



Carbon County 2015 Hazard Mitigation Plan Update

Prepared for:
Carbon County Emergency Management Agency
1264 Emergency Lane
Nesquehoning, PA 18240
with support from PEMA



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CERTIFICATION OF ANNUAL REVIEW MEETINGS

The Carbon County Hazard Mitigation Steering Committee has reviewed this Hazard Mitigation Plan Update. See Section 7 of the Carbon County 2015 Hazard Mitigation Plan Update for further details regarding this form. The director of the Hazard Mitigation Steering Committee hereby certifies the review.

YEAR	DATE OF MEETING	PUBLIC OUTREACH ADDRESSED?*	SIGNATURE
2010	N/A	N/A	To the best knowledge of the Carbon County HMSC, no HMP progress reports were submitted from municipalities for the period from 2010-2014 although some mitigation actions were accomplished in this period. Progress on actions is discussed in detail in Section 6.1 of this plan.
2011	N/A	N/A	
2012	N/A	N/A	
2013	N/A	N/A	
2014	N/A	N/A	
2015			
2016			
2017			
2018			
2019			

**Confirm yes here annually and describe on record of changes 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)
2010-2014	To the best knowledge of the Carbon County HMSC, no HMP progress reports were submitted from municipalities for the period from 2010-2014 although some mitigation actions were accomplished in this period. Progress on actions is discussed in detail in Section 6.1 of this plan.	N/A	N/A

LIST OF ACRONYMS

ACRONYM	DEFINITION
ATV	All-terrain vehicle
CAC	Community Assistance Contacts
CAV	Community Assistance Visit
CCCP	Carbon County Comprehensive Plan (year indicates either 1998 plan or 2010 plan in development)
CCEMA	Carbon County Emergency Management Agency
CEO	Chief Executive Officer
CFR	Code of Federal Regulations
CIS	FEMA Community Information System
CRS	Community Rating System
DCED	Pennsylvania Department of Community and Economic Development
DCNR	Pennsylvania Department of Conservation and Natural Resources
DCNR-BOF	Pennsylvania Department of Conservation and Natural Resources - Bureau of Forestry
DEP	Pennsylvania Department of Environmental Protection
DFIRM	Digital Flood Insurance Rate Map
DMA 2000	Disaster Mitigation Act
EAP	Emergency Action Plan
EMA	Emergency Management Agency
EMC	Emergency Management Coordinator
EOP	Emergency Operations Plan
EPA	United States Environmental Protection Agency
EPZ	Emergency Planning Zone
FBFM	Flood Boundary and Floodway Maps
FEMA	Federal Emergency Management Agency
FHA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance
GIS	Geographic Information Systems
HVA	Hazard Vulnerability Analysis
HAZUS-MH	Hazards United States Multi-Hazard (FEMA Risk Assessment and Loss Estimation Software)
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HMPT	Hazard Mitigation Planning Team
HMSC	Hazard Mitigation Steering Committee
MOM	Mobile Operations Management
mph	Miles per hour

ACRONYM	DEFINITION
MRLC	Multi-Resolution Land Characteristics Consortium
NCDC	National Climatic Data Center
NDMC	National Drought Mitigation Center
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NIDIS	National Integrated Drought Information System
NOAA	National Oceanic and Atmospheric Administration
NRC	United States Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
PaGWIS	Pennsylvania Ground Water Information System
PASDA	Pennsylvania Spatial Data Access
PEMA	Pennsylvania Emergency Management Agency
PennDOT	Pennsylvania Department of Transportation
PPL	Pennsylvania Power and Electric
PSARC	Pennsylvania Search and Rescue Council
PSDI	Palmer Severity Drought Index
RF	Risk Factor
SAR	Search and Rescue
SFHA	Special Flood Hazard Area
SFIP	Standard Flood Insurance Policy
SOG	Commonwealth of Pennsylvania's All-Hazard Mitigation Planning Standard Operating Guide
UCC	Uniform Code of Construction
US DOE	United States Department of Energy
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VSAR	Valley Search and Rescue
WYO	Write Your Own Program

1. INTRODUCTION

1.2. Background

Across the United States, natural and human-caused disasters have led to increasing levels of deaths, injuries, property damage, and interruption of business and government services. The time, money, and efforts to recover from these disasters exhaust resources, diverting attention from important public programs and private agendas. Since 1955 there have been 58 Presidential Disaster and Emergency Declarations in Pennsylvania, 23 of which affected Carbon County. In addition to these Presidential Declarations, there have been fourteen Gubernatorial Proclamations of Disaster Emergency affecting Carbon County since 1954. The emergency management community, citizens, elected officials and other stakeholders in Carbon County, Pennsylvania recognize the impact of disasters on their community and support proactive efforts needed to reduce the impact of natural and human-caused hazards.

