both newly spotted species that caused extreme damage. Even more recently than 2007, the Spotted Lanternfly appeared in Susquehanna County. In 2014, the spotted lanternfly was found in the commonwealth, however, Susquehanna County has not entered the quarantine zone for the Spotted Lanternfly infestation as of 2022.

Table 35 - Prevalent Invasive Species lists problematic non-native species that are established in Susquehanna County.

Table 35-Prevalent Invasive Species

Prevalent Invasive Species		
Scientific Name	**Common Name**	**Type**
Alfalfa	Medicago sativa	Plant
Alsike clover	Trifolium hybridum	Plant
American mannagrass	Glyceria grandis var. grandis	Plant
Annual bluegrass	Poa annua	Plant
Annual sowthistle	Sonchus oleraceus	Plant
Bald brome	Bromus racemosus	Plant
Barnyardgrass	Echinochloa crus-galli	Plant
Beech bark disease	Neonectria faginata	Plant
Beech leaf disease	Litylenchus crenatae mccannii	Plant
Birch leafminer	Fenusa pusilla	Plant

Prevalent Invasive Species		
Scientific Name	**Common Name**	**Type**
Birdsfoot trefoil	Lotus corniculatus	Plant
Bittersweet nightshade	Solanum dulcamara	Plant
Bittersweets	Celastrus spp.	Plant
Black knapweed	Centaurea nigra	Plant
Black locust	Robinia pseudoacacia	Plant
Black medic	Medicago lupulina	Plant
Black mustard	Brassica nigra	Plant
Bladder campion	Silene vulgaris	Plant
Bouncingbet	Saponaria officinalis	Plant
Bristlegrass	Setaria spp.	Plant
Broadleaf dock	Rumex obtusifolius	Plant
Broadleaf plantain	Plantago major	Plant
Brown knapweed	Centaurea jacea	Plant
Buckhorn plantain	Plantago lanceolata	Plant
Bulbous buttercup	Ranunculus bulbosus	Plant
Bull thistle	Cirsium vulgare	Plant
Burcucumber	Sicyos angulatus	Plant
Bush honeysuckles (exotic)	Lonicera spp.	Plant
Butternut canker	Ophiognomonia clavigignenti-juglandacearum	Plant
Canada bluegrass	Poa compressa	Plant
Canada thistle	Cirsium arvense	Plant
Canadian horseweed	Erigeron canadensis	Plant
Catnip	Nepeta cataria	Plant
Cheatgrass, downy brome	Bromus tectorum	Plant
Chestnut blight or canker	Cryphonectria parasitica	Plant
Chicory	Cichorium intybus	Plant
Clover dodder	Cuscuta epithymum	Plant
Colonial bentgrass	Agrostis capillaris	Plant
Coltsfoot	Tussilago farfara	Plant
Common barberry	Berberis vulgaris	Plant
Common burdock, lesser burdock	Arctium minus	Plant
Common caraway	Carum carvi	Plant
Common chickweed	Stellaria pallida	Plant
Common chickweed	Stellaria media	Plant
Common cocklebur	Xanthium strumarium	Plant
Common dandelion	Taraxacum officinale ssp. officinale	Plant
Common duckweed	Lemna minor	Plant
Common hawthorn	Crataegus monogyna	Plant
Common lilac	Syringa vulgaris	Plant
Common mallow	Malva neglecta	Plant
Common mullein	Verbascum thapsus	Plant
Common pear	Pyrus communis	Plant
Common periwinkle	Vinca minor	Plant

Prevalent Invasive Species		
Scientific Name	**Common Name**	**Type**
Common pine shoot beetle, larger pine shoot beetle	Tomicus piniperda	Insect
Common ragweed	Ambrosia artemisiifolia	Plant
Common selfheal	Prunella vulgaris	Plant
Common speedwell	Veronica officinalis	Plant
Common St. Johnswort	Hypericum perforatum	Plant
Common tansy	Tanacetum vulgare	Plant
Common teasel	Dipsacus fullonum	Plant
Common velvetgrass	Holcus lanatus	Plant
Common yarrow	Achillea millefolium	Plant
Corn earworm, tomato fruitworm	Helicoverpa zea	Plant
Corn speedwell	Veronica arvensis	Plant
Corn spurry	Spergula arvensis	Plant
Crack willow	Salix fragilis	Plant
Creeping bellflower	Campanula rapunculoides	Plant
Creeping bentgrass	Agrostis stolonifera	Plant
Creeping buttercup	Ranunculus repens	Plant
Creeping yellow loosestrife, creeping Jenny	Lysimachia nummularia	Plant
Cultivated currant	Ribes rubrum	Plant
Cup rosinweed	Silphium perfoliatum	Plant
Curly dock	Rumex crispus	Plant
Curly dock	Rumex crispus ssp. crispus	Plant
Curly leaf pondweed	Potamogeton crispus	Plant
Dames rocket	Hesperis matronalis	Plant
Dandelion	Taraxacum officinale	Plant
Dwarf snapdragon	Chaenorhinum minus	Plant
Eastern poison-ivy	Toxicodendron radicans	Plant
Eastern redcedar	Juniperus virginiana	Plant
Eastern white pine	Pinus strobus	Plant
Elecampane	Inula helenium	Plant
Elongate hemlock scale	Fiorinia externa	Plant
Emerald ash borer	Agrilus planipennis	Plant
European columbine	Aquilegia vulgaris	Plant
European Corn Borer	Ostrinia nubilalis New York (Z) strain	Plant
European corn borer	Ostrinia nubilalis	Plant
European Corn Borer	Ostrinia nubilalis Iowa (E) strain	Plant
European mountain-ash	Sorbus aucuparia	Plant
European privet	Ligustrum vulgare	Plant
European red raspberry	Rubus idaeus	Plant
Everlasting peavine	Lathyrus latifolius	Plant
Fall armyworm	Spodoptera frugiperda	Insect
Fall panicum	Panicum dichotomiflorum	Plant
False spiraea	Sorbaria sorbifolia	Plant

Prevalent Invasive Species		
Scientific Name	**Common Name**	**Type**
Field horsetail	Equisetum arvense	Plant
Field pennycress	Thlaspi arvense	Plant
Forest tent caterpillar	Malacosoma disstria	Insect
Fragrant waterlily	Nymphaea odorata	Plant
Garden catchfly	Silene armeria	Plant
Garlic mustard	Alliaria petiolata	Plant
Germander speedwell	Veronica chamaedrys	Plant
Giant chickweed	Myosoton aquaticum	Plant
Giant ragweed	Ambrosia trifida	Plant
Grassy arrowhead	Sagittaria graminea	Plant
Great burdock	Arctium lappa	Plant
Green bristlegrass	Setaria viridis var. viridis	Plant
Green foxtail	Setaria viridis	Plant
Ground ivy	Glechoma hederacea	Plant
Hairy galinsoga	Galinsoga quadriradiata	Plant
Hairy vetch	Vicia villosa	Plant
Hairy willowherb	Epilobium hirsutum	Plant
Harlequin blueflag	Iris versicolor	Plant
Hedge bindweed	Calystegia sepium	Plant
Hedge mustard	Sisymbrium officinale	Plant
Hemlock woolly adelgid	Adelges tsugae	Plant
Hemp dogbane	Apocynum cannabinum	Plant
Herb-robert	Geranium robertianum	Plant
Hop clover	Trifolium aureum	Plant
Horsenettle	Solanum carolinense	Plant
Houndstongue	Cynoglossum officinale	Plant
Indian mustard	Brassica juncea	Plant
Japanese barberry	Berberis thunbergii	Plant
Japanese beetle	Popillia japonica	Insect
Japanese honeysuckle	Lonicera japonica	Plant
Japanese knotweed	Reynoutria japonica	Plant
Kentucky bluegrass	Poa pratensis	Plant
Ladysthumb	Persicaria maculosa	Bushes
Lambsquarters	Chenopodium album	Insect
Large aspen tortrix	Choristoneura conflictana	Insect
Large crabgrass	Digitaria sanguinalis	Plant
Little starwort	Stellaria graminea	Plant
Live-forever stonecrop	Hylotelephium telephium	Plant
Low cudweed	Gnaphalium uliginosum	Plant
Maiden pink	Dianthus deltoides	Plant
Marsh-pepper smartweed	Persicaria hydropiper	Plant
Meadow fescue	Festuca pratensis	Plant
Meadow hawkweed	Hieracium caespitosum	Plant

Prevalent Invasive Species		
Scientific Name	**Common Name**	**Type**
Meadow salsify	Tragopogon lamottei	Plant
Motherwort	Leonurus cardiaca	Plant
Mountain-ash sawfly	Pristiphora geniculata	Plant
Mouse-eared hawkweed	Pilosella officinarum	Plant
Mugwort	Artemisia vulgaris	Plant
Multicolored Asian lady beetle	Harmonia axyridis	Insect
Multiflora rose	Rosa multiflora	Plant
Musk mallow	Malva moschata	Plant
Narrowleaf hawkweed	Hieracium umbellatum	Plant
Nimblewill	Muhlenbergia schreberi	Plant
Nipplewort	Lapsana communis	Plant
Norway spruce	Picea abies	Plant
Orange hawkweed	Pilosella aurantiaca	Plant
Orchardgrass	Dactylis glomerata	Plant
Oxeye daisy	Leucanthemum vulgare	Plant
Pale smartweed	Polygonum lapathifolium	Plant
Pale yellow iris, yellow flag iris	Iris pseudacorus	Plant
Paradise apple	Malus pumila	Plant
Pear sawfly	Caliroa cerasi	Plant
Perennial ryegrass	Lolium perenne	Plant
Periwinkle	Vinca	Plant
Pineapple-weed	Matricaria discoidea	Plant
Plumeless thistle	Carduus	Plant
Prickly lettuce	Lactuca serriola	Plant
Princess-feather	Persicaria orientalis	Plant
Prostrate knotweed	Polygonum aviculare	Plant
Purple loosestrife	Lythrum salicaria	Plant
Quackgrass	Elymus repens	Plant
Queen Anne's lace, wild carrot	Daucus carota	Plant
Queen-of-the-meadow	Filipendula ulmaria	Plant
Red clover	Trifolium pratense	Plant
Red fescue	Festuca rubra	Plant
Red sorrel	Rumex acetosella	Plant
Redroot pigweed	Amaranthus retroflexus	Plant
Redtop	Agrostis gigantea	Plant
Reed canarygrass	Phalaris arundinacea	Plant
Scots pine	Pinus sylvestris	Plant
Shepherd's-purse	Capsella bursa-pastoris	Plant
Silvery cinquefoil	Potentilla argentea	Plant
Smallflower sweetbrier	Rosa micrantha	Plant
Smooth bedstraw	Galium mollugo	Plant
Smooth brome	Bromus inermis	Plant
Southern pine beetle	Dendroctonus frontalis	Plant

Prevalent Invasive Species		
Scientific Name	**Common Name**	**Type**
Spiny plumeless thistle	Carduus acanthoides	Plant
Spiny sowthistle	Sonchus asper	Plant
Splitlip hempnettle	Galeopsis bifida	Plant
Spongy moth (formerly gypsy moth)	Lymantria dispar	Plant
Spotted spurge	Euphorbia maculata	Plant
Sticky groundsel	Senecio viscosus	Plant
Stinging nettle	Urtica dioica	Plant
Stinkgrass	Eragrostis cilianensis	Plant
Stinking chamomile	Anthemis cotula	Plant
Sulfur cinquefoil	Potentilla recta	Plant
Sweet cherry	Prunus avium	Plant
Sweet vernalgrass	Anthoxanthum odoratum	Plant
Sweetbriar	Rosa rubiginosa	Plant
Tall buttercup	Ranunculus acris	Plant
Tall oatgrass	Arrhenatherum elatius	Plant
Tatarian honeysuckle	Lonicera tatarica	Plant
Teasel	Dipsacus	Plant
Thymeleaf speedwell	Veronica serpyllifolia	Plant
Thymeleaf speedwell	Veronica serpyllifolia ssp. serpyllifolia	Plant
Timothy	Phleum pratense	Plant
True forget-me-not	Myosotis scorpioides	Plant
Virginia pepperweed	Lepidium virginicum	Plant
Water knotweed	Polygonum amphibium	Plant
Watercress	Nasturtium officinale	Plant
Waterpurslane	Ludwigia palustris	Plant
Western bean cutworm	Striacosta albicosta	Insect
White campion	Silene latifolia	Plant
White clover	Trifolium repens	Plant
White cockle	Silene latifolia ssp. alba	Plant
White pine blister rust	Cronartium ribicola	Plant
Wild buckwheat	Fallopia convolvulus	Plant
Wild mustard	Sinapis arvensis	Plant
Wild onion	Allium canadense	Plant
Wild parsnip	Pastinaca sativa	Plant
Wild-proso millet	Panicum miliaceum	Plant
Wirestem muhly	Muhlenbergia frondosa	Plant
Witch's moneybags	Hylotelephium telephium ssp. telephium	Plant
Woodland strawberry	Fragaria vesca ssp. vesca	Plant
Woodland strawberry	Fragaria vesca	Plant
Yellow archangel	Lamium galeobdolon	Plant
Yellow fieldcress	Rorippa sylvestris	Plant
Yellow foxtail	Setaria pumila	Plant
Yellow nutsedge	Cyperus esculentus	Plant

Prevalent Invasive Species		
Scientific Name	**Common Name**	**Type**
Yellow rocket	Barbarea vulgaris	Plant
Yellow sweet-clover	Melilotus officinalis	Plant
Yellow toadflax	Linaria vulgaris	Plant
Yellow woodsorrel	Oxalis stricta	Plant
Source: EDDMaps, 2021; iMapInvasives, 2021; PA DCNR, 2019		

4.3.7.4. Future Occurrence

According to the Pennsylvania Invasive Species Council (PISC), 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. In 2017, Pennsylvania alone imported over $83 billion in goods from abroad, including agricultural, forestry, and fishery goods that commonly carry unknow pests. Climate change is contributing to the introduction of new invasive species. As maximum and minimum seasonal temperatures change, pests can 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 non-native species. In order to combat the increase in future occurrences, the PISC released the Invasive Species Management Plan in April 2010 and updated the plan in 2017. 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 here: https://www.agriculture.pa.gov/Plants_Land_Water/PlantIndustry/GISC/Pages/default.aspx.

There are several invasive species that are found near Susquehanna County but have not yet been detected inside the county (see *Table 36 – Future 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 in the future. Once a species is established, it is more difficult to eradicate it from an ecosystem, so prevention is very important. The species that are labeled in red are listed as a Rank 1 species, which indicates a severe ecological threat to the environment. Therefore, Corbicula Fluminea, Myriophyllum spicatum, Trapa Natans, Frangula Alnus, Galega Officinalis, Humulus Japonicus, and the Pueraria Montana var. Lobata are all widespread and highly problematic in nearby counties but have not been reported in Susquehanna County (as shown highlighted in red in *Table 36 – Future Vulnerable Species*). The development of appropriate plans will assist the county in reducing the possibility of a future encounter with any of these species. Working toward keeping these species from entering the area would be beneficial to the forests of Susquehanna County.

Table 36-Future Vulnerable Species

Future Vulnerable Species		
Scientific Name	**Common Name**	**Type**
Lithobates catesbeianus	American Bullfrog	Animal
Corbicula fluminea	Asiatic Clam	Animal
Scolytus schevyrewi	Banded Elm Bark Beetle	Insect
Brassica nigra	Black Mustard	Plant
Otiorhynchus sulcatus	Black Vine Weevil	Insect
Linaria dalmatica	Dalmatian Toadflax	Plant
Myriophyllum spicatum	Eurasian Watermilfoil	Plant
Trapa natans	European Water Chestnut	Plant
Convolvulus arvensis	Field Bindweed	Plant
Frangula alnus	Glossy Buckthorn	Plant
Galega officinalis	Goatsrue	Plant
Humulus japonicus	Japanese Hops	Plant
Pueraria montana var. lobata	Kudzu	Plant
Pristiphora erichsonii	Larch Sawfly	Insect
Carduus nutans	Musk Thistle	Plant
Ligustrum spp.	Privet	Plant
Trachemys scripta elegans	Red-eared Slider	Amphibian
Cytisus scoparius L.	Scotch Broom	Plant
Bipalium pennsylvanicum Ogren	Three-Lined Land Planarian	Animal
Salix alba	White Willow	Plant
Source: EDDMaps, 2021; PA DCNR, 2019; iMapInvasives, 2021		

4.3.7.5. 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. While there is significant acreage of wetlands, waterways, state parks, and game lands in Susquehanna County where forest managers can impact invasive species, private lands can provide refuge for invasive species if landowners are unaware of or apathetic towards the threat.

Since there are large swatches of public land in Susquehanna County, there is a risk of future damage from invasive species that are present in the area. With about 526,720 acres of total land in Susquehanna County, there is vulnerability to various land sites and waterways. If an invasive species were to invade the popular terrestrial areas or waterways in Susquehanna County, a negative impact could occur. The invasion from an invasive species could cause damage to the scenic and natural resources needed in the county. Additionally, tourism for the county is vulnerable to the invasive species as well and would be affected if the parks were destroyed. Therefore, a great amount of land and native wildlife within Susquehanna County are at risk with the presence of invasive species.

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 deer prefer. 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.

The Governor's Invasive Species Council of Pennsylvania (PISC) has identified over 100 species threats that are or could potentially become significant in Pennsylvania. Of these threats, county and municipal leaders believe that the most significant are invasive forest pests like the Emerald Ash Borer, Hemlock Woolly Adelgid, the Spotted Lanternfly, and plants like the Tree-of-Heaven which have all been identified in red in *Table 35 - Prevalent Invasive Species for priority species in Susquehanna County.*

Due to the past experiences with invasive plants in the county, there are five primary components which help with managing invasive plants to lower vulnerability:

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 areas around road work, ditch/culvert work, logging activities, stream improvement/stabilization and bridge work. Some species pose a higher risk than others - invasive species are easiest to control before they become widespread and established in an area, and for that reason, species that are less widespread should be prioritized for management.

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.

It is best to act before a species can become established in the county, so forest management such as park rangers should be aware of invasive species found nearby Susquehanna County, but not yet present in the county (priority species in *Table 36 – Future Vulnerable Species*). Public outreach and education are important to increase knowledge of these species to improve identification and prevention of invasion. Without action, due to the instances and extent of the current infestations, it is reasonable to project that the county's vulnerability will increase.

4.3.8. Landslide

4.3.8.1. Location and Extent

Rock falls and other slope failures can occur in areas of Susquehanna County with moderate to steep slopes. Many slope failures are associated with precipitation events – periods of sustained above-average precipitation, specific rainstorms, or snowmelt events. Rockfalls, rockslides, rock topples, block slides, debris flows, mud flows, and mud slides are all forms of landslides. Areas experiencing erosion, decline in vegetation cover and earthquakes are also susceptible to landslides. Human activities that contribute to slope failure include altering the natural slope gradient, increasing soil and water content, and removing vegetation cover. Areas where this type of human activity is common are areas that were excavated along highways and other roadways.

The Pennsylvania Department of Conservation and Natural Resources (PA DCNR) describes landslide susceptibility in Susquehanna County as generally high vulnerability along lake bluffs and stream banks. *Figure 26 – Landslide Hazard Areas* shows areas of landslide susceptibility in Susquehanna County. A majority of Susquehanna County is located in the Appalachian Plateaus and Ridge and Valley physiographic region which is known for moderate vulnerability to all forms of landslide. Steep slopes are evenly spread throughout the county and there are locations that can be prone to landslides in almost every municipality.

4.3.8.2. Range of Magnitude

Landslides cause damage to transportation routes, utilities, and buildings. They can also create travel delays and other side effects for transportation of people and material. Fortunately, death and injuries due to landslides are relatively rare in Pennsylvania. Almost all of the known deaths due to landslides have occurred when rocks fall or other slide along highways involve vehicles. Storm-induced debris flows are the only other type of landslide likely to cause injuries. As residential and recreational development increase 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 objects and buildings, rather than people.

The Pennsylvania Department of Transportation (PennDOT) and large municipalities incur substantial costs due to landslide damage and to additional construction costs for new roads in known landslide-prone areas. A 1991 estimate showed an average of $10 million per year is spent on landslide repair contracts across the Commonwealth of Pennsylvania and a similar amount is spent on mitigation costs for grading projects (DCNR, 2009). A number of highway sites in Pennsylvania need temporary or permanent repair at an estimated cost of between $300,000.00 and $2 million each. Similar landslide events that effect traffic and roadways throughout the commonwealth occur intermittently throughout the year. A 7,500-pound rockslide closed down parts of Pennsylvania State Route 11 in Montour County, Pennsylvania in

November of 2020 for a number of weeks. Events of similar magnitude can and have occurred in and around Susquehanna County.

The 2018 Pennsylvania Hazard Mitigation Plan lists Susquehanna County as having a low incidence of landslides but moderate susceptibility. Susquehanna County landowners and real estate developers must know the magnitude of susceptibility within the county prior to the start of development.

4.3.8.3. Past Occurrence

No comprehensive list of landslide incidents in Susquehanna County is available, as there is no formal reporting system in place. PennDOT and municipal departments are responsible for slides that inhibit the flow of traffic or damage roads and bridges, but they generally only repair the road and the adjacent right-of-way areas.

4.3.8.4. Future Occurrence

Historically, significant landslide events are likely to occur on average once every four years. Mismanaged development in steeply sloped areas could increase the frequency of occurrence. Road cuts are the most common development that puts an area at an increased probability of a slide. The Pennsylvania Department of Environmental Protection (PA DEP) has an Erosion and Sediment (E & S) program that sets requirements intended to mitigate erosion associated with development projects of a certain scale. The guidelines offered in this program are similar to landslides prevention practices.

4.3.8.5. Vulnerability Assessment

Landslides are often precipitated by other natural hazards such as earthquakes or floods. A significant landslide can cause millions of dollars in damages. Continued enforcement of floodplain management and proper road and building construction can mitigate the vulnerability to landslides. Floodplain management is important where mining has occurred within 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 those fractures could lead to unexpected flood events and landslide events.

A comprehensive database of land highly prone to erosion and landslides is difficult to produce. The potential for erosion and landslides should be considered when planning construction projects in Susquehanna County. There are several general factors that can be indicators of landslide prone areas including:

- Locations 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 line, tilted trees, cracks in the ground and irregularly, surfaced ground.

All the municipalities in Susquehanna County are vulnerable to landslides. *Table 37 – Structure Vulnerability Data* illustrates the number of site structure address points per municipality and the number of structures in high slope areas. Landslide events are most likely to occur in steeply sloped areas and in places where landforms have been altered for purposes of highway construction or other development. This is especially true if development is located at the base or crest of cliffs or near large highway cut-outs. These areas should be considered vulnerable to landslides, particularly if mitigation measures have not been implemented.

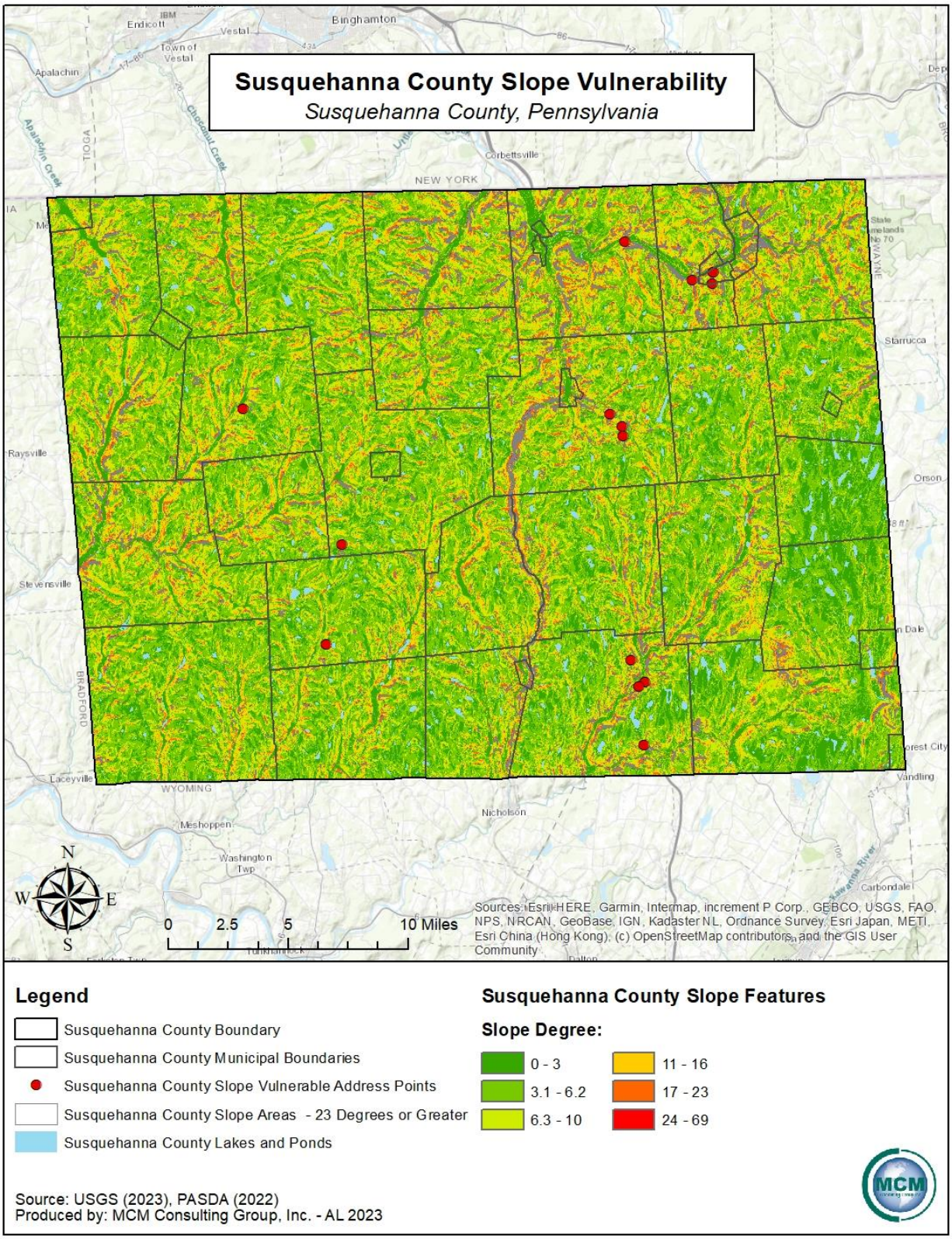
Table 37 - Structure Vulnerability Data

Structure Vulnerability Data		
Municipality	**Number of Addressable Structures Per Municipality**	**Number of Structures in Slope Area**
Apolacon Township	379	0
Ararat Township	535	0
Auburn Township	1,207	0
Bridgewater Township	1,766	1
Brooklyn Township	587	0
Choconut Township	518	0
Clifford Township	1,566	0
Dimock Township	915	1
Forest City Borough	0	0
Forest Lake Township	810	1
Franklin Township	614	0
Friendsville Borough	63	0
Gibson Township	817	0
Great Bend Borough	416	0
Great Bend Township	1,261	1
Hallstead Borough	644	0
Harford Township	1,098	0
Harmony Township	442	0
Herrick Township	950	0
Hop Bottom Borough	167	0
Jackson Township	743	0
Jessup Township	426	0
Lanesboro Borough	213	0
Lathrop Township	539	0
Lenox Township	1,406	4

Structure Vulnerability Data		
Municipality	**Number of Addressable Structures Per Municipality**	**Number of Structures in Slope Area**
Liberty Township	753	0
Little Meadows Borough	166	0
Middletown Township	399	0
Montrose Borough	993	0
New Milford Borough	519	0
New Milford Township	1,666	3
Oakland Borough	281	0
Oakland Township	394	2
Rush Township	916	0
Silver Lake Township	1,258	0
Springville Township	959	0
Susquehanna Depot Borough	814	2
Thompson Borough	173	0
Thompson Township	440	0
Union Dale Borough	202	0
Totals:	**28,015**	**15**

Climate change has the potential to increase the frequency of landslides in Susquehanna County. Climate change could result in more intense rainfall from more frequent hurricanes and tropical storms. This increase in rainfall could cause increased soil runoff, weakening slopes that are steep and considered to be a hazard. More frequent landslides could occur from this weakening of the slopes.

Figure 26-Landslide Hazard Areas



4.3.9. Lightning Strike

4.3.9.1. Location and Extent

Lightning is a massive electrostatic discharge between electrically charged regions within clouds, or between a cloud and the Earth's surface, The charged regions within the atmosphere temporarily equalize themselves through a lightning flash, commonly referred to as a strike if it hits an object on the ground.

There are three primary types:

- A lightning strike from a clod to itself (intra-cloud or IC)
- A lightning strike from one cloud to another cloud (cloud to cloud or CC)
- A lightning strike between the cloud and the ground (cloud to ground or CG)

Lightning is always accompanied by the sound of thunder, although distant lightning may be see but be too far away for the thunder to be heard. Thunder is caused by lightning. The bright light of the lightning flash caused by the expansion of electrons (called the "return stroke") represents a great deal of energy. This energy heats the air in the channel to above 50,000°F in only a few millionths of a second. The air that is now heated to such a high temperature has had no time to expand, so the air has a high pressure. The high-pressure air expands outward into the surrounding air, compressing it and causing a disturbance that propagates in all directions away from the stroke. The disturbance is a shock wave for the first ten yards, after which it becomes an ordinary sound wave, commonly referred to as thunder.

Susquehanna County is subject to lightning strikes and thunderstorm activity throughout the year. Overall, the most active time for lightning strikes is from early spring to early fall. While the impact of flash events is highly localized, strong storms can result in numerous widespread events over a broad area. In addition, the impacts of an event can be serious or widespread if lighting strike a particularly significant location such as a power station, a campground, or a large public venue.

4.3.9.2. Range of Magnitude

Severe thunderstorms have lightning risks, can cause significant damage, and be life threatening, though only a small percentage of thunderstorms become severe. Northeastern Pennsylvania sits in a moderate risk area susceptible to lightning strikes but high risk areas for lightning strikes are the southeast or the central portions of the United States. This information can be seen in *Figure 27 – United States Lightning Risk Rating*. The 2018 Commonwealth of Pennsylvania All Hazards Mitigation Plan states that Pennsylvania ranks ninth among the fifty states in the country's number of lightning deaths. Lightning flashes occur in Susquehanna County during the summer months. Lightning can cause severe injury and in some cases can be fatal. Most fatal strikes are not direct strikes to people but the result of ground current. Most individuals survive

ground current strikes. Other impacts of ground current include death and injuries to livestock, forest and brush fires, and damages to buildings, communication systems, power lines, and utility systems across the country. *Figure 28 – U.S. Lightning Strike Fatalities 2018 to 2022* shows the number of lightning fatalities from direct strikes for the United States. Pennsylvania registered five fatalities for that five year time period.

4.3.9.3. Past Occurrence

Thunderstorms and lightning occur many times each year in Pennsylvania. Lightning has been responsible for five deaths in Pennsylvania from 2018 to 2022 and approximately 644 casualties (deaths and injuries) and damage reports from 1959 to 1994. As of the writing of this plan update, one fatality from lighting has occurred in Pennsylvania in 2023. That occurrence was in Chester County. There were no lightning strike fatalities in Susquehanna County between 2006 and 2023, as reported by the National Weather Service.

4.3.9.4. Future Occurrence

Lightning strikes and thunderstorms are expected during and around the spring and summer months. These events have occurred in Susquehanna County in the past and will continue to occur in the future, although multiple casualties or deaths are highly unlikely. Climate change will result in a greater frequency of storms and an increase in the strength of thunderstorms. The rising temperature will result in warmer air with more moisture which will increase the likelihood of thunderstorms. This increase in thunderstorms is likely to result in more occurrences of lightning strikes.

Land use changes and population may also affect the likelihood of lightning strikes. While this is of high debate, some research suggests that land use changes in the form of urbanization may increase the frequency of lightning strikes. Research suggests that urbanization increases local climate and therefore increases the amount of lightning strikes in that area. These urban areas typically have a higher population density compared to more rural areas, therefore increasing the built environment and heightening the areas vulnerability to lightning strikes.

4.3.9.5. Vulnerability Assessment

The odds of being struck by lightning in an individual's lifetime are one in 15,300 people, according to the National Oceanic and Atmospheric Administration's (NOAA) National Severe Storms Laboratory. Nine out of ten people in the United States who are struck by lightning survive, according to a 2016 study presented at the International Lightning Detection Conference and International Lightning Meteorology Conference. However, lightning strikes can leave an individual with many long-term health problems, including muscle soreness, headaches, cognitive issues, and nausea.

The potential for lightning strikes and thunderstorms exists in all municipalities in Susquehanna County. Events being held outdoors during the summer months are particularly vulnerable to lightning strikes. Due to the recreational and rural characteristics, including waterways, there is the potential in Susquehanna County for death and injuries to occur from lightning strikes.

Utility interruptions will continue to be a vulnerability when lightning strikes are examined. Susquehanna County has had thirty-one recorded power utility interruptions from 2013 to 2022, and some of these interruptions have been caused by lightning strikes to power poles and utility transformers. Additional discussion on utility interruptions, and utility interruptions as a cascading hazard of lightning strikes can be found in Section 4.3.22 of this hazard mitigation plan.

Figure 27-United States Lightning Risk Rating

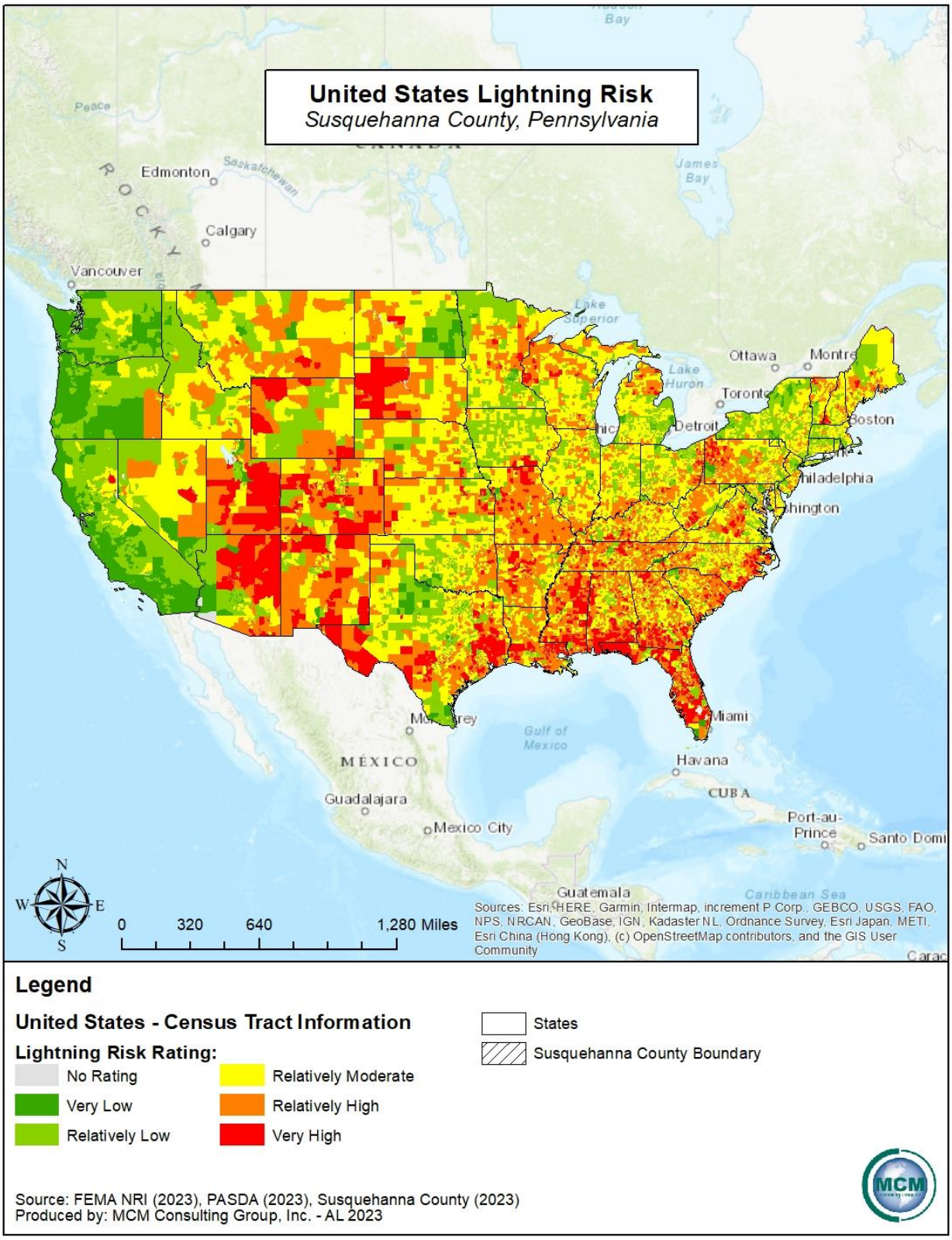
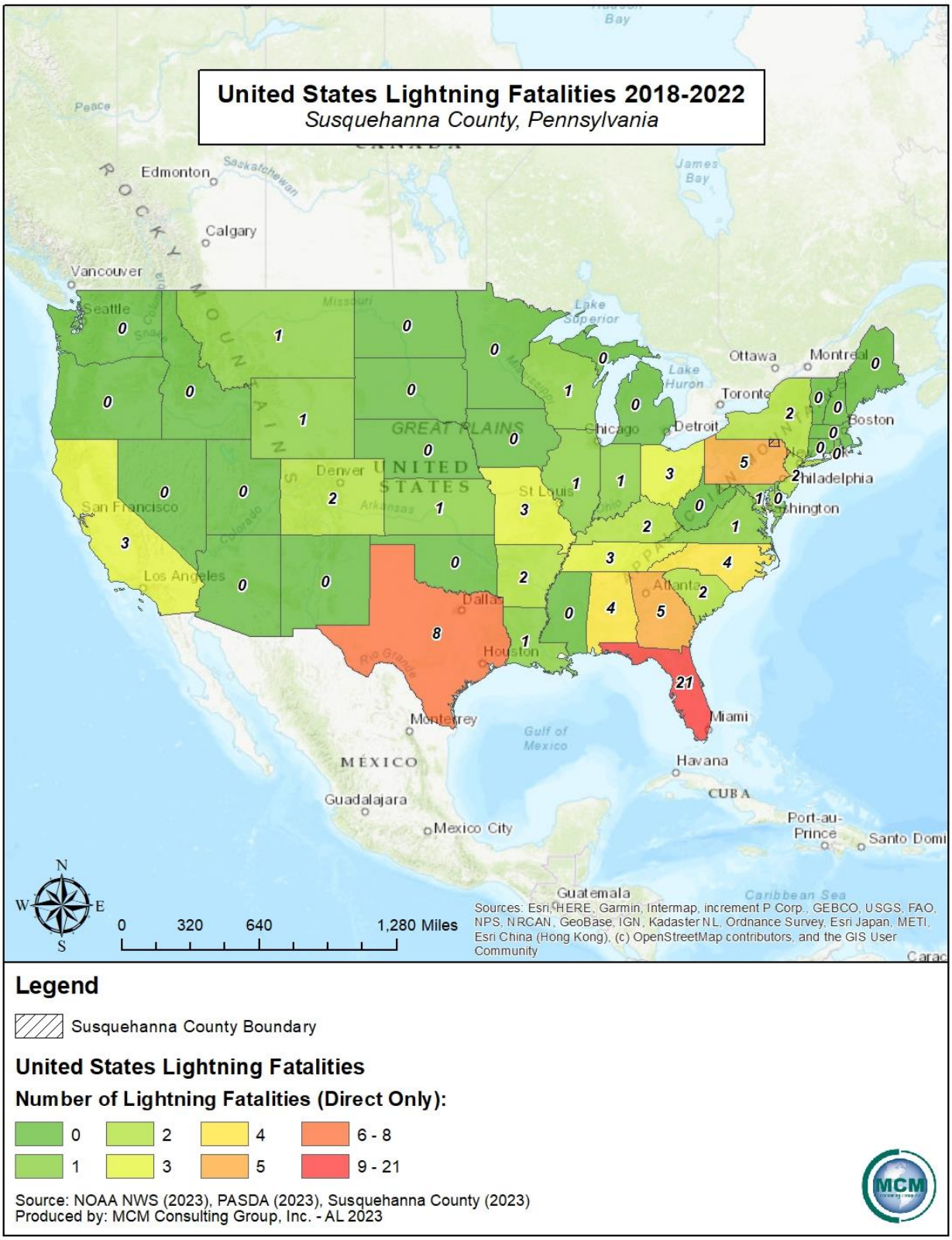


Figure 28-U.S. Lightning Strike Fatalities 2018 to 2022



4.3.10. Pandemic, Epidemic, and Infectious Disease

4.3.10.1. Location and Extent

Epidemic

An epidemic occurs when an infectious disease spreads more quickly than expected by medical and healthcare authorities. It is characterized by widespread growth or extent that spreads quickly and incurs a greater rate of novel or endemic cases than baseline estimates would initially project. When an epidemic occurs, it typically impacts a larger area than a localized outbreak. Epidemics often include multiple countries, although not always spreading to different continents. In short, epidemics are regional.

Pandemic

A pandemic is a disease outbreak that spreads across countries or continents, which affects the population of a vast area. When a pandemic occurs, the event usually affects more people and takes more lives than an epidemic. Pandemics are described as an extensive epidemic. Generally, pandemic diseases cause sudden illness in all age groups on a global scale. Pandemics are continuous events in third-world countries but do not frequently affect the United States. A pandemic is measured and defined by the spreading of a disease rather than the fatalities with which it is associated. The characteristics of a pandemic outbreak include large and rapid scale spread, overload of healthcare systems, inadequate medical supplies, disruption of economy/society, and medical supply shortages. While a pandemic may be characterized as a type of epidemic, an epidemic is not a type of pandemic. Additionally, pandemics travel more efficiently than epidemics. In the event that a pandemic occurs in the eastern United States, the entirety of Susquehanna County would likely be impacted.

Endemic

An endemic is described as a disease that is present in a community at all times but occurs in a relatively low frequency and is not spreading at a rapid rate. An endemic can be a previous pandemic such as influenza, or coronavirus (COVID-19), or a more regionalized virus such as Ebola virus in Africa. An endemic can become a pandemic if the disease mutates into a more virulent strain.

Infectious Disease

Infectious diseases are illnesses caused by pathogenic organisms such bacteria, viruses, fungi, or parasites. Organisms become harmful and cause disease under certain conditions. The sources of infectious disease may originate from contaminated food or waterways, infected animals/livestock, or infection from biological vectors such as mosquitoes, etc. Infectious diseases include influenza, rabies, Middle East Respiratory Syndrome (MERS), West Nile virus, Lyme Disease, Zika virus, and Ebola virus.

Pandemic and infectious disease events cover a wide geographical area and can affect large populations, potentially including the entire population of the Commonwealth of Pennsylvania. The exact size and extent of an infected population is dependent upon how easily the illness is spread, the mode of transmission, and the amount of contact between infected and uninfected individuals. The transmission rates of pandemic illnesses are often higher in more populated and urban areas where there are large concentrations of people. The transmission rate of infectious disease will depend on the mode of transmission of a given illness. Pandemic events can also occur after other natural disasters, particularly floods, when there is the potential for bacteria to grow in, and contaminate, standing water.

4.3.10.2. Range of Magnitude

Public health emergencies typically occur on a regional basis. The magnitude of pandemic or infectious disease threat in the Commonwealth will range significantly depending on the aggressiveness of the virus in question, factors within the community that are impacted (medical care access, population density, etc.), and the ease of transmission. For example, the West Nile virus produces clinically asymptomatic cases less than 80% of the time. Therefore, approximately 20% of the cases result in mild infection, also known as West Nile fever. However, there is a small percentage of cases that could result in severe neurological disease and even death.

Pandemic influenza has a higher transmission rate from person-to-person compared to the West Nile virus. Advances in medical technologies have greatly reduced the number of deaths caused by influenza over time. In the early 1900s, flu pandemics historically caused tens of millions of deaths, while the 2009 Novel H1N1, known as swine flu, caused fewer than 20,000 deaths world-wide. Many people infected with swine flu in 2009 recovered without needing medical treatment. Without recent medical inventions and technologies, modern influenza would be associated with higher morbidity rates. About 70% of those who were hospitalized during the 2009 H1N1 flu virus in the United States belonged to a high-risk group. However, with the COVID-19 pandemic, the transmission rates were much higher than any previous outbreaks related to other members of the coronavirus family such as SARS-CoV and MERS-CoV.

In the past 100 years, humanity did not face a microbial pandemic similar in scale to the COVID-19 pandemic. The worldwide transmission rate of COVID-19 from human to human rapidly advanced in 2020 and 2021. Of the six global outbreaks of viral infections, three were caused by coronaviruses (SARS, MERS, and COVID-19).

While there are limited secondary hazards related to public health emergencies, an outbreak can cause a variety of cascading hazards. Civil disorder due to supply shortages is the most common cascading hazard to result from pandemic, epidemic, or infectious disease. Additional potential effects could include: a shortage of medical supplies and personnel, hoarding of household paper and cleaning supplies, school and business disruption, government closings, government

restrictions on travel, low attendance at places of employment, slowed productivity, and widespread economic instability.

The World Health Organization (WHO) developed an alert system to help inform the world about the seriousness of a pandemic. The alert system has six phases, with Phase 1 being the lowest risk and Phase 6 being the greatest risk of pandemic. The phases were developed in 1999, but then revised in 2005 and 2009 to provide a global framework and aid countries in pandemic preparedness and response planning. These phases of alert systems were used during the COVID-19 pandemic. These phases are listed below in *Table 38 - Pandemic Influenza Phases*.

Table 38 - Pandemic Influenza Phases

Pandemic Influenza Phases	
Phase	**Characteristics**
Phase 1	No animal influenza virus circulating among animals has been reported to cause infection in humans.
Phase 2	An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a specific potential pandemic threat.
Phase 3	An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks.
Phase 4	Human-to-human transmission (H2H) of an animal or human-animal influenza virus able to sustain community-level outbreaks has been verified.
Phase 5	The same identified virus has caused sustained community level outbreaks in two or more countries in one WHO region.
Phase 6	The pandemic phase is characterized by community level outbreaks in at least one other country in a different WHO region in addition to the criteria defined in Phase 5. Designation of this phase will indicate that a global pandemic is under way.
Post-Peak Period	Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels.
Possible New Wave	Level of pandemic influenza activity in most countries with adequate surveillance rising again.

Pandemic Influenza Phases	
Phase	**Characteristics**
Post-Pandemic Period	Levels of influence activity have returned to the levels seen for seasonal influenza in most countries with adequate surveillance.
Source: WHO, 2009	

4.3.10.3. Past Occurrence

Pandemic & Epidemic

Several pandemic influenza outbreaks have occurred over the past 100 years that not only affected Susquehanna County but the United States as a whole. *Table 39 - Past Pandemic Events in the United States* illustrates the various past pandemic events that have occurred since the late 1800's. Prior to COVID-19, the worst recorded pandemic was the Spanish Flu, due to the amount of infection spread that was present in the world. The two most recent pandemics that have occurred in Susquehanna County and the United States are the swine flu/Novel H1N1 and COVID-19 pandemics, with COVID-19 being the most current and having the highest transmission rates.

Spanish Flu

An estimated 1/3 of the world's population was infected and had clinically apparent illnesses during the 1918 - 1919 influenza pandemic. Pennsylvania experienced severe effects from the Spanish Flu. It claimed 500,000 lives in the United States, which included individuals in Susquehanna County. There is a lack of data which provides exact numbers of deaths that occurred in Susquehanna County from the Spanish Flu, however there were a total of 60,000 deaths in Pennsylvania. Deaths occurring in Susquehanna County are included in this number. There were approximately 47,000 reported cases and 12,000 deaths in Philadelphia in just over four weeks. In the first six months, there were about half a million cases and 16,000 deaths of the Spanish Flu in Philadelphia. The factors of high population density including crowded and unhygienic conditions contributed to higher numbers of cases and death rates across Pennsylvania.

Swine Flu/Avian Flu/H1N1

Each year, different strains of influenza are labeled as potential pandemic threats. Strains of influenza, or the flu, are highly contagious as 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 country began planning for flu outbreaks.

Susquehanna County was impacted by the H1N1 virus during 2009. The Pennsylvania Department of Health (PA DOH) set up clinics throughout the county to administer vaccines to at-risk populations. A total 10,940 cases and seventy-eight deaths occurred in Pennsylvania from this pandemic but there is insufficient data to determine the exact number of cases and deaths from swine flu in Susquehanna County.

COVID-19

Susquehanna County was directly impacted by the COVID-19 pandemic. As of March 2023, Susquehanna County had recorded an estimated 10,136 total confirmed cases and 135 deaths related to the COVID-19 pandemic. More recent data was not available because global tracking of COVID-19 cases has stopped. The first cases in Pennsylvania were reported on March 6, 2020, in Delaware and Wayne counties. The first confirmed case of COVID-19 in Susquehanna County was on April 9, 2020. Beginning in December of 2020, there was a large-scale vaccination effort to combat COVID-19. Municipalities in Susquehanna County indicated an increase in the pandemic and infectious disease section of the risk factor assessment municipal comparison.

Table 39 - Past Pandemic Events in the United States

Past Pandemic Events in the United States	
Year(s)	**Common Name**
1889	Russian Flu
1918	Spanish Flu/H1N1
1957	Asian Flu/H2N2
1968	Hong Kong Flu/H3N2
2009	Swine flu/Novel H1NI
2020	COVID-19
Sources: (WHO & CDC, 2020)	

Infectious Disease

Not only has Susquehanna County experienced pandemic events, but the county has also experienced infectious disease events. The two major infectious disease events experienced across Susquehanna County and Pennsylvania as a whole are the West Nile Virus and Lyme Disease. Due to the climatic traits of Pennsylvania these infectious diseases thrive in Susquehanna County. Both diseases are transmitted by the biological vector of an insect which is found throughout the county.

West Nile Virus

West Nile virus reached the United States in 1999 and a year later was detected in Pennsylvania when mosquito pools, dead birds, and/or horses in nineteen counties tested positive for the virus. By 2003, all counties in the Commonwealth had confirmed cases. A comprehensive network has

been developed in Pennsylvania that includes trapping mosquitoes, collecting dead birds, and monitoring horses, people and, in past years, sentinel chickens. Although West Nile Virus positive cases are few in Susquehanna County, 2018 had the most positive cases in Susquehanna County with one positive mosquito result. Over the past five years, no human has tested positive for West Nile Virus in Susquehanna County. *Table 40 - West Nile Virus Control Program in Susquehanna County since 2017* outlines the West Nile Virus within Susquehanna County from 2017 to 2022.

Table 40 - West Nile Virus Control Program in Susquehanna County since 2017

West Nile Virus Control Program in Susquehanna County Since 2017				
Year	**Total Positives**	**Human Positives**	**Mosquito Positives**	**Bird Positives**
2017	0	0	0	0
2018	1	0	1	0
2019	0	0	0	0
2020	0	0	0	0
2021	0	0	0	0
2022	0	0	0	0
Source: PA Department of Environmental Protection, 2023				

Lyme Disease

Lyme Disease has been present in the United States and Susquehanna County for many years. More wooded areas have higher cases due to ticks being the main biological vector. Lyme disease is found in all sixty-seven counties within Pennsylvania. Susquehanna County has an overall approximately 701 confirmed cases of Lyme disease from 2001 until 2020, although actual totals may be significantly higher due to under reporting. Susquehanna County as a whole has a high incidence for Lyme Disease in the county, especially over the past several years. It is possible that numbers have risen dramatically due to lack of testing in previous years. Susquehanna County experienced the highest number of positive cases in 2017 at 129 annual cases. Lyme disease case counts have been consistently rising over the past several years. It should be noted that information represented for each county may vary due to reporting practices. Hence these figures represent a rough estimate of the Lyme disease burden in Susquehanna County. *Table 41 - Lyme Disease Data for Susquehanna County* outlines the total positive cases of Lyme Disease within Susquehanna County from 2014 to 2020. Data after 2020 was not available for this report.

Table 41 - Lyme Disease Data for Susquehanna County

Lyme Disease Data for Susquehanna County	
Year	**Total Positives**
2014	73
2015	93
2016	85
2017	129
2018	74
2019	79
2020	52
Source: PA Department of Environmental Protection, 2020	

Zika Virus

The Zika virus is another infectious disease that is spread by mosquito bites, and it is related to West Nile virus. Zika virus can also be spread through sexual intercourse, blood transfusion, or passed from mother to child in the womb. The virus was first identified in 1947, but largely came to the attention of the United States in 2015 when there was an outbreak of Zika in Brazil. The direct illness caused by Zika can include fever, red eyes, joint pain, headache, and a rash, or sometimes no symptoms at all. Zika is problematic for pregnant mothers as the virus can result in microcephaly or cause other problems for brain development. For adults, the virus can be linked to increased incidence of Guillain-Barré syndrome.

4.3.10.4. Future Occurrence

Pandemic & Epidemic

The probability of a widespread public health emergency effecting Susquehanna County is approximately once every ten years. Minor outbreaks of less serious communicable disease, such as influenza, will occur much more frequently. The occurrence of pandemic influenza outbreaks is unpredictable, and complete avoidance of the events is unlikely. Therefore, future occurrences of pandemics and infectious disease events are very likely. Pandemics may also emerge from other diseases, especially invasive pathogens for which Susquehanna County and Pennsylvania as a whole lack natural immunity.

Influenza

It is estimated that 5% to 25% of Pennsylvanians get the flu each year, and 120 to 2,000 individuals die from complications of influenza. The CDC recommends that everyone six months and older get a flu vaccine every season to prevent future cases from rising. People who are at a high risk of serious flu illness should take flu antiviral drugs as soon as they get sick.

Infectious Disease

Infectious diseases such as West Nile Virus and Lyme Disease have been present in Susquehanna County for many years and are expected to perpetuate. The best way to prevent infectious disease outbreaks, including West Nile Virus and Lyme Disease, is to actively address the causes of the diseases. West Nile Virus occurrence can be reduced by removing mosquito breeding locations in stagnant water sources and Lyme Disease occurrence can be reduced by utilizing insect repellant, removing ticks promptly, applying pesticides, and reducing tick habitats. Occurrence of Zika Virus can also be reduced by removing mosquito breeding areas and areas of stagnant water. Both West Nile Virus and Lyme Disease are expected to continue occurring in Susquehanna County in the future.

4.3.10.5. Vulnerability Assessment

Susquehanna County is considered to be a moderate vulnerability county in regard to pandemic, epidemic, endemic, and infectious disease events. It is extremely difficult to predict the occurrence and the magnitude of a pandemic or epidemic event. The COVID-19 pandemic disproportionately affected populations over the age of sixty-five, especially those in nursing homes. It has had disparate effect on socially vulnerable populations, including unsheltered and homeless individuals.

Elderly individuals, children and immune deficient individuals are the most vulnerable to disease. Nursing facilities, personal care facilities, daycares, schools, and hospitals are considered more vulnerable since there are often groups of these socially vulnerable individuals present at these community lifelines. Congregate living facilities, including correctional institutions and dormitories would also be at an increased risk due to the difficulties in adhering to the social distancing required to help stop the spread of a pandemic. During the COVID-19 pandemic, nursing homes and personal care homes in Pennsylvania reported high numbers of cases and deaths, and several county jails and state correctional institutions reported wide community spread.

Health-care workers and those working in direct-care (such as correctional institutions or those who cannot social distance due to their jobs) are more likely to be exposed to a pandemic disease. Those who work outdoors for extended periods of time in warm months may be more vulnerable to West Nile Virus, Lyme Disease, or the Zika virus.

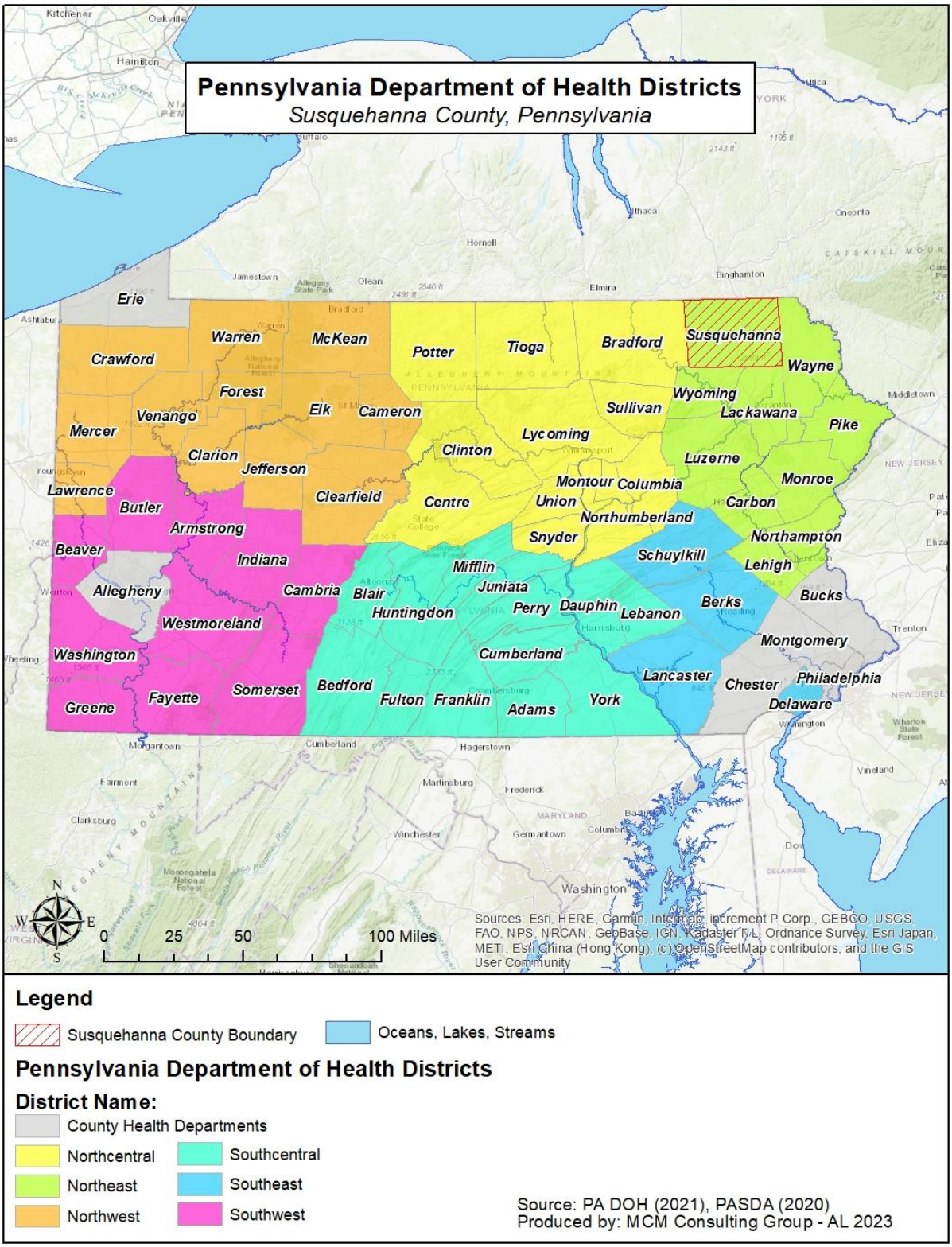
The number of hospitals within the county, and availability of beds within the hospitals, determine the amount of care vulnerable and sick patients will receive. It is important for hospitals to review and exercise emergency response plans and continuity of operations plans (COOP) to ensure that there is an effective public health response.

During a public health emergency, the PA DOH may open emergency medicine centers called points of dispensing (PODs) to ensure that medicine, supplies, vaccines, and information reach Pennsylvania residents during a public health emergency. An open POD is where the general public goes to receive free emergency medicine and supplies from public health officials, while a

closed POD provides free emergency medicine and supplies to a specific community, like a university, including faculty, staff, and students. Dispensing of medications/vaccines is a core function of the Strategic National Stockpile's Mass Dispensing of Medical Countermeasures Plan.

PODs are coordinated with county emergency managers by the PA DOH with the six regional healthcare districts (see *Figure 29 - Pennsylvania Department of Health Districts*). Susquehanna County is in the Northeast district.

Figure 29-Pennsylvania Department of Health Districts



4.3.11. Radon Exposure

4.3.11.1. 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 fifty-five 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 relative proximity to its radioactive parent, usually within tens of feet away. Radon is a carcinogen and when inhaled, it can lead to the development of lung cancer.

Radioactivity, caused by airborne radon, has been recognized for many years as an important component in the natural background radioactivity exposure of humans, but it was not until the 1980s that the wide geographic distribution of elevated values in houses and the possibility of extremely high radon values in houses were recognized. Radon was discovered as a significant source of natural radiation for humans in 1984 in the Reading Prong geologic province in Eastern Pennsylvania, 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. 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:

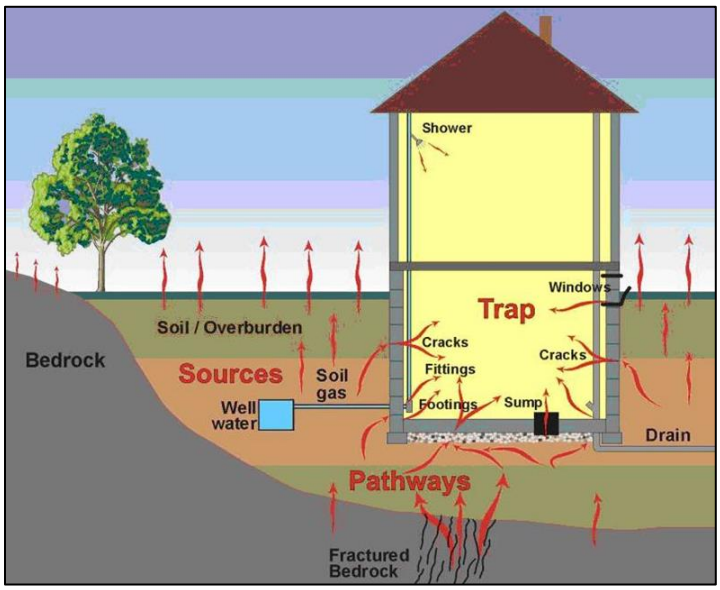
- Proximity to elevated uranium rich deposits (>50ppm). Areas within a few hundred feet of such deposits are most at risk. Such deposits are rare in Pennsylvania.
- Some more common rocks have higher than average uranium content (5 to 50 ppm), and proximity to such rocks also increases the risk of radon 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 State College in Centre County, PA) even with underlying bedrock having normal uranium concentrations (.5 to 5 ppm), the vast majority of locations built on limestone-dolomite soils exceed radon concentrations of 4pCi/L, and many exceeded 20 pCi/L.

The following three sources of radon in houses are now recognized (see *Figure 30 - Sketch of Radon Entry Points into a House* below):

- Radon in soil air that flows into the house
- Radon dissolved in water from private wells and exsolved during water usage; this is rarely a problem in Pennsylvania
- Radon emanating from uranium-rich building materials (e.g., concrete blocks or gypsum wallboard); this is not known to be a problem in Pennsylvania

High radon levels were initially thought to be exacerbated in houses that are tightly sealed, but it is now recognized that rates of airflow into and out of houses, plus the location of air inflow and the radon content of air in the surrounding soil, are key factors in radon concentrations. Outflows of air from a house, caused by a furnace, fan, thermal “chimney” effect, or wind effects, require that air be drawn into the house to compensate. If the upper part of the house is tight enough to impede influx of outdoor air (where radon concentration is generally <0.1 pCi/L), then an appreciable fraction of the air may be drawn in from the soil or fractured bedrock through the foundation and slab beneath the house, or through cracks and openings for pipes, sumps, and similar features. Soil gas typically contains from a few hundred to a few thousand pCi/L of radon; therefore, even a small rate of soil gas inflow can lead to elevated radon concentrations in a house.

Figure 30-Sketch of Radon Entry Points into a House



The radon concentration of soil gas depends upon a number of soil properties, the importance of which is still being evaluated. In general, 10% to 50% of newly formed radon atoms escape the host mineral of their parent radium and gain access to the air-filled pore space. The radon content of soil gas clearly tends to be higher in soils containing higher levels of radium and uranium, especially if the radium occupies a site on or near the surface of a grain from which the radon can easily escape. The amount of pore space in the soil and its permeability for airflow, including cracks and channels, are important factors determining radon concentration in soil gas and its rate of flow into a house. Soil depth and moisture content, mineral host and form for radium, and other soil properties may also be important. For houses built on bedrock, fractured zones may supply air having radon concentrations similar to those in deep soil.

The second factor listed above is most likely the cause of high radon levels in Susquehanna County. The data show that most reported zip codes in the county have high basement radon level test results. The areas and test results are shown in more detail in the past occurrence section.

4.3.11.2. Range of Magnitude

According to the 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. 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 the continued radioactive decay.

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 considering fixing a home if the radon level is between 2 pCi/L and 4 pCi/L.

Table 42 - Radon Risk for Smokers and Nonsmokers shows the relationship between various radon levels, probability of lung cancer, comparable risks from other hazards, and action thresholds. As seen in *Table 42 - Radon Risk for Smokers and Nonsmokers* below, a smoker exposed to radon has a much higher risk of lung cancer.

Table 42 - Radon Risk for Smokers and Nonsmokers

Radon Risk for Smokers and Nonsmokers			
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	
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	

Radon Risk for Smokers and Nonsmokers			
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**
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.			

4.3.11.3. Past Occurrence

In 1984, the Pennsylvania Radon Bureau responded to the newly detected high radon levels with a massive radon monitoring, educational, and remediation effort. In the start of November 1986, over 18,000 homes had been screened for radon and approximately 59% were found to have radon daughter levels in excess of the 0.020 Working Level (WL) guideline. Radon daughter levels ranged up to 13 WL or 2600 pCi/L or radon gas.

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 DEP has estimated that the national average indoor radon concentration is 1.3 pCi/L and the level for action is 4.0 pCi/L; however, they have estimated that the average indoor concentration in Pennsylvania basements is about 7.1 pCi/L and 3.6 pCi/L on the first floor. The PA DEP records all the tests they receive and categorize them in a searchable database by zip code. There are currently 2,174 zip codes in Pennsylvania, but the zip code radon test data only covers for 986 zip codes. The missing zip codes that report in the data base as “N/A” for insufficient data either had fewer than thirty test results or no test results at all.

Figure 43 – Radon Test Results in Susquehanna County shows a total of eighteen zip codes in Susquehanna County where tests were reported to the PA DEP to report their findings; those with no available data were not included in the table. The highest average radon level was reported from the 18824-zip code, which is in the south central area of the county, with an

average reading of 8.7 pCi/L within location of the basement. Most reporting zip codes in Susquehanna County have average basement Radon levels significantly above the suggested EPA action level of 4 pCi/L. The average basement reading for reporting zip codes in the county is 5.98 pCi/L, and the average first floor reading is 2.05 pCi/L.

Table 43 - Radon Test Results in Susquehanna County

Radon Level Test Results					
Zip Code	**Postal Community**	**Location**	**Number of Tests**	**Max Result pCi/L**	**Average Result pCi/L**
18407	Carbondale, PA	Basement	893	100.5	3.8
		First Floor	196	34.0	2.3
18419	Factoryville, PA	Basement	516	113.0	4.7
		First Floor	55	4.6	1.3
18421	Forest City, PA	Basement	356	41.6	3.8
		First Floor	125	12.6	1.8
18446	Nicholson, PA	Basement	222	69.7	6.5
		First Floor	N/A	N/A	N/A
18465	Thompson, PA	Basement	84	65.6	6.0
		First Floor	N/A	N/A	N/A
18470	Union Dale, PA	Basement	171	61.7	4.6
		First Floor	N/A	N/A	N/A
18623	Laceyville, PA	Basement	57	45.8	7.7
		First Floor	N/A	N/A	N/A
18630	Meshoppen, PA	Basement	91	79.5	5.8
		First Floor	N/A	N/A	N/A
18801	Montrose, PA	Basement	397	85.6	5.9
		First Floor	56	13.1	2.1
18812	Brackney, PA	Basement	119	55.1	6.9
		First Floor	N/A	N/A	N/A
18818	Friendsville, PA	Basement	74	24.9	4.6
		First Floor	N/A	N/A	N/A
18821	Great Bend, PA	Basement	33	29.6	6.4
		First Floor	N/A	N/A	N/A
18822	Hallstead, PA	Basement	94	72.7	6.8
		First Floor	57	24.4	2.0
18824	Hop Bottom, PA	Basement	56	50.0	8.7
		First Floor	N/A	N/A	N/A

Radon Level Test Results					
Zip Code	**Postal Community**	**Location**	**Number of Tests**	**Max Result pCi/L**	**Average Result pCi/L**
18826	Kingsley, PA	Basement	70	25.4	6.5
		First Floor	N/A	N/A	N/A
18834	New Milford, PA	Basement	172	92.3	8.5
		First Floor	N/A	N/A	N/A
18844	Springville, PA	Basement	85	68.5	4.8
		First Floor	N/A	N/A	N/A
18847	Susquehanna, PA	Basement	206	73.5	5.8
		First Floor	38	20.2	2.8
Source: PA DEP, 2023					

4.3.11.4. Future Occurrence

Radon exposure is likely 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 into three zones and are assigned by county, as shown in *Figure 31 – Pennsylvania Radon Levels*. 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 counties of the highest potential for radon which indicate an intermediate likelihood of occurrence in the future.

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.

Due to the moderate likelihood of future occurrence, the level of radon daughters should be monitored. Radon daughters are the concentration of decay products of radon in the uranium chain. Fortunately, the presence of radon daughters can be monitored through the means as radon gas. *Table 44 - Suggested Actions and Time Frame for Exposure to Radon Daughters* provides suggested actions and time frames for varying levels of exposure to radon daughters.

Table 44 - Suggested Actions and Time Frame for Exposure to Radon Daughters

Suggested Actions and Timeframe for Exposure to Radon Daughters		
Exposure Level*	Suggested Action**	Timeframe For Plan
more than 5.0 WL***	Residents should either promptly relocate or undertake temporary remedial action to lower levels as far below 5.0 WL as possible. Smoking in high areas discouraged.	Within 2-3 days
1.0 to 5.0 WL	Residents should undertake temporary remedial action to lower levels as far below 1.0 WL as possible. Smoking in high areas discouraged.	Within 1 week
0.5 to 1.0 WL	Residents should undertake temporary remedial action to lower levels as far below 0.5 WL as possible.	Within 2 weeks
0.1 to 0.5 WL	Residents should undertake temporary remedial action to lower levels as far below 0.1 WL as possible. Higher exposure levels require action to be taken in a shorter	3 weeks to 3 months
0.02 to 0.1 WL	Residents should undertake temporary and/or permanent remedial action to lower levels below 0.02 WL. Higher exposure levels require action to be taken in a shorter	4 to 15 months

4.3.11.5. Vulnerability Assessment

Proper testing for radon levels should be conducted across Susquehanna County, especially in the areas of higher incidence levels, and for those individuals and households that face the contributing risks. This testing will determine the level of vulnerability that residents face in their homes, as well as in their businesses and schools.

Susquehanna County is in the EPA Radon Hazard Zone 1, meaning there is a high risk of radon exposure. Smokers can be up to ten times more vulnerable to lung cancer from high levels of radon depending on the level of radon they are exposed to. Additionally, 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 often found to be above the EPA action level of 4 piC/L. *Figure 32 – Radon Levels by Zip Code* shows the best available data from the EPA about the percentage of homes with radon levels at or above the EPA action level. The EPA estimates that an average radon mitigation system costs approximately $1,200.00. 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. The 2018 PA HMP estimates that there are 22,448 vulnerable buildings in Susquehanna County that are in areas with high radon test results, and the cost to mitigate the most impacted of those buildings (an estimated 20% of them or 4,490 buildings) would be $5,387,520.00.

Climate change will have minor impacts on radon exposure in Susquehanna County, if any. Climate change will have an increased impact on the vulnerability of individuals to radon if those individuals live in an area where permafrost is feature of the climate. With rising global temperatures, permafrost can melt, resulting in increased soil and bedrock erosion. This can result in higher rates of radon exposure. This is of primary concern to those areas located in the northern latitudes, and will not have a significant impact on the bedrock or soils of Susquehanna County. It possible that climate change could impact soil and bedrock erosion rates in Susquehanna County, but these impacts are minor or unknow at this time.

Figure 31-Pennsylvania Radon Levels

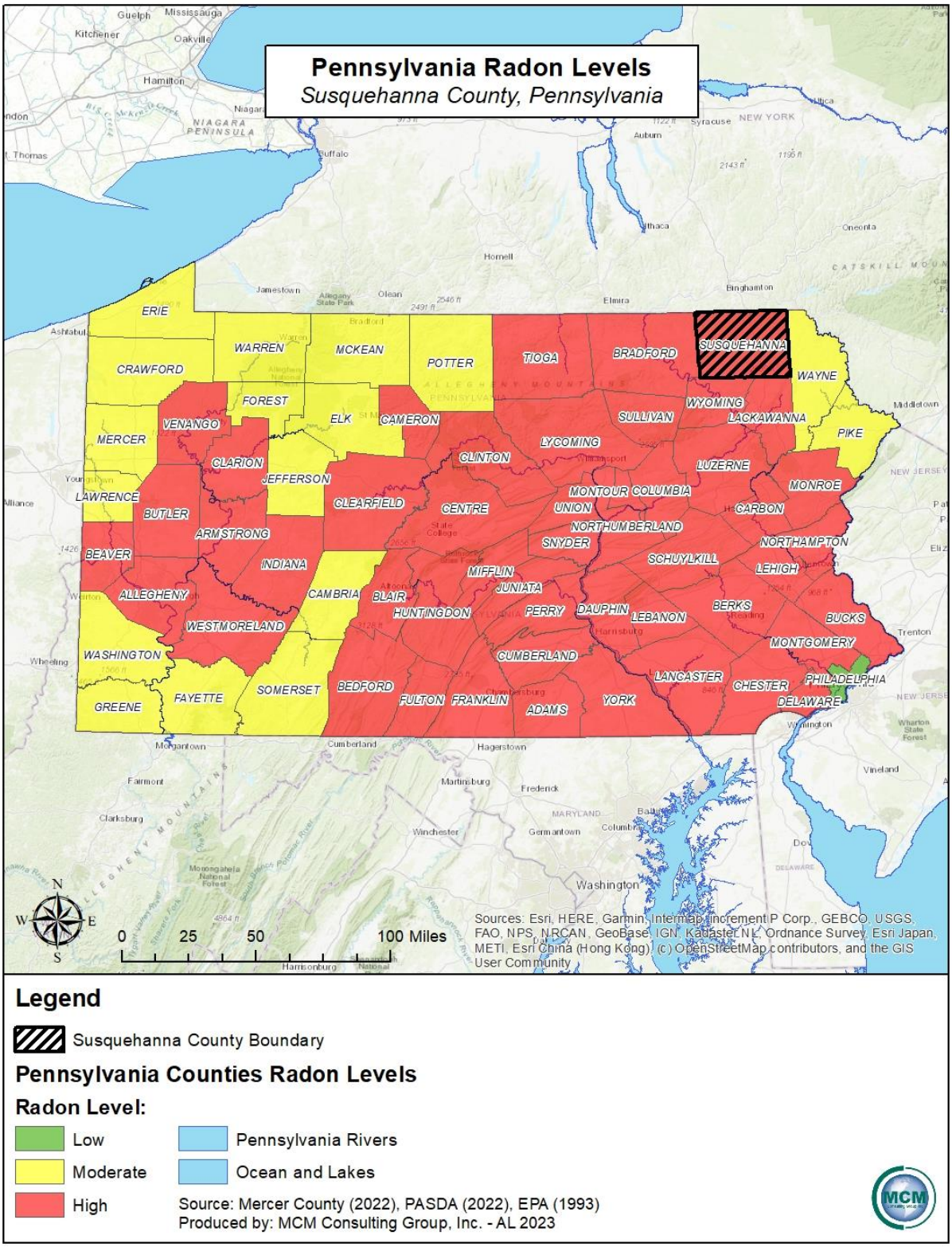
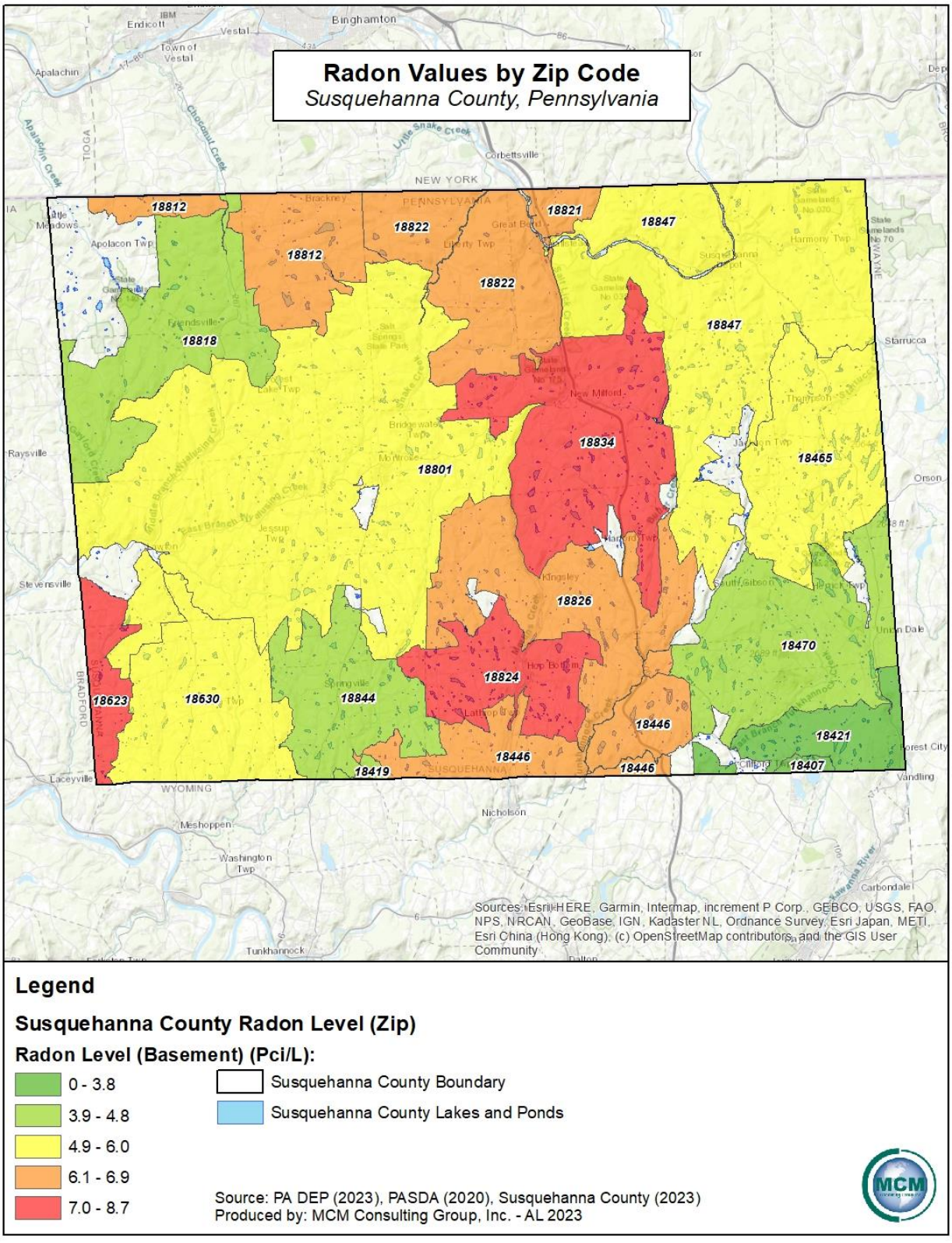


Figure 32-Radon Levels by Zip Code



4.3.12. Tornado and Windstorm

4.3.12.1. Location and Extent

Tornadoes and windstorms can occur throughout Susquehanna County and are usually localized in their location and extent. Severe thunderstorms may result in conditions favorable for the formation of windstorms, including tornadoes. Tornadoes are nature's most violent storms and can cause fatalities and devastation to neighborhoods and municipalities within the county and region. Tornadoes can occur at any time during the day or night but are most frequent during the later afternoon and early evening, which are typically the warmest hours of the day. Tornadoes are most likely to occur in the spring and summer.

Tornadoes

There are two main types of tornadoes: supercell and non-supercell. Supercell tornadoes are the most common and often the most dangerous type of tornado. A rotating updraft is key to the development of a supercell and, eventually, a tornado. Once the updraft is rotating and being fed by warm air, a tornado is formed. The other type of tornado is categorized as non-supercell, which is not as common as a supercell tornado. One type of non-supercell tornado is the "Quasi-Linear Convective Systems" (QLCS). The QLCS tornadoes typically arise during the late night or early morning hours and are typically weaker and more short-lived than supercell tornadoes. However, QLCS are more difficult to detect effectively. Another type of non-supercell tornado is a landspout. These tornadoes are narrow, rope-like funnels that form when a thundercloud grows without a rotating updraft, which causes the spinning motion common with tornadoes to appear near the ground.

Windstorms

Windstorms are experienced on a region-wide scale. The most frequent cause of windstorms in Pennsylvania are thunderstorms, although they may also be caused by hurricanes and winter storms. Windstorms are defined as sustained wind speeds of 40 mph or greater, lasting for at least one hour, or winds of 58 mph or greater lasting for any duration. There are a wide variety of windstorm events that can take place in Susquehanna County.

4.3.12.2. Range of Magnitude

Tornadoes

Each year tornadoes account for $1.1 billion in damages and cause over eighty deaths nationally. Thus far, 2011 was the second worst year on record for deadly tornadoes behind 1936. The number of tornado reports has increased 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. The damage caused by a tornado is a result of the high-wind

velocity and windblown debris, also accompanied by lightning or large hail. The most violent tornadoes have rotating winds of 250 mph or more and are capable of causing extreme destruction and turning normally harmless objects into deadly projectiles.

Tornado movement is characterized in two ways: direction/speed of spinning winds and the forward movement of the tornado, also known as the storm track. The rotational wind speeds can range from 65 to more than 200 miles per hour (mph). The speed of forward motion can range from 0 mph to 50 mph. Forward motion of a tornado path can be a few to several hundred miles in length. Widths of tornadoes vary from less than 100 feet in diameter to more than a mile wide in regard to the largest tornadoes on record. The National Centers for Environmental Information (NCEI) reports that, "the maximum winds in tornadoes are often confined to extremely small areas and vary tremendously over short distance," which explains why one house in a tornado's path may be completely demolished while a neighboring house could remain untouched. Some tornadoes never touch the ground and remain short lived, while others may touch the ground or "jump" along its path.

The destruction from tornadoes can range from minor to severe depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light-weight construction, such as mobile homes. The Enhanced Fujita Scale, also known as the "EF-Scale", measures tornado strength and associated damages. The EF-Scale is an update to the earlier Fujita Scale, also known as the "F-Scale", that was published in 1971. These scales classify U.S. tornadoes into six intensity categories based upon the estimated maximum winds occurring within the wind vortex. This scale can be seen in *Table 45 – Enhanced Fujita Scale*. The EF-Scale became effective on February 1, 2007. Since its implementation by the National Weather Service in 2007, the EF-Scale has become the definitive metric for estimating wind speeds within tornadoes based upon damage to buildings and structures. Previously recorded tornadoes are reported with the older F-Scale values, but *Table 45 – Enhanced Fujita Scale* shows F-Scale categories with corresponding EF-Scale wind speeds.

Figure 33 – Pennsylvania Wind Zones Cont'd identifies wind speeds that could occur across the state, which may be used as the basis for design and evaluation of the structural integrity of shelters and critical facilities. The majority of Pennsylvania falls within Zone III, meaning that the design of shelters and critical facilities should be able to withstand a three-second gust of up to 200 mph, regardless of whether the gust is a result of a tornado, hurricane, tropical storm, or windstorm incident. The western portion of the state falls within Zone IV, which indicates shelters can withstand up to 250 mph winds, while the eastern side falls within Zone II where shelters should be designed to withstand up to 160 mph.

Since Susquehanna County falls within Zone III, shelters and critical facilities should be designed to withstand up to 250 mph winds, regardless of whether the gust is the result of a tornado, coastal storm, or windstorm 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 more prone to tornadoes.

Tornadoes/windstorms of all types have caused the following problems in 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 or damage.
- Trees down or snapped off high above the ground/tree debris-fire fuel.
- Toppled high profile vehicles, including those containing hazardous materials.

Table 45-Enhanced Fujita Scale

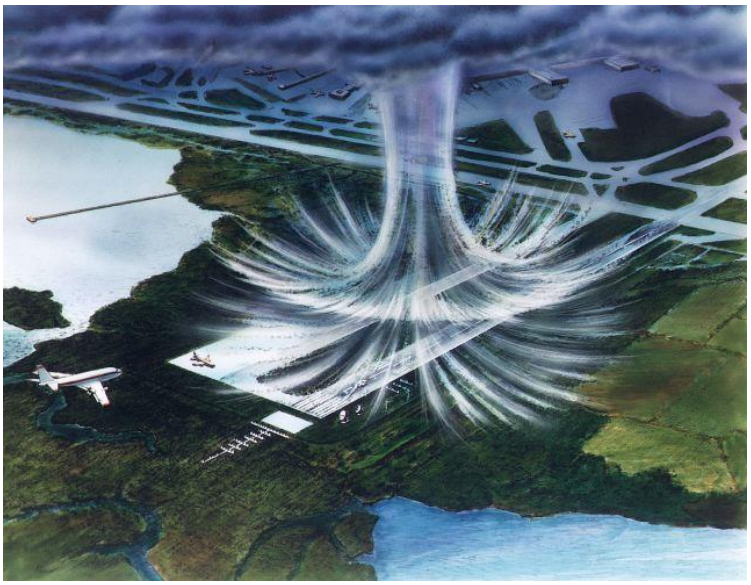
Enhanced Fujita Scale			
EF-Scale Number	**Wind Speed (MPH)**	**F-Scale Number**	**Description of Potential Damage**
EF0	65–85	F0-F1	**Minor damage**: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with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

Enhanced Fujita Scale			
EF-Scale Number	**Wind Speed (MPH)**	**F-Scale Number**	**Description of Potential Damage**
EF5	>200	F3-F6	**Extreme damage**: Strong frame houses leveled off foundations and swept away; automobile-sized projectiles fly through the air in excess of 100 m (300 ft.); steel reinforced concrete structure badly damaged; high-rise buildings have significant structural deformation.
Source: NWS, 2007			

Most of the tornadoes that have struck Susquehanna County have occurred southern portion of the county. In 1985, a total of twenty-three confirmed tornadoes touched down across Eastern Ohio, Southwestern New York, and Central/Western Pennsylvania. This outbreak remains the worst in recorded history for this area. Of these twenty-three tornadoes, eight were of violent intensity (F4 or F5) with estimated wind speeds over 200 mph. Susquehanna County was not impacted by the 1985 outbreak.

Windstorms

Windstorms can be broken down into multiple categories. Straight-line winds are the most common wind event and are different from tornadic winds. It is a ground level, non-rotational, wind that comes out of a thunderstorm. Downdrafts are columns of air that rapidly sinks toward the ground and are classified as either a microburst or microburst. A macroburst is the outward burst of strong winds that are near or at the surface with horizontal dimensions greater than 2 ½ miles. Macrobursts winds may begin over a smaller area and then spread out to a wider area, sometimes producing damage similar to a tornado. On the other hand, microbursts are smaller outward bursts of strong winds near or at the surface. Microbursts are less than 2 ½ miles in horizontal dimension and are typically short-lived winds that last a maximum of ten minutes, with windspeeds



reaching up to 100 mph. Microburst events can be wet or dry events. Wet microbursts are typically associated with heavy precipitation at the surface. Dry microbursts do not have precipitation associated with them and are commonly found in the western portion of the United States.

A gust front is characterized by wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Derecho is a long-lived windstorm that is associated with a band of rapidly moving showers or thunderstorms. A typical derecho contains various downbursts and microbursts. If the wind damage is more than 240 miles and includes wind gusts of at least 58 mph, the event would then be classified as a derecho.

4.3.12.3. Past Occurrence

Susquehanna County has experienced seven tornado events since 2000, and eight wind incidents between 2000 and spring of 2023 as seen in *Table 46 – Susquehanna County Tornado History* and *Table 47 – Susquehanna County High Wind History*. Numerous sources provide information in regard to past occurrences and losses associated with tornadoes/windstorms in Susquehanna County and the commonwealth as a whole. Due to the number of sources available with information, specific number of events and losses could vary slightly between sources. Historically, the county has experienced both severe windstorms and tornadoes.

The most recent tornado impacted Lenox Township on April 15th, 2019. Susquehanna County has not experienced a tornado over EF1 in the past twenty three years. The total property damage from both tornado and high wind events since 2000 totals approximately $850,000.00.

Table 46-Susquehanna County Tornado History

Susquehanna County Tornado History					
Location	**Date**	**Magnitude (F/EF Scale)**	**Deaths**	**Injuries**	**Property Damage**
Little Meadows Borough	06/17/2004	F0	0	0	$100,000.00*
Jessup Township	05/10/2007	EF0	0	0	$15,000.00*
Union Dale Borough	07/23/2010	EF1	0	0	$25,000.00*
Herrick Township	04/28/2011	EF0	0	0	$40,000.00*
Montrose Borough	07/26/2012	EF1	0	0	$35,000.00*
Harford Township	07/08/2014	EF1	0	0	$100,000.00*
Lenox Township	04/15/2019	EF1	0	0	$20,000.00*
		Totals:	0	0	$335,000.00*
Source: NOAA NCEI, 2023 Estimated Values are marked*					

Table 47-Susquehanna County High Wind History

Susquehanna County High Wind History				
Location	**Date**	**Magnitude (knots)**	**Injuries**	**Property Damage**
Susquehanna County (Entire County)	09/19/2003	50	0	$50,000.00*
Susquehanna County (Entire County)	10/15/2003	60	0	$100,000.00*
Susquehanna County (Entire County)	11/13/2003	52	0	$20,000.00*
Susquehanna County (Entire County)	12/01/2006	50	0	$5,000.00*
Susquehanna County (Entire County)	02/18/2011	50	0	$40,000.00*
Susquehanna County (Entire County)	08/28/2011	50	0	$100,000.00*
Susquehanna County (Entire County)	10/29/2012	53	0	$200,000.00*
Susquehanna County (Entire County)	02/25/2019	50	0	$0.00*
		Totals:	0	$515,000.00*
Source: NOAA NCEI, 2023 Estimated Values are marked*				

4.3.12.4. Future Occurrence

In the United States, tornado activity has increased in variability, with a general decrease in the number of days a year on which activity occurs, but an increase in the number of tornadoes on those days. This indicates an increase in tornado outbreaks. The future probability of a disastrous tornado occurring in Susquehanna County is ranked as possible, but not highly likely. While the chance of being hit by a tornado in Susquehanna County is small, the damage that results when the tornado arrives can be devastating. An EF-5 tornado, with a 13% annual probability of occurring, can carry wind velocities of 200 mph, resulting in a force of more than 100 pounds per square foot of surface area. This is a “wind load” that exceeds the design limits of most buildings in Pennsylvania. As jurisdictions within the county grow, and as residential and commercial construction continues, the number of people and properties will be greatly affected by tornadoes and windstorms as they increase accordingly.

Based on historic patterns, tornadoes are unlikely to remain on the ground for long distances, especially in areas of the country with hilly terrain, such as the majority of Pennsylvania. However, the high historical number of windstorms with winds at or over 50 knots indicates that the annual chance of a windstorm in the county is uniquely high. The annual tornado seasoning has begun to lengthen, with the season starting earlier than it has historically and ending later. Pennsylvania had, for example, a record number of tornadoes in April and May of 2019 compared to any other April and May on record. Climate change is causing temperatures and air moisture to increase, increasing the frequency and intensity of tornadoes and windstorms. There remains some uncertainty regarding the recurrence of tornadoes. Therefore, the number of future tornadoes and windstorm events could potentially increase due to known and unknown factors.

Based on historical incidents, there are three zones in Pennsylvania that can either experience less than one, one to four, or five to ten of EF-2 or above tornadoes per 3,700 square miles. Communities in Susquehanna County, as shown in *Figure X – Tornado Activity in Susquehanna County* below, are expected to have one to two tornadoes every three years as a future occurrence. The approximation of one to four tornadoes annually assists with determining the rate of future tornado occurrences within Susquehanna County. Future tornadoes will be similar to those that affected the county in past events.

Windstorm events occur on a more frequent basis compared to tornadoes. Susquehanna County, specifically, experiences windstorm events more commonly than tornadoes, which causes power failure, loss of communication networks, and residents requiring temporary shelters and provision of supplies. Therefore, unlike tornadoes, this hazardous event has a highly likely probability for future events to occur within the county.

4.3.12.5. Vulnerability Assessment

The frequency of windstorms and minor tornadoes is expected to remain relatively constant, vulnerability increases in more densely developed areas. Factors that impact the amount of damage caused by a tornado include 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 tornadoes make them one of the most destructive natural hazards. There can be many cascading impacts of tornadoes and windstorms including, but not limited to, 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 during such events.

Additional dangers that accompany tornado-associated thunderstorms, and which increase the vulnerability of Susquehanna County, include:

- Flash floods – 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 can cause several million in damages annually to property and crops

The economy of Susquehanna County is highly vulnerable to tornadoes. While there may be severe impact on financial and commercial systems of the economy, these storms, and the damage they cause, can disrupt business long-term. The local economy is vulnerable due to the possibility of being crippled by tornadoes and windstorms and their cascading effects when buildings and supporting infrastructure are destroyed in a storm. Power outages can create work

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

Susquehanna County's environment is also vulnerable to tornado events. However, since tornado events are typically localized, environmental impacts are rarely widespread. The impact of windstorms on the environment typically takes place over a large area. In either case, where these events occur, severe damage to plant species is likely. This includes uprooting or total destruction of trees and an increased threat of wildfire in areas where dead trees are not removed. Most notably, hazardous material spills can pollute ground water systems and vegetation. In the case of hazardous material spills, the local environment can be negatively impact and can cause extensive cleanup and mitigation efforts. Susquehanna County is considered a rural county that has a great amount of tourism which occurs in the surrounding hills, mountains, and state parks. Not only is the environment at risk to tornadoes and windstorms, but hikers, tourists, and hunters are also at risk when out in the environment. Consequently, in the event of a tornado or severe storm, these tourists have limited emergency notification measures which result in high vulnerability. A storm has the ability, potentially, to destroy structures, damage private and public property, and injure citizens and tourists to the area. People with disabilities, the elderly, functional needs, and non-English speaking residents are more vulnerable to tornadoes, windstorms, and their cascading effects. Without assistance to evacuate and/or seek shelter, and with potential difficulty understanding information, these at-risk populations may be unable to prepare themselves, or their homes and other possessions, to safely endure the storm.

Tornado, windstorm, and cascading events may affect a small portion, or the entirety, of the county. Therefore, it is important to identify specific critical facilities and assets that are most vulnerable to this hazard. Critical facilities are highly vulnerable to windstorms and tornado events. While many severe storms can cause exterior damage to structures, tornadoes can destroy structures, along with their surrounding infrastructure, immediately halting their function. Tornadoes are often accompanied by severe storms which can be threatening to critical facilities within the county. Many secondary effects from these disasters can jeopardize the operation of these critical facilities as well. Critical facilities are particularly vulnerable to power outages which can leave facilities functionless, potentially crippling infrastructure supporting the population of the county. Due to Pennsylvania Uniform Construction Code Act 45, trailers and mobile homes built before 2004, because of their lightweight construction and often unanchored design, are more vulnerable to high winds/tornadoes and will generally sustain more damage than will mobile homes built after 2004.

The below table illustrates which municipalities have previously been impacted by tornado events, and what specific community lifelines are at increased vulnerability to tornados, being located in previously impacted areas.