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

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

1.3. Purpose

This Hazard Mitigation Plan was developed for the purpose of:

- Providing a blueprint for reducing property damage and saving lives from the effects of future natural and man-made disasters in Carbon County;
- Qualifying the County for pre-disaster and post-disaster grant funding;
- Complying with state and federal legislative requirements related to local hazard mitigation planning;
- Demonstrating a firm local commitment to hazard mitigation principles; and
- Improving community resiliency following a disaster event.

The Disaster Mitigation Act of 2000 (DMA 2000), Section 322 requires that local governments (communities/counties), as a condition of receiving federal disaster mitigation funds, have a mitigation plan that describes the process for identifying hazards, creating a risk assessment and vulnerability analysis, identifying and prioritizing mitigation strategies, and developing an implementation schedule for the County and each of the municipalities.

Congress authorized the establishment of a Federal grant program to provide financial assistance to States and communities for flood mitigation planning and activities. The Federal Emergency Management Agency (FEMA) has designated this Flood Mitigation Assistance (FMA).

1.4.Scope

The Carbon County 2015 HMP has been prepared to meet requirements set forth by the FEMA and the Pennsylvania Emergency Management Agency (PEMA) in order for the County to be eligible for funding and technical assistance from state and federal hazard mitigation programs. It will be updated and maintained to continually address both natural and human-made hazards determined to be of significant risk to the County and/or its local municipalities. Updates will take place following significant disasters or at a minimum, once a year.

1.5.Authority and Reference

Authority for this plan originates from the following federal sources:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C., Section 322, as amended;
- Code of Federal Regulations (CFR), Title 44, Parts 201 and 206; and
- 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 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 Mitigation Planning Handbook. March 2013.
- FEMA. Local Mitigation Plan Review Guide. October 1, 2011.

- FEMA *National Fire Incident Reporting System 5.0: Complete Reference Guide*. January, 2008.
- FEMA Hazard Mitigation Assistance Unified Guidance. September 11, 2013.
- FEMA. Integrating Hazard Mitigation Into Local Planning: Case Studies and Tools for Community Officials. March 1, 2013
- FEMA. Mitigation Ideas. A Resource for Reducing Risk to Natural Hazards. January 2013.

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

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

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

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

2. COMMUNITY PROFILE

2.1 Geography and Environment

Carbon County is a 387.39 square mile county located in eastern Pennsylvania about 90 miles northeast of Philadelphia and 90 miles west of New York City. As seen in Figure 2.1-1, the County is bordered on the north by Luzerne County, on the east by Monroe County, on the west by Schuylkill County, and on the south by Lehigh and Northampton Counties.

Most of the land area of the County is hilly and the northern and eastern portions of the County are part of the Pocono Mountains region of the Commonwealth. Blue Mountain forms the southern boundary of Carbon County. The County is drained by the Lehigh River and its subwatersheds with the exception of a small area in western Packer Township and the Borough of Lansford that are drained by Still and Panther Creeks into the Schuylkill River, and an area in the northwest corner that drains into the Susquehanna River via the Catawissa Creek (Carbon County, 2013). The watersheds of Carbon County are displayed in Figure 2.1-2.

Figure 2.2-1 Base map of Carbon County.