Number of Community Lifelines in Previously Tornado Impacted Municipalities		
Municipality	**Number of Community Lifelines**	**Facility Type**
Apolacon Township	0	N/A
Ararat Township	0	N/A
Auburn Township	5	4 Utility Electric Substations 1 Utility Power Plant
Bridgewater Township	6	1 Assistance Resource 1 Grocery Store 1 Hospital/Clinic 2 Nurisng Homes 1 Utility Electric Substation
Clifford Township	3	1 Fire Department 2 Utility Electric Substation
Dimock Township	1	1 Fire Department
Harmony Township	0	N/A
Herrick Township	1	1 Utility Electric Substation
Jessup Township	1	1 Grocery Store
Lenox Township	2	1 Utility Electric Substation 1 Utility Power Plant
Little Meadows Borough	1	1 Fire Department
Montrose Borough	9	2 Assistance Resource 1 EMS Department 1 Fire Department 2 Grocery Stores 1 Hospital/Clinic 1 Police Department 1 Utility Electric Substation
Rush Township	1	1 Fire Department
Springville Borough	1	1 Fire Department
Union Dale Borough	1	1 Fire Department
Source: PASDA, 2023, FEMA, 2023, Susquehanna County, 2023		

Figure 33-Pennsylvania Wind Zones Cont'd

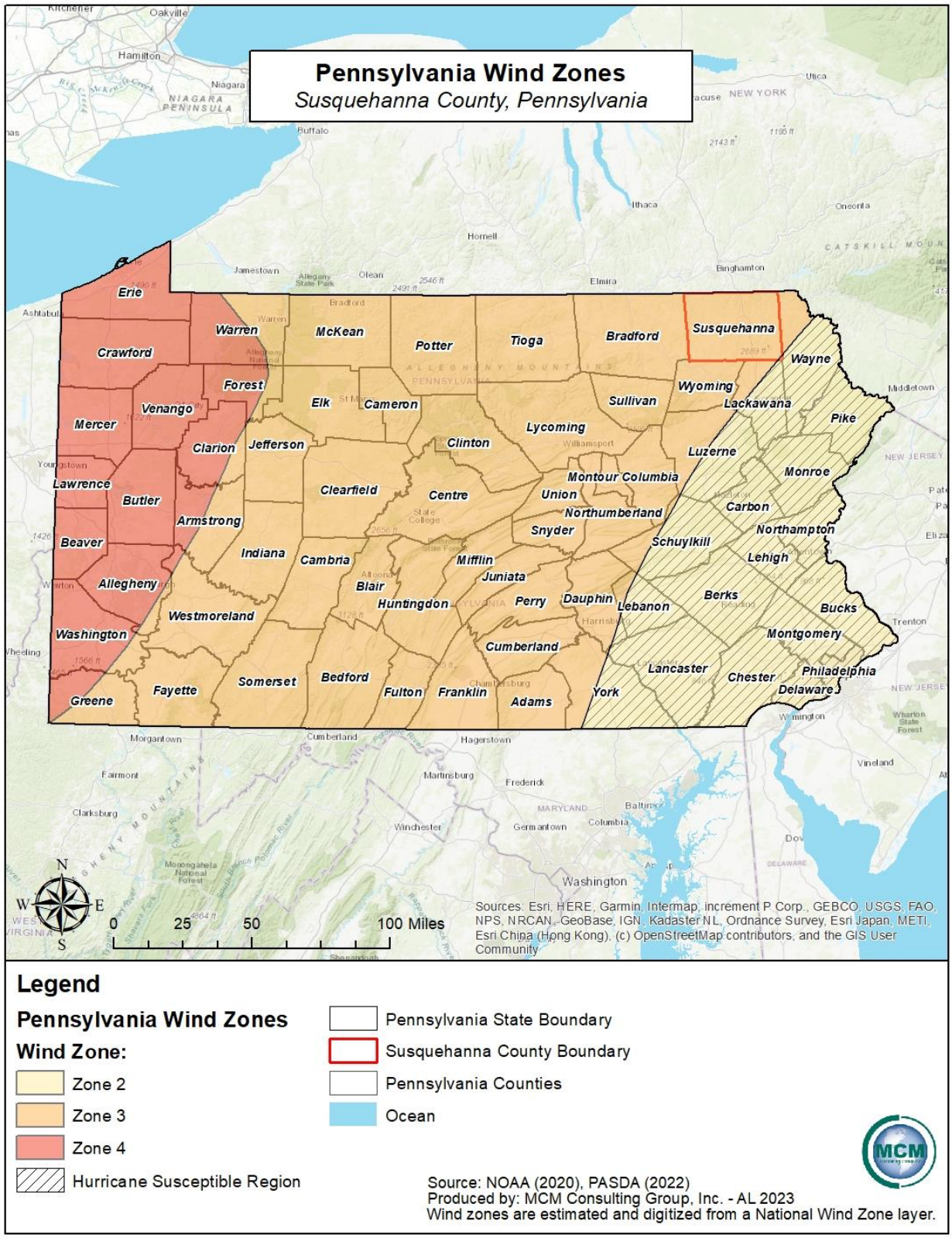


Figure 34-Past Tornado Occurrences in Susquehanna County

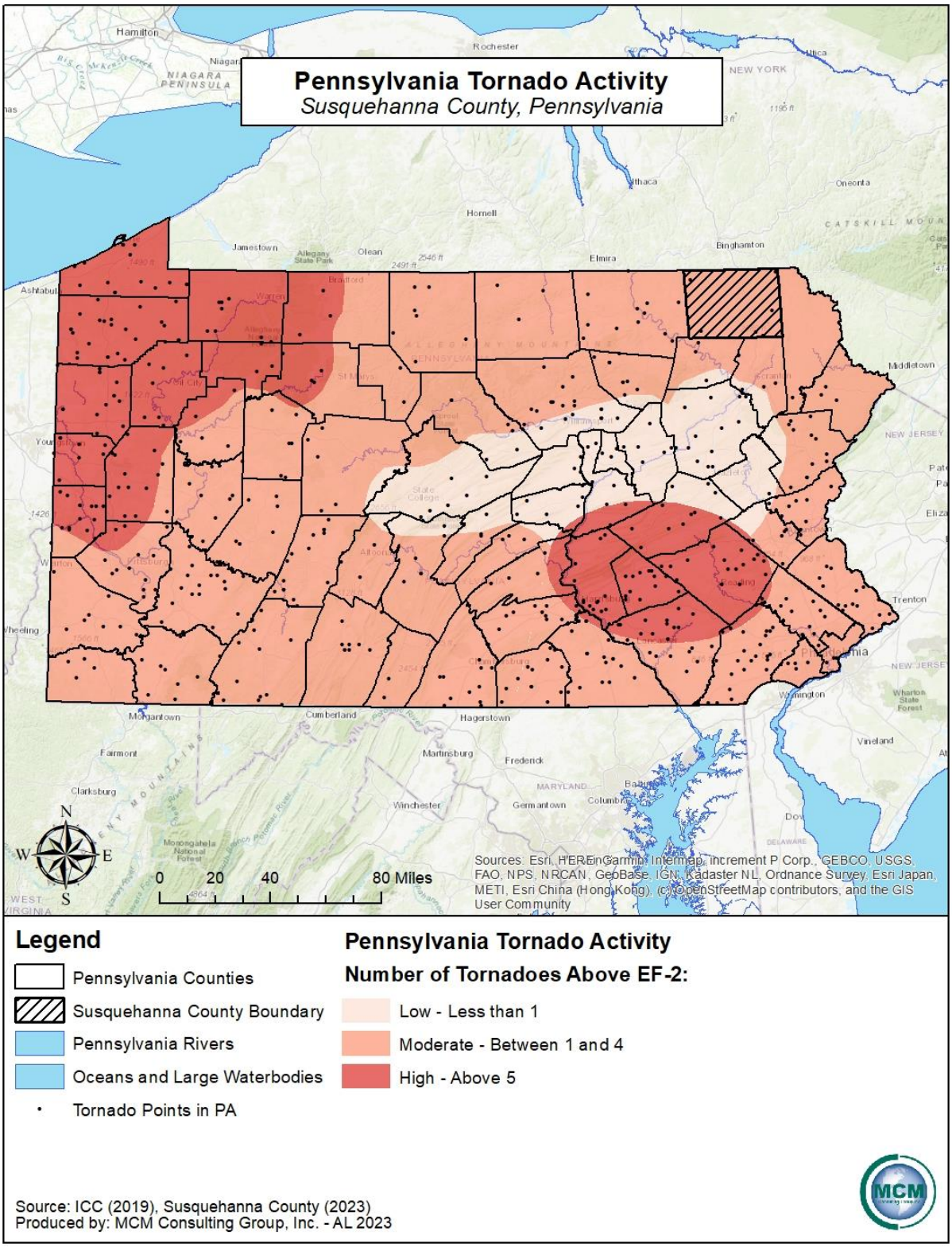
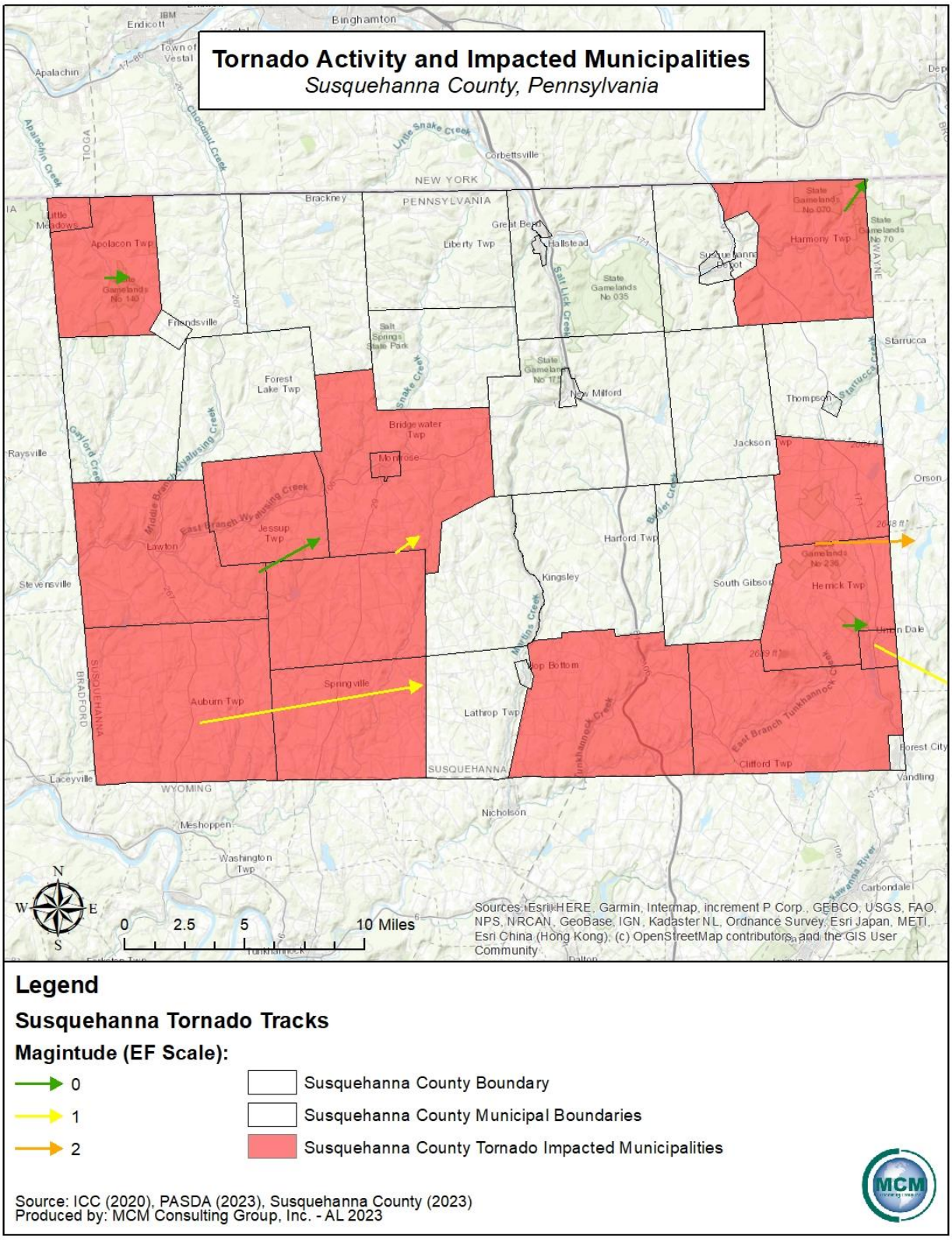


Figure 35-Tornado Activity in Susquehanna County



4.3.13. Wildfire

4.3.13.1. Location and Extent

The most prevalent causes of devastating wildfires are droughts, lighting strikes, arson, human carelessness, and in rare circumstances, spontaneous combustion. Most fires in Pennsylvania are caused by anthropogenic fires such as debris burns that spread and 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 and 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 vegetation and combustible fuels. Wildfires are most prevalent under prolonged dry and hot spells, or general drought conditions.

A large portion of Susquehanna County is covered by either farmland or forested areas, increasing the geographic extent of wildfire vulnerability in the county. Under dry conditions or droughts, wildfires have the potential to burn forests as well as croplands. For recreational enjoyment, the county boasts several local parks and natural areas that include a series of trail systems – all of which are at risk for wildfires.

4.3.13.2. 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 including power outages may result. Other negative impacts of wildfires can include death of people, livestock, fish, and wildlife, and destruction of 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.

Almost all of the wildfires in the county occur in remote areas or areas away from residential structures. Unlike the wildland fires that occur in other parts of the country and affect vast areas of land and residential communities, most fires in Susquehanna County are contained before they cause damage or extensive property loss. However, the county recognizes that wildfires of some magnitude will continue to occur in Susquehanna County and will have more detrimental effects if development in and/or around the natural areas increases.

The United States Forest Service utilizes the Forest Fire Assessment System to classify the dangers of wildfire. *Table 48 – Wildland Fire Assessment System* identifies each threat classification and provides a description of the level.

Table 48-Wildland Fire Assessment System

Wildland Fire Assessment System	
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.
Source: U.S. Forest Service	

4.3.13.3. Past Occurrence

The Pennsylvania Department of Conservation and Natural Resources (DCNR) has an extensive history of reported wildfires in its state forestry system and districts. Historically, Susquehanna County experiences fires annually with all fires being relatively small. However, due to the many acres of farmland, forested areas, and open space in the county, under the right conditions the potential exists for a significant wildfire. Susquehanna County lies entirely in District 11 of the

DCNR's Bureau of Forestry. This district encompasses Lackawanna, Luzerne, Susquehanna, Wayne, and Wyoming counties. In 2021, there were a total of 227 wildfires in District 11 that were responsible for destroying 212.6 acres.

District 11 reports the following twenty-two year wildfire summary based on observed and reported wildfires. *Table 49 – Annual Summary of Wildfire Events* illustrates the number of acres burned in a certain number of fires for District 11 from the year 2000 to the year 2021. There were a total of 1,777 wildfires in District 11 in the twenty-two year period.

Table 49-Annual Summary of Wildfire Events

Annual Summary of Wildfire Events			
Year	**Number of Fires**	**Acres**	**Increase or Decrease**
2000	38	258.1	-
2001	62	237.3	⇧
2002	33	138.8	⇩
2003	46	122.2	⇧
2004	12	106.6	⇩
2005	83	730.3	⇧
2006	73	580.3	⇩
2007	29	121.2	⇩
2008	53	257.3	⇧
2009	47	2,640.6	⇩
2010	64	1,401.4	⇧
2011	16	130.9	⇩
2012	82	389.3	⇧
2013	80	274	⇩
2014	103	842.7	⇧
2015	140	518	⇧
2016	102	411.8	⇩
2017	48	307.4	⇩
2018	76	126.4	⇧
2019	42	85.5	⇩
2020	321	368.5	⇧
2021	227	212.6	⇩
Totals:	**1,777**	**10,261.2**	**⇧ 10 ⇩ 11**
Source: DCNR, 2021			

In recent years, the number of prescribed burns in Pennsylvania has been increasing. This corresponds to an understanding of the need for fire in many natural ecosystems and management strategies for reducing vulnerability to wildfire; it also improves hunting opportunities. The Pennsylvania Game Commission is responsible for a large number of prescribed burns that occur on state game lands and these burns typically occur in March, April, May, and November. These time frames are chosen because grasses are typically dormant, and

leaves are not typically on trees fully. Sunlight is also bountiful in these months to dry the floor of the burn area.

4.3.13.4. Future Occurrence

Annual occurrence of urban fires and wildfires in Susquehanna County are expected. Urban fires are most often the result of human errors, outdated wiring and occasionally, malintent (arson). The occurrence of large scale and intense 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 drought conditions, wildfire caution should be heightened. Any fire without the quick response or attention of firefighters, forestry personnel, or visitors to the forest, has the potential to become a wildfire.

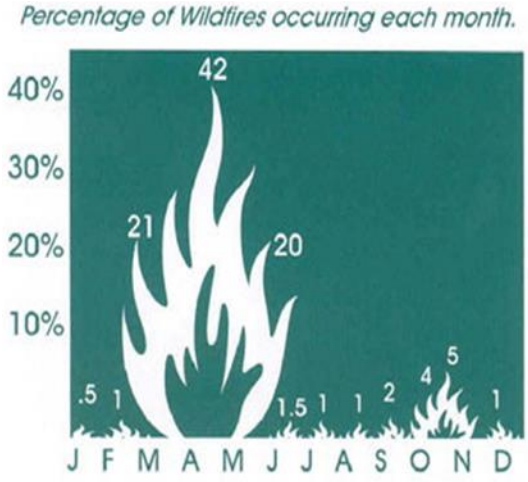
Climate change is expected to bring an elongated wildfire season and more intense and long-burning fires (Pechony & Shindell, 2010). In some regions of the United States, this is a very real concern. Northern California has experienced unprecedented devastating wildfires in 2017, 2018, 2019, 2020, 2021, and 2022. The fires that have been occurring in California are thought to be burning faster and hotter due to worsening drought conditions caused by increased climate change (Cvijanovic et al., 2017). Wildfire conditions in Pennsylvania are not nearly as severe as in Northern California, but the intensification is a signal that the changes brought by climate change are relevant to wildfires. In Pennsylvania, higher air temperatures and earlier warming in the spring are expected to continue, resulting in more wildfire prone conditions in the summer and fall (Shortle et al., 2015).

4.3.13.5. 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. The highest risk for wildfires in Pennsylvania occurs during the spring (March to May) and the fall (October to November) months and 99% of all wildfires in Pennsylvania are caused by people. Approximately 83% of all Pennsylvania wildfires occur in the months outlined above. 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 is fuel for fires. *Figure 36 – Seasonal Wildfire Percentage* shows the wildfire percentage occurrence during each month in Pennsylvania.

Firefighters and other first responders can encounter life-threatening situations due to forest and wildfires. Traffic accidents during a response and the impacts of fighting the fire once on scene are examples of first responder vulnerabilities.

Figure 36-Seasonal Wildfire Percentage



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 related housing density and vegetative density. The dataset provides a way to identify locations where larger numbers of people 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 refers to areas where housing and wildland vegetation intermingle, and interface refers to areas where housing is in the vicinity of a large area of dense wildland vegetation. The WUI was the fastest-growing land use type in the United States between 1990 and 2010. Factors behind the growth include population shifts, expansion of cities into the wildlands, and the expansion of new vegetation growth. The primary cause has been the migration of people, not vegetation growth. Pennsylvania is among the states with the largest WUI and the most housing units in a WUI designated area. Pennsylvanians desire the proximity of natural beauty in their daily lives, and the growth in WUI housing noted above illustrates this. *Figure 37 – Wildland Urban Interface* shows the extent of Susquehanna County and the community lifeline and critical infrastructure facilities, functional needs facilities, and fire stations. Wildfire hazard is defined by conditions that affect wildfire ignition and/or behavior such as fuel, topography, and local weather. The many addressable structures in the Wildland Urban Interface and Intermix zones are equally distributed around the county. The amount of agricultural exposure from a wildfire event would be substantial for Susquehanna County. *Figure 39 – Susquehanna County Wildfire Agriculture Exposure* shows the extent of agriculture exposure from a wildfire event by economic impact.

There are twenty-two fire departments that serve Susquehanna County, a list of which can be seen in *Table 58* of the emergency services profile. Each fire department conducts its own schedule of in-house training sessions for its members.

The response of firefighters is integral to the containment of wildfires in the county. There is a potential for fire stations and services to close, which affects response to a wildfire in Susquehanna County**.** *Figure 38 – Fire Stations Locations* illustrates the position of fire stations and the location of state game lands, state forests, and natural areas within Susquehanna County. It is recommended that each municipality assess vulnerabilities to department closures by building a relationship with their local providers and planning accordingly for if a local service were to close.

At the time of the writing of this plan, it is possible that the continuing emergency services shortages across the Commonwealth of Pennsylvania will impact the availability of firefighters and their response times. Many fire departments have created and begun to enforce new regulations regarding responding to emergencies during the pandemic.

Figure 37-Wildland Urban Interface

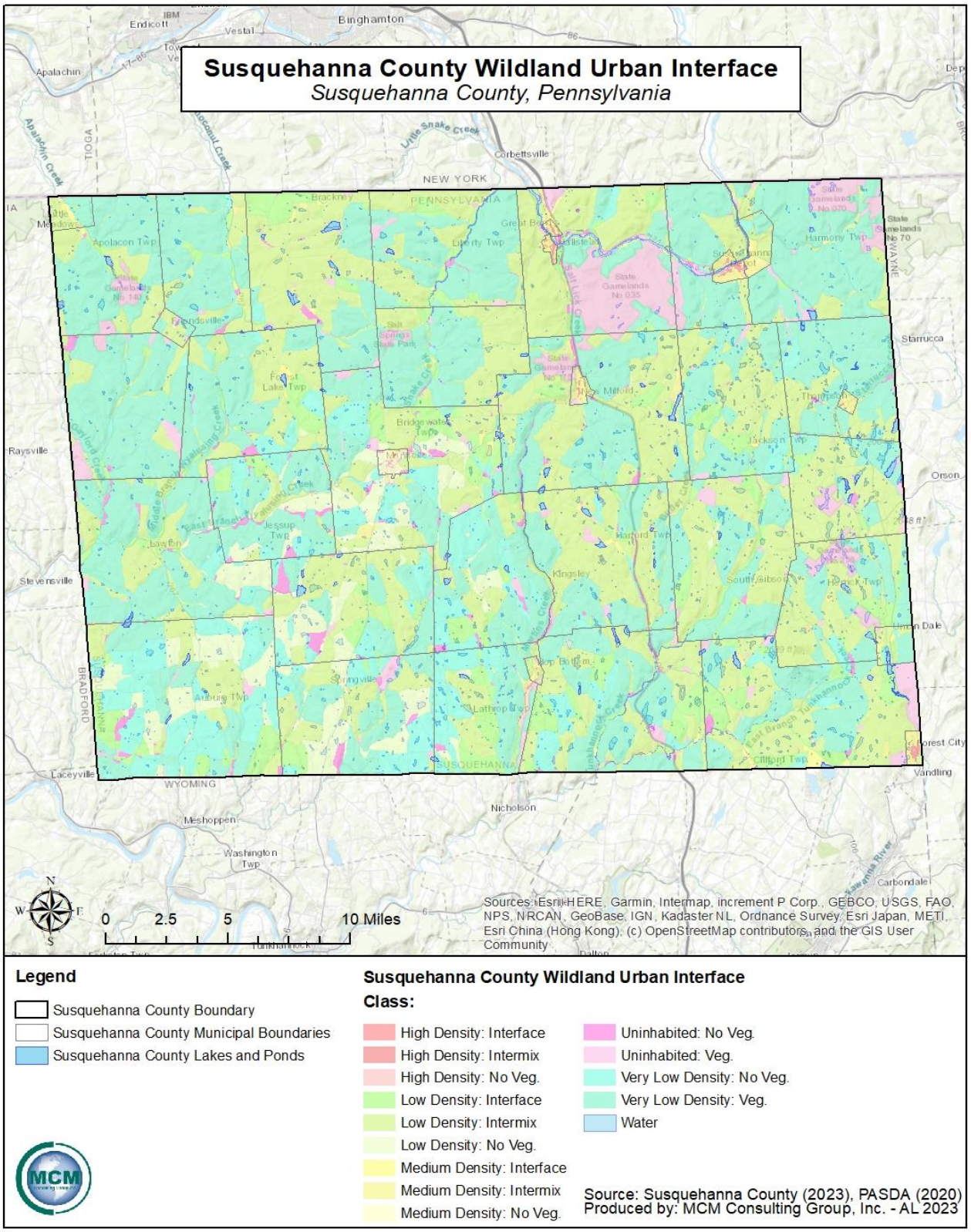


Figure 38- Fire Stations Locations

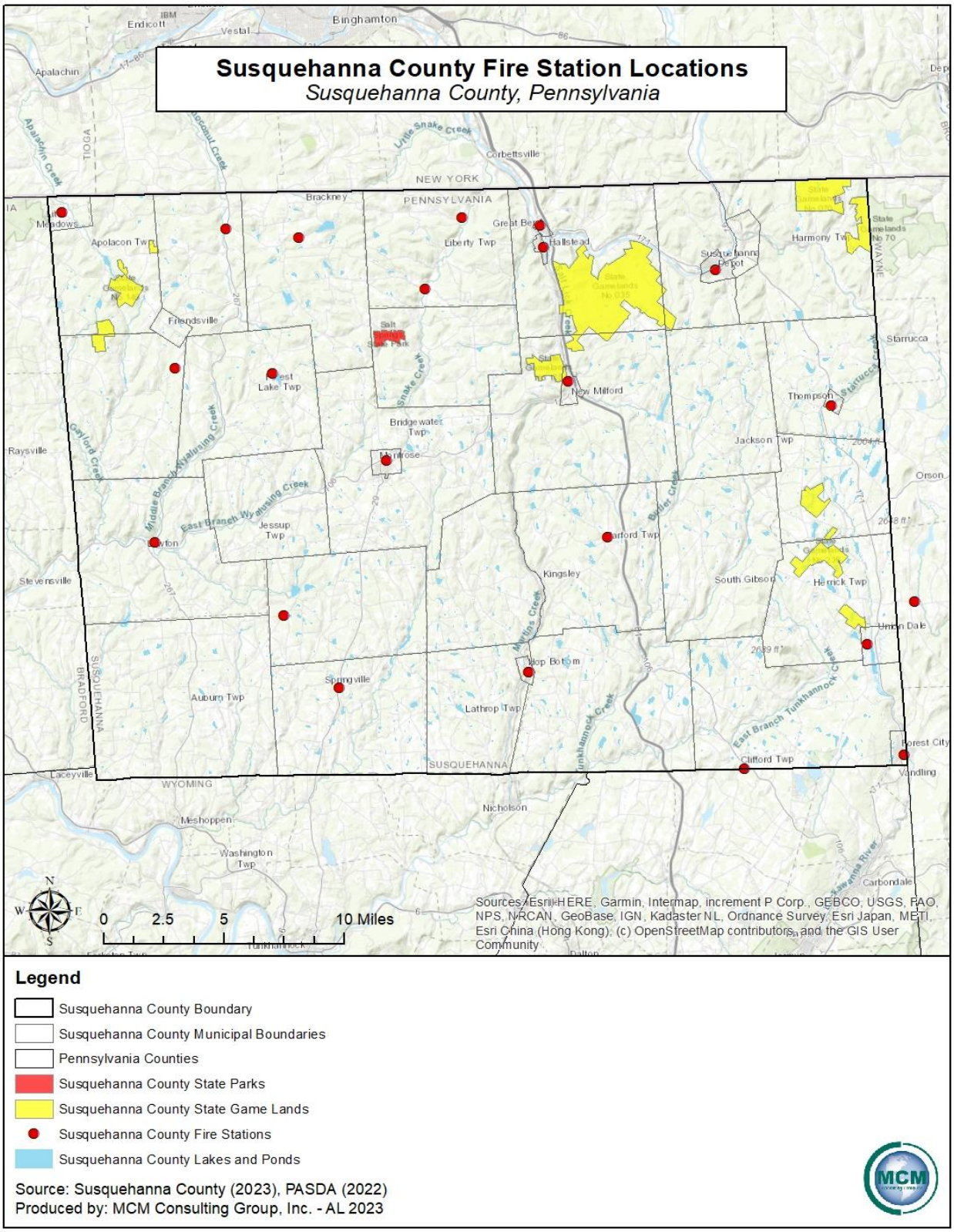
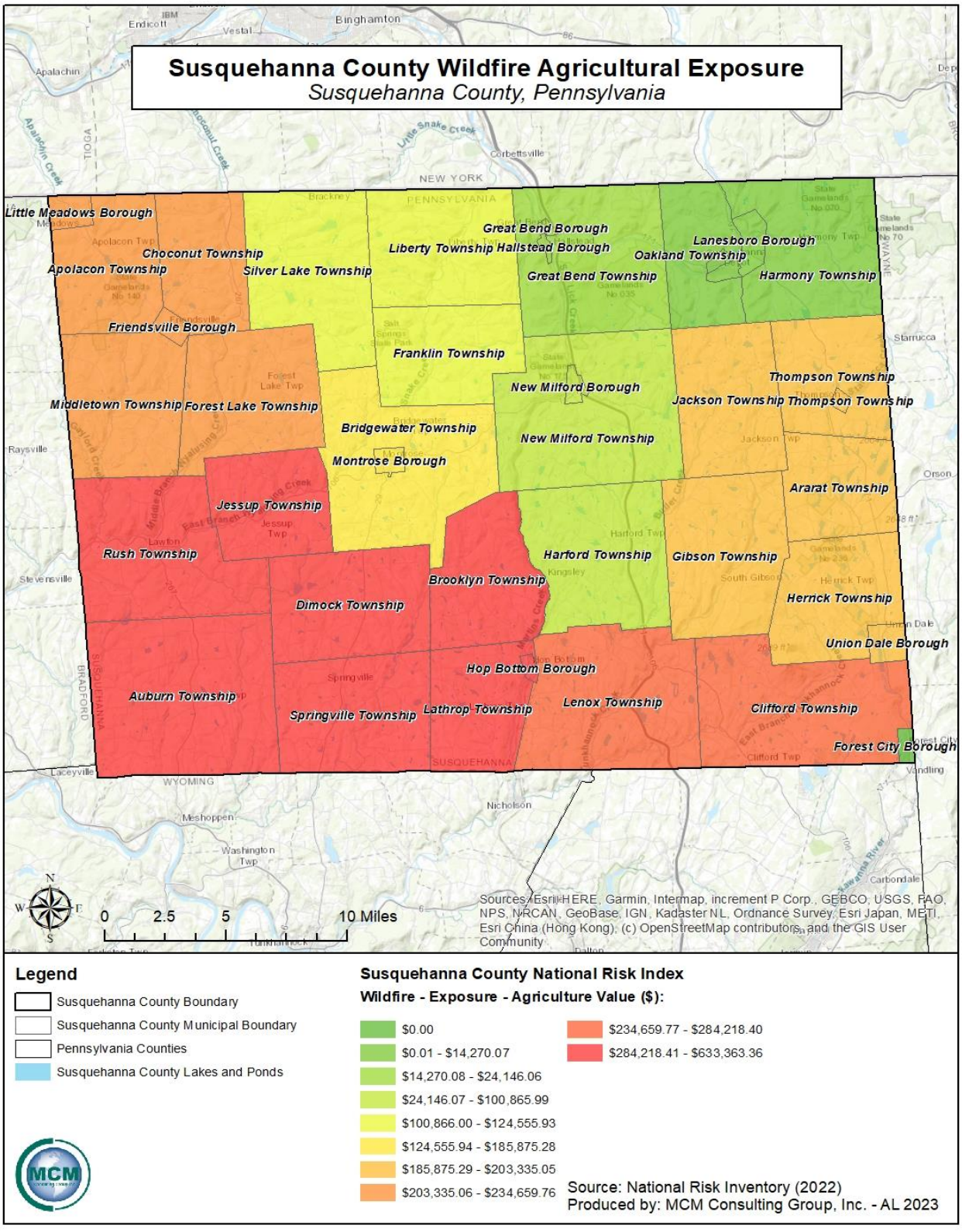


Figure 39-Susquehanna County Wildfire Agriculture Exposure



4.3.14. Winter Storm

4.3.14.1. Location and Extent

Most severe winter storm hazards include heavy snow (snowstorms), blizzards, sleet, freezing rain, and ice storms. Since most extra-tropical cyclones (mid-Atlantic cyclones locally known as Northeasters or Nor'easters), generally take place during the winter weather months, these hazards have also been grouped as a type of severe winter weather storm. According to the Pennsylvania State Hazard Mitigation Plan (PA HMP), winter storms are frequent events for the Commonwealth and occur from late October until mid-April. These types of winter events or conditions are further defined below.

- **Heavy Snow:** According to the National Weather Service (NWS), heavy snow is generally snowfall accumulating to four inches or more in depth in twelve hours or less; or snowfall accumulating to six inches or more in depth in twenty-four hours or less. A snow squall is an intense but limited duration, period of moderate to heavy snowfall, also known as a snowstorm, accompanied by strong, gusty surface winds and possibly lightning.
- **Blizzard:** Blizzards are characterized by low temperatures, wind gusts of thirty-five miles per hour (mph) or more and falling and/or blowing snow that reduces visibility to 1/4-mile or less for an extended period of time (three or more hours).
- **Sleet of Freezing Rainstorm:** Sleet is defined as pellets of ice composed of frozen or mostly frozen raindrops or refrozen partially melted snowflakes. These pellets of ice usually bounce after hitting the ground and other hard surfaces. Freezing rain is rain that falls as a liquid but freezes into glaze upon contact with the ground.
- **Ice Storm:** An ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous and can create extreme hazards to motorists and pedestrians.
- **Extra-Tropical Cyclone:** Sometimes called mid-latitude cyclones, are a group of cyclones defined as synoptic scale, low pressure, weather systems that occur in the middle latitudes of the Earth. These storms have neither tropical nor polar characteristics and are connected with fronts and horizontal gradients in temperature and dew point otherwise known as "baroclinic zones". Extra-tropical cyclones are everyday weather phenomena which, along with anticyclones, drive the weather over much of the Earth. These cyclones produce impacts ranging from cloudiness and mild showers to heavy gales and thunderstorms. Tropical cyclones often transform into extra-tropical cyclones at the end of their tropical existence, usually between 30˚ and 40˚ latitude, where there is insufficient force from upper-level shortwave troughs riding the westerlies (weather

systems moving west to east) for the process of extra-tropical transition to begin. A shortwave trough is a disturbance in the mid or upper part of the atmosphere which induces upward motion ahead of it. During an extra-tropical transition, a cyclone begins to tilt back into the colder air mass with height, and the cyclone's primary energy source converts from the release of latent heat from condensation to baroclinic processes.

4.3.14.2. Range of Magnitude

The magnitude or severity of a severe winter storm depends on several factors including a region's susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, and time of occurrence during the day (e.g., weekday versus weekend), and time of season. The extent of a severe winter storm can be classified by meteorological measurements, such as those above, and by evaluating its societal impacts.

The Northeast Snowfall Impact Scale (NESIS) categorizes snowstorms in this manner. Unlike the Fujita Scale (tornado) and Saffir Simpson Scale (hurricanes), there is no widely used scale to classify snowstorms. NESIS was developed by Paul Kocin of The Weather Channel and Louis Uccellini of the National Weather Service and rank high impact, northeast snowstorms. These storms have large areas of ten-inch snowfall accumulations and greater. NESIS has five ranking categories: Notable (1), Significant (2), Major (3), Crippling (4), and Extreme (5). These ranking can be seen in *Table 50 – NESIS Winter Storm Rankings*. The index differs from other meteorological indices in that it uses population information in addition to meteorological measurements. Thus, NESIS gives an indication of a storm's societal impacts. This scale was developed because of the impact of northeast snowstorms can have on the rest of the country in terms of transportation and economic impact.

Table 50-NESIS Winter Storm Rankings

NESIS Winter Storm Rankings			
Category	**Description**	**NESIS Range**	**Definition**
1	Notable	1.0 – 2.49	These storms are notable for their large areas of 4-inch accumulations and small areas of 10-inch snowfall.
2	Significant	2.5 – 3.99	Includes storms that produce significant areas of greater than 10-inch snows while some include small areas of 20-inch snowfalls. A few cases may even include relatively small areas of very heavy snowfall accumulations (greater than 30 inches).
3	Major	4.0 – 5.99	This category encompasses the typical major Northeast snowstorm, with large areas of 10-inch snows (generally between 50 and 150 x 103 mi^2 –

NESIS Winter Storm Rankings			
Category	**Description**	**NESIS Range**	**Definition**
			roughly one to three times the size of New York State with significant areas of 20-inch accumulations.
4	Crippling	6.0 – 9.99	These storms consist of some of the most widespread, heavy snows of the sample and can be best described as crippling to the northeast U.S, with the impact to transportation and the economy felt throughout the United States. These storms encompass huge areas of 10-inch snowfalls, and each case is marked by large areas of 20-inch and greater snowfall.
5	Extreme	10+	The storms represent those with the most extreme snowfall distributions, blanketing large areas and populations with snowfalls greater than 10, 20, and 30 inches. These are only storms in which the 10-inch accumulations exceed 200 X 103 mi^2 and affect more than 60 million people.
Source: Kocin and Uccellini, 2004			

The climate of Pennsylvania is marked by abundant snowfall. Winter weather can reach Pennsylvania as early as October and is usually in full force by late November with average winter temperatures between 20- and 40-degrees Fahrenheit. Susquehanna County receives an average of between 54" and 84" of snowfall a year. Most areas of Susquehanna County experience the effects of winter storms frequently. The general indication of the average annual snowfall map shows areas that are subject to a consistent risk for large quantities of snow. *Figure 40 - Pennsylvania Annual Snowfall 1981 – 2010* illustrates the long-term trends for snowfall accumulation in Pennsylvania over three decades.

4.3.14.3. Past Occurrence

Figure 41 – Winter Storm Events by County in Pennsylvania shows the number of winter storm events from 1950 – 2013 for the Commonwealth of Pennsylvania. Susquehanna County had between forty-eight and fifty-eight such events. *Table 51 – Recent Annual Snowfall Estimates* shows recent annual snowfall measurements as stated by NOAA. Susquehanna County has experienced over 20 inches of snow annually on eleven occasions. Overall, Susquehanna County has experienced an moderately steady snow totals over the twenty-four year period. On average, the annual snowfall totals have varied in the time periods from 2018 to 2023. There were eleven instances of increases in snow from previous years.

Table 51-Recent Annual Snowfall Estimates

Recent Annual Snowfall Estimates		
Time Span	**Snowfall Estimates (inches)**	**Increase or Decrease**
1999-2000	21.53	-
2000-2001	19.53	⇩
2001-2002	14.80	⇩
2002-2003	27.53	⇧
2003-2004	27.93	⇧
2004-2005	26.13	⇩
2005-2006	15.47	⇩
2006-2007	13.77	⇩
2007-2008	18.93	⇧
2008-2009	18.67	⇩
2009-2010	25.23	⇧
2010-2011	29.47	⇧
2011-2012	11.97	⇩
2012-2013	16.40	⇧
2013-2014	24.77	⇧
2014-2015	20.70	⇩
2015-2016	6.87	⇩
2016-2017	21.63	⇧
2017-2018	15.43	⇩
2018-2019	15.33	⇩
2019-2020	19.33	⇧
2020-2021	31.43	⇧
2021-2022	13.10	⇩
2022-2023	20.40	⇧
Source: NOAA, 2023		

4.3.14.4. Future Occurrence

Winter storm hazards in Pennsylvania are guaranteed yearly since the state is located at a relatively high latitudes resulting in winter temperatures that range between 0- and 32-degrees Fahrenheit for a good deal of the fall through early spring season (later October until mid-April). In addition, the state is exposed to large quantities of moisture from both the Great Lakes and the Atlantic Ocean. While it is almost certain that a number of significant winter storms will occur during the winter and fall season, what is not easily determined is how many such storms will occur during that time frame. Based on historical snow related disaster declaration occurrences, the Commonwealth of Pennsylvania can expect a snowstorm of disaster declaration proportions, on average, once every three to five years. Similarly, for ice storms, based on historical disaster

declarations, it is expected that on average, ice storms of disaster proportions will occur once every seven to ten years within the state.

4.3.14.5. Vulnerability Assessment

Severe winter storms are of significant concern to Susquehanna County because of their frequency and magnitude in the region. Additionally, they are of significant concern due to the direct and indirect costs associated with these events; delays caused by the storms and impacts on the people and facilities of the region related to snow and ice removal, health problems, cascade effects such as utility failure and traffic accidents, and stress on community resources.

Every year, winter weather indirectly and deceptively kills hundreds of people in the United States, primarily from automobile accidents, over exertion, and exposure. Winter storms are often accompanied by strong winds creating blizzard conditions with blinding win-drive snow, drifting snow, extreme cold temperatures, and dangerous wind chill. They are considered deceptive killers because most deaths and other impacts or losses are indirectly related to the storm. Heavy accumulations of ice can bring down trees and powerlines, disabling electrical power and communications for days or weeks. Heavy snow can immobilize a region and paralyze a city, shutting down all air and rail transportation and disrupting medical and emergency services. The economic impact of winter weather each year is quite large, with costs for snow removal, damage, and loss of business in the millions each year. Heavy snow can immobilize and strand commuters as well as stopping the flow of supplies through an area or transportation corridor. In rural areas, homes and farms may be isolated for days and unprotected livestock may be lost. Bridge and overpasses are particularly dangerous because they freeze before other transportation surfaces. For the purposes of this Hazard Mitigation Plan, the entire population of Susquehanna County (38,434) is exposed to severe winter storm events. The elderly are considered the most susceptible to this hazard due to their increased risk of injury and death from falls, overexertion, and or attempts to clear ice and snow. The elderly population is also more vulnerable to utility outages in winter, especially when they are paired with winter storm events. *Table 52 – Utility Outages in Susquehanna County in Winter* shows the number of power outages, phone outages, and 911 outages, that have occurred in the county during winter months from 2018 to 2023. To see a more detailed discussion on utility interruptions, please see the utility interruption hazard profile in Section 4.3. Vulnerable populations within Susquehanna County may not have access to housing or their housing may be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply). The unsheltered populations of an area are at most risk to winter storm events.

During winter storms in Susquehanna County, the unsheltered population my face severe challenges. Bitter cold temperatures, snow accumulation, and icy conditions exacerbate their vulnerability, as they lack proper shelter and resources. Exposure to the elements increases the risk of hypothermia, frostbite, and other health issues. Limited access to warm clothing, food,

and hygiene facilities further compounds their struggles. Addressing the unique needs of the unsheltered during winter storms is crucial for ensuring their safety and well-being in Susquehanna County. During the writing of this plan, statistics for unsheltered populations were not readily available for each municipality within Susquehanna County. Due to the ruralness of Susquehanna County there are no homeless shelters currently within the county boundary but neighboring counties have homeless shelters to accommodate individuals in need. Currently two homeless shelters are in Scranton, Pennsylvania and two are close to the New York and Pennsylvania border in Binghamton, New York. The table below illustrates the number of persons per municipality who are 65 years or older and the percentage of those individuals per municipality.

Vulnerable Populations per Municipality in Susquehanna County		
Municipality	**Number of People 65 years or older**	**Percent of Population (%)**
Apolacon Township	109	29.9
Ararat Township	128	26.3
Auburn Township	423	28.7
Bridgewater Township	717	27.3
Brooklyn Township	268	35.5
Choconut Township	192	29.6
Clifford Township	649	26.4
Dimock Township	171	13.8
Forest City Borough	466	28.9
Forest Lake Township	265	23.3
Franklin Township	154	22.5
Friendsville Borough	25	15.2
Gibson Township	229	18.3
Great Bend Borough	175	26.0
Great Bend Township	406	28.5
Hallstead Borough	216	16.1
Harford Township	303	20.5
Harmony Township	99	28.2
Herrick Township	195	35.2
Hop Bottom Borough	68	22.9
Jackson Township	233	27.3
Jessup Township	119	29.8
Lanesboro Borough	170	28.7
Lathrop Township	164	21.3

Vulnerable Populations per Municipality in Susquehanna County		
Municipality	**Number of People 65 years or older**	**Percent of Population (%)**
Lenox Township	490	30.7
Liberty Township	271	23.8
Little Meadows Borough	49	23.8
Middletown Township	78	31.0
Montrose Borough	319	22.9
New Milford Borough	124	18.3
New Milford Township	456	27.2
Oakland Borough	83	15.5
Oakland Township	87	15.0
Rush Township	264	21.1
Silver Lake Township	380	21.5
Springville Township	392	24.6
Susquehanna Depot Borough	200	14.3
Thompson Borough	29	10.0
Thompson Township	102	27.0
Union Dale Borough	49	30.6
Total:	**9,317**	**-**

Table 52-Utility Outages in Susquehanna County in Winter

Utility Outages in Susquehanna County in Winter		
Location	**Date**	**Event**
Susquehanna County (Entire County)	03/02/2018	Power Outage
Susquehanna County (Entire County)	08/14/2018	Power Outage
Susquehanna County (Entire County)	01/01/2021	Power Outage
Susquehanna County (Entire County)	12/11/2021	Power Outage
Susquehanna County (Entire County)	03/07/2022	Power Outage
Susquehanna County (Entire County)	12/15/2022	Power Outage

The entire general building stock inventory in Susquehanna County is exposed and vulnerable to the severe winter storm hazard. In general, structural impacts include damage to rood and building frames, rather than building content. There was no historical information available that identified property damages within Susquehanna County due to a single severe winter storm event. Current modeling tools are not available to estimate specific losses for this hazard. A specific area that is vulnerable to the severe winter storm hazard is the floodplain. At risk general building stock and infrastructure in floodplains are presented in the flood profile due to snow and

ice melt. Generally, losses from flooding associated with severe winter storms should be less than that associated with a 100-year or 500-year flood.

Full functionality of critical facilities such as police, fire, and medical facilities is essential for response during and after a severe winter storm event. These critical facility structures are largely constructed of concrete and masonry; therefore, they should only suffer minimal structural damage from severe winter storm events. Backup power is recommended critical infrastructure and facilities due to the potential for power interruption. Infrastructure at risk for this hazard includes roadways that could be damaged due to the application of salt and intermittent freezing and warming conditions that can damage roads over time. Severe snowfall requires infrastructure to clear roadways and alert citizens to dangerous conditions. In spring, this type of roadway damage must be repaired. Additionally, freezing rain and ice storms impact utilities (i.e., power lines and overhead utility wires) causing power outages for hundreds to thousands of residents.

The cost of snow and ice removal and repair of roads from the freeze/thaw process can drain local financial resources. However, because severe winter storms are a regular occurrence in this area, Susquehanna County is generally well-prepared for snow and ice removal each season.

Winter storm vulnerability has the potential to increase in Susquehanna County due to climate change. As mentioned above in Section 4.2.3, climate change is expected to increase the intensity of winter storms. With warmer air temperatures, more moisture will be held in the air, and if temperatures on the ground rapidly decrease, or fall below freezing, this could result in more snow falling during a weather event like a winter storm. These events may become less frequent as the global temperatures increase, but they could become more intense.

Figure 40-Pennsylvania Annual Snowfall 1981 – 2010

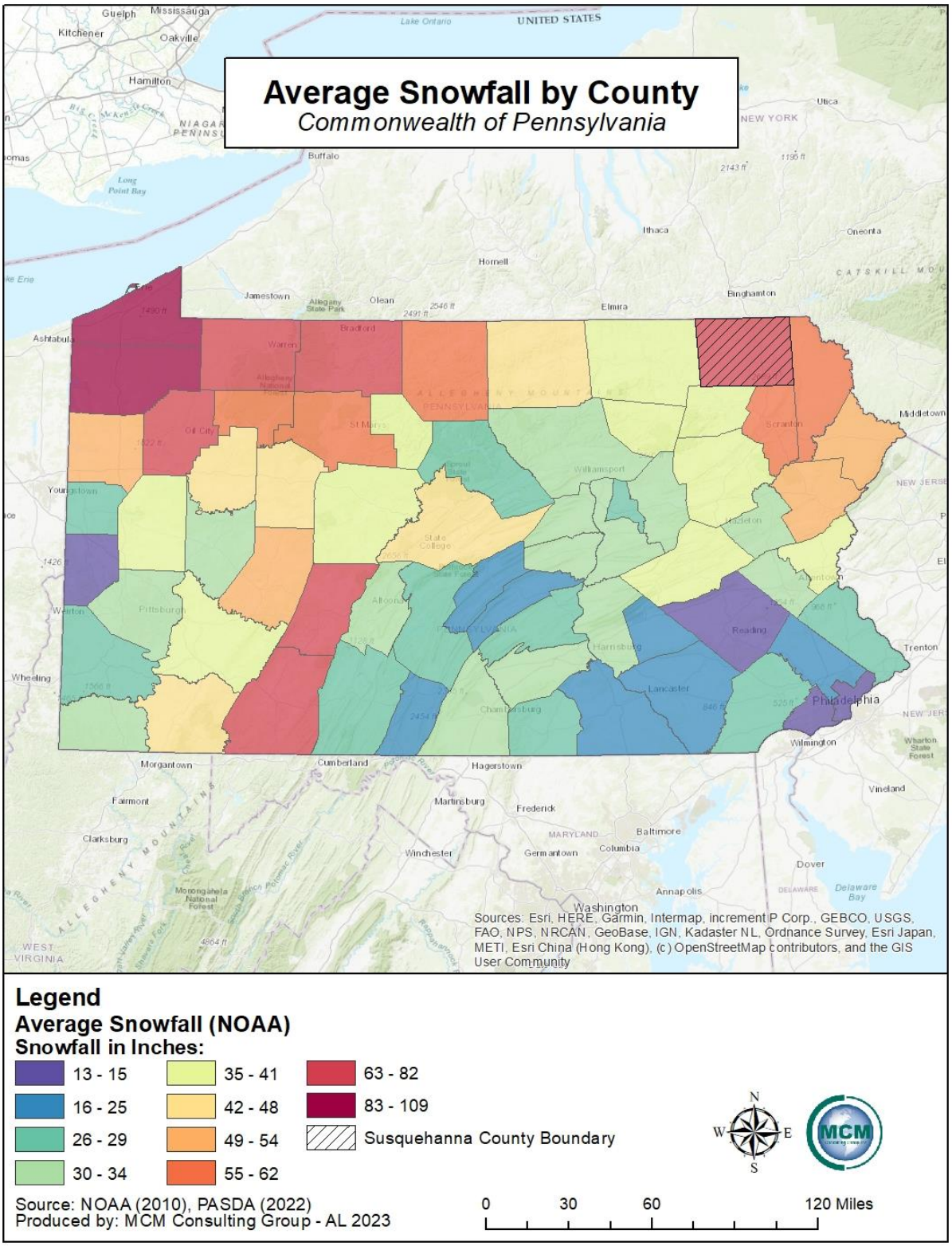
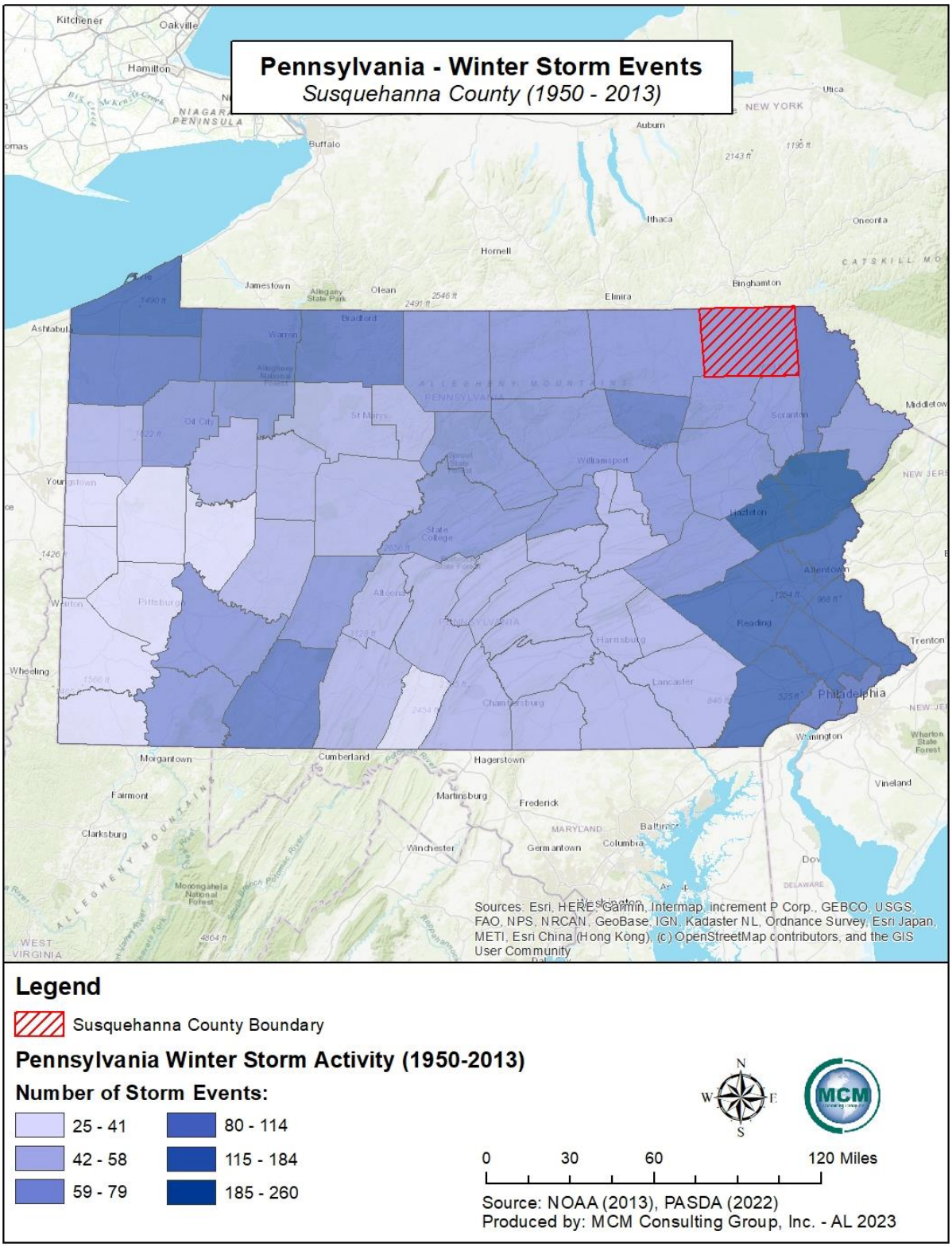


Figure 41-Winter Storm Events by County in Pennsylvania



4.3.15. Dam Failure

4.3.15.1. Location and Extent

A dam restricts the flow of water or underground streams and often creates reservoirs for water storage. The reservoirs created by these barriers not only suppress floods but also provide water for activities such as irrigation, human consumption, industrial use aquaculture, and navigability.

Dam failures occur usually as a secondary effect of massive amounts of rainfall and flooding, causing too much water to enter the spillway system. This type of failure occurs with little to no warning. Spring thaws, severe thunderstorms, and heavy rainfall are also contributing factors to potential dam failures. Depending on the size of the body of water where the dam is constructed, additional water may come from distant upstream locations. Water contributions may also come from dam failures in adjoining counties that are along the same riverine or water features.

FEMA considers the following to be the most frequent causes of dam failures:

- Overtopping caused by floods that exceed the capacity of the dam
- Deliberate acts of sabotage
- Structural failure of materials used in dam construction
- Movement and/or failure of the foundation supporting the dam
- Settlement and cracking of concrete or embankment dams
- Piping and internal erosion of soil in embankment dams
- Inadequate maintenance and upkeep

Poor engineering or poor maintenance may also cause dam failure. The Pennsylvania Department of Environmental Protection (PA DEP) and the United States Army Corps of Engineers (USACE) awards permits for dams and also share inspection responsibilities. Inspection results are characterized as either safe or unsafe.

The National Inventory of Dams (NID) is a registry that captures information about structures that are greater than or equal to 25 feet in height or impound 50-acre-feet or more of water (an acre-foot is equal to 325,851 gallons of water); it includes structures above 6 feet in height where failure would potentially cause damage downstream. The dams are classified in terms of hazard potential as “High”, “Significant”, or “Low”, with high-hazard dams requiring emergency action plans (EAPS) There are fifty-five high-hazard and low-hazard dams in Susquehanna County that are both publicly and privately owned and are registered with the USACE in the NID. There are also eighteen dams with a hazard classification as significant. There are twenty-five dams within the county that are high-hazard and require an emergency action plan. *Table 54 – Susquehanna County Dam Inventory* illustrates the dams located in Susquehanna County. *Table 53 – High-Hazard Dams Municipal Summary* summarizes the high-hazard dams in Susquehanna County by municipality. The municipalities not listed do not have high-hazard dams. *Table 55 – Dam Name*

and Purpose lists the dams located in Susquehanna County and their purpose code, and the description of purpose based on the Pennsylvania DEP codes.

Table 53 - High-Hazard Dams Municipality Summary

High-Hazard Dams – Municipal Summary	
Municipality	**Number of High-Hazard Dams**
Auburn Township	1
Bridgewater Township	2
Brooklyn Township	2
Clifford Township	1
Dimock Township	1
Forest Lake Township	2
Harford Township	2
Harmony Township	1
Jackson Township	2
Lenox Township	2
Liberty Township	1
New Milford Township	1
Silver Lake Township	3
Springville Township	2
Thompson Township	1
Union Dale Borough	1
Total:	**25**
Source: NID, 2023	

Table 54 - Susquehanna County Dam Inventory

Susquehanna County Dams							
Dam Name:	**River or Stream Name:**	**Owner Name:**	**Year Completed:**	**Dam Height (Ft)**	**Drainage Area (Sq Miles)**	**Hazard Potential Classification:**	**EAP Prepared:**
Acre Pond	Partners Creek	Acre Lake Improvement Association	1825	11.5	3.63	High	Yes
Baker	Tr Rhiney Creek	Wlr Family Lp	1963	32	1	Low	Not Required
Bel-Aire Lake	Tr Snake Creek	Kevin Noonan, President	1950	17	1.49	High	Yes
Big Elk Lake	Elk Lake Stream	Raymond Warriner	1860	12	2.88	Significant	Yes
Brewster Pond	Tr Meshoppen Creek	Ann E. Tego	1919	9	1	Low	Not Required

Susquehanna County Dams							
Dam Name:	**River or Stream Name:**	**Owner Name:**	**Year Completed:**	**Dam Height (Ft)**	**Drainage Area (Sq Miles)**	**Hazard Potential Classification:**	**EAP Prepared:**
Brooklyn Run (Pa-468)	Brooklyn Run	Susquehanna County Commissioners	1967	64	0.38	High	Yes
Brooks	Unt Meshoppen Creek	John W. Brooks		14	0.77	Low	Not Required
Cassidy Lake	Fiddle Creek E Branch Headwater	Floyd Cassidy	1970	16	0.21	Low	Not Required
Chalker	Tr Forest Lake Creek	George W. Chalker	1984	21	0.1	High	Yes
Comfort Lake	East Branch Canawacta Creek	Pa American Water Company	1916	13	1.8	High	Yes
Cranberry Lake	Tr Silver Creek	Cranberry Lake Association	1919	8	1.1	Low	Not Required
Crescent Lake	Little Meshoppen Creek	Crescent Lake Association	1919	9	1.4	Low	Not Required
Drann	Tr Mitchell Creek	John Drann	1919	12	0.6	Low	Not Required
Duffield Pond	Wyalusing Creek	Joseph Zercoe	1973	25	0.05	Significant	Not Required
East Lake	East Lake Creek	East Lake Conservation Association, Inc.	1919	6.5	0.56	Low	Not Required
Forest Lake	Forest Lake Creek	Forest Lake Cottage Owners Association	1842	12	0.84	Significant	Yes
Four Seasons Lake	Tr East Br Tunkhannock Creek	Village Of Four Seasons Assoc		12	0.55	Significant	Yes
Foxton Lake	Drinker Creek	Foxton Lake Association	1874	18	1.3	Low	Not Required
Fullers Lake	Salt Lick Creek	John R. Belmont	1870	9	0.95	Significant	No
Gillespies Pond	Meylert Creek	Fred Ehmann		10.2	2.07	Significant	Yes
Griffis	Tr Middle Br Wyalusing Creek	Anita Griffis	1989	17	0.72	Significant	No
Hart	Tr Pettis Creek	Terrace Hill Ventures		19	1.24	Significant	No

Susquehanna County Dams							
Dam Name:	**River or Stream Name:**	**Owner Name:**	**Year Completed:**	**Dam Height (Ft)**	**Drainage Area (Sq Miles)**	**Hazard Potential Classification:**	**EAP Prepared:**
Hathaway Pond	West Branch Lackawanna River	Dr Kamel Kazan	1919	16	1.92	Significant	No
Holly	Tr Martins Creek	Lynn Butler	1988	25	0.39	Low	Not Required
Horton Lake	Sterling Brook	John & Rena Beeman	1956	10	0.58	High	Yes
Indian Lake	White Creek	Mark T Ridge	1916	39	2.1	High	Yes
Jeffers Pond	Milland Creek	Richard & Diane Marino	1919	13	3.24	Low	Not Required
Kapp	Tr Snake Creek	Jake & June Kapp	1990	25	0.14	Low	Not Required
Lake Chrisann	Tr Hop Bottom Creek	Lake Chrisann Community Association	1961	22.6	1.14	High	Yes
Lake Courtland	Stonestreet Creek	Fiondi Inc.	1962	21	0.58	High	Yes
Lake Marge	Tr Choconut Creek	Stephen Holgash		29.5	0.31	High	Yes
Lake Montrose	Snake Creek	Pa American Water Company	1919	14	0.88	High	Yes
Lake Shawnee	Branch Butler Creek	Thad Keene	1970	25	0.28	Significant	Not Required
Lake Sophia	Tr Choconut Creek	Stephen Holgash	1957	30	1.3	High	Yes
Lake Timberline	Tr Choconut Creek	Richard O'Reilly	1958	14	1.28	Low	Not Required
Lake Verex	Carter Creek	George Mowry	1969	16	0.38	Low	Not Required
Lake Walter	Spring Run	Lake Walter Landowners Association	1968	32	0.49	High	Yes
Lakeside Pond	Tr Horton Creek	Nicholson Borough Water Authority	1840	12	1.8	Low	Not Required
Lee Smith Dam	Wyalusing Creek	B And B Sportsman's	1964	18	0.25	Low	Not Required
Lewis Lake	Fiddle Lake Creek	Lewis Lake Association, Inc	1835	15	6.52	High	Yes
Lindy Lake	Tr Partners Creek	Geoffery T. Mckernan	1985	23	0.24	High	Yes
Longford Lake	Tr Choconut Creek	Longford Lake Association, Inc.	1974	37	0.39	High	Yes

Susquehanna County Dams							
Dam Name:	**River or Stream Name:**	**Owner Name:**	**Year Completed:**	**Dam Height (Ft)**	**Drainage Area (Sq Miles)**	**Hazard Potential Classification:**	**EAP Prepared:**
Lowe Lake	Tr Fiddler Lake Creek	Maple Highlands LLC	1917	5	0.7	Significant	Yes
Lower Alford Lake	Martins Creek	Kevin Rought	1919	14.5	5.34	High	Yes
Lower Lake	East Branch Martin Creek	Phillip & Lillian Stein	1919	7	2.3	Low	Not Required
Martins Creek (Pa-467)	Tr Martins Creek	Susquehanna County Commissioners	1967	52	0.8	High	Yes
Middle Lake	East Branch Martin Creek	Elbert Seamans	1914	7	1.7	Low	Not Required
Mingo Lake	Tr Snake Creek	Chief Logan Sportsman's Preserve	1895	15	0.3	Low	Not Required
Nick Pond	Tr Nick Creek	John F. Naber	1996	10	0.78	Significant	No
Oakland	Susquehanna River	River Bounty, Inc. (Dissolved)	1896	18	2160	Significant	No
Oteyokwa Lake	Beaver Creek	Oteyokwa Lake Club Farm	1965	5	0.3	Significant	Yes
Page Lake	Salt Lick Creek	Russell Pepe	1863	17	4.78	High	Yes
Polk Pond	Tr Nine Partners Creek	James & Paula Adams	1996	11	0.34	Low	Not Required
Posts Pond	Tr Meshoppen Creek	Tom Ferme	1910	10	0.9	Low	Not Required
Purdy (Stump Pond)	Salt Lick Creek	Pa Fish & Boat Commission	1919	7	6.63	Low	Not Required
Reddon-Hall	Tr Tunkhannock Creek	0	1985	23	0.63	High	Yes
Reflection Lake (Romosa Lake)	Apalachin Creek	Curtis L. Eshbaugh	1952	11	3.3	Low	Not Required
Reynolds Pond	Williams Pond Branch Snake River	Robert Stankiewicz	1972	24	0.14	Low	Not Required

Susquehanna County Dams							
Dam Name:	**River or Stream Name:**	**Owner Name:**	**Year Completed:**	**Dam Height (Ft)**	**Drainage Area (Sq Miles)**	**Hazard Potential Classification:**	**EAP Prepared:**
Romobe Lake	West Branch Lackawanna River	Michael Puskas	1914	8		Low	Not Required
Ross	East Branch Tunkhannock Creek	Hilary Ross	1974	21	0.85	Significant	Yes
Sediment Pond In Pit		Eastern Industries, Inc.		45		Low	No
Snyder Lake	Thompson; Tr- Starrucca Creek	Charles Snyder	1971	23	0.34	Significant	Not Required
Spencer Mill	Starrucca Creek	Alexander Curtis	1919	16	3.9	Significant	No
Spring Lake	Tr Starrucca Creek	Makram M. & Shadia Erianc	1919	10	0.8	High	No
Star Lake	Drinker Creek	John Wesley Ross		26	0.98	High	Yes
Stillwater Dam	Lackawanna River	USACE - Baltimore District	1960	77	37	High	Yes
Thomas Creek (Rc & D-105)	Thomas Creek	Susquehanna County Commissioners	1978	24	0.6	High	Yes
Tingley Lake	East Branch Leslie Creek	Richard J. Berish	1919	7	1.4	Low	Not Required
Tuscarora Lake	Tuscarora Creek	Jayne's Orchards	1919	12	0.95	High	Yes
Tyler Lake	East Branch Leslie Creek	Thomas W. Rutherford	1919	6	1.2	Significant	No
Warner	Tr Snake Creek	Stella Warner Estate	1930	13	0.34	Low	Not Required
Way Lake	Tr Starrucca Creek	Deanna E. Kory	1992	12	0.59	Low	Not Required
Williams Pond	Tr Snake Creek	Russell Brown	1919	10	3.6	Low	Not Required
Source: NID, 2023							

Table 55 - Dam Name and Purpose

Susquehanna County Dams and Purposes		
Dam Name	Purpose Code	Purposes
Acre Pond	R	Recreation
Bel-Aire Lake	R	Recreation

Susquehanna County Dams and Purposes		
Dam Name	Purpose Code	Purposes
Brooklyn Run (Pa-468)	C	Flood Risk Reduction
Chalker	R	Recreation
Comfort Lake	S	Water Supply
Horton Lake	R	Recreation
Indian Lake	R	Recreation
Lake Chrisann	R	Recreation
Lake Courtland	R	Recreation
Lake Marge	R	Recreation
Lake Montrose	S	Water Supply
Lake Sophia	R	Recreation
Lake Walter	R	Recreation
Lewis Lake	R	Recreation
Lindy Lake	R	Recreation
Longford Lake	R	Recreation
Lower Alford Lake	R	Recreation
Martins Creek (Pa-467)	C	Flood Risk Reduction
Page Lake	R	Recreation
Reddon-Hall	R	Recreation
Spring Lake	R	Recreation
Star Lake	R	Recreation
Stillwater Dam	C, S, R	Recreation; Water Supply; Flood Risk Reduction
Thomas Creek (Rc & D-105)	C	Flood Risk Reduction
Tuscarora Lake	R	Recreation
Baker	R	Recreation
Brewster Pond	R	Recreation
Brooks	R	Recreation
Cassidy Lake	F, R	Fish and Wildlife Pond; Recreation
Cranberry Lake	R	Recreation
Crescent Lake	R	Recreation
Drann	R	Recreation
East Lake	R	Recreation
Foxton Lake	R	Recreation
Holly	R	Recreation
Jeffers Pond	R	Recreation
Kapp	R	Recreation
Lake Timberline	R	Recreation
Lake Verex	R	Recreation

Susquehanna County Dams and Purposes		
Dam Name	Purpose Code	Purposes
Lakeside Pond	R	Recreation
Lee Smith Dam	F, R	Fish and Wildlife Pond; Recreation
Lower Lake	R	Recreation
Middle Lake	R	Recreation
Mingo Lake	R	Recreation
Polk Pond	R	Recreation
Posts Pond	R	Recreation
Purdy (Stump Pond)	R	Recreation
Reflection Lake (Romosa Lake)	R	Recreation
Reynolds Pond	F, R	Fish and Wildlife Pond; Recreation
Romobe Lake	R	Recreation
Sediment Pond In Pit	T	Tailings
Tingley Lake	R	Recreation
Warner	R	Recreation
Way Lake	R	Recreation
Williams Pond	R	Recreation
Big Elk Lake	S, R	Recreation; Water Supply
Duffield Pond	F, R	Fish and Wildlife Pond; Recreation
Forest Lake	R	Recreation
Four Seasons Lake	R	Recreation
Fullers Lake	R	Recreation
Gillespies Pond	R	Recreation
Griffis	R	Recreation
Hart	R	Recreation
Hathaway Pond	R	Recreation
Lake Shawnee	F, R	Fish and Wildlife Pond; Recreation
Lowe Lake	R	Recreation
Nick Pond	R	Recreation
Oakland	H, R	Recreation; Hydroelectric
Oteyokwa Lake	R	Recreation
Ross	R	Recreation
Snyder Lake	F, R	Fish and Wildlife Pond; Recreation
Spencer Mill	R, O	Recreation; Other
Tyler Lake	R	Recreation
Source: PA DEP, 2019 & NID, 2023		

The Pennsylvania Department of Environmental Protection defines a high-hazard dam as “Any dam so located as to endanger populated areas downstream by its failure”. High-hazard dams

receive two inspections each year, once by a professional engineer on behalf of the owner and once by a PA DEP inspector (DEP, 2008).

4.3.15.2. Range of Magnitude

Dam failures can pose a serious threat to communities located downstream from major dams. The impact of a dam failure is dependent on the volume of water impounded by the dam and the amount of population or assets located downstream. Catastrophic failures are characterized by the sudden, rapid, and uncontrolled release of impounded water from a dammed impoundment or water body. *Figure 42 – Susquehanna County Dams* shows the location of dams within Susquehanna County as well as their hazard designation.

4.3.15.3. Past Occurrence

There have been no past occurrences of dam failure or major incidence occurring at the locations of dams within Susquehanna County. Smaller incidents have occurred but have not had significant impacts in the county.

There have been a few historically destructive dam failures in Pennsylvania over the course of the past two hundred years. The most destructive dam failure in United States history took place in Johnstown, Pennsylvania (Cambria County) in 1889, claiming 2,209 lives. Another significant dam failure took place in Austin, Pennsylvania (Potter County) in 1911, claiming seventy-eight lives. Similarly, a dam failure in West Taylor Township, Pennsylvania (Cambria County) claimed the lives of forty people when the Laurel Run Dam, No. 2 failed during the Johnstown Flood in the early morning hours of July 20th, 1977.

4.3.15.4. Future Occurrence

Although dam failures can occur at any time, given the right circumstances, the likelihood of a dam failure in Susquehanna County is considered to be unlikely.

The presence of structural integrity and inspection programs significantly reduces the potential for major dam failure events to occur. The PA DEP inventories and regulates all the dams that meet or exceed the following criteria (PA, DEP, 2008):

- Impound water from a drainage area of greater than 100 acres
- Have a maximum water depth greater than 15 feet
- Have a maximum storage capacity of 50 acre-feet or greater

The construction, operation, maintenance, and abandonment of dams is reviewed and monitored by the PA DEP Division of Dam Safety. Dams are evaluated based on those categories such as slope stability, undermining seepage, and spillway adequacy. With more strict construction and design procedures in place, the future occurrence of a dam failure is increasingly small. The new procedures and rules protect public safety and both public and private property. Newly

constructed dams are thoroughly examined by professional engineers to prevent future dam failure events.

4.3.15.5. Vulnerability Assessment

Property and populations located downstream from any dams are vulnerable to dam failures. The Pennsylvania Code (§105.91 Classification of dams and reservoirs) classifies doth dams by size and the amount of loss of life and economic loss expected in a failure event. *Table 56 – Dam Classification* displays the dam classification guide for the Commonwealth of Pennsylvania. Although the size of a dam may result in varying impacts, the hazard potential classification of category one dams is a more important indicator, since that will indicate the level of potential substantial loss of life and excessive economic loss.

Table 56 - Dam Classification

Dam Classification (PA Code 1980)		
Dam Size Classification		
Class	**Impoundment Storage (Acre-Feet)**	**Dam Height (Feet)**
A	Equal to or greater than 50,000	Equal to or greater than 100
B	Less than 50,000 but greater than 1,000	Less than 100 but greater than 40
C	Equal to or less than 1,000	Equal to or less than 40
Dam Damage Classification		
Category	**Loss of Life**	**Economic Loss**
1	Substantial	Excessive
2	Few	Appreciable
3	None Expected	Minimal

Dam failures can cause significant environmental effects, as the resulting flood from a dam failure is likely to disperse debris and hazardous materials downstream that can damage local ecosystems. Debris carried downstream can block roads, cause traffic accidents, disrupt traffic patterns, and delay the delivery of essential services along major traffic corridors. Debris flow can also cause landslides along steep slopes and embankments with low slope stability. The economic and financial impact from damage and recovery ranges from minimal to severe, depending on the magnitude of damage and scale of failure event.

Emergency action plans are developed by the owners of high-hazard dams. These plans are then disseminated to first responders and other planning partners within the county. Vulnerable populations are those residents and businesses located downstream from a high-hazard dam

within the inundation area. The emergency action plan identifies a call list to notify downstream at-risk populations. Emergency action plan exercises are held every five to seven years depending on local policy.

The characteristics of the twenty-five high-hazard dams in Susquehanna County vary greatly. The Oakland Dam, located in Susquehanna Depot Borough, has the largest drainage area with a total of 2160 sq. miles. The dams that were constructed most recently are the Polk Pond Dam, located in Harford Township, which was constructed in 1996, and the Nick Pond Dam in Auburn Township, which was constructed in 1996. The dam that is the oldest in the county is Acre Pond Dam, which was constructed in 1825. The Stillwater Dam is the tallest in the county with a height of seventy-seven feet. The Susquehanna County Commissioners own the most dams in Susquehanna County with a total of three dams. These dams are the Brooklyn Run Dam, the Martins Creek Dam, and the Thomas Creek Dam. The dams in Susquehanna County are owned by a mix of public and private owners and vary in almost every aspect. The county dams are distributed relatively evenly throughout the county and municipalities, with an even mix of high and low hazard dams in the municipalities.

The failure or partial failure of a High-Hazard Potential Dam can have impacts that affect many different jurisdictions across Susquehanna County and counties adjacent to Susquehanna County. A failure at any of the dams in Susquehanna County would result in some inundation in at least those municipalities adjacent to the dam in question. A more comprehensive examination of risk inundation areas from High-Hazard Potential Dams can be conducted in future iterations of the Susquehanna County Hazard Mitigation Plan. This dataset was not readily accessible at the time of this writing. However, each of this municipalities that could be affected by the failure of a High-Hazard Potential Dam could result in the inundation of police stations and fire departments, critical infrastructure facilities, and community lifeline locations like medical facilities, power and energy facilities, and schools, nursing homes, and senior care and long term care facilities.

Susquehanna County is at risk when high-hazard potential dams are considered. There are three types of risk related to high-hazard potential dams and they are listed below in *Table 57 – High-Hazard Potential Dams Risk Type*:

Table 57 - High-Hazard Potential Dams Risk Type

High-Hazard Potential Dams Risk Types	
Type of Risk	**Description**
Incremental Risk	The risk (likelihood and consequences) to the pool area and downstream floodplain occupants that can be attributed to the presence of the dam should the dam breach prior or subsequent to overtopping, or undergo component malfunction or misoperation, where the consequences considered are over and above those that would occur without dam breach. The consequences typically are due to downstream inundation, but loss of the pool can result in significant consequences in the pool area upstream of the dam.
Non-Breach Risk	The risk in the reservoir pool area and affected downstream floodplain due to 'normal' dam operation of the dam (e.g., large spillway flows within the design capacity that exceed channel capacity) or 'overtopping of the dam without breaching' scenarios.
Residual Risk	The risk that remains after all mitigation actions and risk reduction actions have been completed. With respect to dams, FEMA defines residual risk as "risk remaining at any time" (FEMA, 2015, p A-2). It is the risk that remains after decisions related to a specific dam safety issue are made and prudent actions have been taken to address the risk. It is the remote risk associated with a condition that was judged to not be a credible dam safety issue.
Source: "Rehabilitation of High Hazard Potential Dams Grant Program Guidance," June 2020	

At this time, insufficient information is available to conduct a substantive analysis of incremental, non-breach and residual risk relative to Susquehanna County's high hazard potential dams. However, it is acknowledged that incremental risk is "the risk (likelihood and consequences) to the pool area and downstream floodplain occupants that can be attributed to the presence of the dam should the dam breach prior or subsequent to overtopping, or undergo component malfunction or misoperation, where the consequences considered are over and above those that would occur without dam breach;" non-breach risk is "the risk in the reservoir pool area and affected downstream floodplain due to 'normal' dam operation of the dam (e.g., large spillway flows within the design capacity that exceed channel capacity) or 'overtopping of the dam without breaching' scenarios;" and residual risk) is "the risk that remains after decisions related to a specific dam safety issue are made and prudent actions have been taken to address the risk. It is the remote risk associated with a condition that was judged to not be a credible dam safety issue" (FEMA, 2020 Rehabilitation of High Hazard Potential Dams Grant Program Guidance)

The risk of high-hazard potential dams in Susquehanna County is present but at the time of this writing, there is insufficient data to identify in exact detail the vulnerable populations and assets in inundation areas for the high-hazard potential dams. The areas downstream from the high-hazard potential dams are more vulnerable to inundation than areas that are upstream from said dams. There are current datasets to address high-hazard potential dam impacts in greater detail, but these datasets are still in development from the Pennsylvania Department of Environmental Protection, Pennsylvania Emergency Management Agency, the United States Army Corp of Engineers, and the Federal Emergency Management Agency. Once these datasets have been published and inundation data is easier to acquire, this information will be used to develop more details risk assessment and vulnerability assessments for dam failure at the high-hazard potential dams.

Although there are data limitations to take into account in regard to high hazard potential dams in Susquehanna County, some open source, nationally available data can be integrated into this vulnerability assessment. One of those tools is the Resilience Analysis and Planning Tool (RAPT) administered by FEMA. This tool can overlay areas of interest around certain features to determine what types of populations are within certain distances of those features. In the table below, a 2-mile distance was calculated around each high-hazard dam in Susquehanna County. Those locations were then used to determine how many people or households are vulnerable to a dam failure based strictly on distance. Some of the indicators used for this analysis were total population, households without vehicles, households with limited English, and housing units that are mobile homes.

High-Hazard Dam Vulnerability Data				
Dam	**Total Population**	**Households without a vehicle**	**Households with limited English**	**Housing units that are mobile homes**
Acre Pond	610	16	2	86
Bel-Aire Lake	530	7	1	79
Brooklyn Run (Pa-468)	611	30	0	98
Chalker	343	11	3	56
Comfort Lake	672	65	0	84
Horton Lake	608	18	2	83
Indian Lake	594	31	0	93
Lake Chrisann	968	79	2	120
Lake Courtland	316	8	1	59
Lake Marge	521	10	1	69
Lake Montrose	1,115	98	0	143
Lake Sophia	481	8	1	71

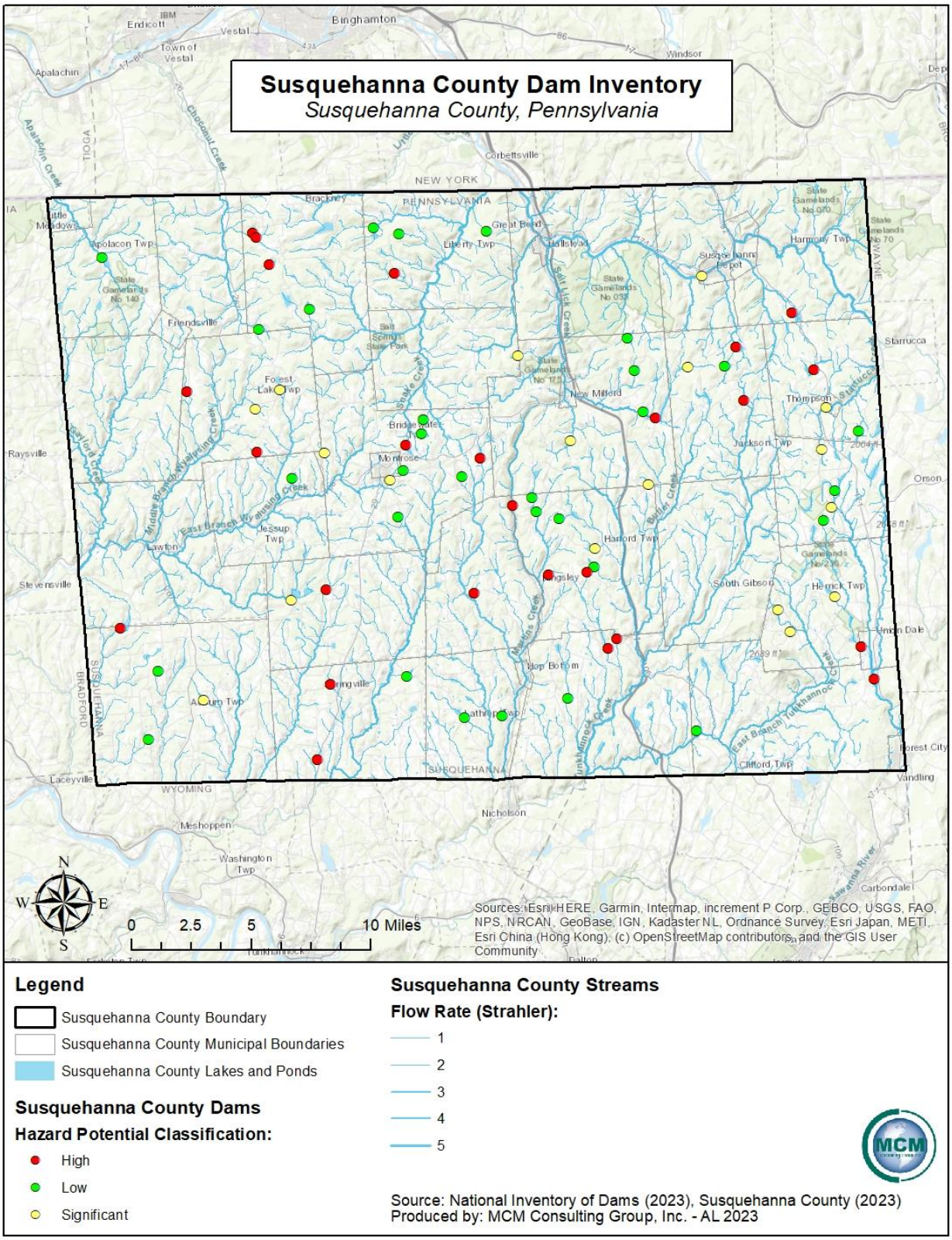
High-Hazard Dam Vulnerability Data				
Dam	**Total Population**	**Households without a vehicle**	**Households with limited English**	**Housing units that are mobile homes**
Lake Walter	510	24	0	76
Lewis Lake	393	15	0	48
Lindy Lake	606	30	5	67
Longford Lake	483	6	1	74
Lower Alford Lake	655	37	3	84
Martins Creek (Pa-467)	593	29	4	74
Page Lake	561	23	4	64
Reddon-Hall	429	9	0	53
Spring Lake	327	17	0	35
Star Lake	529	29	0	66
Stillwater Dam	481	11	0	64
Thomas Creek (Rc & D-105)	573	28	0	93
Tuscarora Lake	402	18	3	55
Total				
Source: RAPT, ACS, 2017-2021, Table B08201, Table S1602, and Table DP04				

An analysis was also conducted for high priority infrastructure within 2-miles of high-hazard dams in Susquehanna County. The information in the table below illustrates which infrastructure was located in that vulnerability zone.

High-Hazard Dam Vulnerability Data – Infrastructure				
Dam	**Hospitals**	**Nursing Homes**	**Fire Stations**	**Public Schools**
Acre Pond	0	0	0	2
Bel-Aire Lake	0	0	0	0
Brooklyn Run (Pa-468)	0	0	0	0
Chalker	0	0	0	0
Comfort Lake	0	0	0	0
Horton Lake	0	0	0	0
Indian Lake	0	0	0	0
Lake Chrisann	0	0	0	0
Lake Courtland	0	0	1	0

High-Hazard Dam Vulnerability Data – Infrastructure				
Dam	**Hospitals**	**Nursing Homes**	**Fire Stations**	**Public Schools**
Lake Marge	0	0	1	1
Lake Montrose	2	1	1	2
Lake Sophia	0	0	1	1
Lake Walter	0	0	0	0
Lewis Lake	0	0	1	0
Lindy Lake	0	0	1	2
Longford Lake	0	0	1	1
Lower Alford Lake	0	0	0	0
Martins Creek (Pa-467)	0	0	0	1
Page Lake	0	0	0	0
Reddon-Hall	0	0	0	0
Spring Lake	0	0	1	0
Star Lake	0	0	0	0
Stillwater Dam	0	0	0	0
Thomas Creek (Rc & D-105)	0	0	1	0
Tuscarora Lake	0	0	0	0
Source: RAPT, Homeland Infrastructure Foundation-Level Data, 2024				

Figure 42-Susquehanna County Dams



4.3.16. Emergency Services

4.3.16.1. Location and Extent

Fire, emergency medical services (EMS), local emergency management coordinators (LEMC), and law enforcement service agencies are defined per municipality in Susquehanna County. In addition to the local services, the county hosts numerous special teams. Regional and state-wide services are also available.

With the exception of law enforcement, most areas are served by volunteers instead of career personnel, which increases response time due to volunteer availability. Volunteers provide emergency services above separately from their regular careers. Often agencies struggle with the availability of skilled personnel and resources at certain times of the day. The number of responders in general has decreased, in part due to issues including funding and retention of personnel.

Additionally, the time and expense obligations of required training are a factor in the decrease in number of responders. The initial training time for fire, EMS, and law enforcement can take several months to complete. Emergency medical services, requires a regular schedule of continued education to maintain certification. In the fire service, after the initial training, there are specialty courses offered, which are recommended, but not required. For law enforcement, skills such as firearms proficiency must be maintained, and updates to new laws and regulations continues throughout the officer's career.

4.3.16.2. Range of Magnitude

Finances, changing political climates, leadership, or a significant high-profile event can trigger a system to be declared as "success" or "failure". In some cases, a combination of these factors can create a perfect storm. Unfortunately, many "failed" systems are measured by recent events, no matter how successful they may have been in the past. Although financial problems are often blamed on poor leadership, they may have many root causes. Labor rates, benefits, poor productivity, operational design, insurance reimbursements, and market regulation all have a significant direct impact on the financial viability of an organization.

Two fundamental, yet misunderstood, topics are the financial and economic variables that drive emergency service systems. These systems typically generate revenue through tax subsidies, memberships, direct sales, diversification into other lines of business, grants, or fundraising. They spend most of these revenues on direct and indirect labor, and benefits. The remaining dollars go into infrastructure, fuel, medical supplies, insurances, fleet maintenance, dispatch, and other essential items, with hopefully, some left over for recapitalization or fund balance development. The range of the issues related to emergency service shortages are felt across the entire United States of America and the Commonwealth of Pennsylvania. Susquehanna County

has felt emergency shortages and these shortages have had adverse effects on emergency response in the county.

4.3.16.3. Past Occurrence

There have been no official records kept on shortages to emergency services. However, there has been a decrease in the number of new volunteers in the fire service for several years. Most agencies are private organizations that lack local funding and exist based on tax dollars, fund raising, and donations received from their community. The need for fund raising adds to availability issues of volunteers. Most services past practices are not sustaining the current needs for funding and manpower. Without financial support from the communities, services may not be able to remain in operation to serve those same communities. Recruitment and personnel retention are a key to success.

Susquehanna County has had multiple events that were caused by emergency service shortages, most significantly from 2020 to 2022, exacerbated by the COVID-19 pandemic. However, this shortage has not been caused exclusively by the COVID-19 pandemic and was occurring before the pandemic across Susquehanna County and the Commonwealth of Pennsylvania.

4.3.16.4. Future Occurrence

Historically, it has been difficult for small communities to have a paid fire or EMS service, therefore requiring volunteers. Fewer volunteers to perform the tasks associated with fire, medical, and rescue operations, can negatively affect a service's ability to respond to emergencies. Additionally, operational needs are impacted if there are fewer volunteers to raise funds. Without fundraising and community support these fire departments and volunteer EMS agencies will experience broader challenges. Municipalities can help offset some of the financial burdens to their local fire company with a fire tax.

There are also challenges for individuals who volunteer, including dedicating time beyond their current employment, family, and community commitments to dedicate to training, responding, and fundraising. Training is essential to provide for the general knowledge and safety of volunteers. Becoming certified as a volunteer firefighter requires hundreds of hours of training. With a decrease in the numbers of new volunteers, many current volunteers are aging and unable to perform at the same levels they once were.

Fire departments and EMS agencies, often are tasked with responding to a variety of emergencies, including not only fire and medical emergencies, but also incidents requiring rescue, containment of hazardous materials, or assistance to law enforcement. Volunteers need to be well trained and able to respond to different scenarios as needed.

The future occurrence of emergency service shortages is likely to continue in Susquehanna County and across the Commonwealth of Pennsylvania. With a lack of new recruits and officers

for emergency services, response will continue to be hindered and response times will continue to be high. Institutional change is the most efficient way to decrease the likelihood of emergency service shortages in Susquehanna County, but that type of change is slow and often long-term.

4.3.16.5. Vulnerability Assessment

The possibility that EMS agencies and fire services could fail creates a vulnerability to all Susquehanna County communities. Occasionally, residents of communities mistakenly think that their local fire department is a paid service. Most municipal fire departments are volunteer agencies and need the support of their communities to maintain their departments.

Personnel shortages have been occurring in law enforcements for several reasons. More students are pursuing other professional careers instead of becoming public safety professionals than previously. This trend could be an effect of the recent changes in the social climate toward law enforcement, the increased number of college students pursuing graduate school degrees, or many other factors. As with any profession, becoming a law enforcement officer requires a commitment of time and money for training at local, state, or federal levels. The selection of law enforcement officers includes not only physical and mental aptitudes, but also a comprehensive physiological screening.

If any current public service agency fails to provide enough personnel to perform their required duties, then those duties must be provided for by another service agency that may be many miles away, creating an increased response time. An increased response time could lead to additional or greater severity in injury or property damage. Many communities in Pennsylvania have already experienced the closure of emergency response agencies.

It is recommended that each municipality assess their own vulnerabilities by maintaining and building relationships with their local providers and working with them to make to plan accordingly for if a local service were to close its operations. Consolidation of services is a possible solution for agencies that are struggling to maintain operations. Statistics, response times, and all times associated with units dispatched are easily obtainable from the county 911 center. Municipalities should research all of the factors which would be part of a consolidation of emergency services with neighboring communities.

The emergency services departments in Susquehanna County need to be supported to create and or discover new ways to not only recruit but to retain volunteers. If left unattended, the issue will continue and the lack of response will grow, leaving communities more vulnerable to loss of life and loss of property. Community education is a key factor in the maintenance of emergency response agencies. In addition, continued support, and efforts to inform legislature could all prove to be important in assuring that these services remain in operation into the future. At the time of the writing of this plan, a number of bills has been introduced in both the House of Representative and the Senate as a result of a two-year study initiated by Senate Resolution 6

(SR6). The final report can be found here: http://pehsc.org/wp-content/uploads/2014/05/SR-6-REPORT-FINAL.pdf.

Emergency response agencies that currently provide services within Susquehanna County are identified in the following tables, *Table 58 – Susquehanna County Fire Departments* identifies the municipalities served. All fire departments in Susquehanna County are volunteer and four of the EMS agencies in the county are paid. *Table 59 – Susquehanna County EMS Agencies* identifies each emergency medical service agency and the municipalities served. *Table 60 – Susquehanna County Law Enforcement Agencies* identifies each police department to include the Pennsylvania State Police (PSP) and the municipalities served. Susquehanna County does not have any individual specialty teams but does have trained personnel in specialty areas like search and rescue and swiftwater rescue. This information was provided by the Susquehanna County Emergency Services.

Table 58- Susquehanna County Fire Departments

Susquehanna County Fire Departments	
Station Name	**Municipalities Covered**
Clifford Volunteer Fire Department	Clifford Township, parts of Gibson Township and Lenox Township
Elk Lake Volunteer Fire Department	Parts of Dimock Township and Auburn Township
Forest City Volunteer Fire Department	Forest City Borough
Forest Lake Volunteer Fire Department	Forest Lake Township, Parts of Jessup Township and Middletown Township
Great Bend Fire Company	Great Bend Borough, Parts of Great Bend Township
Hallstead Fire Department	Hallstead Borough, Parts of Great Bend Township and Liberty Township
Harford Volunteer Fire Department	Harford Township, Parts of Gibson Township and Lenox Township
Hop Bottom Volunteer Fire Department	Hop Bottom Borough, Parts of Brooklyn Township, Lathrop Township, and Lenox Township
Little Meadows Fire Department	Little Meadows Borough, Apolacon Township
New Milford Volunteer Fire Department	New Milford Borough, New Milford Township, Parts of Franklin Township, Great Bend Township, and Jackson Township
Rush Station #2	Rush Township, Parts of Auburn Township, Jessup Township, and Middletown Township

Susquehanna County Fire Departments	
Station Name	**Municipalities Covered**
Rush Volunteer Fire Department	Rush Township, Parts of Auburn Township, Jessup Township, and Middletown Township
Silver Lake Station 1	Silver Lake Township, Choconut Township
Silver Lake Station 2	Silver Lake Township, Choconut Township
Snake Creek Station 1	Parts of Liberty Township and Franklin Township
Snake Creek Station 2	Parts of Liberty Township and Franklin Township
Springville Fire Department	Springville Township, Parts of Auburn Township and Dimock Township
Susquehanna Fire Department	Harmony Township, Oakland Borough, Oakland Township, and Susquehanna Depot Borough
Thompson Hose Company	Ararat Township, Thompson Borough, Thompson Township, Parts of Gibson Township and Jackson Township
Union Dale Volunteer Fire Department	Union Dale Borough
United Fire Department	Montrose Borough, Parts of Bridgewater Township, Dimock Township, Franklin Township, and Jessup Township

Table 59- Susquehanna County EMS Agencies

Susquehanna County EMS Agencies		
Station Name	**Municipalities Covered**	
	Full Coverage	**Portion Coverage**
Barnes Kasson EMS	Susquehanna Depot Borough	Nearby municipalities
Clifford Ambulance	Clifford Township	Nearby municipalities
Forest City Ambulance	Forest City Borough	Nearby municipalities
Forest Lake QRS	Forest Lake Township	Nearby municipalities
Great Bend – Hallstead Ambulance	Great Bend Borough & Hallstead Borough	Nearby municipalities
Harford Ambulance	New Milford Township	Nearby municipalities
Hop Bottom QRS	Hop Bottom Borough	Nearby municipalities
Little Meadows Ambulance	Little Meadows Borough	Nearby municipalities
New Milford Ambulance	New Milford Borough	Nearby municipalities
Rush QRS	Rush Township	Nearby municipalities
Silver Lake Ambulance Station 1	Silver Lake Township	Nearby municipalities
Silver Lake Ambulance Station 2	Choconut Township	Nearby municipalities

Susquehanna County EMS Agencies		
Station Name	**Municipalities Covered**	
	Full Coverage	**Portion Coverage**
Springville QRS	Springville Township	Nearby municipalities
Susquehanna Ambulance	Susquehanna Depot Borough	Nearby municipalities
Thompson Ambulance	Thompson Borough	Nearby municipalities

Table 60-Susquehanna County Law Enforcement Agencies

Susquehanna County Police Departments	
Agency Name	**Area Covered**
Gibson – Pennsylvania State Police	Susquehanna County
Great Bend Borough Police	Great Bend Borough
Lanesboro Borough Police	Lanesboro Borough
Montrose Borough Police	Montrose Borough
Silver Lake Township Police	Silver Lake Township
Susquehanna Depot Borough Police	Susquehanna Depot Borough

4.3.17. Environmental Hazards

4.3.17.1. Location and Extent

Transportation

Environmental hazards are most commonly due to hazardous materials incidents occurring when such materials are manufactured, used, stored, or transported. Most hazardous materials incidents are unintentional, however hazardous materials could also be released in a criminal or terrorist act. A release, whether it is intentional or accidental, can result in injury or death and may contaminate air, water and/or soils. Hazardous materials incidents can be generally broken down into the subcategories of transportation and fixed facility. This section will focus on environmental hazards and how they relate to transportation of hazardous materials.

Tanker trucks, tractor trailers, and rail cars often are used to transport hazardous materials. When there are transportation incidents involving these types of vehicles, hazardous materials can be released in significant quantities. *Figure 45 – Environmental Hazard Transportation Vulnerability* shows major transportation routes through Susquehanna County, including Interstate 81, Pennsylvania Route 29, Pennsylvania Route 706, and United States Route 11.

Fixed Facility

Hazardous materials incidents can be broken down into the subcategories of transportation and fixed facility. This section of the report focuses on environmental hazardous materials at fixed facilities.

In Pennsylvania, facilities that use, manufacture, or store hazardous materials must comply with Title III of the federal Superfund Amendments and Reauthorization Act (SARA), and the Commonwealth's reporting requirements under the Hazardous Materials Emergency Planning and Response Act (1990-165), as amended. There are 348 SARA Title III facilities in Susquehanna County. These facilities listed as SARA sites should not be considered an exhaustive and comprehensive list of all locations where hazardous materials reside in the county. *Figure 44 – Hazardous Waste Locations* identifies SARA Title III facilities as well as several other locations that consume, store, or release potentially hazardous materials and wastes.

Fixed facilities are also monitored by the Environmental Protection Agency (EPA). The EPA has identified hazardous materials sites, not regulated by SARA Title III, and are known as Toxic Releases Inventory (TRI) sites. Facilities which employ ten or more full time employees, and which manufacture or process more than 25,000 pounds (or use more than 10,000 pounds) of any SARA Section 313-listed toxic chemical in the course of a calendar year are required to report TRI information to the EPA. The EPA is the federal enforcement agency responsible for SARA Title III and PEMA classifications. As of 2023, there is one TRI facility in Susquehanna County, located near Montrose Borough.

Oil and gas extraction facilities can also be sources of hazardous material release. Most wells in the county are active, but there are also many inactive and abandoned wells. *Figure 43 – Oil & Gas Well Locations* shows the location of all oil and gas wells in the county along with their proximity to surface waters.

4.3.17.2. Range of Magnitude

Transportation

While often accidental, releases can occur because of human carelessness, intentional acts, or natural hazards. When caused by natural hazards, environmental hazards are known as secondary events. Hazardous materials can include toxic chemicals, radioactive materials, infectious substances, or hazardous wastes. Such releases can affect nearby populations and contaminate critical or sensitive environmental areas.

Hazardous material release can contaminate air, water, and soil, and can possibly cause injuries, poisonings, or deaths. Hazardous materials fall into nine hazards classes. These hazard classes are as follows:

- Class #1: Explosives
- Class #2: Gases (flammable, non-flammable, non-toxic, and toxic)
- Class #3: Flammable and Combustible Liquids
- Class #4: Flammable Solids (spontaneously combustible and dangerous when wet materials/water reactive substances)
- Class #5: Oxidizing substances and organic peroxides
- Class #6: Toxic Substances and Infectious Substances
- Class #7: Radioactive Materials
- Class #8: Corrosive Substances
- Class #9: Miscellaneous Hazardous Materials / Substances

All nine hazard classes can be found in transportation incidences.

Fixed Facility

All nine hazard classes can be found at fixed facilities. Certain conditions can exacerbate release incidents and these events include fixed facilities:

- Micrometeorological effects of buildings and terrain which alters the dispersion of hazardous materials.
- Proximity to surface water and ground water resources.
- 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.

The type of material released, distance, and related response time of emergency responders also significantly impact severity and scope of hazardous material releases and clean-up efforts. Areas most proximal to the release are usually at the greatest level of risk, but depending on the material, a release can travel great distances or remain present in the environment for long periods of time (centuries or millennia for some radioactive materials) resulting in chronic and extensive impacts on people and the environment.

Oil and gas well drilling can have a variety of effects on the environment. Abandoned oil and gas wells, not properly plugged can contaminate groundwater and consequently drinking water wells. Surface waters and soil are sometimes polluted by brine, a salty wastewater product of oil and gas well drilling, and from oil spills occurring at the drilling site or from a pipeline breach. A pipeline breach or an accidental dispersal can spoil public drinking water supplies and can be particularly detrimental to vegetation and aquatic animals, making water safety an important factor in oil and gas extraction. In some cases, associated with hydraulic fracturing (fracking), methane has been found contaminating drinking water in surrounding areas.

Natural gas fires occur when natural gas is ignited at the well site. Often, these fires erupt during drilling when a spark from machinery or equipment ignites the gas. The initial explosion and resulting flames have the potential to seriously injure or kill individuals in the immediate area. These fires are often difficult to extinguish due to the intensity of the flame and the abundant fuel source.

4.3.17.3. Past Occurrence

In the past, Susquehanna County has experienced a moderate number of hazardous material events related to transportation. From 2018 to 2023, there were approximately twenty-one reported events related to hazardous material incidents for transportation in the county. Five of these events are categorized in the county interface as “diesel fuel leaks” and one is categorized as “transportation accident.” The most recent events are recorded in the WebEOC and county reporting software and are summarized in *Table 61 – Hazardous Material Incidents*. Transportation accidents that involved hazardous materials were included in the table below.