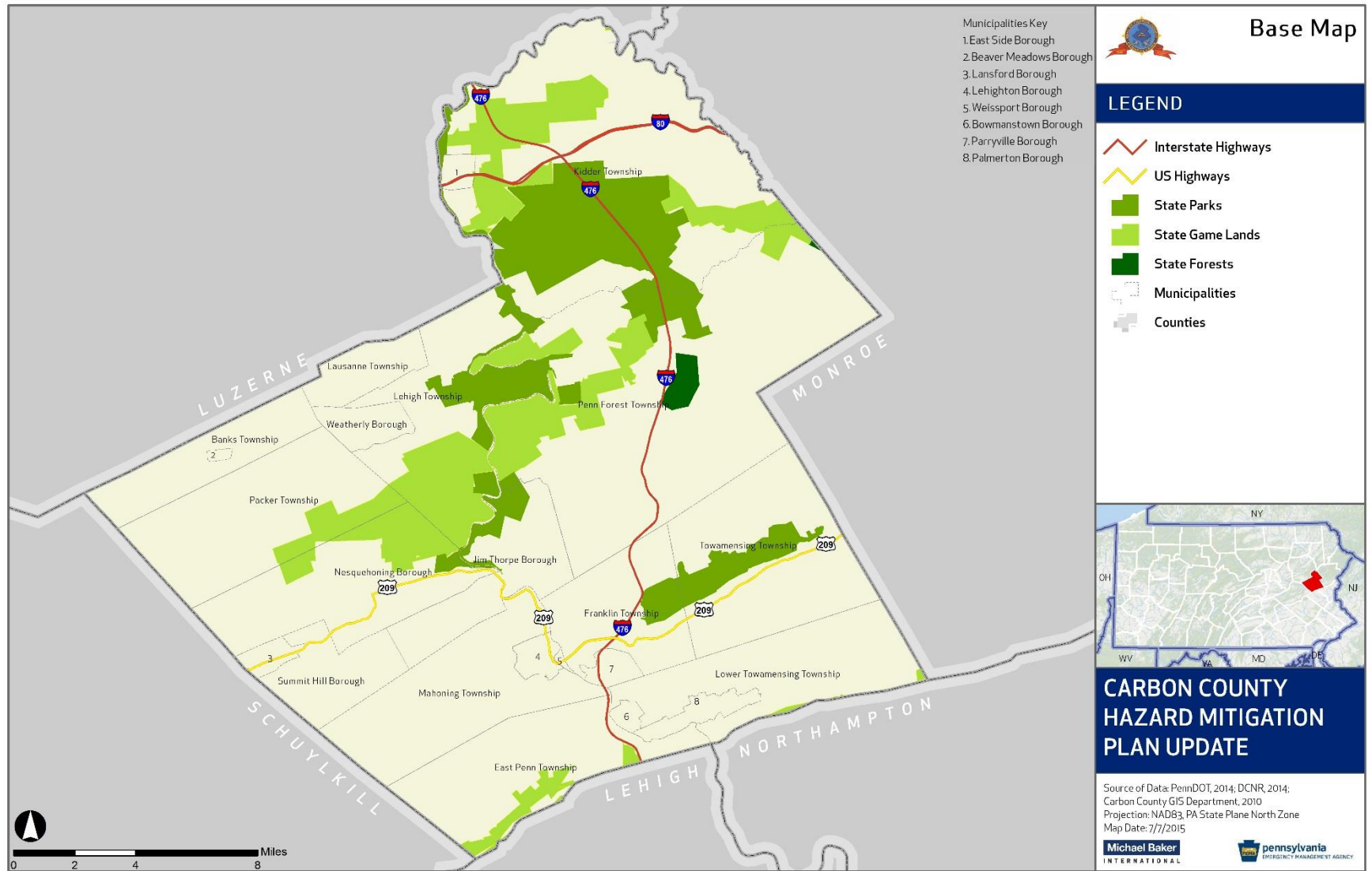
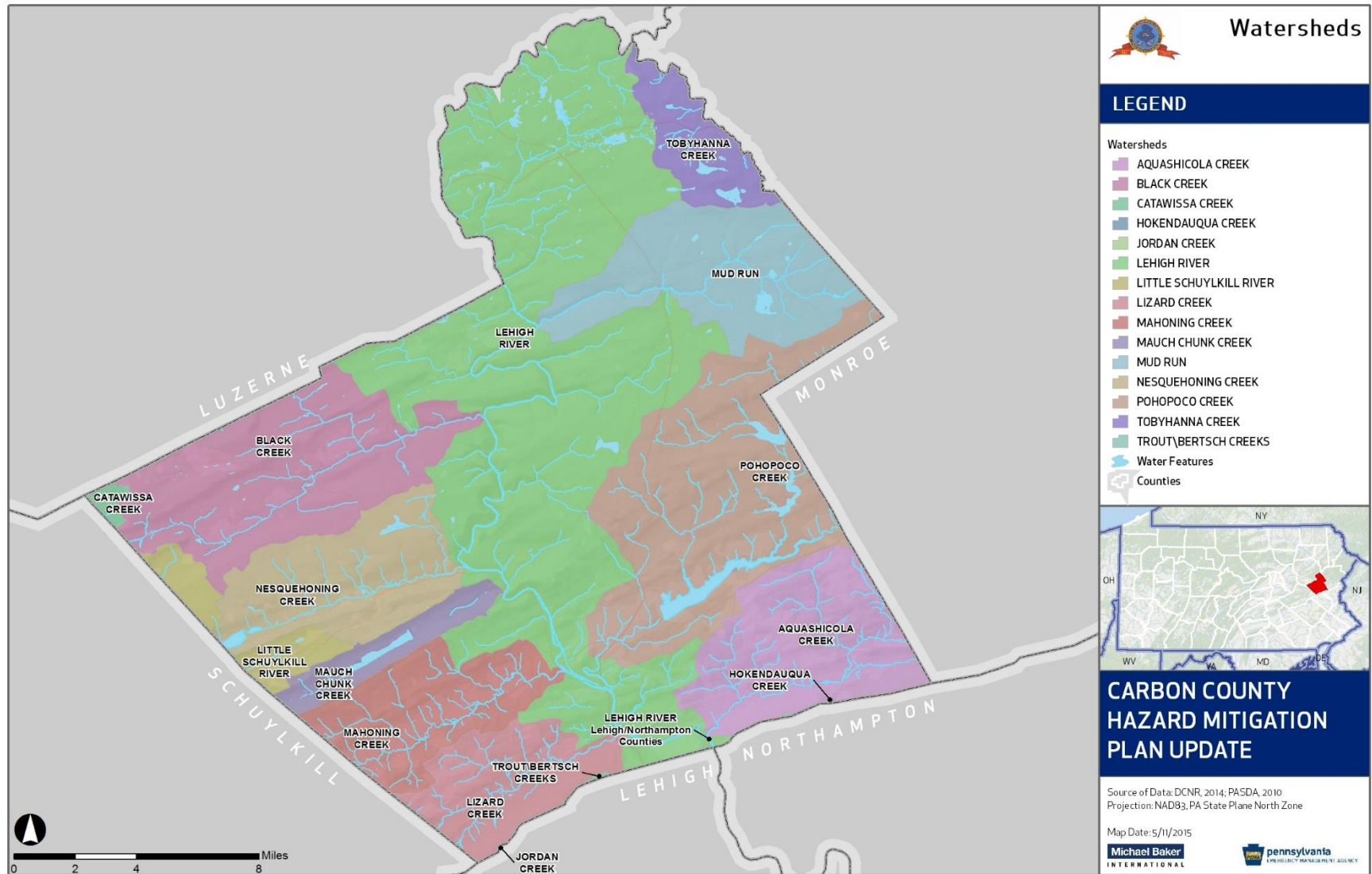