Table 61-Hazardous Material Incidents

Hazardous Material Incidents		
Municipality	**Date**	**Event**
Liberty Township	11/02/2018	Excavator Fire – HazMat
Gibson Township	11/13/2018	Dumping – Biohazardous Waste
Dimock Township	11/16/2018	Fuel Leak into Storm Drain
New Milford Township	01/07/2019	Diesel Fuel Spill
Susquehanna County	10/29/2019	Fuel Spill from Punctured Fuel Tank
Great Bend Township	12/16/2019	Fuel Leak

Hazardous Material Incidents		
Municipality	**Date**	**Event**
Lenox Township	04/30/2019	Fuel Spill
Susquehanna County	08/05/2019	HazMat Incident
Auburn Township	06/21/2020	Drinking Water Contamination
Bridgewater Township	08/30/2020	Diesel Fuel Spill
Lenox Township	09/28/2020	Stone Crusher Fire and Fuel Spill
Bridgewater Township	09/30/2020	Gasoline Spill
New Milford Township	10/20/2021	Sewage Spill
Montrose Borough	12/22/2021	Transportation Accident
Clifford Township	12/27/2021	Fuel Spill
Montrose Borough	02/08/2022	Airborne Natural Gas Release
Susquehanna Depot Borough	03/23/2022	Home Heating Oil Leak
Rush Township	04/26/2022	Diesel Fuel Spill
Middletown Township	05/25/2022	Waste Oil Spill
Uniondale Borough	06/20/2022	Diesel Fuel Spill
Harford Township	09/15/2022	Industrial Equipment Fire
Clifford Township	03/03/2023	Home Heating Oil Spill
Franklin Township	03/17/2023	Vehicle Fire with Fuel Release
New Milford Township	03/21/2023	Diesel Fuel Spill
Source: WebEOC, County Reporting System, 2023		

Hazardous materials can be transported by air, sea, and land (over the road or through pipelines). Transportation accidents along roadways is a regular occurrence and a large number of hazardous materials are transported by roadway every day.

Fixed Facility

There have been a number of hazardous material incidents in Susquehanna County in the past but few of those events have been related to fixed facilities in the county. Three of the twenty-four reported events in Susquehanna County's data from 2018 to 2023 are related to fixed facility events. One of those events is categorized as a "stone crusher fire and fuel spill" and two events are categorized as "home heating oil leaks or spills." More recent events are recorded in WebEOC and county reporting software and are summarized in *Table 61 – Hazardous Material Incidents*.

The EPA tracks the management of hazardous materials in facilities that handle significant amounts of hazardous materials. There is only one Toxic Release Inventory (TRI) location in Susquehanna County as of 2023 and its information is summarized in *Table 62 – TRI Facilities*. Production-related waste managed is a collective term to refer to how much of a chemical is recycled, combusted for energy recovery, treated for destruction, or disposed of, or otherwise released on and off site.

Table 62-TRI Facilities

Toxic Release Inventory Facilities			
Name	**Industry Sector**	**Chemical**	**Production-related Waste Managed (lbs)**
Sponge-Jet, Inc.	Nonmetallic Mineral Product	Toulene diisocyanate (mixed isomers)	Less than 1
Source: EPA, 2023			

4.3.17.4. Future Occurrence

Transportation

While many incidents involving hazardous material releases have occurred in Susquehanna County in the past, they are generally difficult to predict. The nature of traffic accidents is that there is little to no warning for their occurrence, and they can have disastrous results. An occurrence is largely dependent upon the accidental or intentional actions of a person or group.

Fixed Facility

Hazardous material release incidents are generally difficult to predict, but the presence of such dangerous materials warrants preparation for accidental or intentional release events. Emergency response agencies in Susquehanna County should be prepared to handle the types of hazardous materials housed and used the SARA Title III facilities, TRI facilities, and oil and gas wells that are located within the county. The Federal Superfund Amendments and Reauthorization Act (SARA) is also known as the Emergency Planning and Community Right-to-Know Act (EPCRA), and the Local Emergency Planning Committees (LEPCs) are designed by EPCRA to ensure that state and local communities are prepared to respond to potential chemical accidents.

4.3.17.5. Vulnerability Assessment

Transportation

Quick response to transportation accidents involving hazardous materials minimizes the volume and concentration of hazardous materials that are transported and dispersed through the air, water, and soil. Every municipality within Susquehanna County is vulnerable to hazardous materials incidents caused along a transportation route. These incidents can occur along highways, railways, and pipelines. *Figure 45 – Environmental Hazard Transportation Vulnerability Map* identified the 2,000-foot hazard corridor for all major highways in

Susquehanna County. *Figure 46 – Annual Truck Traffic Percentages* identifies the annual truck traffic percentages for all of the roadways in Susquehanna County.

Fixed Facility

Populations, critical infrastructure, and natural habitats within 1.5 miles of SARA Title III and Toxic Release Inventory sites are vulnerable to hazardous material incidents.

Private water suppliers such as domestic drinking water wells in the vicinity of oil and gas wells are at risk of contamination from brine and other pollutants, including methane, which can pose a fire and explosive hazard. Ideally, vulnerability of private drinking well owners would be established by comparing the distance of drinking water wells to known oil and gas well locations, but this extensive detailed data is not readily available. Private drinking water is largely unregulated and information on these wells is voluntarily submitted to the Pennsylvania Topographic and Geologic Survey by water well drillers, and the existing data is largely incomplete and/or not completely accurate. Dimock Township contains the most oil and gas wells. Clifford Township contains the most drinking water wells, meaning that Clifford Township is most vulnerable to water contamination from oil and gas wells. *Table 63 – Oil and Gas Wells & Drinking Water Wells* illustrates the type of well and the local domestic drinking water wells for each municipality.

Table 63-Oil and Gas Wells & Drinking Water Wells

Conventional Oil & Gas Wells in Susquehanna County					
Municipality	**Type of Well**				**Water Wells**
	Active	**Abandoned**	**Inactive**	**Proposed**	
Apolacon Township	0	0	0	2	48
Ararat Township	0	0	0	0	60
Auburn Township	0	0	0	0	149
Bridgewater Township	0	0	0	0	285
Brooklyn Township	0	0	0	0	115
Choconut Township	1	0	3	0	53
Clifford Township	0	0	0	0	308
Dimock Township	0	0	1	4	158
Forest City Borough	0	0	0	0	0
Forest Lake Township	1	0	0	1	127
Franklin Township	0	0	0	0	53
Friendsville Borough	0	0	0	0	8
Gibson Township	0	0	0	0	100
Great Bend Borough	0	0	0	0	0
Great Bend Township	0	0	0	1	147
Hallstead Borough	0	0	0	0	5

Conventional Oil & Gas Wells in Susquehanna County					
Municipality	**Type of Well**				**Water Wells**
	Active	**Abandoned**	**Inactive**	**Proposed**	
Harford Township	1	0	1	0	169
Harmony Township	0	0	0	0	34
Herrick Township	0	0	0	0	110
Hop Bottom Borough	0	0	0	0	7
Jackson Township	0	0	0	0	88
Jessup Township	1	0	0	0	49
Lanesboro Borough	0	0	0	0	1
Lathrop Township	0	0	0	0	108
Lenox Township	1	0	0	1	175
Liberty Township	0	0	0	0	76
Little Meadows Borough	0	0	0	0	28
Middletown Township	0	0	0	0	49
Montrose Borough	0	0	0	0	33
New Milford Borough	0	0	0	0	0
New Milford Township	0	0	0	3	297
Oakland Borough	0	0	0	0	0
Oakland Township	0	0	1	0	38
Rush Township	0	0	0	1	109
Silver Lake Township	1	0	0	0	186
Springville Township	1	0	0	3	106
Susquehanna Depot Borough	0	0	0	0	3
Thompson Borough	0	0	0	0	0
Thompson Township	0	0	0	0	60
Union Dale Borough	0	0	0	0	18
Total:	**7**	**0**	**6**	**16**	**3,360**
Source: PA DEP, 2023					

Figure 43-Oil and Gas Well Locations

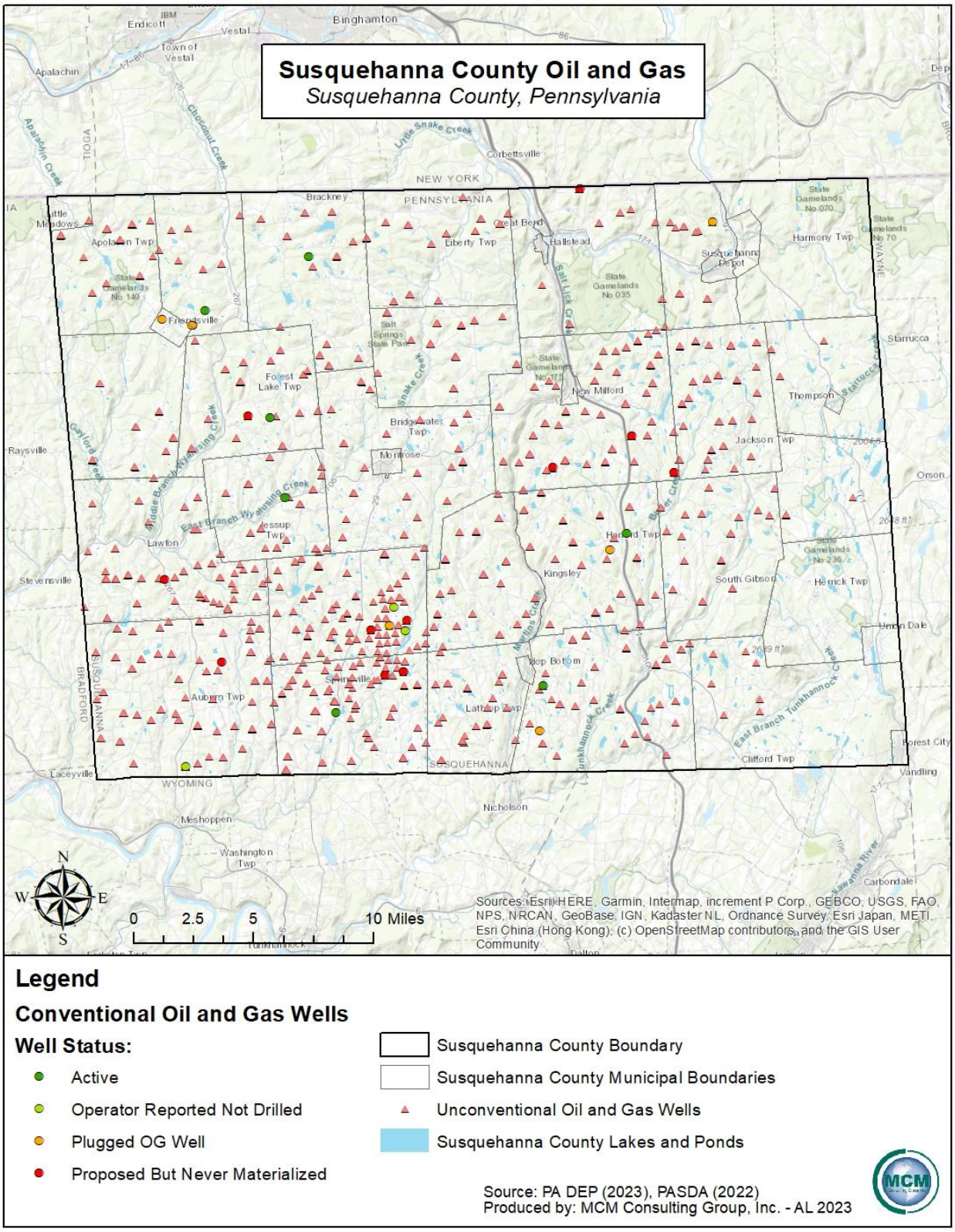


Figure 44-Hazardous Waste Locations

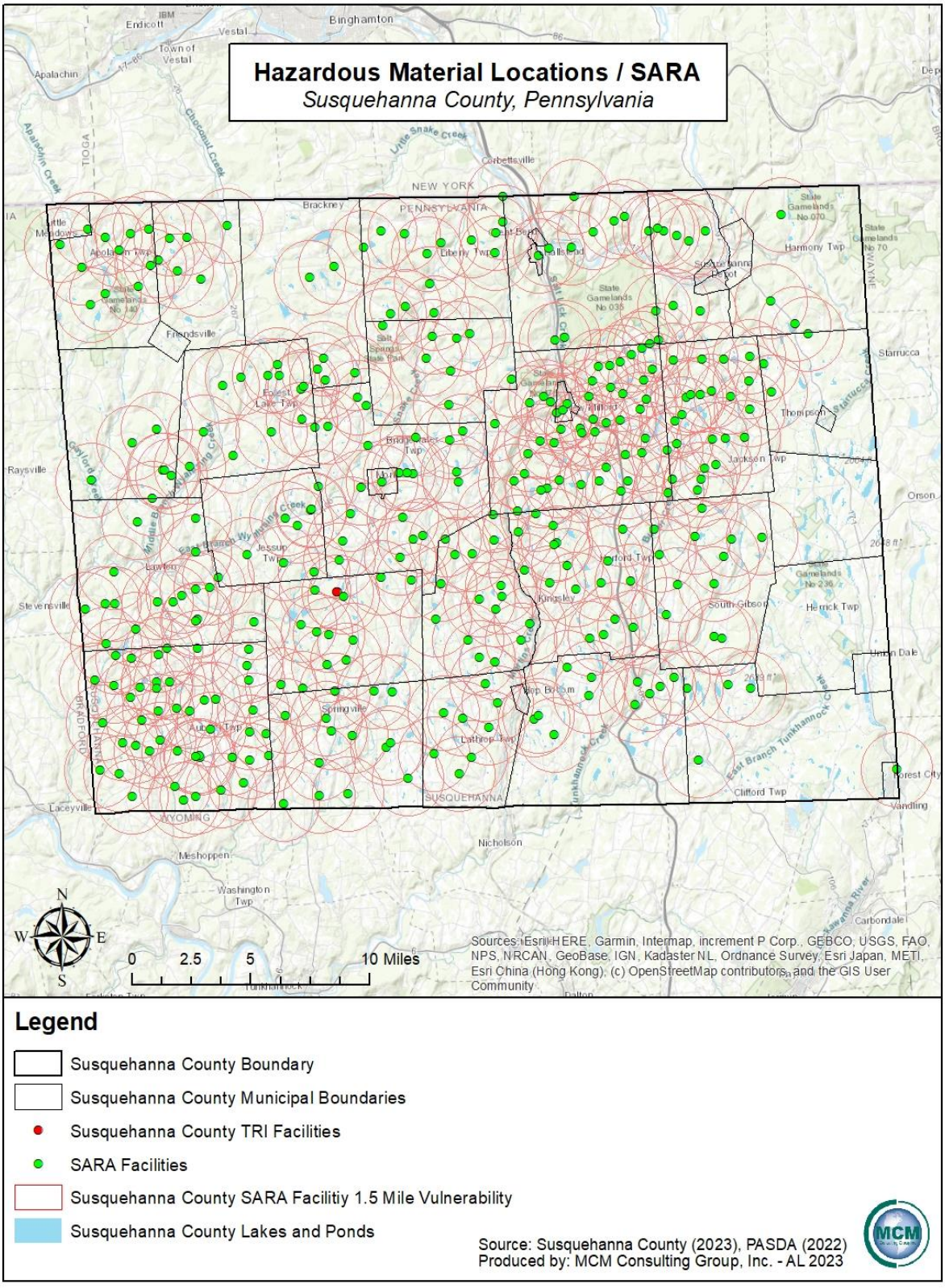


Figure 45-Environmental Hazard Transportation Vulnerability

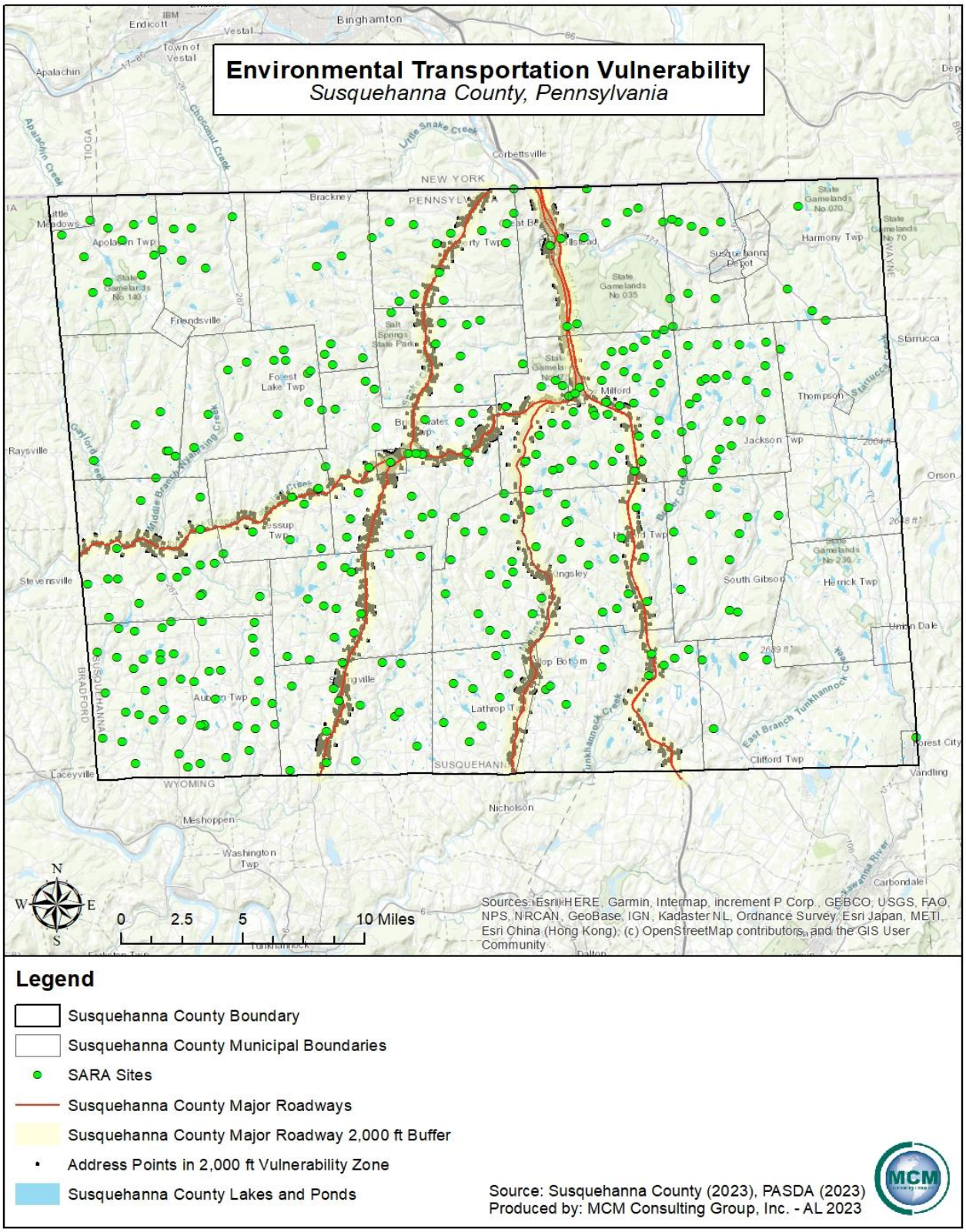
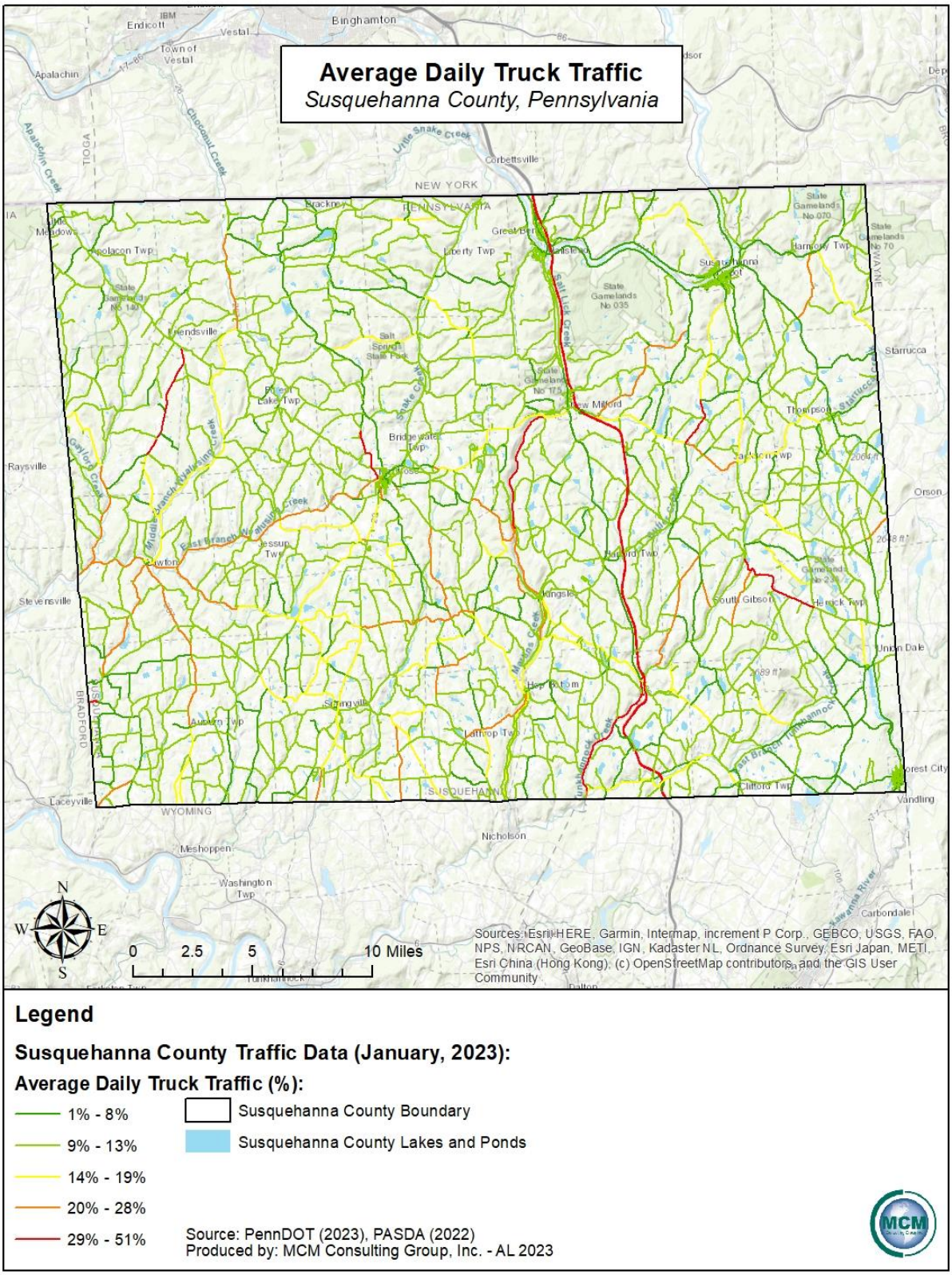


Figure 46-Annual Truck Traffic Percentages



4.3.18. Mental Health Services

4.3.18.1. Location and Extent

Mental health services in Susquehanna County are at an increased risk of being overstressed and overtaxed due to the demand of those services across the county. Often these mental health services struggle with the limited availability of skilled personnel and resources at certain times of day, and the number of individuals who assist with mental health services is variable by location. The entire county is vulnerable to mental health service shortages, and this is not defined to any one geographic municipality or local jurisdiction.

4.3.18.2. Range of Magnitude

As with emergency services, the success of the mental health services in Susquehanna County is dependent on finances, political climates, leadership, and significant high-profile events. The mental health service shortages have a severe impact on the life safety of Susquehanna County. There is a large need in Susquehanna County to ensure that mental health services continue and that those services are available to the public for continued support. A worst case scenario would be a breakdown of all mental health facilities that serve the county. This could result in adverse health effects and a reduction in life safety in Susquehanna County.

Based on information published by the National Alliance on Mental Illness in 2023, one in five adults in the United States will experience mental illness each calendar year. Based on that same information, approximately one in twenty adults in the United States will experience serious mental illness each year. Based on information provided by the Center for Disease Control and Prevention, one in five minor aged 13 to 18 have either had or will have a debilitating mental illness. Based on these estimates from the National Alliance on Mental Illness and the Center for Disease Control and Prevention, approximately 7,687 individuals in Susquehanna County experience mental illness each year, 1,922 individuals in Susquehanna County experience serious mental illness each year, and 420 minors have had or will have a debilitating mental illness in Susquehanna County.

4.3.18.3. Past Occurrence

There have been no official records on mental health service shortages in Susquehanna County. Mental health service shortages increased during the COVID-19 pandemic, specifically between January 2020 and May 2023. There are mental health service shortages that occur on a day-to-day basis that most likely will go unreported in an area or a jurisdiction. If an individual cannot access mental health services, it is likely that they are also not reporting those access issues to the local government or the county.

4.3.18.4. Future Occurrence

Shortages in mental health services is expected to stay relatively the same during this planning period if political support and capabilities remain consistent. With the end of the COVID-19 pandemic, more mental health services have allowed for in person assistance with mental health issues. Increased mental health service shortages could occur if political responses to mental health services do not meet the demand for those services, or if priorities change for political leadership in a given area.

4.3.18.5. Vulnerability Assessment

As discussed above, there are approximately 10,000 individuals in Susquehanna County who are either experiencing or will experience a mental health illness in their lifetime. The local planning team identified mental health service shortages as a high risk hazard during the risk factor assessment process. The numerical score for the risk factor for mental health service shortages is 3.7. Susquehanna County has a significant vulnerability to mental health services due to the small number of therapists and psychiatrists physically within the county.

To increase the availability of mental health services in an area, first responders could also be trained for different mental health events. Training first responders, or placing a trained mental health professional, would allow for a faster response to mental health events, and ensure that the proper resources are available for what the situation requires.

Additionally, the American Red Cross follows up with individuals in a disaster area within two to three days following an event to ensure that individuals effected by an event are receiving the physical and mental care necessary. This type of response would occur in Susquehanna County if a disaster event were to occur.

While not located in Susquehanna County, the Northeast Behavioral Health Care Consortium (NBHCC) offers and provides mental health resources in the northeastern Pennsylvania region. The NBHCC also offers a list of providers for services in northeastern Pennsylvania.

Table 64 – Susquehanna County Mental Health Resources lists the mental health resources that citizens of Susquehanna County can use in the event of a mental health event or for treatment. Information related to many of the resources listed below can be found on the county's website at the following web address: https://www.susqco.com/community-information/community-resources

Table 64-Susquehanna County Mental Health Resources

Susquehanna County Mental Health Resources		
Resource Name	**Location**	**Service**
Trehab – Susquehanna County	Montrose, PA	Addiction care and mental health care
Susquehanna County Interfaith	Montrose, PA	Mental health and faith based care

Mental Health Resources located outside Susquehanna County		
Northeast Behavioral Health Care Consortium	Moosic, PA (Lackawanna County)	Behavioral health services
Source: Susquehanna County Local Planning Team, 2023		

Additional resources on mental health related topics can be found on the PA 211 social services database and website. This website can be used for finding outpatient locations, and assistance in the event of a mental health related incident or event. Crisis hotlines for mental health include dialing 988 and the suicide prevention hotline at 1-800-273-8255 (TALK).

4.3.19. Opioid Epidemic

4.3.19.1. Location and Extent

Pennsylvania and the United States at large have been experiencing an epidemic of opioid drug abuse. According to the Pennsylvania Department of Health, the opioid overdose epidemic is the worst public health crisis in Pennsylvania. It affects Pennsylvanians across the state, from big cities to rural communities. Opioid addiction has increased drastically over the last year due to the hardships faced from the COVID-19 pandemic. Opioid use has increased since the beginning of the COVID-19 pandemic which is being attributed to the uncertainty people are feeling due to the pandemic.

Opioids, mainly synthetic opioids (other than methadone), are currently the main driver of drug overdose deaths. According to the Center for Disease Control and Prevention (CDC), 72.9% of opioid-involved overdose deaths involved synthetic opioids. Opioid addiction occurs when an individual becomes physically dependent on opioids. Opioids are a class of drug that reduces pain by interacting with receptors on nerve cells in the body and brain. The use of opioids is a broad term and includes opiates, which are drugs naturally extracted from certain types of poppy plants, and narcotics. Opioids can also be synthetically made to emulate opium. Opioid drugs are highly addictive and typically result in increasing numbers of overdose deaths both prescribed (e.g. fentanyl) and illicit (e.g. heroin) opioids. Overdose deaths from opioids occur when a large dose slows breathing, which can occur when opioids are combined with alcohol or antianxiety drugs. While generally prescribed with good intentions, opioids can be over-prescribed, resulting in addiction.

According to the Drug Enforcement Administration (DEA), opioids come in various forms such as tablets, capsules, skin patches, powder, chunks in various colors from white to brown/black, liquid form for oral or injection use, syrups, suppositories, and lollipops. The Centers for Disease Control and Prevention (CDC) defines the following as the three most common types of opioids:

- **Prescription Opioids**: Opioid medication prescribed by doctors for pain treatment. These can be synthetic oxycodone (OxyContin), hydrocodone (Vicodin), or natural (morphine).
- **Fentanyl**: A powerful synthetic opioid that is 50 to 100 times more powerful than morphine and used for treating severe pain; illegally made and distributed fentanyl is becoming more prevalent.
- **Heroin**: An illegal natural opioid processed from morphine which is becoming more commonly used in the United States.

Opioids are highly addictive. They block the body's ability to feel pain and can create a sense of euphoria. Additionally, individuals often build a tolerance to opioids, which can lead to misuse and overdose.

While other addictive substances such as methamphetamines and alcohol can be problematic for the health of individuals in Susquehanna County, this profile focuses on opioid drugs and the opioid epidemic. The opioid crisis was declared to be a public health emergency on 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 Tom Wolf declared the opioid epidemic to be a statewide public health disaster emergency for Pennsylvania. The declaration is intended to enhance response and increase access to treatment.

4.3.19.2. Range of Magnitude

Opioid addiction can lead to overdose, which can be fatal. This type of addiction can affect others that are not the user themselves. The most dangerous side effect of an opioid overdose is depressed breathing. The lack of oxygen to the brain causes permanent brain damage, leading to organ failure, and eventually death. Signs and symptoms include respiratory depression, drowsiness, disorientation, pinpoint pupils, and clammy skin. Opioid addiction can also be passed from mother to child in the womb. This condition, known as neonatal abstinence syndrome, has increased five-fold, according to the National Institute on Drug Abuse (NIDA). This results in an estimated 22,000 babies in the United States born with this condition. First responders such as paramedics, police officers, and firefighters are also affected by the opioid addiction crisis. First responders face exposure risk due to an increase in emergency calls due to an increase in the crisis, particularly to synthetic fentanyl. Two to three milligrams of fentanyl can cause an induced respiratory depression, arrest, and possibly death to occur. Since fentanyl is indistinguishable from several other narcotics and powdered substances, first responders must take extra precaution when dealing with calls related to drug abuse. A worst-case scenario with the opioid epidemic in Susquehanna County would be a high number of overdoses between residents and/or first responders throughout the county.

According to the Center for Disease Control and Prevention (CDC), more than 192 Americans die every day from an opioid overdose. In 2021, a total of 5,343 deaths related to opioid use occurred in Pennsylvania. From February 2020 to February 2021, there has been a 3.34% increase across the commonwealth of Pennsylvania. This could indicate a significant increase in opioid overdoses in Pennsylvania. Heroin and fentanyl are the two drugs most often found in overdose deaths, and they are considered to be highly available and nearly ubiquitous in Pennsylvania.

4.3.19.3. Past Occurrence

In 2021, there was an estimated total of 107,622 drug-related overdose deaths in the United States. This is the highest number of overdose deaths ever recorded in a 12-month period, according to the recent provisional date from the CDC. The Pennsylvania Attorney General's Office notes that approximately 5,168 people died from overdose deaths in Pennsylvania in 2021. There were a total of forty-six drug related deaths in Susquehanna County from 2015 – 2020. There was a total of at most nine overdose deaths in 2015, ten deaths in 2016, at most nine deaths in 2017, no deaths in 2018, at most nine deaths in 2019, and at most nine in 2020. The Pennsylvania Department of Health does not publish overdose death numbers under ten deaths per year by county, so the years with between one and nine deaths have been noted of at most nine in this report. The most common age group for opioid abuse in Susquehanna County is the 35 to 44 years of age demographic. In 2020, it was reported by the Pennsylvania Department of Health that approximately 74% of any drug overdose deaths occurred in white individuals. In Susquehanna County the overdose rate of males is greater than the overdose rate of females. The most used opioids in Susquehanna County are fentanyl, heroin, cocaine, benzodiazepines, and Rx opioids.

Table 65-Drugs Present in 2020 Pennsylvania Overdose Deaths

Drugs Present in 2020 PA Overdose Deaths	
Drug Category	**Percent Reported Among 2020 Decedents**
Cannabis	25%
Cocaine	20%
Heroin	15%
Fentanyl	14%
Methamphetamine	10%
Prescription Opioids	5.5%
Cathinones	5.5%
Benzodiazepines	5%
Source: DEA, 2020	

4.3.19.4. Future Occurrence

Both Susquehanna County, and Pennsylvania as a whole, have seen a steady rise in opioid related deaths over the last several years, with drug-related death rates increasing at a high percentage. Future occurrences of opioid addiction and overdose are unclear as the state moves forward with overdose prevention initiatives through the use of Naloxone, alternative pain treatments, improvement of tools for families and first responders, and expansion of treatment

access. The Wolf Administration has taken various approaches to help with the prevention of mass future occurrences across the Commonwealth. To help prevent future drug abuse and protect individual health among communities in Pennsylvania, the Pennsylvania's Prescription Drug Monitoring Program (PA PDMP) collects information on all filled prescriptions for controlled substances. This information helps health care providers safely prescribe controlled substances and helps patients get correct treatment. The PA PDMP also has drug take-back boxes located in the counties for an easy, convenient location where anyone can dispose of their unused, expired, or unwanted prescriptions to help lower potential drug overuse. In Susquehanna County, there are two drug take-back boxes located throughout the county. The drug take-back box locations include The Susquehanna County Courthouse in Montrose Borough and the Pennsylvania State Police Troop G Barracks - Gibson. These locations help reduce future occurrences of opioid use from occurring by reducing the available supply of prescription medications and opioids in Susquehanna County.

In the event of an opioid overdose, death can sometimes be prevented with the use of the drug naloxone. Pennsylvania Secretary of Health, Dr. Rachel Levine, previously signed updated standing order prescriptions of naloxone. The updated standing orders include the 2mg dose auto injector which has recently become available. Naloxone is a medication that can reverse an overdose that is caused by an opioid drug (i.e., prescription pain medication or heroin). Naloxone is used to block the effects of opioid and is sold under the brand name of Narcan. When administered during an overdose, naloxone blocks the effects of opioids on the brain and restores breathing within two to eight minutes. Naloxone has been used safely by medical professionals for more than 40 years and has only one function to reverse the effects of opioids on the brain and respiratory system in order to prevent death. Emergency medical responders have access to the treatment, and as of 2015, naloxone is available without a prescription in Pennsylvania. Also, with the January 10, 2018 disaster declaration, emergency medical technicians (EMTs) are now allowed to leave naloxone behind at a scene, further increasing the distribution and accessibility of the lifesaving medication. According to a study published in September 2018, drug users reported that users often have multiple overdoses in the course of their drug use, and availability of naloxone has saved many lives. While the introduction of naloxone has been a significant benefit to the fight against opioid abuse, efforts to prevent future overdoses are still underway. Naloxone is another way to reduce future occurrences of the opioid epidemic from occurring in Susquehanna County.

Opioid drugs have been a problematic and addictive method for patients to deal with pain. Employing alternative approaches to pain management could prevent patients from ever being introduced to addictive opioids, especially considering the most common overdose drugs in Susquehanna County have been prescription opioids. A possible alternative pain treatment comes from hemp extracted cannabidiol, or CBD. Unlike THC (the psychoactive constituent of cannabis), CBD is non-psychoactive and does not have the same intoxicating effect as THC;

however, CBD can provide relief from pain, inflammation, anxiety, and even psychosis. CBD is legal without a prescription throughout the United States of America.

4.3.19.5. Vulnerability Assessment

Opioid overdoses have resulted in many tragic deaths in Pennsylvania and many people have been affected by the epidemic through the loss of either a family member, a close friend, or member of their community. Opioid addiction is a direct detriment to the personal wellbeing of addicts, a burden to their families and communities, and a strain to the emergency response system that cares for overdose victims. In general, jurisdictions that are more densely populated are more vulnerable to opioid addiction threats as access to the drugs increases. However, rural communities in general experience larger per-capita opioid-related deaths. Jurisdictional losses in the opioid addiction crisis stem from lost wages, productivity, and resources rather than losses to buildings or land. Many counties across the Commonwealth, including Susquehanna County, have seen an increase of time and resources devoted to the opioid epidemic as overdose and response increase.

The vulnerability in the county depends on the number of additional risk factors on the vulnerable population such as genetic, psychological, and environmental factors that play a role in addiction. The known risk factors of opioid misuse and addiction include poverty, unemployment, family and/or personal history of substance abuse, history of criminal activity, history of severe depression or anxiety, and prior drug/alcohol rehabilitation. In addition, women have a unique set of risk factors for opioid addiction. Women are more likely than men to have diagnosed chronic pain. Compared with men, women are also more likely to be prescribed opioid medications, to be given higher doses, and to use opioids for longer periods of time. Women may also have biological tendencies to become dependent on prescription pain relievers more quickly than men. Therefore, if the county were to have a population with a great amount of these risk factors, the county would be very vulnerable to the opioid epidemic.

The COVID-19 pandemic and its periods of quarantine caused vulnerability in opioid users throughout Susquehanna County. It is likely that the emergence of COVID-19 and subsequent disruptions in health care and social safety nets combined with social and economic stressors has fueled the opioid epidemic. The COVID-19 pandemic has challenged vulnerable populations, including those with opioid use disorders. The opioid epidemic and COVID-19 pandemic are intersecting and presenting unprecedented challenges for families and communities. Opioid use affects respiratory and pulmonary health which may make those with opioid use disorders more susceptible to COVID-19. In addition, chronic respiratory disease is already known to increase overdose mortality risk among people taking opioids, and decreased lung capacity from COVID-19 could lead to similar health effects. Secondary impacts from the COVID-19 pandemic, including disruptions of treatment and recovery services, limited access to mental health services and peer support, disrupted routines, loss of work, and stress, may lead to increased opioid use

and risk of relapse for those in recovery. Risk factors also arise from indirect factors including housing instability and incarceration. Those with opioid use disorders are at higher risk for housing insecurity, homelessness, and incarceration. Congregate living facilities such as homeless shelters, jails, and prisons are high-risk environments for coronavirus transmission, and there are challenges in implementing recommendations from the CDC such as social distancing and quarantine. Additionally, the pandemic took away the attention from the media, from legislators, and from public health agencies that was being focused on the opioid crisis. The opioid epidemic in Pennsylvania increased 22.9% since the beginning of the pandemic.

Additionally, first responders and medical personnel are also a very vulnerable population when dealing with the opioid epidemic. Fentanyl and related substances are hazardous materials, which cause the environment and the people around the substance to be vulnerable. Contact with fentanyl can impact first responders and others that are related to the opioid user. Depending on the potency of the drug, it can take as little as the equivalent of few grams of table salt to cause health complications. There have been several reports nationally of first responders accidentally overdosing on fentanyl through brief skin contact or the drug becoming airborne. It is best for first responders to err on the side of caution to avoid any potential exposure. The American College of Medical Toxicology (ACMT) and the American Academy of Clinical Toxicology (AACT) suggest that nitrile gloves provide sufficient protection for handling fentanyl, and for "exceptional circumstances where the drug particles or droplets suspended in the air, an N95 respirator provides sufficient protection". Other environmental structures such as streams, rivers, and lakes have been known to contain traces of opioids and other drugs within them. These traces come from human urine, feces, or medications that have been discarded in the bathroom. The Environmental Protection Agency (EPA) suggests that while the risks of pharmaceuticals found in wastewater, ambient water, and drinking water are low, further research is needed. State facilities are not at risk to the opioid crisis, but there are some occupation-specific risks that may make some employees more vulnerable. State employees working in direct patient care are vulnerable to fentanyl exposure. However, the physical plant and facilities of the Commonwealth and Susquehanna County are not likely to experience losses from the opioid addiction crisis. Absenteeism associated with an opioid addiction in state facilities located in high-risk areas could lead to economic loss through lost productivity and increased medical costs. *Figure 47 – Opioid Overdose Deaths in Pennsylvania 2020* and *Figure 48 – Opioid Overdose Deaths in Pennsylvania 2021* illustrate the number of deaths per county in the state of Pennsylvania.

Figure 47-Opioid Overdose Deaths in Pennsylvania 2020

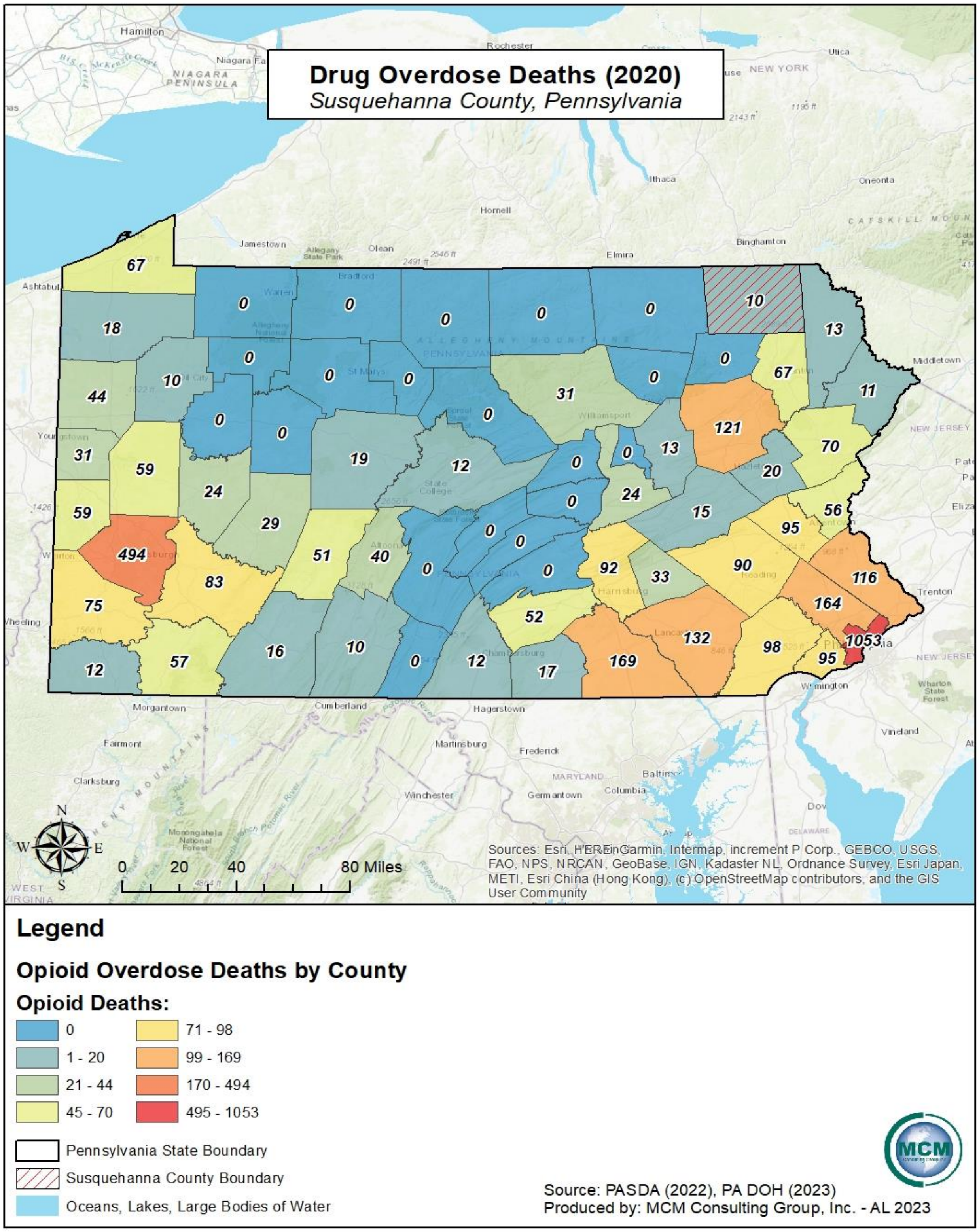
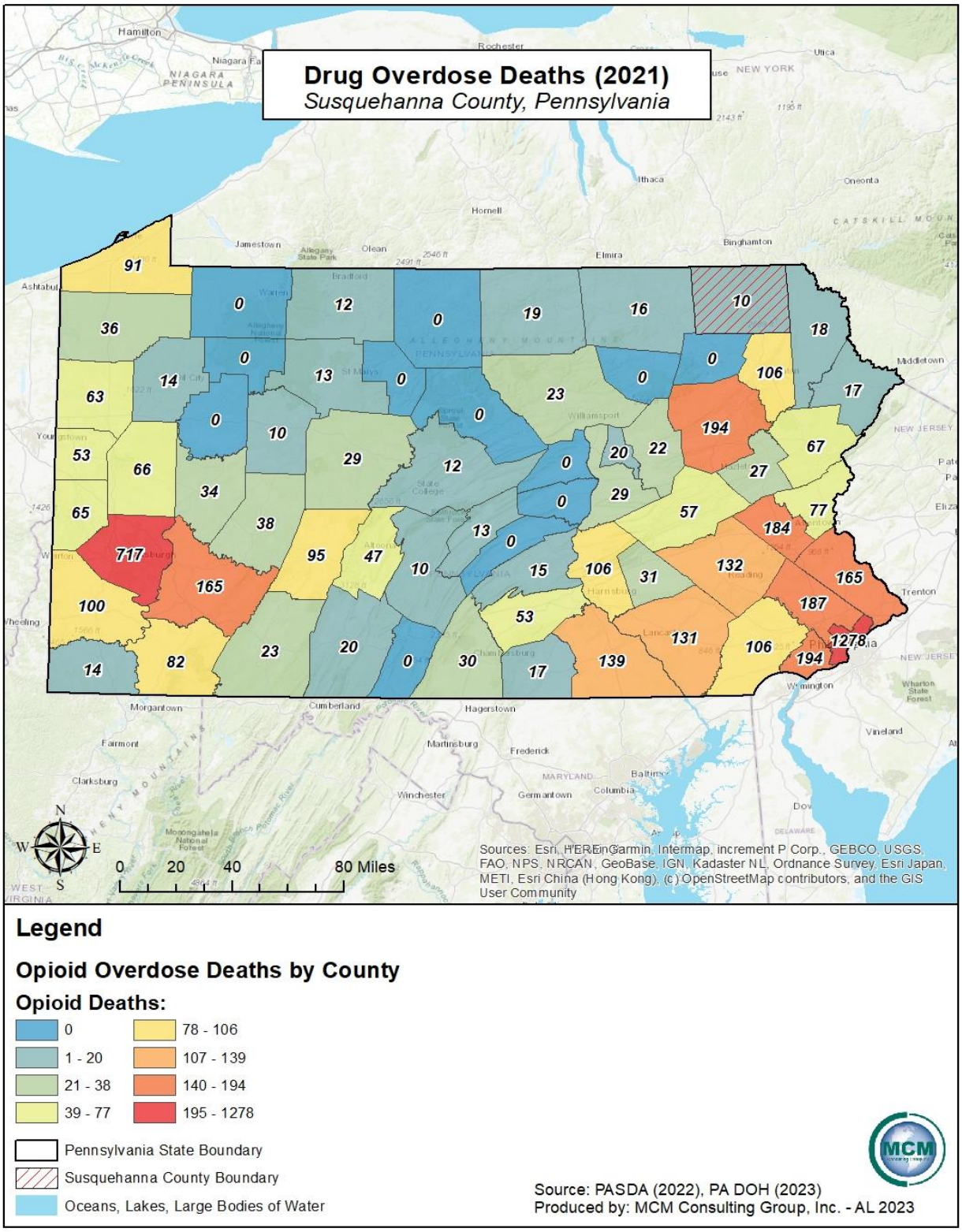


Figure 48-Opioid Overdose Deaths in Pennsylvania 2021



4.3.20. Terrorism/Cyberterrorism

4.3.20.1. Location and Extent

Following several serious international and domestic terrorist incidents during the 1990s and early 2000s, 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)

Cyber-terrorism is the unlawful use of force and violence over technological methods to cause harm to financial security, identity information, personal information, and attacking personal computers, mobile phones, gaming systems, and other Bluetooth or wirelessly connected devices. Cyber-terrorism can be just as damaging to infrastructure as conventional terrorism, due to the large amount of business that is carried out over the internet, through wirelessly connected devices, or from employees of companies working remotely.

The Federal Bureau of Investigations (FBI) further characterizes terrorism as either domestic or international, depending on the origin, base, and objectives of the terrorist organization. Often, the origin of the terrorist or person causing the hazard is far less relevant to mitigation planning than the hazard itself and the consequences. However, it is important to consider that the prevalence of homegrown violent extremists (HVEs) has increased in recent years, with individuals able to become radicalized on the internet. In a speech on August 29, 2018, addressed to the 11th annual Utah National Security and Anti-Terrorism Conference, FBI Director Christopher Wray describes HVEs as "the primary terrorist threat to the homeland here today, without question."

Community lifeline facilities are either in the public or private sector that provide essential products and/or services to the general public. Community lifeline 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. Community lifeline facilities identified in the county are hospitals and health care facilities, schools, childcare centers, fire stations, police departments, municipal buildings, and hazardous waste facilities. 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 major highway and marginalized groups such as LGBTQ persons and racial, religious, or other minorities.

Potential targets include:

- Commercial facilities
- Family planning clinics/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
- Cultural sites
- Government facilities

4.3.20.2. Range of Magnitude

Terrorism may include use of Weapons of Mass Destruction (WMD) (including chemical, biological, radiological, nuclear, and explosive weapons) which include arson, incendiary, explosive, armed attacks, industrial sabotage, intentional release of hazardous materials, and cyber-terrorism. Within these general categories, there are many variations. There is a wide variety of agents and ways for them to be disseminated, particularly in the case of biological and chemical weapons.

Terrorist methods can take many forms including:

- Active assailant
- Agri-terrorism
- Arson/incendiary attack
- Armed attack
- Assassination
- Biological agent
- Chemical agent
- Cyber-terrorism
- Conventional bomb or bomb threat
- Hijackings
- Release of hazardous materials
- Kidnapping
- Nuclear bomb
- Radiological agent

Active assailant incidents and threats can disrupt the learning atmosphere in schools, interfere with worship services, cause traffic to be re-routed, and use taxpayer assets by deploying police,

EMS and/or fire units. Susquehanna County has six school districts (public schools K through 12th grade) that include fourteen primary, secondary, and high schools. There are no post-secondary schools located in Susquehanna County.

The areas along major transportation routes can be susceptible to forms of public transit terrorist attacks. More populated areas of the county, including the county seat of Montrose Borough, can be susceptible to chemical, biological, radiological, nuclear, or explosive (CBRNE) events due to the concentration and density of residential communities and government activity and buildings. Secondary effects from CBRNE incidents can be damaging as well. Mass evacuations could result in congestion of roadways and possibly result in breakdown of civil order, further exacerbating the situation. Government operations may be disrupted due to the need to displace or operate under reduced capacity. Radiation fallout, hazardous chemical introduction into the groundwater or biologic/germ agents can cause long-term environmental damage.

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 cyber terrorism threat to institutions comes from any processes that are networked or controlled via computers.

Ransomware continues to be the leading threat, with Maze ransomware accounting for nearly half of all known cases in 2020. Cybercriminals have increasingly begun to steal proprietary – and sometimes embarrassing – data before encrypting it. The cybercriminal will then threaten to publicly release the stolen files if the victims do not provide financial transactions.

4.3.20.3. Past Occurrence

No major terrorism or cyber terrorism events have occurred in Susquehanna County, Pennsylvania. Cyber terrorism events are becoming more common in areas of local government, and these include counties near Susquehanna County, PA.

Significant international terrorism incidents in the United States include the World Trade Center bombing in 1993, the bombing of the Murrow Building in Oklahoma City in 1995, and the September 11th, 2001, attacks on the World Trade Center and the Pentagon. One of the aircrafts hijacked in the September 11th attacks crash landed in Somerset County, Pennsylvania before it reached its intended target. While fatalities and destruction at the intended target were avoided, all passengers on the flight perished.

While the largest scale terrorist incidents have often had international stimuli, many other incidents are caused by home grown actors who may have become radicalized through hate groups either in person or via the internet, and who may struggle with mental health issues. Hate groups such as the Ku Klux Klan (KKK), Aryan Nation, the New Black Panther Party, and more recently, the Alt-Right, Antifa, anarcho-communists, Proud Boys, plus conspiracy theorist believers/promoters such as QAnon, have been part of domestic terrorism in different forms. During the May 2020 George Floyd protests, anti-police individuals associated with one or more of the groups created incendiary devices to burn down the Minneapolis Third Precinct. On January 6, 2021, individuals associated with one or more of the groups, stormed the United States Capitol to disrupt the certification of the 2020 presidential election, resulting in five deaths and evacuation of Congress.

Active Shooters

An active assailant (shooter), as defined by the U.S. 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 firearms and there is not necessarily a pattern or method to their selection of victims. Throughout the year in 2023, there were a total of at least 160 mass shooting incidents in the United States according to the Gun Violence Archive. Often these shooters are HVEs. Two significant events have occurred in Pennsylvania in recent history: one occurred on October 27, 2018, when eleven people were killed by a gunman in the Pittsburgh neighborhood of Squirrel Hill; the gunman was a homegrown violent extremist and attacked the congregation of the Tree of Life Synagogue in a shooting that targeted the Jewish population and was fueled by the gunman's anti-Semitic, anti-immigrant, and anti-refugee sentiments. Another event occurred in January of 2019, where a gunman killed two people and permanently injured one inside P.J. Harrigan's bar in State College and later killed a homeowner and himself. One of the most tragic recent active shooters occurred in Uvalde, Texas, where an armored and masked gunman entered the Robb Elementary School on May 24, 2022 and killed nineteen students and two teachers. Another active shooter event occurred on November 22, 2022 when an employee at a Walmart in Chesapeake, Virginia entered the breakroom of the Chesapeake Walmart and killed six individuals before taking his own life.

Other active shooter events in the United States in recent years include Virginia Tech (April 2007), Sandy Hook Elementary School (December 2012), San Bernardino, California (December 2015), an Aurora, Colorado movie theater (July 2012) a church in Charleston, South Carolina (June 2015). An *Active Shooter Incidents 20-Year Review* by the FBI concluded that there has been a significant recent increase in frequency of active shooter incidents, and that most shooters were male. The report documents data from all the incidents, including location, commercial environments, educational environments, open spaces, military and other government properties, residential locations, houses of worship, and health care facilities (FBI, 2021). *Figure 49 – Active Shooter Incidents – 20 Year Active Shooter Summary* is one page from the report that illustrates a

numerical breakdown of shooting events for those twenty years. *Figure 50 – Education Environments* shows two more summary pages from the report that detail active shooter statistics in educational environments.

Figure 49-Active Shooter Incidents - 20 Year Active Shooter Summary

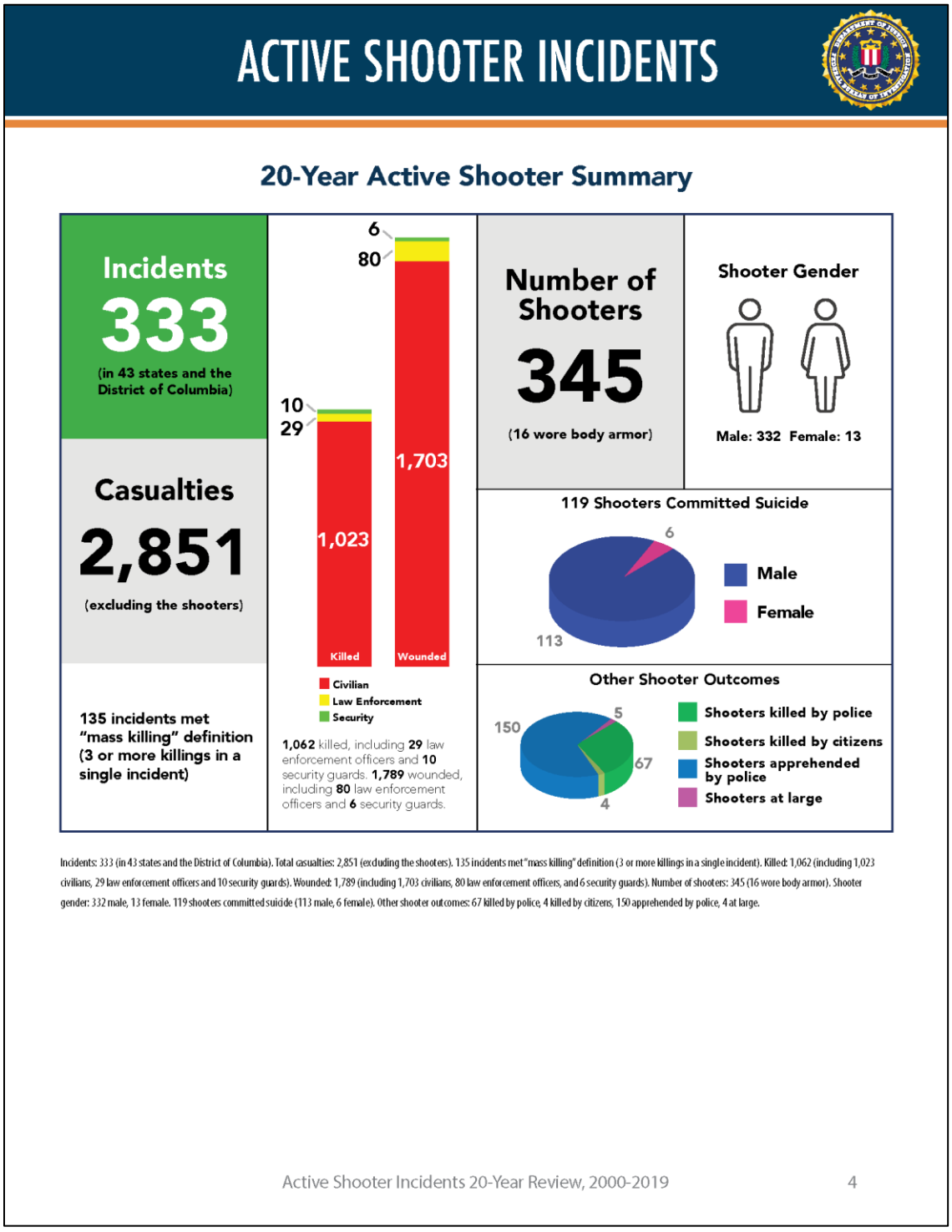


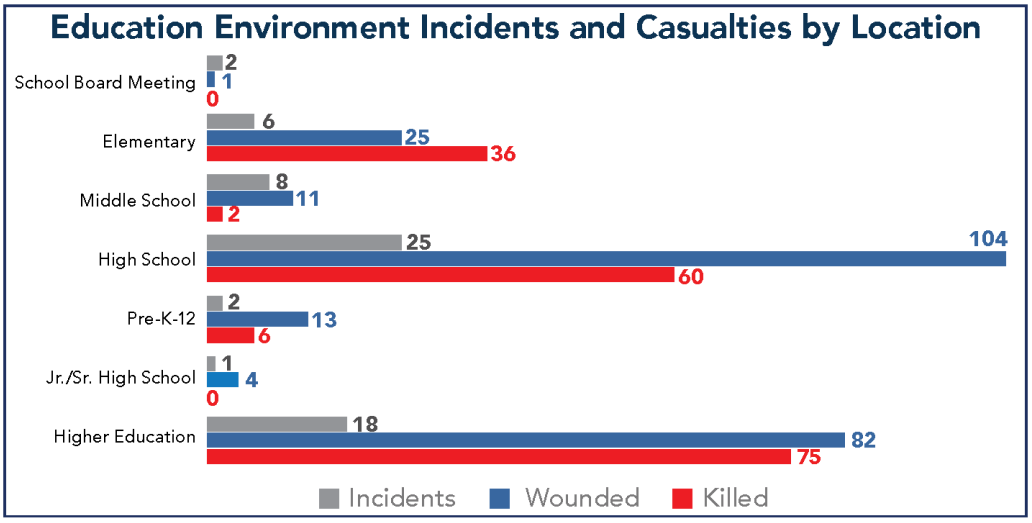
Figure 50-Education Environments

ACTIVE SHOOTER INCIDENTS

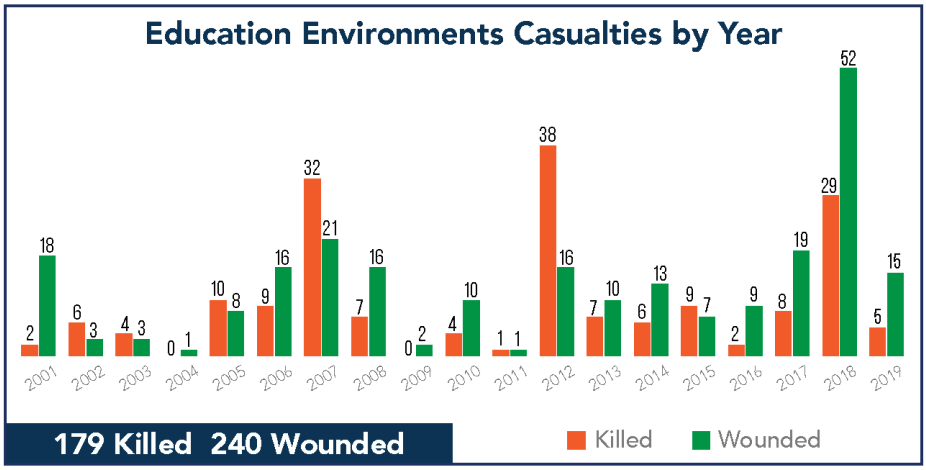
Education Environments

Quick Look:

Sixty-two incidents occurred in public and private educational settings, defined as schools covering pre-kindergarten to 12th grade, institutes of higher education, and school board meetings.



Education Environment Incidents and Casualties by Location: School Board Meeting (2 incidents, 1 wounded, 0 killed); Elementary (6 incidents, 25 wounded, 36 killed); Middle School (8 incidents, 11 wounded, 2 killed); High School (25 incidents, 104 wounded, 60 killed); Pre-K-12 (2 incidents, 13 wounded, 6 killed); Jr./Sr. High School (1 incident, 4 wounded, 0 killed); Higher Education (18 incidents, 82 wounded, 75 killed)

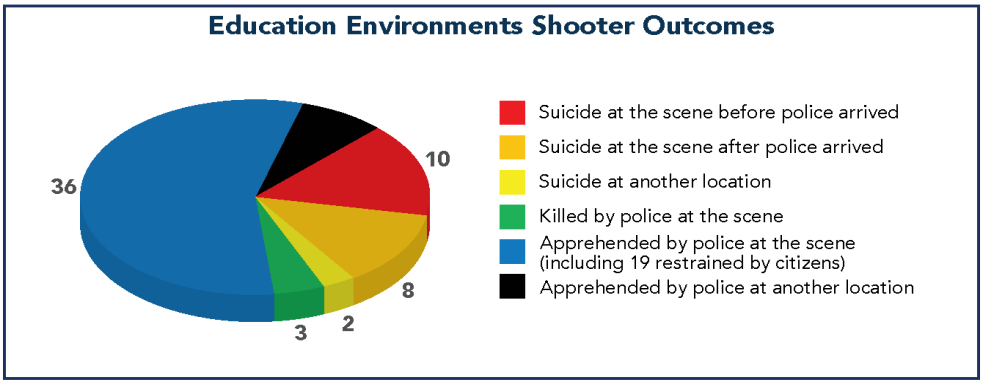


Education Environments Casualties by Year: 2001 (2 killed, 18 wounded); 2002 (6 killed, 3 wounded); 2003 (4 killed, 3 wounded); 2004 (0 killed, 1 wounded); 2005 (10 killed, 8 wounded); 2006 (9 killed, 16 wounded); 2007 (32 killed, 21 wounded); 2008 (7 killed, 16 wounded); 2009 (0 killed, 2 wounded); 2010 (4 killed, 10 wounded); 2011 (1 killed, 1 wounded); 2012 (38 killed, 16 wounded); 2013 (7 killed, 10 wounded); 2014 (6 killed, 13 wounded); 2015 (9 killed, 7 wounded); 2016 (2 killed, 9 wounded); 2017 (8 killed, 19 wounded); 2018 (29 killed, 52 wounded); 2019 (5 killed, 15 wounded)

Active Shooter Incidents 20-Year Review, 2000-2019 13

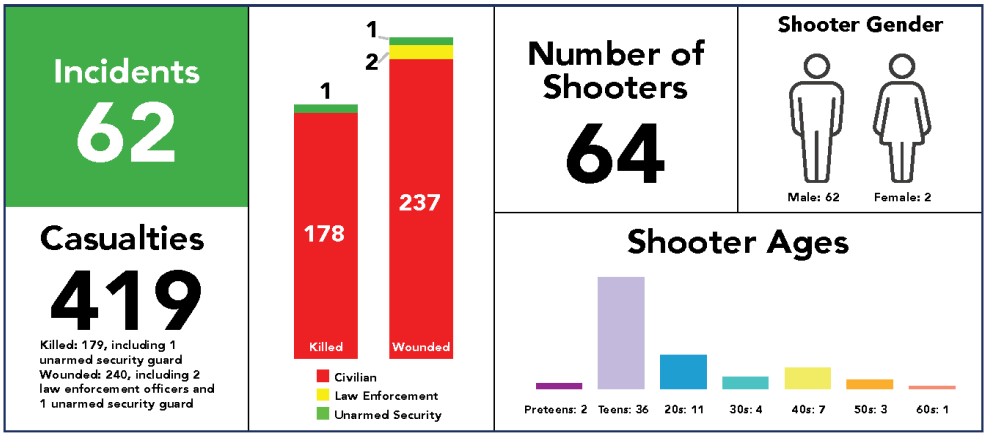
ACTIVE SHOOTER INCIDENTS

Education Environments



Education Environments Shooter Outcomes: Suicide at the scene before police arrived (10); Suicide at the scene after police arrived (8); Suicide at another location (2); Killed by police at the scene (3); Apprehended by police at the scene (including 19 restrained by citizens) (36); Apprehended by police at another location (5)

Key Findings:



Incidents: 62. Total casualties: 419. Killed: 179 (including 178 civilians and 1 unarmed security guard). Wounded: 240 (including 237 civilians, 2 law enforcement officers, and 1 unarmed security guard). Number of shooters: 64. Shooter gender: 62 male, 2 female. Shooter ages: Preteens (2); Teens (36); 20s (11); 30s (4); 40s (7); 50s (3); 60s (1).

Active Shooter Incidents 20-Year Review, 2000-2019 14

The complete report may be found here: https://www.fbi.gov/file-repository/active-shooter-incidents-20-year-review-2000-2019-060121.pdf/view.

Cyber-Threats

While Susquehanna County has not been the target of any critical cyber terrorist events, the county has seen multiple security breaches due to online phishing and other scams.

One hack attack took down the largest fuel pipeline in the U.S. and led to massive gasoline shortages; it was the result of a single compromised password. Hackers gained entry into the networks of Colonial Pipeline Company on April 29, 2021 through a virtual private network account, which allowed employees to remotely access the company's computer network. On May 7, 2021, a ransom of $4.4 million was demanded by the hackers, causing Colonial to shut down the entire supply line, immediately prompting temporary gasoline shortages and panic buying up and down the East Coast. The hackers, who were an affiliate of a Russian-linked cybercrime group known as *DarkSide*, were paid the ransom. The hackers also stole nearly 100 gigabytes of data from Colonial Pipeline and threatened to leak it if the ransom was not paid, according to Bloomberg News.

Then, in early June 2021, JBS, the world's largest meat company by sales, paid an $11 million ransom to cybercriminals who temporarily knocked out plants that process roughly one-fifth of the nation's meat supply. The ransom payment, in bitcoin, was made to shield JBS meat plants from further disruption and to limit the potential impact on restaurants, grocery stores and farmers that rely on JBS, according to the company.

The attack on JBS was part of a wave of incursions using ransomware, in which companies are hit with demands for multimillion-dollar payments to regain control of their operating systems. The attacks show how hackers have shifted from targeting data-rich companies such as retailers, banks and insurers to essential-service providers such as hospitals, transport operators and food companies.

4.3.20.4. Future Occurrence

The likelihood of Susquehanna County being a primary target for a major international terrorist attack is small and unlikely. More likely terrorist activity in Susquehanna County includes bomb threats or other incidents at schools. Susquehanna County has six school districts consisting of fourteen public schools. Several private schools and colleges/universities are also located in Susquehanna County. These locations are considered soft targets and may be vulnerable, especially to domestic incidents.

4.3.20.5. Vulnerability Assessment

Susquehanna County should stay prepared for terroristic events. The existence of industrial commerce, interstate highways and freight railroad activity create soft targets that could be used to interfere with the focus of day-to-day life that the county experiences. It is important to note

that the use of and exposure to biological agents can remain unknown for several days until the infected person(s), livestock, or crops begin to experience symptoms or show damages. Often such agents are contagious, and the infected person(s) must be quarantined, livestock culled, and/or crops destroyed.

Although previous events have not resulted in what are considered to be significant terrorist attacks, the severity of a future incident cannot be predicted with a total level of certainty. One of the major concerns with agroterrorism is that acts can be carried out with minimal planning, effort, or expense.

Acronis, a global technology company that develops on-premises and cloud software for backup, disaster recovery, and secure file sync and share and data access, issues an annual threat scape report on cybercrime. Entitled *The Acronis Cyberthreats Report*, it contains an in-depth review of the current threat landscape and projections for the coming year. Based on the protection and security challenges that were amplified by the shift to remote work during the COVID-19 pandemic, Acronis warns aggressive cybercrime activities will continue as criminals pivot their attacks from data encryption to data exfiltration.

The major points illustrated in the report are as follows:

- Attacks against remote workers will increase due to the movement of workers to less secure working areas.
- Ransomware will look for new victims and will become more automated.
- Legacy IT and technical solutions will struggle to keep pace with ransomware and cybercrime attacks.

According to a study carried out on the data sourced from the Federal Bureau of Investigation, Pennsylvania is ranked second worst among states when it comes to handling cyber-attacks. The study made by Information Network Associates – an international security consulting company – says an increase of 25% was witnessed in cyber-attacks between 2016 and 2017. This illustrates the amount of preparation that must occur in the commonwealth so that it can better respond to potential cybercrime attacks.

The probability of terrorist activity is more difficult to quantify than some other hazards. Instead of considering the likelihood of occurrence, vulnerability is assessed in terms of specific assets. By identifying potentially at-risk terrorist targets in communities, planning efforts can be put in place to reduce the risk of attack. Planning should work towards identifying potentially at-risk critical infrastructure and functional needs facilities in the community, prioritizing those assets and locations, and identifying 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 with schools and government infrastructure like the county seat, should be considered more likely to attract terrorist activity.

4.3.21. Transportation Accidents

4.3.21.1. Location and Extent

Transportation accidents are defined as accidents involving highway, air, and rail travel. These incidents are collectively the costliest of all hazards in the Commonwealth in terms of lives lost, injuries, and economic losses. The sheer amount of roadway, coupled with the high volume of traffic, creates the potential for serious accidents along the roads and bridges. In Susquehanna County there are 413 state-maintained and sixty-eight locally maintained bridges, according to PennDOT. Major transportation routes in Susquehanna County include Interstate 81, United States Route 11, Pennsylvania Route 29, and Pennsylvania Route 706. Other state routes are also present in the county including Pennsylvania Route 171, Pennsylvania Route 267, and Pennsylvania Route 492. Overall, PennDOT has 793.11 jurisdictional miles in Susquehanna County. *Figure 51 – Major Transportation Routes* shows the major transportation systems in Susquehanna County.

Susquehanna County has Enter Number public airports; Enter airports and provide description. There exists a potential extent for air transportation accidents to occur due to the number of commercial air traffic that flyovers the county every day. However, a five-mile radius around each airport can be considered a high-risk area since most aviation incidents occur near take-off and landing sites. *Figure 52 – Airports and Vulnerability Zones*.

There are a few freight rail lines in Susquehanna County. The railroad company that operates in Susquehanna County is primarily Norfolk Southern. Goods can be transported into and out of Susquehanna County on the freight rail lines which run through the central and northeastern part of the county. Municipalities that are intersected by rail lines in Susquehanna County include:

Boroughs:

- Great Bend Borough
- Hallstead Borough
- Hop Bottom Borough
- Lanesboro Borough
- New Milford Borough
- Susquehanna Depot Borough

Townships:

- Brooklyn Township
- Great Bend Township
- Harford Township
- Harmony Township
- Lathrop Township
- Lenox Township
- New Milford Township
- Oakland Township

Rail transportation accidents are generally classified as one of these three types:

- Derailment – an accident on a railway in which a train leaves the rails
- Collision – an accident in which a train strikes something such as another train or highway motor vehicle
- Other – accidents caused by other circumstances like obstructions on rails, fire, or explosion

Rail transportation is divided into two major categories: freight and passenger. Each category can be subdivided according to carrier type: major carrier and local/regional carriers. Rail accidents can occur anywhere along the miles of rail located in Susquehanna County.

There are 2,794 oil and gas wells located in Susquehanna County. Pipeline infrastructure is seen throughout the county. There is only one major pipeline company that transports hazardous materials in and through Susquehanna County and that is Tennessee Pipeline Company. This is a natural gas pipeline. *Figure 54 – Utility Pipelines Vulnerability* shows the various pipelines that run through Susquehanna County.

4.3.21.2. Range of Magnitude

Significant passenger vehicle, air, and rail transportation accidents can result in a wide range of outcomes from damage solely to property to serious injury or even death. The majority of motor vehicle crashes in Pennsylvania are non-fatal, but PennDOT estimates that every hour nine people are injured in a car crash, and every seven hours someone dies as a result of a car crash. Most fatal crashes occur in May and June, but the highest number of crashes overall occur in October, November, and December. Inclement weather and higher traffic volumes and speeds increase the risk for automobile accidents.

Railway and roadway accidents have the potential to result in hazardous materials release. Railroad accidents occur with less frequency than highway accidents. However, when these types of incidents occur, they often cause extensive property damage and have the potential to cause serious injuries or deaths.

The worst-case scenario for a transportation accident impacting the county would be a road accident which results in a hazardous material spill in any of the areas on or surrounding the Interstate 81 corridor. Such an event would constitute an immediate health hazard to the population and require evacuation and would result in a reduction in transportation to and from Susquehanna County. Interstate 81 is the primary north/south roadway in Susquehanna County and connects Scranton, Pennsylvania and Binghamton, NY.

4.3.21.3. Past Occurrence

Table 66 – PennDOT Crash Report for Susquehanna County shows crash statistics recorded by the Pennsylvania Department of Transportation between 2011 and 2021. Reports for 2022 and 2023 were not available at the time of this report. The year 2013 had the highest total crashes in Susquehanna County while 2020 had the lowest total crashes. This significantly low number of crashes in Susquehanna County in 2020 is related to shelter in place and stay at home orders that were common and in place for most of the spring and summer due to the COVID-19 pandemic. The number of total crashes has declined over the span of eleven years between 2011 and 2021 in the county. There were no train with vehicle crashes on record for that eleven year time frame.

The majority of municipalities noted, on the municipality hazard identification worksheet that they received, that there was no increase in the risk of transportation accidents in Susquehanna County. Twenty-four hazard identification and risk evaluation worksheets had no change marked on the worksheet for transportation accidents. Seven municipalities have stated that there has been an increase in transportation accident risk over the past five years. The reasons for the increases include increased volume of traffic, increased number of hazardous material vehicles on the road, and lowered driver perception while operating a motor vehicle.

Table 66-PennDOT Crash Report for Susquehanna County

PennDOT Crash Report for Susquehanna County								
Year	Vehicle accidents for Susquehanna County				Vehicle Accident Deaths for Susquehanna County			Train/Trolley with Motor Vehicle Crashes/ Fatalities
	Total	Fatal Accidents	Injury Crashes	Property Damage Only	Total Vehicle Accident Fatalities	Alcohol-Related Fatalities	Pedestrian Fatalities	
2011	514	10	229	275	5	5	0	0
2012	511	13	252	246	10	8	2	0
2013	533	8	228	297	5	5	0	0
2014	523	10	204	309	8	6	2	0
2015	467	10	206	251	3	2	1	0
2016	493	10	202	281	6	6	0	0
2017	477	9	173	295	3	3	0	0
2018	494	7	184	303	4	3	1	0
2019	462	9	187	266	3	2	1	0
2020	359	11	137	211	6	6	0	0
2021	428	6	172	250	4	3	1	0

4.3.21.4. Future Occurrence

Susquehanna County's population has decreased over the last decade, so it can be assumed that local traffic has decreased slightly as well. However, with the increasing volume of goods and trucking through the county, transportation accidents will continue to occur routinely. Hazardous material release through transportation accidents is difficult to predict but can be assumed to happen in future events as well. The U.S. Census Bureau reports the mean travel time to work for those aged 16 plus is approximately twenty-four minutes. Automobile accidents occur frequently, and typically occur more frequently than rail or aviation accidents. In the case of highway accidents, PennDOT has taken great strides to reduce the number of highway transportation accidents through programs such as the Pennsylvania Highway Safety Corridor. In this program, PennDOT designates sections of highway where traffic citation fines are doubled in the hopes that higher fines will deter unsafe driving and reduce accidents. Transportation accidents are impossible to predict accurately; however, areas prone to these hazards can be located, quantified through analysis of historical records, and plotted on countywide and municipal base maps.

4.3.21.5. Vulnerability Assessment

A transportation accident can occur anywhere in Susquehanna County. However, severe accidents are more likely to occur on the county's major highways due to the heavier traffic volumes which make highways extremely vulnerable. The vulnerability for accidents on either highway, railway, or aviation, are directly related to the population and traffic density within the county. The vulnerability increases if there are hazardous materials involved. Hazards associated with causing transportation accidents can include natural hazards that affect the environment, such as winter storms or heavy rains that cause slippery roadways or mud slides, to windstorms or tornadoes that cause high-profile vehicles or train cars to topple over. Loss of roadway use, and public transportation services would affect commuters, employment, delivery of critical municipal and emergency services, and day-to-day operations within the county.

With highway accidents, there is an added vulnerability that stems from the age and upkeep of bridges throughout the county. Unrepaired, deficient bridges may be more likely to break, thus leading to highway transportation damages or deaths. Approximately 50% of Susquehanna County bridges are in poor condition, indicating an increased vulnerability to transportation accidents, while 50% remain in fair condition.

Studying traffic and potential transportation accident patterns could provide information on vulnerability of specific road segments and nearby populations. Increased understanding of the types of hazardous materials transported through the county will also support mitigation efforts. Maintaining a record of these frequently transported materials can facilitate development of

preparatory measures for response to a release. *Figure 53– Average Daily Traffic on Major Highway Vulnerability* identifies all major highways and railroads within Susquehanna County.

Figure 51-Major Transportation Routes

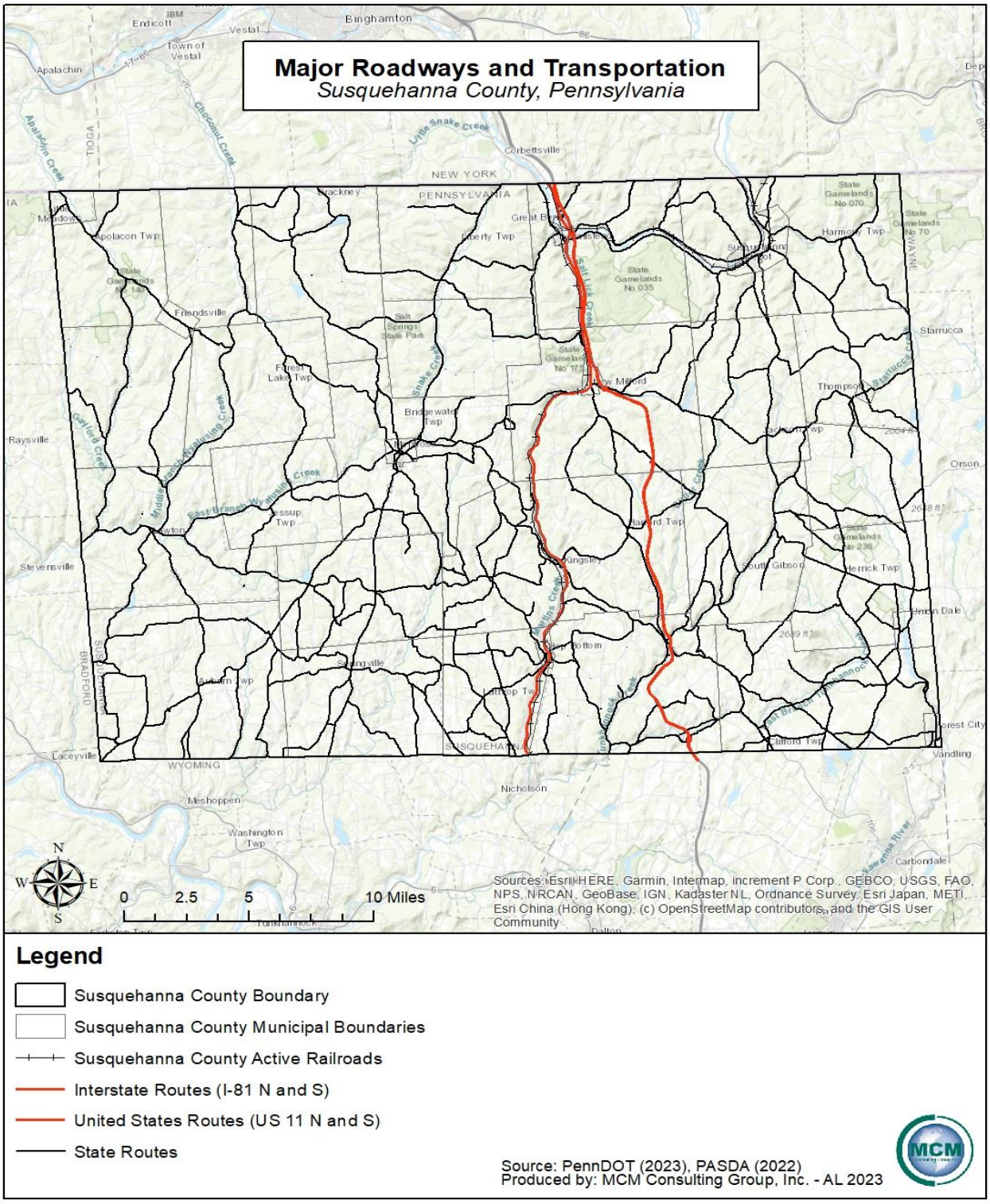


Figure 52-Airports and Vulnerability Zones

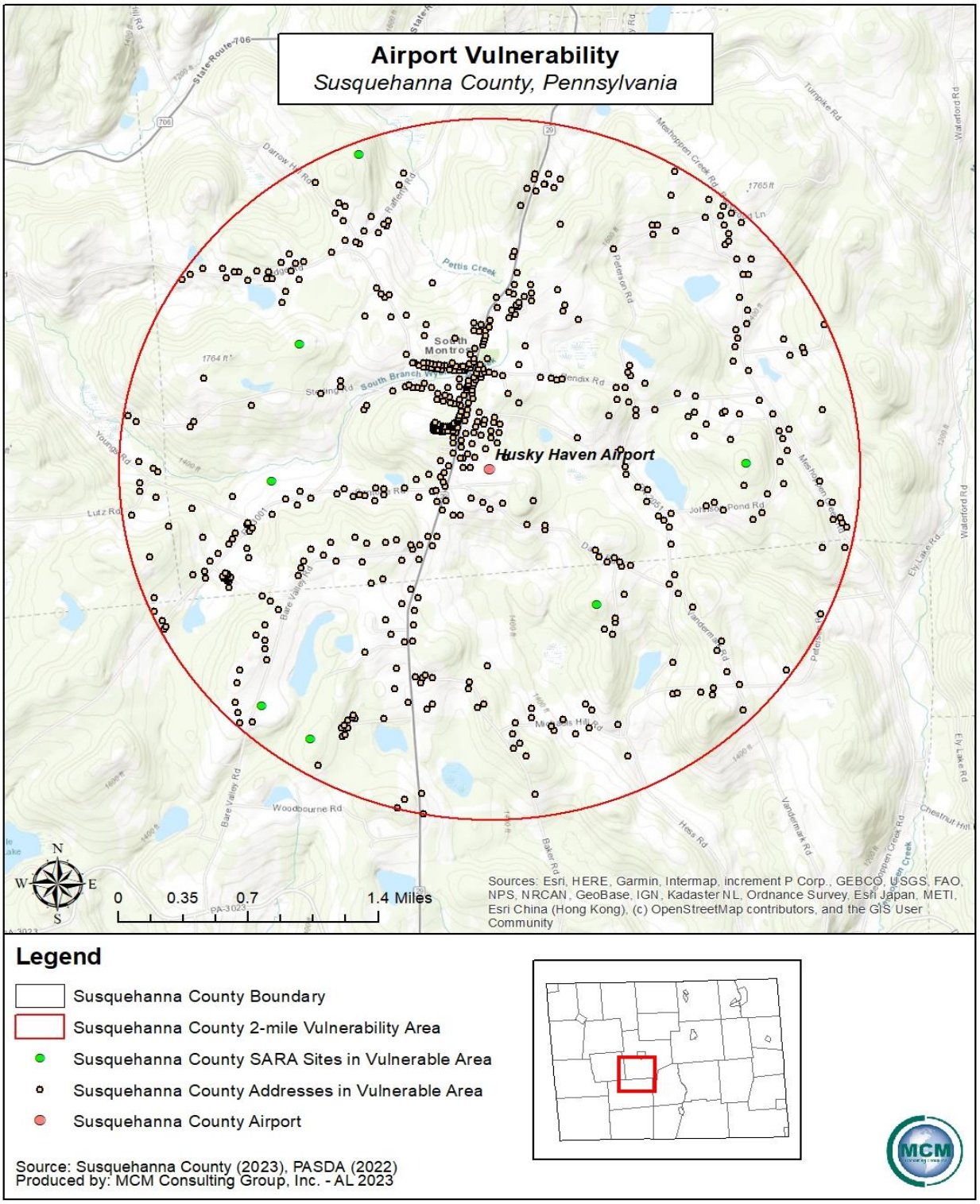


Figure 53-Average Daily Traffic on Major Highway Vulnerability

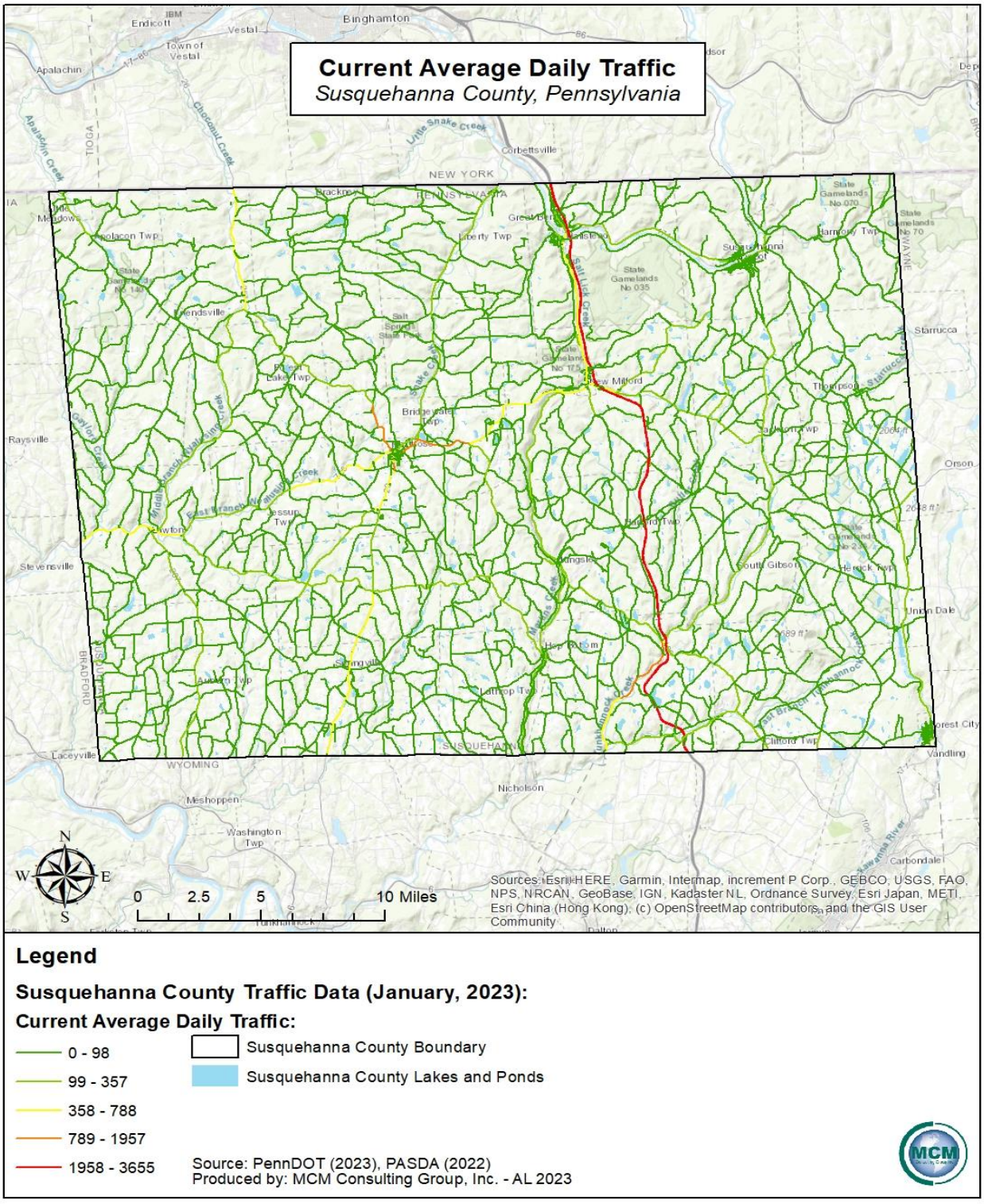
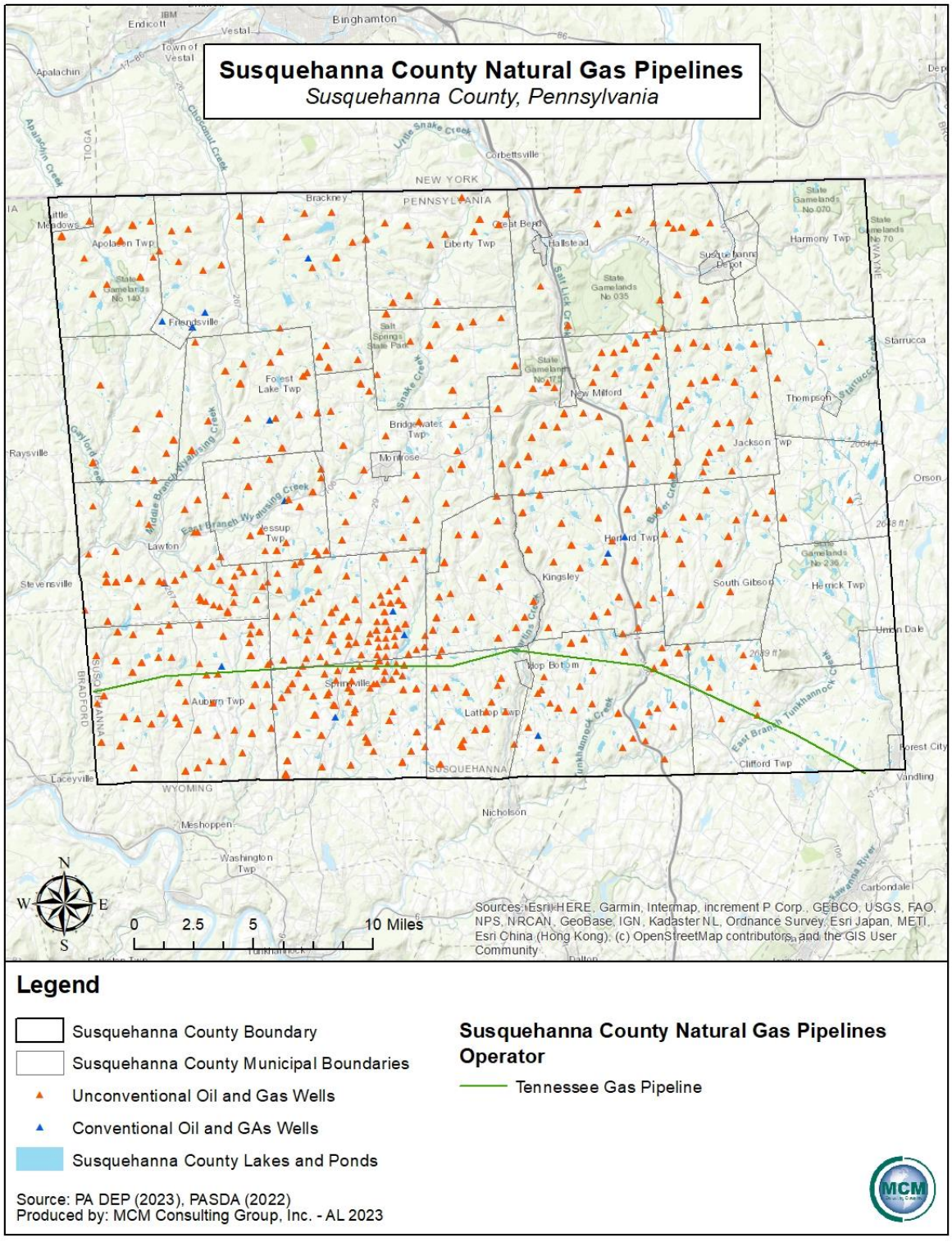


Figure 54-Utility Pipelines Vulnerability



4.3.22. Utility Interruptions

4.3.22.1. Location and Extent

Utility interruptions can occur from an internal system failure or as a secondary impact of another hazard, such as windstorm, winter storm, extreme temperatures, or a traffic accident. Strong adverse weather conditions and storms can cause widespread disruptions in electric and telecommunications service due to power lines being brought down by falling tree branches across a region. Strong heat waves may result in rolling blackouts where power may not be available for an extended period, impacting air conditioning across a region. Space weather, specifically solar flares, can also pose a threat to utility service across the globe. Although uncommon, the northeastern seaboard and the north central regions of the United States are particularly susceptible to this hazard.

The age of utility infrastructure also plays a role in interruptions, causing longer periods of outages in a larger area. Natural gas, water, telecommunications, and electric capabilities can all experience disruptions. Worker strikes at power generation facilities have also been known to cause minor and temporary power outages and failures. Other causes for minor power outages include but are not limited to vehicle accidents and wire destruction due to animals or wildlife. Outages can also be caused by blown transformers or tripped circuit breakers in the electric system. Major power outages typically occur on a regional scale and can last both short term and long term.

The list of utility providers in Susquehanna County is shown in *Table 67 – Susquehanna County Utility Providers*.

Table 67-Susquehanna County Utility Providers

Susquehanna County Utility Providers	
Utility Type	**Name of Utility Provider**
Electricity	Claverack Rural Electric Penelec PP&L
Telephone/9-1-1/Wireless	Adams Cable AT&T Blue Ridge CenturyLink Frontier NEP Telephone Company Spectrum Verizon

Susquehanna County Utility Providers	
Utility Type	**Name of Utility Provider**
Natural Gas	Leatherstocking UGI
Water	Aqua PA – Brooklyn Aqua PA – Hop Bottom Choconut Creek Apartments Elk Meadows Association Harford Municipal Authority Water Systems Lake Raylean Water Association Lake Walter Water Company Lazybrook Trailer Court Liberty MHP Susquehanna County New Milford Municipal Authority Oakland Borough Water Oakland Trailer Park PA American Water Company – Montrose District PA American Water Company – Scranton District PA American Water Company – Susquehanna District PA American Water Company – Thompson District Shady Lake MHP Terrace Hill MHP Weidas MHP Whites MHP
Source: PA Public Utility Commission, 2023, Susquehanna County, 2023	

4.3.22.2. Range of Magnitude

Utility interruptions do not typically lead to large-scale problems by themselves. Typically, human casualties are not a direct result from outages. Many utility interruptions occur during storms or other severe weather events, and they can have secondary consequences. Typical secondary effects from a power outage can include a delay in emergency response and those services arriving in timely manner. A lack of potable drinking water can also become a major issue for areas impacted by utility interruptions.

Electricity:

Interruptions or power failures could have the following impacts:

- Public safety concerns
- Food spoilage
- Loss of heating or air conditioning

- Basement flooding due to sump pump failure
- Loss of indoor lighting
- Loss of internet service
- Stopped and stalled elevators
- Direct economic impact from retail settings

Of all the above listed impacts, the loss of heating or air conditioning poses the greatest risk to the elderly and very young populations during times of extreme temperature. Prolonged power outages also pose a risk to residents that rely on home-based medical equipment such as home-supply oxygen units. Some of the issues that are listed above can be considered more of a nuisance than a hazard, such as food spoilage due to long-term electrical outages. However, significant damage or harm can occur depending on the population affected, the duration, and the severity of the outage.

A worst-case scenario for the utility interruptions would be a county-wide power outage during winter months, forcing the evacuation of vulnerable populations to facilities outside of the county or to warming shelters within the county.

Fuel:

Interruptions of the transportation of gas and other products used for fuel can lead to a loss of heating and manufacturing capabilities. This can adversely affect the economic stability of a region and the production of needed products for consumption.

Telecommunications:

Interruptions to telecommunications systems include impacts to the 9-1-1 capabilities of a region, telephone, and internet service. The greatest risk in losing this utility to interruption is the risk of an emergency not being able to be reported to a public safety answering point (PSAP). Extensive loss of telephone and internet service can be detrimental to government, businesses, and to residents. With much of the country now dependent on wireless networks, signal interruptions can cause a large issue for people who are utilizing wireless telecommunications for work. There are also many concerns regarding safety and internet security due to the increase in people working over wireless networks that occurred during the COVID-19 pandemic. These interruptions and issues can be detrimental for the Susquehanna County workforce.

4.3.22.3. Past Occurrence

Minor utility interruptions occur annually in Susquehanna County and occur most often in conjunction with weather events including but not limited to winter storms, tornadoes and windstorms, hurricanes, tropical storms, hail events, and floods. Susquehanna County does not

utilize a database system to track incidents within the county and no such comprehensive data was available for refence, from 2012 through 2022, during the development of this report. *Table 68 – Utility Interruptions in Susquehanna County* illustrates the number of interruptions to electric, natural gas, telecommunications, and water services between 2012 and 2022. This information was compiled by reaching out to utility companies and from research of past events in Susquehanna County.

Table 68-Utility Interruptions in Susquehanna County

Utility Interruptions in Susquehanna County		
Date	**Event Type**	**Municipality or Area**
03/31/2012	Power Outage	Bridgewater Township
05/13/2012	Phone Outage	Forest Lake Township
07/07/2012	Communication Center Outage	Montrose Borough
07/13/2012	Cell, Landline, and Cable Service Outage	Susquehanna Depot Borough
07/18/2012	911 Center Microwave Outage	Susquehanna County
08/14/2012	Court House Phone Outage	Montrose Borough
10/29/2012	Power Outage	Susquehanna County
11/19/2012	NEP Phone Outage	Susquehanna County
12/13/2012	Power Outage	Montrose Borough
03/22/2013	Phone Outage	Dimock Township
04/16/2013	Power Outage - Courthouse	Montrose Borough
04/16/2013	911 Phone Outage	Montrose Borough
04/27/2013	Phone Outage	Montrose Borough
06/19/2013	Well Contamination	Thompson Township
08/25/2013	911 Phone Outage	Susquehanna County
09/25/2013	911 Phone Outage	Little Meadows Borough
11/04/2013	Phone Outage	Susquehanna County
11/05/2013	Phone Outage	Lathrop Township
01/03/2014	Phone Outage	Susquehanna County
01/04/2014	Power Outage	Mew Milford Borough
02/05/2014	Power Outage	Great Bend Township
02/17/2014	Water Main Break	Susquehanna Depot Borough
03/06/2014	Residential Gas Leak	Clifford Township
03/10/2014	Frozen Water Main	Susquehanna Depot Borough
03/12/2014	Power Outage	Montrose Borough
03/12/2014	Phone Outage	West-Central Susquehanna County
03/13/2014	Power Outage	Montrose and New Milford Boroughs
03/18/2014	Power Outage	East-Central Susquehanna County

Utility Interruptions in Susquehanna County		
Date	**Event Type**	**Municipality or Area**
03/20/2014	911 Phone Outage	Susquehanna County
04/02/2014	Partial Breach of Dam Bulkhead	Lenox Township
04/16/2014	Phone Outage	East Rush Township
05/22/2014	Phone Outage	Dimock Township
06/05/2014	911 Phone Outage	Susquehanna County
06/13/2014	Power Outage	Lanesboro Borough
06/19/2014	Phone Outage	Southern Susquehanna County
07/15/2014	Phone Outage	Brooklyn Township
07/29/2014	Water Main Break	Bridgewater Township
07/31/2014	Water Main Break	Bridgewater Township
08/18/2014	Phone Outage	Jessup Township
08/30/2014	Phone Outage	Brooklyn Township
09/20/2014	Natural Gas Line Leak	Montrose Borough
11/02/2014	Phone Outage	Montrose Borough
01/06/2015	Water Main Break	Bridgewater Township
02/01/2015	Water Main Break	Oakland Township
02/21/2015	Fire Hydrant Leak	Hallstead Borough
02/25/2015	Frozen Water Main	Forest City Borough
02/27/2015	Water Outage	Montrose Borough
02/27/2015	Power Outage	Auburn and Springville Townships
03/02/2015	Frozen Water Service	Thompson Borough
03/02/2015	Frozen Water Service	Susquehanna County
03/03/2015	Water Main Break	Susquehanna Depot Borough
03/04/2015	Frozen Water Main	Hallstead Borough
03/12/2015	Frozen Water Services	Susquehanna Depot Borough
03/13/2015	Phone Outage	Susquehanna County
03/18/2015	Frontier Utility Issue	Susquehanna County
03/25/2015	Phone Outage	Susquehanna County
03/26/2015	Power Outage	Little Meadows Borough
04/02/2015	Water Main Break	Hallstead Borough
04/06/2015	Power Outage	Susquehanna County
06/05/2015	Water Main Break	Hallstead Borough
06/08/2015	Phone Outage	Forest Lake Township
06/17/2015	Power Outage	Susquehanna County
07/14/2015	Phone Outage	Susquehanna County
07/18/2015	Phone Outage	Susquehanna County
08/05/2015	Outage	Susquehanna County
08/08/2015	Phone Outage	Susquehanna County

Utility Interruptions in Susquehanna County		
Date	**Event Type**	**Municipality or Area**
08/11/2015	Power Outage	Clifford and West Clifford Townships
09/05/2015	Phone Outage	Susquehanna County
09/22/2015	Phone Outage	Susquehanna County
09/22/2015	Power Outage	Forest City Borough
09/30/2015	Power Outage with Road Closure	Bridgewater Township
10/07/2015	Phone Outage	Susquehanna County
10/18/2015	Phone Outage	Susquehanna County
10/19/2015	Phone Outage	Susquehanna County
10/19/2015	Power Outage	Montrose Borough
10/30/2015	Communications Outage	Susquehanna County
11/03/2015	Heat Outages	Forest City Borough
11/13/2015	Cell Phone Outage	Montrose Borough
11/14/2015	Power Outage	Susquehanna County
12/29/2015	Phone Outage	Susquehanna County
01/10/2016	Power Outage	Susquehanna County
01/13/2016	Cable/VOIP Outage	Susquehanna County
01/29/2016	Phone Outage	Susquehanna County
02/02/2016	Outage	Susquehanna County
02/06/2016	Outage	Susquehanna County
02/12/2016	Power Outage	Forest Lake Township
03/02/2016	Power Outage	Susquehanna County
04/03/2016	Phone Outage	Susquehanna County
05/12/2016	Outages	Susquehanna County
07/15/2016	Phone Outage	Susquehanna County
08/12/2016	911 Phone Outage	Susquehanna County
09/12/2016	Water Main Break	Susquehanna Depot Borough
10/26/2016	Outages	Susquehanna County
05/01/2017	Outages	Susquehanna County
05/04/2017	Phone Outage	Susquehanna County
05/05/2017	Major Outages	Susquehanna County
07/17/2017	Outages	Bridgewater Township
10/30/2017	Communications Outage	Susquehanna County
11/08/2017	911 Phone System Technical Issue	Susquehanna County
03/02/2018	Power Outage	Susquehanna County
08/14/2018	Power Outage	Susquehanna County
04/15/2019	Power Outage	Susquehanna County
06/03/2020	Power Outage	Susquehanna County
01/01/2021	Power Outage	Susquehanna County

Utility Interruptions in Susquehanna County		
Date	**Event Type**	**Municipality or Area**
07/06/2021	Power Outage	Susquehanna County
12/11/2021	Power Outage	Susquehanna County
03/07/2022	Power Outage	Susquehanna County
04/19/2022	Power Outage	Susquehanna County
07/24/2022	Power Outage	Susquehanna County
12/15/2022	Power Outage	Susquehanna County
Source: Susquehanna County, 2023		

A large number of the municipalities in Susquehanna County have reported water interruption issues, phone outages, and power outage issues. The above table shows that some of these events may be related or occurred on subsequent days. These events may be cascade events from items listed prior in the table. Hallstead Borough, Montrose Borough, and Susquehanna Depot Borough each reported a large number of utility interruptions events on average. This does not mean that there were fewer events in other municipalities, simply that they may not have been reported or added to the report function for Susquehanna County.

The Pennsylvania Public Utility Commission tracks the reliability of electric distribution companies (EDC) and outages. *Table 69 – 2018 Winter Storms Riley and Quinn Power Outages* by EDC compares the customers affected by power outage in Pennsylvania during these storm events and compares the to statistics from Nika from 2014 and Sandy from 2012. Some of the EDCs were not impacted by Winter Storm Quinn. PP&L customers experienced power outages for a duration of eight days with Winter Storm Quinn and Winter Storm Riley, whereas during Sandy in 2012, the duration was nine days. Nika in 2014 had a duration of just over three days.

Table 69-2018 Winter Storms Riley and Quinn Power Outages

2018 Winter Storms Riley and Quinn Power Outages			
Electric Distribution Company	**Customers affected by storms Riley and Quinn 2018 (Percentage of total customers)**	**Customers affected by Nika 2014 (Percentage of total customer)**	**Customers affected by Sandy 2012 (Percentage of total customers)**
Met-Ed	272,928 (49.22%)	144,000 (26.00%)	298,300 (54.00%)
PECO	794,969 (46.76%)	723,681 (42.00%)	845,703 (54.20%)
Penelec	90,856 (15.61%)	N/A	96,847 (16.40%)
PCLP	2,101 (47.44%)	N/A	4,487 (100.00%)
PP&L	261,341 (18.67%)	92,283 (7.00%)	523, 936 (37.50%)
Total:	**1,422,195**	**959,964**	**1,769,273**

2018 Winter Storms Riley and Quinn Power Outages			
Electric Distribution Company	**Customers affected by storms Riley and Quinn 2018 (Percentage of total customers)**	**Customers affected by Nika 2014 (Percentage of total customer)**	**Customers affected by Sandy 2012 (Percentage of total customers)**
Source: Winter Storm Riley and Quinn Report 2019			

Other past significant events of utility interruptions in the United States occur on a regional basis and can have varied effects related to number of impacted customers. A large water treatment plant failure occurred in Jackson, Mississippi in August of 2022 after flooding impacted the treatment facility. The city of Jackson was left without safe drinking water for close to two months until the water was deemed safe and potable in October of 2022. This event stood out as a large scale failure of community lifelines and utilities. This event also opened discussions related to equity in infrastructure repairs, as the repairs took a significant amount of time in a vulnerable socio-economic area.

4.3.22.4. Future Occurrence

Utility Interruptions are difficult to predict, and minor interruptions may occur several times a year to all utilities. Even so, utility interruptions occur more frequently as a secondary factor to severe weather events or transportation accidents.

Space weather is getting more attention as an infrastructure risk due in part to a March 2020 report by the United States Geological Survey (USGS). The report noted that geomagnetic storms caused by the dynamic action of the Sun and solar wind on the space environment surrounding the Earth can generate electric fields in the Earth's crust and mantle. These electric fields can interfere with the operation of grounded electric power-grid systems. Geomagnetic storms occur only occasionally, but when sufficiently energetic they can produce blackouts on a large scale.

As utility infrastructure ages, interruption events could occur more frequently if the maintenance of the infrastructure is not maintained. Utility providers can reduce Susquehanna County's vulnerability to power outages by implementing improvement plans for utility infrastructure. Total replacement is not a feasible solution to the issue, but compromises can be reached to ensure that the new and old equipment along a utility line can work together efficiently.

4.3.22.5. Vulnerability Assessment

Resources such as electricity, communications, gas, and water supply are critical to ensure the health, safety, and general welfare of the citizenry. *Figure 55 – Susquehanna County Utilities*

illustrates the approximate locations of service lines and pipelines throughout Susquehanna County.

Power outages can cause even greater detriment to at-risk and vulnerable populations, such as elderly (e.g., supplemental oxygen power needs) or those with functional and access needs to consider. All critical infrastructure is vulnerable to the effects of a power surge. The probability of a large-scale, extended utility failure is low; however, small-scale failures lasting short periods of time occur annually.

Long-term care facilities, senior centers, hospitals, and emergency medical facilities are all vulnerable to utility interruptions. Often back-up power generators are used at these facilities to offset electrical needs during extreme hot or cold temperature events. However, these back-up power generators must be maintained, and fuel supplies must be secured in advance of the utility interruption to ensure a seamless transition from the everyday, grid power source to the emergency generator. When officials consider maintenance and supplies for a facility, long-term use of back-up generators should be planned.

Electricity:

Severe weather is one of the largest causes of power loss. The electric power grid infrastructure can be damaged by snow, ice, high winds, lightning, flooding, falling tree limbs, and vehicle accidents involving utility poles. Small animals can also cause minor power outages by climbing along the lines and shorting out the system.

Causes of a regional scale power outage or failure could be from infrastructure failure, sabotage, human error, or worker strikes. Community lifeline facilities are vulnerable to utility interruptions, especially the loss of power. The establishment of reliable backup power at these facilities is extremely important to provide continued support of the health, safety, and well-being of Susquehanna County residents and visitors.

The occurrence of severe weather related utility interruptions will increase due to climate change in the Commonwealth of Pennsylvania and the United States as a whole. Climate change will cause weather to become more severe on a more frequent basis.

Water:

Water distribution can be affected in three ways.

- The amount of water available (depends on nature)
- The quality of the water (depends on human responsibility)
- The viability of the physical components of the distribution system

Well contamination or water shortages due to drought could pose a high vulnerability to local water distribution. Drought events will continue to occur more frequently as climate change alters that available amount of ground water for consumption. This will result in greater well shortages and water utility interruptions for citizens that have well water.

Water contamination can occur naturally, by human error, or intentionally. Releases of manure and milk into the water supply can cause contamination. Overflows from sewage systems and lagoons on farms can also cause contamination of groundwater and drinking water. There are times when accidental spills and releases of hazardous materials contaminate water supplies, thereby, water supplies along transportation routes may be affected.

Gas and Liquid Pipelines:

Interruptions to natural gas distribution lines could be affected by:

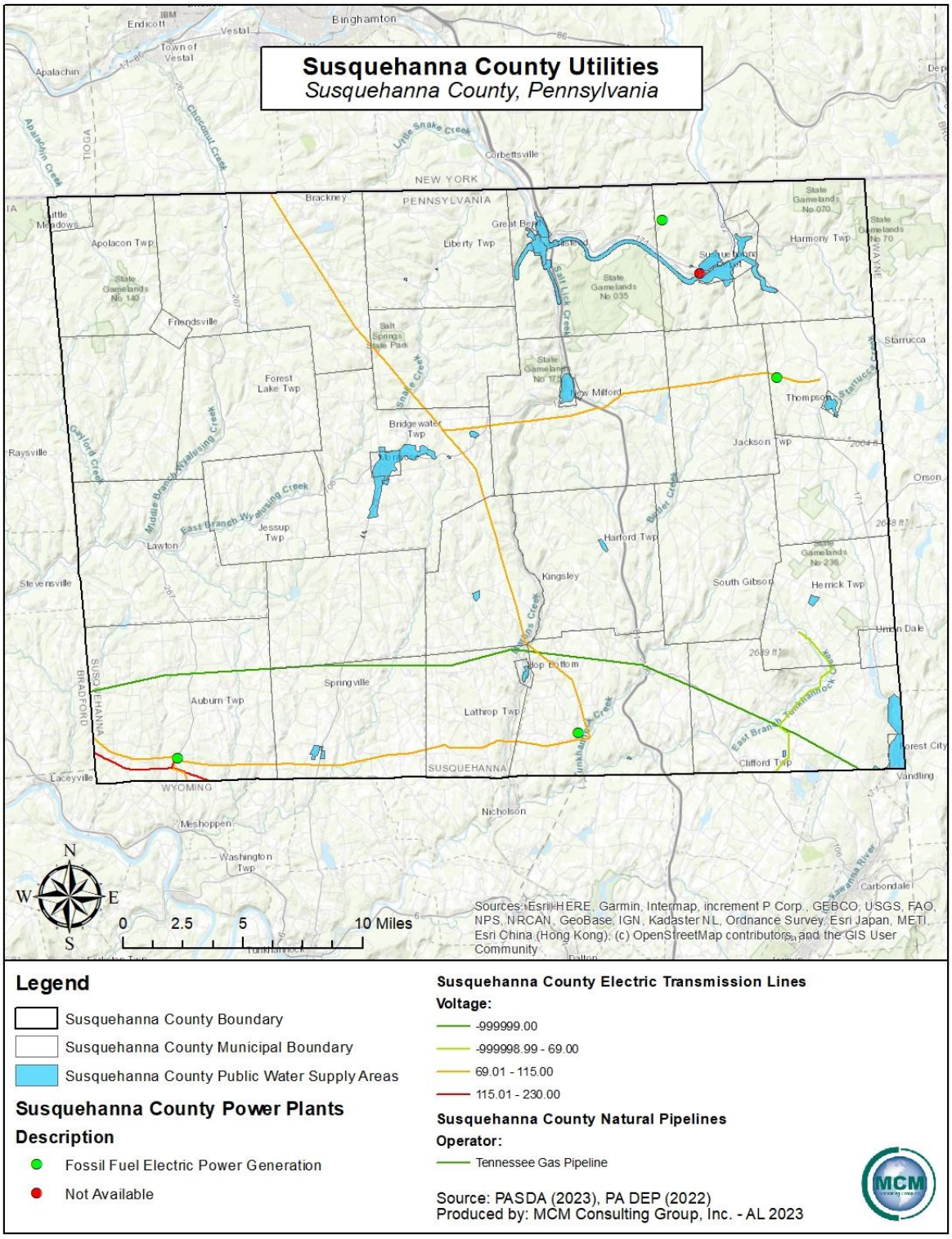
- Deterioration of line and facilities
- Puncturing the distribution lines by humans (either intentional or accidental)
- Coastal or winter storms
- Extreme heat or cold events
- Transportation accidents

Communications:

Interruptions in communications could be caused as a secondary effect of storms or high winds, infrastructure failure, or by humans (intentional or accidental). A loss of communications by emergency services would be devastating to the population of Susquehanna County if 9-1-1 calls could not be received, or if emergency units could not be dispatched properly and/or timely.

No data regarding economic impacts from utility interruptions in Susquehanna County are available. However, utility interruptions can cause economic impacts stemming from lost income, spoiled food and other goods, costs to the owners or operators of the utility facilities, and costs to government and community service groups.

Figure 55-Susquehanna County Utilities



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 70 – 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:

Table 70-Risk Factor Approach Summary

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

Table 71 – Risk Factor Approach Summary Cont'd 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 71-Risk Factor Approach Summary Cont'd

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	
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 72 – Risk Factor Assessment* lists the risk factor calculated for each of twenty-seven potential hazards identified in the 2023 HMP. Hazards identified as *high* risk have risk factors greater than 2.5. Risk factors ranging from 2.0 to 2.4 were deemed *moderate* risk hazards. Hazards with risk factors 1.9 and less are considered *low* risk.

Table 72-Risk Factor Assessment

Susquehanna County Hazard Ranking Based on Risk Factor Assessment Methodology							
Hazard Risk	Hazard Natural (N) or Human Caused (H)	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
		Probability	Impact	Spatial Extent	Warning Time	Duration	
HIGH	Utility Interruptions (H)	4	4	4	4	3	**3.9**
	Hailstorm (N)	4	4	4	2	3	**3.7**
	Emergency Services (H)	4	4	4	1	4	**3.7**
	Mental Health Services (H)	4	4	4	1	4	**3.7**
	Opioid Epidemic (H)	4	3	4	4	4	**3.7**
	Terrorism (H)	4	4	3	4	1	**3.5**
	Invasive Species (N)	4	3	4	1	4	**3.4**
	Cyber Crime Attack (H)	4	3	4	4	1	**3.4**
	Transportation Accidents (H)	4	3	4	4	1	**3.4**
	Environmental Hazards - Transportation HazMat (H)	4	3	3	4	2	**3.3**
	Windstorm (N)	4	3	3	4	1	**3.2**
	Hurricanes, Tropical Storms, Nor'easter (N)	2	4	4	1	4	**3.1**
	Winter Storm (N)	2	4	4	1	4	**3.1**
	Flash Flooding (N)	2	3	4	4	3	**3**
	Pandemic, Epidemic, and Infectious Disease (N)	3	2	4	1	4	**2.8**
	Tornado (N)	3	3	2	4	1	**2.7**
MODERATE	Environmental Hazards - Fixed Facility HazMat (H)	2	2	3	4	1	**2.3**
	Ice Jam Flooding (N)	2	2	2	4	3	**2.3**
	Extreme Temperatures (N)	2	2	3	1	3	**2.2**
	Flooding (100 year flood) (N)	2	2	2	1	4	**2.1**

Susquehanna County Hazard Ranking Based on Risk Factor Assessment Methodology							
Hazard Risk	Hazard Natural (N) or Human Caused (H)	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
		Probability	Impact	Spatial Extent	Warning Time	Duration	
	Lightning Strike (N)	2	2	2	4	1	**2.1**
	Dam Failure (H)	1	3	3	2	1	**2.1**
	Radon Exposure (N)	2	1	3	1	4	**2**
LOW	Wildfire (N)	3	1	1	4	1	**1.9**
	Drought (N)	2	1	2	1	4	**1.8**
	Landslide (N)	1	2	1	4	2	**1.7**
	Earthquake (N)	1	1	2	4	1	**1.5**

Based on these results, there are sixteen high risk hazards, seven 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 73 – Countywide Risk Factor Assessment* shows the different municipalities in Susquehanna County and what their risk factor for each hazard is compared 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 4.3.22.

Table 73-Countywide Risk Factor

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk									
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
JURISDICTION	Utility Interruptions	Hailstorm	Emergency Services	Mental Health Services	Opioid Epidemic	Terrorism	Invasive Species	Cyber Crime Attack	Transportation Accidents
	3.9	3.7	3.7	3.7	3.7	3.5	3.4	3.4	3.4
Apolacon Township	Not completed by municipality.								
Ararat Township	Not completed by municipality.								
Auburn Township	Not completed by municipality.								
Bridgewater Township	2.5	1.8	1.3	N/A	2.4	1.7	1.3	1.1	2.0
Brooklyn Township	Not completed by municipality.								
Choconut Township	Not completed by municipality.								
Clifford Township	3.5	2.5	3.7	N/A	2.9	1.8	2.9	2.3	3.5
Dimock Township	2.8	1.9	2.1	N/A	2.5	1.5	2.0	2.4	2.4
Forest City Borough	Not completed by municipality.								
Forest Lake Township	Not completed by municipality.								
Franklin Township	3.2	2.1	1.6	N/A	1.9	1.5	2.5	1.6	2.2
Friendsville Borough	Not completed by municipality.								
Gibson Township	3.0	2.0	2.2	N/A	1.3	1.4	2.2	1.7	2.2
Great Bend Borough	Not completed by municipality.								
Great Bend Township	Not completed by municipality.								
Hallstead Borough	3.9	3.5	3.9	N/A	3.7	3.2	3.1	3.7	3.4
Harford Township	3.0	2.5	2.2	N/A	3.7	2.1	2.3	1.9	2.4
Harmony Township	3.0	2.0	N/A	N/A	2.0	1.0	2.8	2.0	2.0
Herrick Township	Not completed by municipality.								
Hop Bottom Borough	Not completed by municipality.								

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk									
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
JURISDICTION	Utility Interruptions	Hailstorm	Emergency Services	Mental Health Services	Opioid Epidemic	Terrorism	Invasive Species	Cyber Crime Attack	Transportation Accidents
	3.9	3.7	3.7	3.7	3.7	3.5	3.4	3.4	3.4
Jackson Township	Not completed by municipality.								
Jessup Township	4.0	3.8	3.6	N/A	3.7	3.1	3.4	3.4	3.4
Lanesboro Borough	Not completed by municipality.								
Lathrop Township	2.5	2.2	N/A	N/A	N/A	N/A	2.6	1.8	1.9
Lenox Township	2.0	2.1	N/A	N/A	1.9	2.8	2.0	1.3	1.6
Liberty Township	Not completed by municipality.								
Little Meadows Borough	Not completed by municipality.								
Middletown Township	3.1	1.6	3.0	N/A	2.2	1.9	1.8	2.2	1.9
Montrose Borough	3.1	2.2	3.7	N/A	3.7	3.0	3.2	3.7	3.2
New Milford Borough	3.9	3.7	3.7	N/A	3.7	3.5	3.4	3.4	3.4
New Milford Township	3.6	2.5	3.4	N/A	2.8	2.8	1.8	1.3	2.2
Oakland Borough	3.1	2.1	2.1	N/A	3.5	2.1	2.1	2.1	2.7
Oakland Township	Not completed by municipality.								
Rush Township	4.0	3.7	1.6	N/A	1.9	1.6	3.4	2.4	1.3
Silver Lake Township	Not completed by municipality.								
Springville Township	4.0	2.2	3.7	N/A	3.0	1.3	3.7	1.6	3.4
Susquehanna Depot Borough	3.1	2.1	2.1	N/A	3.5	2.1	2.1	2.1	2.7
Thompson Borough	2.6	1.5	3.0	N/A	2.7	1.2	1.5	1.6	2.1
Thompson Township	Not completed by municipality.								
Union Dale Borough	Not completed by municipality.								

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk									
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
JURISDICTION	Environmental Hazards - Transportation	Windstorm	Hurricane, and Tropical Storm	Winter Storm	Flash Flooding	Pandemic, Epidemic, and Infectious Disease	Tornado	Environmental Hazards – Fixed Facility	Ice Jam Flooding
	3.3	3.2	3.1	3.1	3	2.8	2.7	2.3	2.3
Apolacon Township	Not completed by municipality.								
Ararat Township	Not completed by municipality.								
Auburn Township	Not completed by municipality.								
Bridgewater Township	2.1	2.3	2.7	3.0	2.7	2.9	2.5	2.1	1.0
Brooklyn Township	Not completed by municipality.								
Choconut Township	Not completed by municipality.								
Clifford Township	3.3	2.6	2.9	2.9	3.0	2.9	2.6	3.0	3.0
Dimock Township	2.4	1.7	2.4	2.4	2.4	3.4	2.2	2.4	1.2
Forest City Borough	Not completed by municipality.								
Forest Lake Township	Not completed by municipality.								
Franklin Township	1.3	2.4	2.7	3.1	2.4	1.6	1.2	1.3	1.5
Friendsville Borough	Not completed by municipality.								
Gibson Township	1.7	2.6	2.1	2.6	2.1	2.1	2.6	1.4	1.4
Great Bend Borough	Not completed by municipality.								
Great Bend Township	Not completed by municipality.								
Hallstead Borough	3.5	3.2	3.1	3.1	3.0	2.8	2.7	2.1	2.8
Harford Township	2.4	2.9	2.5	2.7	2.5	2.8	2.7	1.9	2.3
Harmony Township	2.0	3.0	3.0	3.0	2.8	1.0	2.0	1.0	2.0
Herrick Township	Not completed by municipality.								
Hop Bottom Borough	Not completed by municipality.								
Jackson Township	Not completed by municipality.								

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk									
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
JURISDICTION	Environmental Hazards - Transportation	Windstorm	Hurricane, and Tropical Storm	Winter Storm	Flash Flooding	Pandemic, Epidemic, and Infectious Disease	Tornado	Environmental Hazards – Fixed Facility	Ice Jam Flooding
	3.3	3.2	3.1	3.1	3	2.8	2.7	2.3	2.3
Jessup Township	3.3	3.3	3.4	2.7	2.2	3.4	2.1	2.3	2.1
Lanesboro Borough	Not completed by municipality.								
Lathrop Township	2.0	2.0	2.1	2.4	1.4	1.7	2.1	2.0	1.5
Lenox Township	1.4	2.1	2.5	2.4	1.6	1.7	1.8	1.4	1.4
Liberty Township	Not completed by municipality.								
Little Meadows Borough	Not completed by municipality.								
Middletown Township	1.8	2.5	2.5	2.9	2.0	2.6	1.9	1.8	1.5
Montrose Borough	3.3	2.7	2.6	2.8	2.3	2.7	2.6	2.8	1.0
New Milford Borough	3.3	3.2	3.1	3.1	3.0	2.8	2.7	2.3	2.3
New Milford Township	3.1	2.5	2.8	2.5	2.7	3.1	1.6	1.8	2.2
Oakland Borough	3.2	2.2	2.4	2.7	1.8	2.8	1.8	3.2	1.6
Oakland Township	Not completed by municipality.								
Rush Township	1.6	3.5	1.6	3.6	4.0	1.6	2.1	1.6	2.8
Silver Lake Township	Not completed by municipality.								
Springville Township	3.5	3.7	3.6	3.6	3.8	3.7	2.4	3.5	1.0
Susquehanna Depot Borough	3.2	2.2	2.4	2.7	1.8	2.8	2.0	3.2	1.6
Thompson Borough	1.7	2.3	2.6	2.8	1.7	3.2	1.4	1.5	1.5
Thompson Township	Not completed by municipality.								
Union Dale Borough	Not completed by municipality.								

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk									
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
JURISDICTION	Extreme Temperatures	Flooding (100-year)	Lightning Strike	Dam Failure	Radon Exposure	Wildfire	Drought	Landslide	Earthquake
	2.2	2.1	2.1	2.1	2	1.9	1.8	1.7	1.5
Apolacon Township	Not completed by municipality.								
Ararat Township	Not completed by municipality.								
Auburn Township	Not completed by municipality.								
Bridgewater Township	2.2	2.7	2.7	1.0	1.3	1.3	1.8	1.1	1.3
Brooklyn Township	Not completed by municipality.								
Choconut Township	Not completed by municipality.								
Clifford Township	3.0	2.1	1.9	1.6	1.2	2.4	1.9	2.0	1.8
Dimock Township	2.5	1.8	1.4	2.1	2.6	2.3	2.2	1.0	1.9
Forest City Borough	Not completed by municipality.								
Forest Lake Township	Not completed by municipality.								
Franklin Township	1.0	3.1	2.2	2.0	1.6	1.5	2.0	2.1	1.0
Friendsville Borough	Not completed by municipality.								
Gibson Township	2.1	1.7	2.2	1.3	1.6	1.6	2.0	1.4	1.3
Great Bend Borough	Not completed by municipality.								
Great Bend Township	Not completed by municipality.								
Hallstead Borough	2.2	2.1	2.1	2.1	2.9	1.9	1.8	1.7	1.5
Harford Township	1.9	2.0	2.1	2.1	1.7	1.9	1.8	1.3	1.5
Harmony Township	3.2	2.8	1.0	1.0	1.0	1.0	3.2	2.1	2.3
Herrick Township	Not completed by municipality.								
Hop Bottom Borough	Not completed by municipality.								
Jackson Township	Not completed by municipality.								

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk									
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
JURISDICTION	Extreme Temperatures	Flooding (100-year)	Lightning Strike	Dam Failure	Radon Exposure	Wildfire	Drought	Landslide	Earthquake
	2.2	2.1	2.1	2.1	2	1.9	1.8	1.7	1.5
Jessup Township	2.5	2.4	1.7	1.9	2.0	1.9	2.9	1.3	1.3
Lanesboro Borough	Not completed by municipality.								
Lathrop Township	2.1	1.3	1.6	2.0	1.6	1.5	2.5	1.3	1.3
Lenox Township	2.1	1.8	1.6	1.4	1.3	1.3	1.5	1.3	1.5
Liberty Township	Not completed by municipality.								
Little Meadows Borough	Not completed by municipality.								
Middletown Township	2.3	2.5	1.4	1.7	1.6	2.2	1.6	1.5	1.3
Montrose Borough	1.7	2.0	2.1	1.2	1.9	1.6	2.8	1.3	1.5
New Milford Borough	2.2	2.1	2.1	2.1	2.0	1.9	1.8	1.7	1.5
New Milford Township	2.1	2.2	2.2	1.6	2.5	1.3	2.2	1.3	1.9
Oakland Borough	1.8	2.4	2.6	2.4	2.6	2.0	1.8	2.6	1.5
Oakland Township	Not completed by municipality.								
Rush Township	N/A	4.0	2.8	1.5	1.0	1.8	1.7	2.2	1.3
Silver Lake Township	Not completed by municipality.								
Springville Township	2.5	3.0	2.5	3.0	1.6	1.1	2.1	1.4	1.0
Susquehanna Depot Borough	1.8	2.4	2.4	2.2	2.2	1.8	1.8	2.6	1.5
Thompson Borough	2.1	2.1	1.0	3.1	2.8	1.8	1.9	1.6	1.8
Thompson Township	Not completed by municipality.								
Union Dale Borough	Not completed by municipality.								

4.4.3. Potential Loss Estimates

Based on various kinds of available data, potential loss estimates were established for flooding. 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.

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 4.3.4 of the flooding hazard profile.

MCM Consulting Group, Inc. conducted a countywide 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 $74.87 million with 40.38% of that coming from residential homes. Total economic loss, including replacement value, content loss, functional loss, and displacement cost, from a countywide 1%-annual-chance flood are estimated to equal $166,810,000.00.

4.4.4. Future Development and Vulnerability

The 2020 census population for Susquehanna County is 38,434 which is 4,922 fewer than the 2010 census. There was an overall decrease of 11.4% in population based on the data. Three municipalities have seen population increases while the remaining municipalities had decreases in the period between 2010 and the 2020 as seen in *Table 74 – 2010 – 2020 Population Change.*

Table 74-2010 – 2020 Population Change

Population Change in Susquehanna County from 2010-2020			
Municipality	**2010 Census**	**2020 Census**	**Percent of Change 2010-2020**
Apolacon Township	500	426	**-14.8%**
Auburn Township	1,939	1,732	**-10.7%**
Bridgewater Township	2,844	2,636	**-7.3%**
Brooklyn Township	963	787	**-18.3%**
Choconut Township	713	679	**-4.8%**
Dimock Township	1,497	1,228	**-17.9%**
Forest City Borough	1,911	1,780	**-6.9%**
Forest Lake Township	1,193	1,114	**-6.6%**
Franklin Township	937	833	**-11.1%**
Friendsville Borough	111	101	**-9.0%**
Gibson Township	1,221	1,012	**-17.1%**
Great Bend Borough	734	627	**-14.6%**
Great Bend Township	1,949	1,708	**-12.4%**
Hallstead Borough	1,303	1,174	**-9.9%**
Harford Township	1,430	1,254	**-12.3%**
Harmony Township	528	508	**-3.8%**
Herrick Township	713	710	**-0.4%**
Hop Bottom Borough	337	311	**-7.7%**
Jackson Township	848	856	**+0.95%**
Jessup Township	536	464	**-13.4%**
Lanesboro Borough	506	508	**+0.4%**
Lathrop Township	841	766	**-8.9%**
Lenox Township	1,934	1,603	**-17.1%**
Liberty Township	1,292	1,130	**-12.5%**
Little Meadows Borough	273	245	**-10.3%**
Middletown Township	382	284	**-25.7%**
Montrose Borough	1,617	1,290	**-20.3%**
New Milford Borough	868	812	**-6.5%**

Population Change in Susquehanna County from 2010-2020			
Municipality	**2010 Census**	**2020 Census**	**Percent of Change 2010-2020**
New Milford Township	2,042	1,789	**-12.4%**
Oakland Borough	616	563	**-8.6%**
Oakland Township	564	488	**-13.5%**
Rush Township	1,267	1,133	**-10.6%**
Silver Lake Township	1,716	1,513	**-11.8%**
Springville Township	1,641	1,467	**-10.6%**
Susquehanna Depot Borough	1,643	1,365	**-16.9%**
Thompson Borough	299	254	**-15.1%**
Thompson Township	410	438	**+6.8%**
Union Dale Borough	267	220	**-17.6%**
Source: United States Census Bureau (2023), 2020 Census Data			

The 2021 American Community Survey from the United States Census Bureau estimates indicates that there are approximately 21,484 housing units in Susquehanna County, Pennsylvania. Of those, 15,430 are occupied housing units and of those 78.5% of the structures are occupied-housing units. The county-wide population changes indicate a potential alteration to overall hazard vulnerability. Municipalities that undergo widespread population reductions may have more difficulty meeting personnel demands than expanding jurisdictions. However, certain municipalities experienced significant resident increases and, thus, may be more vulnerable to certain hazards due to development and residential growth. Although expanding population zones may be especially vulnerable to hazards outlined in section 4.3 of this hazard mitigation plan update, natural and human caused hazards could potentially occur at any time regardless of population change. The Susquehanna County Hazard Mitigation Local Planning Team will conduct annual reviews of this plan and the impacts all hazards have on the county and new development every year and within a time frame after a disaster or major emergency.

5. Capability Assessment

5.1. Update Process Summary

The capability assessment is an evaluation of Susquehanna County governmental structure, political framework, legal jurisdiction, fiscal status, policies and programs, regulations, 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 municipalities during the planning process at meetings held with Susquehanna County officials. These meetings were designed to seek input from the 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. Therefore, these capability assessments consider the various characteristics and capabilities of municipalities under study.

The evaluation of the following categories – political framework, legal jurisdictions, 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 several 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

Thirty of the municipalities in Susquehanna County completed and submitted a capability assessment survey. In addition to those municipalities, Montrose Area School District, Susquehanna County, and Susquehanna River Basin Commission 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 compliant 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 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, land development, building codes, building permits, floodplain management and/or stormwater management ordinances. When effectively prepared and administered, these regulations can lead to an opportunity for hazard mitigation. For example, the National Flood Insurance Program (NFIP) established minimum floodplain management criteria, and adoption of the Pennsylvania Floodplain Management Act (Act 166 of 1978) established even higher floodplain management 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 and the municipal 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 that exist in that area. Consequently, structures that are built according to applicable codes are inherently resistant to many hazards, such as intense 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 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 Pennsylvania 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 Code (Act 45). All municipalities in Susquehanna County enforce their own 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, and 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.

Subdivision Ordinance

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

utilities and other improvements are provided in a manner that will not pollute streams, wells and/or soils, to reduce traffic congestions, and to 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. Of the forty municipalities in Susquehanna County, some have subdivision/land use ordinances, some have zoning regulations – some have both and some have neither (Susquehanna County Planning Commission, November 2018).

Stormwater Management Plan/Stormwater 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 Pennsylvania Department of Environmental Protection (PA DEP), which may grant an extension of time for 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. 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 ordinance depends on the extent of existing and projected land 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. All municipalities in Susquehanna County have adopted the county's stormwater management plan.

Comprehensive Plan

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

present and charts the community's future path. The Pennsylvania Municipalities 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.

Regarding 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 consider 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 that recommends considering storm drainage and floodplain management.

Susquehanna County last updated its comprehensive plan in 2018.

Article III of the MPC enables municipalities to prepare a comprehensive plan: however, development of a comprehensive plan is voluntary. Twenty-one of the forty municipalities in Susquehanna County have adopted their own comprehensive plans.

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.

Participation in the National Flood Insurance Program (NFIP)

Floodplain management is the operation of programs or activities that may consist of both corrective and preventative 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) require every municipality identified by the Federal Emergency Management Agency (FEMA) to participate in the National Flood Insurance Program 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 ensures that the risk of flood damage is not increased by property development.

The Pennsylvania Emergency Management Agency (PEMA) was appointed by legislation in September 2021 to coordinate the Commonwealth NFIP and employ the State NFIP Coordinator. For many years prior, these roles were held by the Pennsylvania Department of Community and Economic Development (DCED), which still offers support to communities through its Floodplain Mitigation Program. PEMA provides communities, based on 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, the below.

1. Prohibiting manufactured homes in the floodway
2. Prohibiting manufactured homes within the area measured fifty 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 structure
5. Prohibiting new construction and development within the area measured fifty feet landward from the top-of-bank of any watercourse within a special flood hazard area
6. Providing the county conservation district an opportunity to review and comment on all applications and plans for any proposed construction or development in any identified floodplain area

Act 166 mandates municipal participation in, and compliance with, the NFIP. It also establishes higher regulatory standards for new or substantially improved structures which are used for the production or storage of dangerous materials (as defined by Act 166) by prohibiting them in the floodway. Additionally, Act 166 established 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 5% for Class 9 communities up to 45% for Class 1 communities. The CRS recognizes eighteen 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. PEMA 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 established 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.

According to the State NFIP Coordinator, all but two of Susquehanna County's forty municipalities have floodplain regulations in place that meet requirements set forth by 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.

To spread awareness as well as capture participation levels, all municipalities were instructed to complete an NFIP survey provided by the Federal Emergency Management Agency. In total, twenty-nine municipalities submitted an NFIP survey. These surveys can be found in Appendix C of this plan.

5.2.2. Administrative and Technical Capability

There are thirteen boroughs, twenty-seven townships, and no cities within Susquehanna County. Each of these municipalities conducts it 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. Other municipalities choose to operate independently and provide such services internally. Municipalities vary in staff size, resource availability, fiscal status, service provision, constituent population, overall size, and vulnerability to the profile hazards. Technical capability relates to an adequacy of knowledge and technical expertise of local government employees or the ability to contract resources for this expertise in order to effectively execute mitigation activities. Common examples of skill sets, and technical personnel needed for hazard mitigation include: planners with knowledge of land development and management practices, engineers or professionals trained in construction practices related to buildings and/or infrastructure (e.g. building inspectors), planners or engineers with an understanding of natural and/or human caused hazards, emergency managers, floodplain managers, land surveyors, scientists familiar with hazards in the community, staff with education of expertise to assess community vulnerability to hazards, personnel skilled in geographic information systems, resource development staff or grant writers, fiscal staff to handle complex grant application processes.

County Planning Commission

In Pennsylvania, planning responsibilities traditionally have been delegated to each county and local municipality through the Municipalities Planning Code (MPC). A planning agency acts as an advisor to the governing body on matters of community growth and development. A governing body may appoint individuals to serve as legal or engineering advisors to the planning agency. In addition to the duties and responsibilities authorized by Article II of the MPC, a governing body may, by ordinance, delegate approval authority to a planning agency for subdivision and land development applications. A governing body has considerable flexibility,

not only as to which powers and duties are assigned to a planning agency, but also what form an agency will possess. A governing body can create a planning commission, a planning department, or both. The Susquehanna County Planning Commission assists all municipalities in the county as needed.

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. Most municipalities in Susquehanna County have a municipal engineer under contract to perform these duties.

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 data is managed, maintained, and developed by the Susquehanna County GIS Department, which is available to assist all the county's municipalities. GIS data is an important tool to use in hazard mitigation planning and is instrumental in assessing the risk of municipalities to various hazards.

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. Hence, the National Preparedness Goal of 2011 also defines what it means for the whole community to be prepared for all types of disasters and emergencies and lists five mission areas which support preparedness: prevention, protection, mitigation, response, and recovery – doubling the emphasis on mitigation activities in an emergency management program.

The Pennsylvania Emergency Management Services Code (PA 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 hazardous events have on their community.

A municipal emergency management coordinator is responsible for emergency management – preparedness, response, recovery, and mitigation within his/her respective authority having jurisdiction (AHJ). The responsibilities of the emergency management coordinator are outlined in PA Title 35 §7633.

- Prepare and maintain a current disaster emergency management plan
- Establish, equip, and staff an emergency operations center
- Provide individual 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 public
- Participate in all tests, drills, and exercises, including remedial drills and exercises, scheduled by the agency or by the federal government

PA Title 35 requires that all municipalities in the Commonwealth have a local emergency operations plan (EOP) which is updated every two years. All municipalities in Susquehanna County have adopted the county EOP. The notification and resource section of the plan was developed individually by each municipality.

Federal Agency Assistance

There are many federal agencies that can provide technical assistance for mitigation activities, and these include, but are not limited to:

- United States Army Corps of Engineers (USACE)
- Department of Housing and Urban Development (HUD)
- Department of Agriculture (DOA)
- Economic Development Administration
- Emergency Management Institute (EMI)
- Environmental Protection Agency (EPA)

- Federal Emergency Management Agency (FEMA)
- Small Business Administration (SBA)

State Agency Assistance

There are many commonwealth agencies that can provide technical assistance for mitigation activities, and these include but are not limited to:

- Pennsylvania Emergency Management Agency (PEMA)
- Pennsylvania Department of Community and Economic Development
- Pennsylvania Department of Conservation and Natural Resources
- Pennsylvania Department of Environmental Protection

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. *Table 75 – Susquehanna County Community Political Capability* summarizes the results of political capability.

Table 75-Susquehanna County Community Political Capability

Susquehanna County Community Political Capability						
Municipality Name	**Capability Ranking**					
	0	**1**	**2**	**3**	**4**	**5**
Apolacon Township	Did not respond to this question.					

Susquehanna County Community Political Capability						
Municipality Name	**Capability Ranking**					
	0	**1**	**2**	**3**	**4**	**5**
Ararat Township	Did not respond to this question.					
Auburn Township				X		
Bridgewater Township	Did not respond to this question.					
Brooklyn Township	Did not respond to this question.					
Choconut Township	Did not respond to this question.					
Clifford Township				X		
Dimock Township				X		
Forest City Borough				X		
Forest Lake Township			X			
Franklin Township					X	
Friendsville Borough	Did not complete capability assessment.					
Gibson Township	Did not respond to this question.					
Great Bend Borough	Did not complete capability assessment.					
Great Bend Township	Did not complete capability assessment.					
Hallstead Borough		X				
Harford Township				X		
Harmony Township	Did not respond to this question.					
Herrick Township	Did not respond to this question.					
Hop Bottom Borough						X
Jackson Township				X		
Jessup Township	Did not complete capability assessment.					
Lanesboro Borough	Did not complete capability assessment.					
Lathrop Township					X	
Lenox Township	Did not complete capability assessment.					
Liberty Township				X		
Little Meadows Borough	Did not respond to this question.					
Middletown Township				X		
Montrose Borough						X
New Milford Borough	Did not complete capability assessment.					
New Milford Township						X
Oakland Borough						X

Susquehanna County Community Political Capability						
Municipality Name	**Capability Ranking**					
	0	**1**	**2**	**3**	**4**	**5**
Oakland Township						X
Rush Township	Did not complete capability assessment.					
Silver Lake Township	Did not complete capability assessment.					
Springville Township					X	
Susquehanna Depot Borough						X
Thompson Borough				X		
Thompson Township	Did not respond to this question.					
Union Dale Borough	Did not complete capability assessment.					
Other Stakeholders						
Thompson Township	Did not respond to this question.					
Montrose Area School District	Did not respond to this question.					
Susquehanna County	Did not respond to this question.					
Susquehanna River Basin Commission		X				

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 mechanisms that could enhance of further such strategies. In response to the survey questionnaire, local officials classified each of the capabilities as wither "L = Limited", "M = Moderate", or "H = High." *Table 76 – Capability Self-Assessment Matrix* summarizes the results of the self-assessment survey. Twenty-nine municipalities returned this section of the assessment completed. If a municipality is not on the list, they have not completed the capability self-assessment matrix.

Table 76-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	M	M
Ararat Township	Not completed by municipality.			
Auburn Township	M	M	M	M
Bridgewater Township	M	M	M	M
Brooklyn Township	M	L	H	M
Choconut Township	M	M	L	M
Clifford Township	H	M	H	M
Dimock Township	M	M	M	M
Forest City Borough	M	L	M	L
Forest Lake Township	M	M	M	L
Franklin Township	H	M	M	M
Gibson Township	L	L	M	M
Hallstead Borough	L	L	L	L
Harford Township	M	M	M	M
Harmony Township	L	L	L	L
Herrick Township	M	M	H	M
Hop Bottom Borough	H	H	H	H
Jackson Township	L	L	M	L
Lathrop Township	L	L	L	L
Liberty Township	L	L	L	L
Little Meadows Borough	L	L	L	L
Middletown Township	L	M	L	L
Montrose Borough	L	L	L	L
New Milford Township	M	M	M	Not completed by municipality.
Oakland Borough	M	H	H	M
Oakland Township	L	M	L	L

Susquehanna County Capability Self-Assessment Matrix				
Municipality Name	**Capability Category**			
	Planning and Regulatory Capability	**Administrative and Technical Capability**	**Fiscal Capability**	**Community Political Capability**
Springville Township	M	M	H	H
Susquehanna Depot Borough	M	M	M	H
Thompson Borough	H	M	M	M
Thompson Township	L	L	L	L
Union Dale Borough	Not completed by municipality.			
Other Stakeholders				
Montrose Area School District	H	H	M	M
Susquehanna County	M	M	M	M
Susquehanna River Basin Commission	M	H	M	L

In addition to the institutional capability of the municipal government structure described above, the county itself can engage in mitigation activities. The county has its own staff, resources, budget, and objectives, which may or may not be like those of its constituent municipalities. Therefore, the county has its own capabilities to mitigate the profiled hazards through planning and coordination of local mitigation efforts. The Susquehanna County GIS Department can provide needed skills in the analysis of geographic data. Other local organizations that can and do act as partners include the Susquehanna County Planning Commission, the Susquehanna County Conservation District, the Susquehanna County Redevelopment Authority, the Susquehanna County Area Agency on Aging, the Fire Advisory Committee and Regional Firefighters Association, business development organizations, and historical or cultural agencies.

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 the municipalities. The county and municipality 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 decision and capacity to implement mitigation-related activities is often strongly dependent on the presence of financial resources. While some mitigation actions are less costly than others, it is important that money is available locally to implement policies and projects. Financial resources are particularly important if communities are trying to take advantage of state or federal mitigation grant funding opportunities that require local-match contributions. Based on survey results, most municipalities within the county perceive fiscal capability to be moderate. 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 many 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".

Grant programs that may be utilized to accomplish hazard mitigation objectives include the: Pennsylvania Department of Community and Economic Development Community Development Block Grant (CDBG); Land Use Planning and Technical Assistance (LUPTAP); Shared Municipal Services (SMS); Community Revitalization (CR) and Floodplain Land Use Assistance Programs; the PA DEP's Growing Greener; Act 167 Stormwater Management; Source Water Protection; and Flood Protection Programs. The Flood Protection Programs include the PA DCNR's Community Conservation Partnership Program, PEMA's Pre-Disaster Mitigation (PDM) Grant, Flood Mitigation Assistance Grant Programs (FMA), and Hazard Mitigation Grant Program.

Below are some of the other state programs that may provide financial support for mitigation activities:

- DCED Flood Mitigation Program
- DCED H2O PA Flood Control Projects
- DCED H2O PA High Hazard Unsafe Dam Projects
- DCED H2O PA Water Supply, Sanitary Sewer and Storm Water Projects
- DCED PA Small Water and Sewer
- DCNR Community Conservation Partnerships Program

- DCNR Pennsylvania Heritage Areas Program
- DCNR Pennsylvania Recreational Trails Program
- DCNR Land and Water Conservation Fund

Below are some of the federal programs that may provide financial support for mitigation activities:

- FEMA Community Assistance Program – State Support Services Element (CAP-SSSE)
- FEMA Community Disaster Loan Program
- FEMA Community Rating System
- FEMA Emergency Management Performance Grants (EMPG)
- FEMA Environmental Planning and Historic Preservation Program (EHP)
- FEMA Flood Mitigation Assistance Program
- FEMA Hazard Mitigation Grant Program (HMGP)
- FEMA Individuals and Households Program (IHAP)
- FEMA National Dam Safety Program
- FEMA National Flood Insurance Program
- FEMA Pre-Disaster Mitigation Program
- FEMA Public Assistance Program (PA)
- FEMA Regional Catastrophic Preparedness Grant Program
- FEMA Repetitive Flood Claims Program (RFC)
- FEMA Severe Repetitive Loss Grant Program
- USACE Continuing Authorities Program
- USACE Flood Plain Management Services Program (FPMS)
- USACE Inspection of Completed Works Program (ICW)
- USACE National Levee Safety Program
- USACE Planning Assistance to States
- USACE Rehabilitation and Inspection Program (RIP)

Capital Improvement Financing

Because most of the 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 are always priorities.

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 recreational facilities. Voter approval for this 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 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 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 one of the principal activities of the local government facilities' financing authorities. An operating water authority issues bonds to purchase existing facilities 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 Pennsylvania Public Utility Commission. The Pennsylvania Department of

Environmental Protection has a program to assist with consolidating small water systems to make system upgrades more cost effective.

U.S. Department of Agriculture Circuit Riding Program (Engineer)

The Circuit Riding Program is an example of intergovernmental cooperation. This program offers municipalities the ability to join 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

The Susquehanna County Emergency Management Agency conducts 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.

Education activities that directly impact hazard mitigation in Susquehanna County predominantly revolve around the first responders. Providing fire, medical, search and rescue training, and education enhances the response and recovery capabilities of response agencies in the county. Newly appointed emergency management coordinators are trained in both Duties and Responsibilities and damage assessment – which includes a discussion on mitigation; this training can be translated into teaching municipal employees or local emergency services to assist them during a disaster.

The county also has several websites and social media accounts that can educate residents about hazard mitigation and risk while also communicating information in the event of a disaster:

- Susquehanna County Webpage: https://susqco.com
- Susquehanna County Emergency Management Agency Webpage: https://susqco.com/departments/emergency-management
- Susquehanna County Emergency Management Agency Facebook: https://www.facebook.com/susqema/

The Susquehanna County GIS Department website has an education and outreach capability, particularly with the county map viewer, which could be updated to include hazard mitigation data. The websites of the Susquehanna County Emergency Management Agency and the Susquehanna County Planning Commission also post information to educate residents, particularly in disaster preparedness, floodplain management, and zoning requirements. The

Susquehanna County Planning Commission currently provides access to planning documents and educational brochures about the benefits of planning and helpful guides. The DES also holds quarterly Local Emergency Planning Committee (LEPC) meetings that are open to the public, which serve as another means to conduct outreach and educate the public about hazard mitigation.

Education and outreach on the NFIP are necessary. With new regulations in flood-plain management, updated digital flood insurance rate maps and new rates 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

Plan integration recognizes that hazard mitigation is most effective when it works in efficient coordination with other plans, regulations, and programs. Plan integration promotes safe, resilient growth, effective management, an overall reduction of risk, by ensuring that the goals and actions established in the Hazard Mitigation Plan are included in the comprehensive planning efforts so they can affect future land use and development. Some of the most important areas of planning and regulatory capabilities which hazard mitigation goals and actions should be integrated include comprehensive plans, the hazard mitigation plans from all surrounding or encompassing areas, EOPs, building codes, floodplain ordinances, subdivision, land development ordinances, stormwater management plans and ordinances, and zoning ordinances. All of these tools provide mechanisms for the implementation of adopted mitigation strategies.

Communities can integrate hazard mitigation principles and items from this hazard mitigation plan in their planning mechanisms, including municipal comprehensive plans, emergency operations plans, and other items. Municipalities in Susquehanna County can utilize portions of the risk assessment section and the mitigation strategy sections when trying to determine risk of the community to hazards, and ways to reduce the risk and vulnerability of those hazards to the community. This hazard mitigation plan should be considered a source of information for use by municipalities and participating jurisdictions in this planning process. Each municipality should review plan integration and planning mechanisms during the next five year update window, and the planning mechanisms should be reviewed on a regular basis. This regular basis could include during potential annual updates or annual reviews as part of the hazard mitigation planning process.

Currently, this hazard mitigation plan has been lightly integrated into municipal planning mechanisms, but this integration level can increase with this hazard mitigation plan update and future mitigation development at the municipal level.

Susquehanna County Comprehensive Plan

Overview

Comprehensive plans establish the overall vision, goals, and objectives for a community's growth. The Susquehanna County Comprehensive Plan was adopted by the Susquehanna County Commissioners on November 14, 2018. The plan is a collaborative effort between the eleven counties in the Northeast region and contains both regional priorities and action plans for each county in the region. The plan establishes countywide goals and objectives, describes environmental and demographic characteristics, identifies potential capital improvement projects, and inventories existing planning initiatives and tools in the county.

As part of the update process, the goals and objectives in the 2018 Comprehensive Plan were reviewed, and those that are currently supportive of hazard mitigation goals and principles were identified. The plan also identified opportunities to integrate goals and objectives from the 2018 Hazard Mitigation Plan and 2023 HMP Update into the next update of the comprehensive plan.

Recommendations for Continued and Future Integration

As discussed, many of the goals and objectives outlined in the Susquehanna County Comprehensive Plan are related to the hazard mitigation risks and goals established in the HMP. Several could be revised to include updated information from this HMP. Additionally, the comprehensive plan can identify the places of higher vulnerability that are identified in this plan for all the high-risk hazards, and include objectives aimed at reducing the risk to these vulnerable areas. For example, an objective of the comprehensive plan could be to encourage elevation and flood proofing of structures in the Special Flood Hazard Area (SFHA) by seeking Flood Mitigation Assistance (FMA) grants and strictly enforcing floodplain management ordinances in certain communities (See Section 4.3.3 for Flooding and Flash Flooding information). Similarly, an objective for communities that are most vulnerable to subsidence and land failure could be to educate property owners about mine subsidence, associated risks, and actions to take in the event of an emergency. These types of objectives could also be created for medium-risk hazards when appropriate.

Another key opportunity for further integration of hazard mitigation into planning and regulatory tools is to incorporate hazard mitigation goals and objectives into the future Susquehanna County Comprehensive Plan update.

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 eighteen objectives identified in the 2018 hazard mitigation plan. The 2023 Susquehanna County Hazard Mitigation Plan Update has five goals and twenty-two objectives. Objectives have been added and arranged in order to associate them with the most appropriate goal. These changes are noted in *Table 77 – 2018 Mitigation Goals and Objectives Review*. These reviews are based on the five-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 thirty-eight actions identified in the 2018 mitigation strategy. A review of the 2018 mitigation actions was completed by the local planning team. The results of this review are identified in *Table 78 – 2018 Mitigation Actions Review*. 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 77-2018 Mitigation Goals and Objectives Review

Susquehanna County 2018 Mitigation Goals and Objectives		
GOAL Objective	**Description**	**Comment**
Goal 1	**Protect life and property from all natural and human-caused hazards.**	**2023 Review Comment:** No comment.
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.	**2023 Review Comment:** "community lifelines and critical facilities"

Susquehanna County 2018 Mitigation Goals and Objectives		
GOAL Objective	**Description**	**Comment**
Objective 1.2	Encourage property owners to take preventive actions in areas that are especially vulnerable to hazards.	**2023 Review Comment:** "….all stakeholders….
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.	**2023 Review Comment:** Remove safety inspection procedures. Make Action from safety inspection procedures. "…..And associated inspections."
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.	**2023 Review Comment:** "risk of all natural and human-caused 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.	**2023 Review Comment:** "emergency services, community lifelines, and essential facilities at the local and county level before, during, and immediately after disasters and hazard events."
Objective 1.6	Integrate hazard mitigation principals from the 2018 plan into local and county plans and programs.	**2023 Review Comment:** "2023 plan"
Objective 1.7	Implement mitigation activities that encourage environmental stewardship and protection of the environment.	**2023 Review Comment:** "the protection of environmental systems and resources."
GOAL 2	**Increase education and risk awareness regarding natural and human-caused hazards.**	**2023 Review Comment:** "all natural and human-caused hazards."

Susquehanna County 2018 Mitigation Goals and Objectives		
GOAL Objective	**Description**	**Comment**
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.	**2023 Review Comment:** Remove additional. "Develop, implement, and maintain….."
Objective 2.2	Research and identify information on tools, partnership opportunities, funding resources, and current government initiatives to assist in implementing mitigation activities.	**2023 Review Comment:** Move to Goal 3.
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.	**2023 Review Comment: "**Provide comprehensive information to all stakeholders, before, during, and immediately following disasters and hazard events."
Objective 2.4	Formalize hazard mitigation as a factor in all facets of community planning and development activities.	**2023 Review Comment:** "Integrate hazard mitigation principles…."
Objective 2.5	Encourage homeowners, renters, and businesses to purchase insurance coverage for potential damages caused by hazards.	**2023 Review Comment:** Edit to cover NFIP in name? "Encourage non-governmental stakeholders….."
Goal 3	**Encourage and develop local, state, regional and federal partnerships to improve coordination, planning and regulation development and enforcement.**	**2023 Review Comment:** No comment.

Susquehanna County 2018 Mitigation Goals and Objectives		
GOAL Objective	**Description**	**Comment**
Objective 3.1	Encourage and develop inter-jurisdictional and inter-agency partnerships to foster hazard mitigation strategies and/or projects.	**2023 Review Comment:** No comment.
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.	**2023 Review Comment: "**Identify and implement ways to engage all stakeholders to implement mitigation activities more effectively."
Objective 3.3	Encourage mutual aid relationships in acquiring, maintaining, and providing emergency resources.	**2023 Review Comment:** No comment.
Goal 4	**Enhance and improve emergency preparedness, warning and response procedures and capabilities.**	**2023 Review Comment:** No comment.
Objective 4.1	Encourage the establishment of policies at the county and local level to help ensure the prioritization and implementation of mitigation measures.	**2023 Review Comment:** "…local and county level…." "mitigation strategies"
Objective 4.2	Identify and acquire, any emergency services, training, and equipment needed to enhance response capabilities for specific hazards.	**2023 Review Comment:** "Identify any training and equipment needed to enhance response capabilities to high-risk hazards."
Objective 4.3	Review and improve emergency traffic routes and communicate such routes to the public and communities.	**2023 Review Comment:** "… and communicate routes and any changes to the public and municipalities."

Table 78-2018 Mitigation Actions Review

Susquehanna County Mitigation Actions Review Worksheet						
Existing Mitigation Actions *(2018 HMP)*	***Status***					***Review Comments***
	No Progress/ Unknown	**In Progress/Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
1.1.1 Monitor, remove stream debris, stabilize streambanks, and restore streams as needed.			X			**2023 Review Comment:** Carry over.
1.1.2 Install new pipe/culvert or increase size of pipe/culvert to reduce runoff and flooding at identified problem areas.			X			**2023 Review Comment:** Carry over.
1.1.3 Inspect and maintain Thompson Mill Pond Dam.	X					**2023 Review Comment:** Remove.
1.1.4 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.			X			**2023 Review Comment:** Carry over.
1.1.5 Where necessary, obtain funding for back-up generators and other redundant systems and utilities necessary for nursing homes, person-al care facilities, and other critical assets vital to safety and the delivery of government services.	X					**2023 Review Comment:** Carry over. Update to include community lifelines and critical facilities.
1.2.1 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.			X			**2023 Review Comment:** Move to Objective 1.8.

Susquehanna County Mitigation Actions Review Worksheet						
Existing Mitigation Actions *(2018 HMP)*	***Status***					***Review Comments***
	No Progress/ Unknown	**In Progress/Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
1.2.2 Conduct educational sessions on the community rating system offered by the National Flood Insurance Pro-gram for all municipalities.	X					**2023 Review Comment:** Carry Over.
1.3.1 Develop a flood control plan with the Choconut Creek Watershed Association.	X					**2023 Review Comment:** Carry Over. Review.
1.3.2 Continue code enforcement for land use, building codes and floodplain.			X			**2023 Review Comment:** Carry Over.
1.3.3 Develop, promote, and adopt model floodplain ordinances to reduce vulnerabilities to flooding.			X			**2023 Review Comment:** Carry Over.
1.3.4 Encourage continued compliance and greater participation in the NFIP.			X			**2023 Review Comment:** Carry Over.
1.3.5 Support remapping of floodplain within Susquehanna County and the development of better floodplain management tools.		X				**2023 Review Comment:** Carry Over.
1.4.1 Conduct a county wide hazardous material commodity flow study.				X		**2023 Review Comment:** Carry Over.
1.4.2 Susquehanna County GIS will develop layers for future hazard mitigation planning and vulnerability assessments.			X			**2023 Review Comment:** Carry Over.
1.4.3 Susquehanna County GIS will complete HAZUS loss estimation software training.		X				**2023 Review Comment:** Carry Over.

Susquehanna County Mitigation Actions Review Worksheet						
Existing Mitigation Actions *(2018 HMP)*	***Status***					***Review Comments***
	No Progress/ Unknown	**In Progress/Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
1.5.1 Susquehanna County to implement new fire walls to decrease the impact of cyber-attacks.			X			**2023 Review Comment:** Move to Objective 1.4. Update verbiage "Implement new firewalls and cybersecurity procedures and best practices to decrease the impact of a potential cyberattack."
1.5.2 Susquehanna County will exercise the county continuity of government plan and update with information from the after action report.		X				**2023 Review Comment:** Carry Over.
1.5.3 Outreach to businesses will be completed to encourage the development of a continuity of operations plan to ensure the survivability of business post disaster.	X					**2023 Review Comment:** Carry Over.
1.6.1 Integrate 2018 hazard mitigation principals into the next county comprehensive plan update.		X				**2023 Review Comment:** "2023"
1.6.2 Update the municipal regional comprehensive plans and integrate hazard mitigation principles.		X				**2023 Review Comment:** Carry Over.
1.7.1 Enact a county burn ban during drought to prevent wildfires.			X			**2023 Review Comment:** Carry Over.
2.1.1 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			**2023 Review Comment:** Move to Objective 3.4.
2.1.2 Develop a training pro-gram on household hazardous materials and conduct various sessions across the county.					X	**2023 Review Comment:** Carry Over.

Susquehanna County Mitigation Actions Review Worksheet						
Existing Mitigation Actions *(2018 HMP)*	***Status***					***Review Comments***
	No Progress/ Unknown	**In Progress/Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
2.1.3 Conduct a Narcan training program for all first responders and secondary responders of the county.			X			**2023 Review Comment:** Carry Over.
2.1.4 Conduct first responder training on transportation and fixed facility HazMat emergencies.			X			**2023 Review Comment:** Carry Over.
2.1.5 Conduct public education and outreach so the residents of the county are aware of the threat level of radon in the county per municipality.					X	**2023 Review Comment:** Carry Over.
2.1.6 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.	X					**2023 Review Comment:** Carry Over.
2.2.1 Conduct engineering study to determine necessary modifications for drainage systems at: State, High and East High Streets.			X			**2023 Review Comment:** Move to Objective 1.1
2.2.2 Actively pursue funding on annual basis, out-side disaster assistance programs, for flood mitigation activities that target repetitive loss properties and im-prove public safety.			X			**2023 Review Comment:** Move to Objective 3.4.
2.2.3 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.			X			**2023 Review Comment:** Move to Objective 2.1.
2.2.4 Drug and Alcohol Task Force activities to decrease the impact of opioid epidemic.					X	**2023 Review Comment:** Move to Objective 3.4.

Susquehanna County Mitigation Actions Review Worksheet						
Existing Mitigation Actions *(2018 HMP)*	***Status***					***Review Comments***
	No Progress/ Unknown	**In Progress/Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
2.3.1 Seek guidance on risk potential of natural gas exploration and drilling.			X			**2023 Review Comment:** Carry Over.
2.3.2 Publicize/release shelter information during an emergency with special attention to facilities that accommodate pets.			X			**2023 Review Comment:** Carry Over.
2.4.1 Actively integrate recommendations and principles of the 2018 hazard mitigation plan into existing local and county emergency operations plans.			X			**2023 Review Comment:** Carry Over. Update to say "2023"
2.5.1 Encourage citizens to purchase flood insurance for properties located in the special flood hazard area or known flooding areas.			X			**2023 Review Comment:** Carry Over. Update verbiage to say, "Encourage citizens to *research* the purchase flood insurance for properties located in the special flood hazard area or known flooding areas."
3.2.1 Dropbox locations throughout the county to return prescription drugs to ensure that abuse is decreased.			X			**2023 Review Comment:** Carry Over. Move to Objective 3.1.
3.3.1 Maintain, update, and enhance Mutual Aid Agreements at all levels of government.			X			**2023 Review Comment:** Carry Over.
4.2.1 Review, update and enhance early warning and notification systems.			X			**2023 Review Comment:** Move to Objective 2.2.

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 five goals and twenty-two corresponding objectives were developed. *Table 79 – 2023 Goals and Objectives* details the mitigation goals and objectives established for the 2023 Susquehanna County Hazard Mitigation Plan.

Table 79-Susquehanna County 2023 Mitigation Goals and Objectives

Susquehanna County 2023 Mitigation Goals and Objectives	
Goal/Objective	**Description**
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, community lifelines, and critical facilities more resistant to hazards.
Objective 1.2	Encourage all stakeholders 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, and applicable rules to help ensure that they employ the most recent and generally accepted standards 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 the risk of all natural and human-caused hazards.
Objective 1.5	Ensure continuity of governmental operations, emergency services, community lifelines, and critical facilities at the local and county level before, during, and immediately after disasters and hazard events.
Objective 1.6	Integrate hazard mitigation principles and strategies from the 2023 plan into local and county plans and programs.
Objective 1.7	Implement mitigation activities that encourage environmental stewardship and protection of the environmental systems and resources.
Objective 1.8	Complete actions and projects to acquire, elevate, demolish or demolish/reconstruct properties, repetitive loss properties and severe repetitive loss properties.

Susquehanna County 2023 Mitigation Goals and Objectives	
Goal/Objective	**Description**
GOAL 2	**Increase education, outreach, and risk awareness regarding all natural and human-caused hazards.**
Objective 2.1	Develop, implement, and maintain 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	Provide comprehensive information to all stakeholders, before, during, and immediately following disasters and hazard events.
Objective 2.3	Integrate hazard mitigation principles and strategies in all facets of community planning and development activities.
Objective 2.4	Encourage non-governmental stakeholders to purchase insurance coverage, such as the National Flood Insurance Program (NFIP), 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 all stakeholders to implement mitigation activities more effectively.
Objective 3.3	Encourage mutual aid agreements in acquiring, maintaining, and providing resources and emergency services.
Objective 3.4	Research and identify information on tools, partnership opportunities, funding resources, and current government initiatives to assist in implementing mitigation activities.
Goal 4	**Enhance and improve emergency preparedness, warning and response procedures and capabilities.**

Susquehanna County 2023 Mitigation Goals and Objectives	
Goal/Objective	**Description**
Objective 4.1	Encourage the establishment of policies at the local and county level to help ensure the prioritization and implementation of mitigation strategies.
Objective 4.2	Identify any training and equipment needed to enhance response capabilities to high-risk hazards.
Objective 4.3	Review and improve emergency traffic routes and collaborate with all stakeholders on any requested changes to those routes.
Goal 5	**Participate in FEMA's High-Hazard Potential Dam Program (HHPD).**
Objective 5.1	Educate all stakeholders regarding FEMA's HHPD program.
Objective 5.2	Reduce long-term vulnerabilities from eligible high-hazard potential dams that pose an unacceptable risk to the public.
Objective 5.3	Identify, by area, locations that could potentially be impacted by FEMA's HHPD program.

Goal 5 and Objective 5.1, Objective 5.2, and Objective 5.3 relate to multiple mitigation actions in *Table 81 – 2023 Mitigation Action Plan*. Action 5.1.1 relates to Objective 5.1, Action 5.2.1 relates to Objective 5.2, and Action 5.3.1relates to Objective 5.3. All three of the mitigation actions are covered by Goal 5 of the goals and objectives for the 2023 Hazard Mitigation Plan. These mitigations reduce the vulnerability of county populations and structures by educating the public on the HHPD program, enhancing local policies and procedures for HHPD planning, and digitizing dam inundation areas for future analysis and prevention of losses.

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.

- Planning and regulations
- Structure and infrastructure
- Natural systems protection
- Education and awareness

Planning 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 planning 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 structure or protects the structure from a specific hazard. The new or renovated structures are therefore protected or have a reduced impact of hazards.

Natural Systems 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 impacts of hazards.

Table 80 – 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 X – 2023 Mitigation Action Plan*.

Table 80-Mitigation Strategy Technique Matrix

Susquehanna County Mitigation Strategy Technique Matrix				
Hazard	**MITIGATION TECHNIQUE**			
	Planning and Regulations	**Structure and Infrastructure**	**Natural Systems Protection**	**Education and Awareness**
Drought	X	X		X
Earthquake	X	X		X
Extreme Temperature	X	X		X
Flooding, Flash Flooding, Ice Jam	X	X	X	X
Hailstorm	X	X		X
Hurricanes/Tropical Storm	X	X		X
Invasive Species	X	X		X
Landslide	X	X		X
Lightning Strike	X	X		X
Pandemic, Epidemic, Infectious Disease	X	X		X
Radon Exposure	X	X		X
Tornado/Windstorm	X	X		X
Wildfire	X	X	X	X
Winter Storm	X	X		X
Dam Failure	X	X		X
Emergency Services	X	X		X
Environmental Hazards	X	X		X
Mental Health Services	X	X		X
Opioid Epidemic	X	X		X
Transportation Accidents	X	X		X
Terrorism/Cyberterrorism	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 2023 hazard mitigation plan (HMP) update after the risk assessment section was completed. The LPT started this section by reviewing the 2018 HMP mitigation strategy section. A review of the previous goals, objectives, actions, and project opportunities documented in the 2018 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 via virtual platforms or in-person meetings. 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. Municipalities that were not able to join conference calls were contacted individually.

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 2023 Susquehanna County HMP are listed in the mitigation action plan. *Table 81 – 2023 Mitigation Action Plan* is the 2023 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 81 – 2023 Mitigation Action Plan* is a matrix that identifies the county and/or municipalities responsible for mitigation actions in the new mitigation action plan. *Table 82 – Municipal Hazard Mitigation Actions Checklist* shows which actions tie to specific municipalities for responsibilities. *Table 83 – Objective to Action Checklist* shows that each mitigation objective has a mitigation action item related to it. *Table 84 – Actions Tied to Hazards* illustrates the specific actions that are tied to each hazard outlined in the hazard mitigation plan.

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
BRIC:	Building Resilient Infrastructure and Communities (BRIC) Program, 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

HMERP: Hazard Mitigation Emergency Response Program administered by the Pennsylvania Emergency Management Agency

HHPD: Rehabilitation of High-Hazard Potential Dams Grant Program, administered by the Federal Emergency Management Agency

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 is highly effective or feasible, a "-" if the action was ineffective or not feasible, and a "N" if no cost of benefit could be associated with the suggested action or the action was no 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.
- Address High Risk Hazard (weight: 15% of score): The action reduces vulnerability for people and property from a hazard identified as high risk.
- Address 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, and 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.

Table 81-2023 Mitigation Action Plan

Susquehanna County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
1.1.1	Natural System Protections	Monitor, remove stream debris, stabilize streambanks, and restore streams as needed.	Flooding Flash Flooding		X		2023 - 2028	Local, HMGP, PDM and FMA	Susquehanna County Municipalities
1.1.2	Structure and Infrastructure	Install new pipe/culvert or increase size of pipe/culvert to reduce runoff and flooding at identified problem areas	Flooding Flash Flooding		X		2023 - 2028	Local, HMGP, PDM and FMA	Susquehanna County Municipalities
1.1.3	Structure 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.	Flooding Flash Flooding		X		2023 - 2028	Local	Susquehanna County Municipalities
1.1.4	Structure and Infrastructure	Where necessary, obtain funding for backup generators and other redundant systems and utilities necessary for community lifelines and critical facilities vital to the delivery of life supporting services.	All Hazards	X			2023 - 2028	Local	Susquehanna County EMA and Susquehanna County Municipalities EMA
1.1.5	Natural System Protections	Conduct engineering study to determine necessary modifications for drainage systems at State Street, High Street, and East High Street.	Flash Flooding			X	2023 - 2028	Local, HMGP, PDM and FMA	Oakland Borough
1.2.1	Education and Awareness	Conduct educational sessions on the community rating system offered by the National Flood Insurance Program (NFIP) for all municipalities.	Flooding Flash Flooding		X		2023 - 2028	Local, FMA	Susquehanna County EMA and Susquehanna County Municipalities EMA

Susquehanna County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
1.3.1	Planning and Regulations	Develop a flood control plan with the Choconut Creek Watershed Association.	Flooding Flash Flooding			X	2023 - 2028	Local	Susquehanna County Conservation District and Choconut Township
1.3.2	Planning and Regulations	Continue code enforcement for land use, building codes, and floodplain enforcement at the municipal level.	All Hazards		X		2023 - 2028	Local	Susquehanna County Municipalities
1.3.3	Planning and Regulations	Develop, promote, and adopt model floodplain ordinances to reduce vulnerabilities to flooding.	Flooding	X			2023 - 2028	Local	Susquehanna County Planning and Susquehanna County Municipalities
1.3.4	Planning and Regulations	Encourage continued compliance and greater participation in the National Flood Insurance Program (NFIP).	Flooding Flash Flooding		X		2023 - 2028	Local	Susquehanna County Planning and Susquehanna County Municipalities
1.3.5	Planning and Regulations	Support remapping of floodplain within Susquehanna County and the development of better floodplain management tools.	Flooding		X		2023 - 2028	Local, HMGP, PDM, and FMA.	Susquehanna County Planning and Susquehanna County Municipalities
1.3.6	Planning and Regulations	Review and implement items from community floodplain ordinances related to substantial damage/substantial improvement for all local jurisdictions in the next hazard mitigation plan update.	Flooding Flash Flooding Ice Jam Flooding		X		2023-2028	Local Tax Dollars	Susquehanna County Planning and Susquehanna County Municipalities
1.3.7	Education and Outreach	Educate locals on the community floodplain ordinances that are related to substantial damage/substantial improvements.	Flooding Flash Flooding Ice Jam Flooding		X		2023-2028	Local Tax Dollars	Susquehanna County Planning and Susquehanna County Municipalities

Susquehanna County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
1.3.8	Education and Outreach	Susquehanna County will look into or request SI/SD training from FEMA Region III FMI staff. If deemed appropriate by Susquehanna County	Flooding Flash Flooding Ice Jam Flooding		X		2023-2028	Local Tax Dollars	Susquehanna County Planning and Susquehanna County Municipalities
1.4.1	Planning and Regulations	Conduct a county wide hazardous material commodity flow study within this next planning period.	Environmental Hazards/Transportation		X		2023 - 2028	Act 165 and HMEP	Susquehanna County EMA and LEPC
1.4.2	Planning and Regulations	Develop GIS layers for future use in hazard mitigation planning and vulnerability assessments.	All Hazards		X		2023 - 2028	Local	Susquehanna County GIS
1.4.3	Education and Outreach	Complete HAZUS loss estimation software training and research functionality in county procedures.	Flooding Hurricane and Windstorm		X		2023 - 2028	Local	Susquehanna County GIS
1.4.4	Planning and Regulations	Implement new firewalls and cybersecurity procedures and best practices to decrease the impact of a potential cyberattack.	Cyberterrorism	X			2023 - 2028	Local and Act 12 Funds	Susquehanna County IT, 911, and EMA
1.4.5	Planning and Regulations	Examine and research cybersecurity directives, best practices, and resources from the United States Department of Homeland Security's (US DHS) Cybersecurity & Infrastructure Security Agency (CISA) to lessen the impact of a potential cyber-security incident at the county.	Cyberterrorism	X			2023 - 2028	Local	Susquehanna County IT
1.5.1	Planning and Regulations	Exercise the county continuity of government plan and update with information from the after action report of the exercise.	All Hazards	X			2023 - 2028	Local, HSGP, and EMPG	Susquehanna County

Susquehanna County 2023 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 Outreach	Outreach to businesses to encourage the development of a continuity of operations plan to ensure the survivability of business post disaster.	All Hazards		X		2023 - 2028	Local and EMPG	Susquehanna County EMA
1.6.1	Planning and Regulations	Integrate 2023 hazard mitigation principles into the next county comprehensive plan update.	All Hazards		X		2023 - 2028	Local and MAP funds	Susquehanna County Commissioners and Planning
1.6.2	Planning and Regulations	Update the municipal regional comprehensive plans and integrate hazard mitigation principles.	All Hazards		X		2023 - 2028	Local and EMPG	Susquehanna County EMA and Susquehanna County Municipalities
1.7.1	Natural System Protections	Enact a county burn ban during drought events to prevent wildfires.	Wildfire			X	2023 - 2028	Local	Susquehanna County EMA and County Fire Chiefs
1.8.1	Planning and Regulations	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 Flash Flooding		X		2023 - 2028	Local	Susquehanna County Municipalities
1.8.2	Planning and Regulations	Prioritize and target all communities within Susquehanna County for structural and property protection projects to reduce the impacts from flooding including flood proofing, acquisition, elevation, relocation, and demolition/reconstruction projects.	Flooding Flash Flooding		X		2023 - 2028	Local Tax Dollars and FMA	Susquehanna County Municipalities

Susquehanna County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
2.1.1	Education and Outreach	Develop a training program on household hazardous materials and conduct various sessions across the county.	Environmental Hazards			X	2023 - 2028	Local and Act 165	Susquehanna County Commissioners, EMA, and LEPC
2.1.2	Education and Outreach	Conduct a Narcan training program for all first responders and secondary responders of the county.	Opioid Epidemic			X	2023 - 2028	Local and PCCD	Susquehanna County Coroner
2.1.3	Education and Outreach	Conduct first responder training on transportation and fixed facility HazMat emergencies.	Environmental Hazards		X		2023 - 2028	Local and Act 165	Susquehanna County EMA and LEPC
2.1.4	Education and Outreach	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 Exposure			X	2023 - 2028	Local and Act 165	Susquehanna County EMA
2.1.5	Education and Outreach	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 Exposure			X	2023 - 2028	Local and Act 165	Susquehanna County EMA
2.1.6	Education and Outreach	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.	Urban Fire Emergency Services			X	2023 - 2028	Local and Act 13	Susquehanna County Commissioners
2.2.1	Education and Outreach	Determine communications plan with all stakeholders in the event of a disaster event.	All Hazards		X		2023 - 2028	Local	Susquehanna County EMA
2.2.2	Education and Outreach	Publicize/release shelter information during an emergency with special attention to facilities that accommodate pets.	All Natural Hazards	X			2023 - 2028	Local, HSGP, and EMPG	Susquehanna County 911, EMA, and Red Cross

Susquehanna County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
2.2.3	Education and Outreach	Distribute hazard mitigation pamphlets and handouts on hazards in the county at county events including county fairs, festivals, etc. and have those pamphlets in county offices for distribution.	All Hazards		X		2023 - 2028	Local	Susquehanna County EMA
2.2.4	Education and Outreach	Review, update and enhance early warning and notification systems.	All Hazards	X			2023 - 2028	Local, HSGP, and Act 12 Funds	Susquehanna County 911 and EMA
2.3.1	Planning and Regulations	Seek guidance on risk potential of natural gas exploration and drilling and the potential future development of extraction activities.	Environmental Hazards		X		2023 - 2028	Local	Lathrop Township
2.3.2	Planning and Regulations	Actively integrate recommendations and principles of the 2023 hazard mitigation plan into existing local and county emergency operations plans.	All Hazards		X		2023 - 2028	Local and EMPG	Susquehanna County EMA and Susquehanna County Municipalities EMA
2.4.1	Planning and Regulations	Encourage citizens to research the purchase flood insurance for properties located in the special flood hazard area or known flooding areas.	Flooding Flash Flooding		X		2023 - 2028	Local	Susquehanna County Planning
3.1.1	Planning and Regulations	Work with other stakeholders and agencies to increase the amount of prescription drug take back boxes around the county to reduce the amount of unregulated opioid drug use in the county.	Opioid Epidemic		X		2023 - 2028	Local and PCCD	Susquehanna County EMA, Susquehanna County Law Enforcement Agencies
3.2.1	Education and Outreach	Conduct surveys to determine what aspects of hazard mitigation stakeholders and citizens are familiar with, and which areas need more training regarding mitigation actions at a local level.	All Hazards		X		2023 - 2028	Local	Susquehanna County EMA

Susquehanna County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
3.2.2	Planning and Regulations	The Susquehanna County local planning team will work with human services in Susquehanna County and the Susquehanna County Area Agency on Aging to identify socially vulnerable populations and present those communities with planning items.	All Hazards	X			2023 - 2028	Local	Susquehanna County Hazard Mitigation Officer Susquehanna County Local Planning Team
3.2.3	Planning and Regulations	Update the Susquehanna County local planning team with stakeholders involved in outreach to socially vulnerable populations, including those identified in the action above.	All Hazards	X			2023 - 2028	Local	Susquehanna County Hazard Mitigation Officer Susquehanna County Local Planning Team
3.2.4	Planning and Regulations	Provide hard copies of the hazard mitigation plan documents during annual reviews and future HMP development to government facilities and media locations, to facilitate access for socially vulnerable populations.	All Hazards	X			2023 - 2028	Local	Susquehanna County Hazard Mitigation Officer Susquehanna County Local Planning Team

Susquehanna County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
3.2.5	Planning and Regulations	Develop multilingual hazard mitigation plan public notices in languages including Spanish to enhance accessibility for those whose primary language is not English	All Hazards	X			2023 - 2028	Local	Susquehanna County Hazard Mitigation Officer Susquehanna County Local Planning Team
3.3.1	Planning and Regulations	Maintain, update, and enhance Mutual Aid Agreements at all levels of government.	Emergency Services		X		2023 - 2028	Local	Susquehanna County and Susquehanna County Municipalities
3.4.1	Education and Outreach	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		2023 - 2028	Local	Susquehanna County EMA
3.4.2	Planning and Regulations	Engage with Drug and Alcohol Task Force activities to decrease the impact of opioid epidemic.	Opioid Epidemic		X		2023 - 2028	Local and PCCD	Susquehanna County DA
3.4.3	Planning 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 Flash Flooding		X		2023 - 2028	Local, HMGP, PDM and FMA	Susquehanna County Municipalities
4.1.1	Planning and Regulations	Conduct a yearly review, or hazard mitigation maintenance program to determine the status and prioritization of mitigation goals, objectives, and strategies.	All Hazards		X		2023 - 2028	Local	Susquehanna County EMA

Susquehanna County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
4.2.1	Planning and Regulations	Conduct a survey of needed emergency response equipment in Susquehanna County EMS stations, police stations, and fire stations.	Emergency Services	X			2023 - 2028	Local	Susquehanna County EMA
4.3.1	Structure and Infrastructure	Review emergency signage throughout the county including on major highways, to determine which signs need replaced or updated.	All Natural Hazards		X		2023 - 2028	Local	Susquehanna County Transportation
4.3.2	Planning and Regulations	Travel emergency routes within Susquehanna County to confirm status of those routes before they are needed during a disaster event.	All Natural Hazards		X		2023 - 2028	Local	Susquehanna County EMA
5.1.1	Planning and Regulations	Distribute educational pamphlets about the High Hazard Potential Dam (HHPD) program to municipalities and county residents.	Dam Failure		X		2023 - 2028	Local	Susquehanna County EMA
5.2.1	Planning and Regulations	Educate residents on local mitigation policies and programs that address high-hazard potential dams.	Dam Failure		X		2023 - 2028	Local, HHPD	Susquehanna County EMA
5.2.2	Planning and Regulations	Ensure collaboration with both private and public dam owners, to ensure that their input is included in the local planning team, and the planning process in general	Dam Failure		X		2023 - 2028	Local, HHPD	Susquehanna County Hazard Mitigation Officer Susquehanna County Local Planning Team

Susquehanna County 2023 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
5.2.3	Natural Systems Protection	Research the feasibility of installing flood protection measures in areas around Susquehanna County that would be adversely impacted by flooding from a high-hazard potential dam failure, including natural spaces, local parks, and outdoor areas.	Dam Failure		X		2023-2028	Local, HHPD	Susquehanna County EMA Susquehanna County Hazard Mitigation Officer Susquehanna County Local Planning Team
5.2.4	Structural and Infrastructure	If funding becomes available, perform acquisitions, elevations, relocations, and foundation stabilization on homes and structure within areas of potential impact from a failure of a high-hazard potential dam in Susquehanna County.	Dam Failure		X		2023-2028	Local, HHPD	Susquehanna County EMA Susquehanna County Hazard Mitigation Officer Susquehanna County Local Planning Team
5.3.1	Planning and Regulations	Acquire or maintain digitized dam inundation GIS polygons to determine at risk populations for dams designated High-Hazard Potential Dams by FEMA.	Dam Failure		X		2023 - 2028	Local	Susquehanna County GIS

Table 82-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**	**1.3.1**
Apolacon Township	X	X	X	X		X	
Ararat Township	X	X	X	X		X	
Auburn Township	X	X	X	X		X	
Bridgewater Township	X	X	X	X		X	
Brooklyn Township	X	X	X	X		X	
Choconut Township	X	X	X	X		X	X
Clifford Township	X	X	X	X		X	
Dimock Township	X	X	X	X		X	
Forest City Borough	X	X	X	X		X	
Forest Lake Township	X	X	X	X		X	
Franklin Township	X	X	X	X		X	
Friendsville Borough	X	X	X	X		X	
Gibson Township	X	X	X	X		X	
Great Bend Borough	X	X	X	X		X	
Great Bend Township	X	X	X	X		X	
Hallstead Borough	X	X	X	X		X	
Harford Township	X	X	X	X		X	
Harmony Township	X	X	X	X		X	
Herrick Township	X	X	X	X		X	
Hop Bottom Borough	X	X	X	X		X	
Jackson Township	X	X	X	X		X	
Jessup Township	X	X	X	X		X	
Lanesboro Borough	X	X	X	X		X	
Lathrop Township	X	X	X	X		X	
Lenox Township	X	X	X	X		X	
Liberty Township	X	X	X	X		X	
Little Meadows Borough	X	X	X	X		X	
Middletown Township	X	X	X	X		X	
Montrose Borough	X	X	X	X		X	
New Milford Borough	X	X	X	X		X	
New Milford Township	X	X	X	X		X	
Oakland Borough	X	X	X	X	X	X	
Oakland Township	X	X	X	X		X	
Rush Township	X	X	X	X		X	
Silver Lake Township	X	X	X	X		X	
Springville Township	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**	**1.3.1**
Susquehanna Depot Borough	X	X	X	X		X	
Thompson Borough	X	X	X	X		X	
Thompson Township	X	X	X	X		X	
Union Dale Borough	X	X	X	X		X	
Susquehanna County or county office				X	X		X

Municipal Hazard Mitigation Actions Checklist							
Municipality	**1.3.2**	**1.3.3**	**1.3.4**	**1.3.5**	**1.4.1**	**1.4.2**	**1.4.3**
Apolacon Township	X	X	X	X			
Ararat Township	X	X	X	X			
Auburn Township	X	X	X	X			
Bridgewater Township	X	X	X	X			
Brooklyn Township	X	X	X	X			
Choconut Township	X	X	X	X			
Clifford Township	X	X	X	X			
Dimock Township	X	X	X	X			
Forest City Borough	X	X	X	X			
Forest Lake Township	X	X	X	X			
Franklin Township	X	X	X	X			
Friendsville Borough	X	X	X	X			
Gibson Township	X	X	X	X			
Great Bend Borough	X	X	X	X			
Great Bend Township	X	X	X	X			
Hallstead Borough	X	X	X	X			
Harford Township	X	X	X	X			
Harmony Township	X	X	X	X			
Herrick Township	X	X	X	X			
Hop Bottom Borough	X	X	X	X			
Jackson Township	X	X	X	X			
Jessup Township	X	X	X	X			
Lanesboro Borough	X	X	X	X			
Lathrop Township	X	X	X	X			
Lenox Township	X	X	X	X			
Liberty Township	X	X	X	X			
Little Meadows Borough	X	X	X	X			
Middletown Township	X	X	X	X			

Municipal Hazard Mitigation Actions Checklist							
Municipality	**1.3.2**	**1.3.3**	**1.3.4**	**1.3.5**	**1.4.1**	**1.4.2**	**1.4.3**
Montrose Borough	X	X	X	X			
New Milford Borough	X	X	X	X			
New Milford Township	X	X	X	X			
Oakland Borough	X	X	X	X			
Oakland Township	X	X	X	X			
Rush Township	X	X	X	X			
Silver Lake Township	X	X	X	X			
Springville Township	X	X	X	X			
Susquehanna Depot Borough	X	X	X	X			
Thompson Borough	X	X	X	X			
Thompson Township	X	X	X	X			
Union Dale Borough	X	X	X	X			
Susquehanna County or county office		X	X	X	X	X	X

Municipal Hazard Mitigation Actions Checklist							
Municipality	**1.4.4**	**1.4.5**	**1.5.1**	**1.5.2**	**1.6.1**	**1.6.2**	**1.7.1**
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	
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	

Municipal Hazard Mitigation Actions Checklist							
Municipality	**1.4.4**	**1.4.5**	**1.5.1**	**1.5.2**	**1.6.1**	**1.6.2**	**1.7.1**
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	
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 or county office	X	X	X	X	X	X	X

Municipal Hazard Mitigation Actions Checklist							
Municipality	**1.8.1**	**2.1.1**	**2.1.2**	**2.1.3**	**2.1.4**	**2.1.5**	**2.1.6**
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	**1.8.1**	**2.1.1**	**2.1.2**	**2.1.3**	**2.1.4**	**2.1.5**	**2.1.6**
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						
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 or county office		X	X	X	X	X	X

Municipal Hazard Mitigation Actions Checklist							
Municipality	**2.2.1**	**2.2.2**	**2.2.3**	**2.2.4**	**2.3.1**	**2.3.2**	**2.4.1**
Apolacon Township						X	
Ararat Township						X	
Auburn Township						X	
Bridgewater Township						X	

Municipal Hazard Mitigation Actions Checklist							
Municipality	**2.2.1**	**2.2.2**	**2.2.3**	**2.2.4**	**2.3.1**	**2.3.2**	**2.4.1**
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	
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	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	
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 or county office	X	X	X	X		X	X

Municipal Hazard Mitigation Actions Checklist							
Municipality	**3.1.1**	**3.2.1**	**3.3.1**	**3.4.1**	**3.4.2**	**3.4.3**	**4.1.1**
Apolacon Township			X			X	
Ararat Township			X			X	
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	
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	**3.1.1**	**3.2.1**	**3.3.1**	**3.4.1**	**3.4.2**	**3.4.3**	**4.1.1**
Thompson Township			X			X	
Union Dale Borough			X			X	
Susquehanna County or county office	X	X	X	X	X		X

Municipal Hazard Mitigation Actions Checklist						
Municipality	**4.2.1**	**4.3.1**	**4.3.2**	**5.1.1**	**5.2.1**	**5.3.1**
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						
Middletown Township						
Montrose Borough						
New Milford Borough						

Municipal Hazard Mitigation Actions Checklist						
Municipality	**4.2.1**	**4.3.1**	**4.3.2**	**5.1.1**	**5.2.1**	**5.3.1**
New Milford Township						
Oakland Borough						
Oakland Township						
Rush Township						
Silver Lake Township						
Springville Township						
Susquehanna Depot Borough						
Thompson Borough						
Thompson Township						
Union Dale Borough						
Susquehanna County or county office	X	X	X	X	X	X

Table 83-Objective to Action Checklist

Objective	Number of Actions
Objective 1.1	5
Objective 1.2	1
Objective 1.3	5
Objective 1.4	5
Objective 1.5	2
Objective 1.6	2
Objective 1.7	1
Objective 1.8	1
Objective 2.1	6
Objective 2.2	4
Objective 2.3	2
Objective 2.4	1
Objective 3.1	1
Objective 3.2	1
Objective 3.3	1
Objective 3.4	3
Objective 4.1	1
Objective 4.2	1
Objective 4.3	2
Objective 5.1	1
Objective 5.2	1
Objective 5.3	1

Table 84-Actions Tied to Hazard

Actions Tied to Hazard	
Hazard	**Actions Related**
Drought	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1, 4.3.1, 4.3.2
Earthquake	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1, 4.3.1, 4.3.2
Extreme Temperature	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1, 4.3.1, 4.3.2
Flooding	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.2.1, 1.3.1, 1.3.3, 1.3.4, 1.3.5, 1.4.2, 1.4.3, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 1.8.1, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1, 3.2.1, 3.4.1, 3.4.3, 4.1.1, 4.3.1, 4.3.2
Flash Flooding	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.5, 1.2.1, 1.3.1, 1.3.4, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 1.8.1, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1, 3.2.1, 3.4.1, 3.4.3, 4.1.1, 4.3.1, 4.3.2
Hailstorm	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1, 4.3.1, 4.3.2
Hurricanes/Tropical Storm	1.1.4, 1.3.2, 1.4.2, 1.4.3, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1, 4.3.1, 4.3.2
Ice Jam Flooding	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1, 4.3.1, 4.3.2
Invasive Species	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1, 4.3.1, 4.3.2
Landslide	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1, 4.3.1, 4.3.2
Lightning Strike	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1, 4.3.1, 4.3.2
Pandemic, Epidemic, Infectious Disease	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1, 4.3.1, 4.3.2

Actions Tied to Hazard	
Hazard	**Actions Related**
Radon Exposure	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.1.4, 2.1.5, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1, 4.3.1, 4.3.2
Tornado/Windstorm	1.1.4, 1.3.2, 1.4.2, 1.4.3, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1, 4.3.1, 4.3.2
Wildfire	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 1.7.1, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1, 4.3.1, 4.3.2
Winter Storm	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1, 4.3.1, 4.3.2
Cyberterrorism	1.1.4, 1.3.2, 1.4.2, 1.4.4, 1.4.5, 1.5.1, 2.2.1, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1
Dam Failure	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.3.1, 3.4.1, 4.1.1, 5.1.1, 5.2.1, 5.3.1
Emergency Services	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.1.6, 2.2.1, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1, 4.2.1
Environmental Hazards	1.1.4, 1.3.2, 1.4.1, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 3.2.1, 3.4.1, 4.1.1
Mental Health Services	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1
Opioid Epidemic	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.1.2, 2.2.1, 2.2.3, 2.2.4, 2.3.2, 3.1.1, 3.2.1, 3.4.1, 3.4.2, 4.1.1
Transportation Accidents	1.1.4, 1.3.2, 1.4.1, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1
Terrorism/Cyberterrorism	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1
Utility Interruptions	1.1.4, 1.3.2, 1.4.2, 1.5.1, 1.5.3, 1.6.1, 1.6.2, 2.2.1, 2.2.3, 2.2.4, 2.3.2, 3.2.1, 3.4.1, 4.1.1

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. This HMP update also defines the municipalities' role in updating and evaluating the plan. Finally, the 2023 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 also be afforded the opportunity to provide updated information or information specific to hazards encountered during an emergency or disaster. Each review process will ensure that the hazard vulnerability and risk analysis reflect the current conditions of the county, that the capabilities assessment accurately reflects local circumstances and that the hazard mitigation strategies are updated based on the county's damage assessment reports and local mitigation project priorities. The HMP must be updated on a five-year cycle. An updated HMP must be completed and approved by the end of the five-year period. The monitoring, evaluating, and updating of the plan every five years will rely heavily on the outcomes of the annual HMP 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 annual plan review will be distributed to appropriate representatives at both PEMA and FEMA. The following items will be completed during the annual review and reporting process:

- Review the risk assessment section and identify occurrences of hazards within the last year. Identify date, time, damage, fatalities, and other specific information of the events. Also identify any new hazards that have occurred or increased risk with the county.

- Complete a review and update of the capability assessment section. Identify any capability weaknesses since the last review.
- Complete a review of the mitigation strategy section. Review the goals and objectives identified in the 2023 HMP and determine if any updates are needed. Provide all mitigation actions and opportunities to the county and municipalities that are applicable. Have all entities complete an action review matrix and document all results in the report. Also, add any new actions that are identified. Complete a review of each mitigation opportunity and identify the status of each opportunity on the opportunity review spreadsheet. All information will be included in the annual review report.

The annual review of the Susquehanna County Hazard Mitigation Plan will allow for the effectiveness of the mitigation actions and project opportunities to be examined and reviewed. During the annual review process, effectiveness can be determined by completion of mitigation actions and by the completion of mitigation project opportunities by local jurisdictions and the county. Projects that were completed or that are in progress could be considered effective for the local jurisdictions, and those completed projects should be replaced by new projects. Projects and actions that were not completed during annual reviews can be re-evaluated for their effectiveness with the municipalities that submitted them and can be modified during the next hazard mitigation plan.

The effectiveness of the plan will also be evaluated during the annual review process to determine how it can be integrated into other planning mechanisms. Further discussion on this item can be found in the capability assessment section of this hazard mitigation plan. Evaluation processes can be honed and implemented during annual review periods and the next hazard mitigation plan update to define the effectiveness of plan mechanisms more accurately.

The Susquehanna County Emergency Management Agency will maintain a copy of these records and place them in Appendix I 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 2023 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://www.susqco.com/Dept/EMA/Pages/Hazard-Mitigation-Plan.aspx

The public will have access to the 2023 Susquehanna County HMP through their local municipal office, the Susquehanna County Department of Planning and Development, 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 wells 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 2023 Susquehanna County Hazard Mitigation Plan. Copies of the adopting resolutions are included in this plan in Appendix J. FEMA Region III in Philadelphia, Pennsylvania 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 Community Lifeline Facilities**

APPENDIX F: **2023 HAZUS Reports**

APPENDIX G: **2023 Mitigation Project Opportunities**

APPENDIX H: **2023 Mitigation Action Evaluation & Prioritization**

APPENDIX I: **Annual Review Documentation**

APPENDIX J: **Susquehanna County & Municipal Adoption Resolutions**