Figure 2.2-2 Watersheds of Carbon County.



2.2. Community Facts

Carbon County was created in 1843 from parts of Northampton and Monroe Counties and was named for its coal deposits. The discovery of anthracite coal and railroad transportation in the mid-1800s helped the County rise to prominence. During the coal industry's boom period, Carbon County ranked second only to Schuylkill County in terms of coal production (DCED, 2005). Carbon County was home of the first large-scale railroad built in America called the "Switchback" railroad which was designed to carry coal (Carbon County, 2002). A canal system was constructed along the Lehigh River to transport coal south to markets in Philadelphia.

Although coal mining was the prominent industry in Carbon County's history, the lumber and farming industries also attracted residents to Carbon County. However, the Great Depression and several large mining disasters caused the coal mining industry to weaken and the County to lose population until the 1970's when tourism began to grow in the County. Today, top employers in Carbon County are manufacturing, retail trade, health care and social assistance, and accommodation and food services (U.S. Census, 2007). The County also produces dairy and poultry products, and manufactures fire equipment, die castings and garments (CCEMA, 2009).

Because of its vast natural resources, Carbon County has been and continues to grow in popularity as a tourist destination year-round. The County lies in the Pocono Mountain region of the state which draws many visitors. Many tourists flock to the County for sightseeing, historic tours, horseback riding, train rides, skiing, mountain biking, and water-skiing. In addition, the County contains the Lehigh River which is a popular whitewater rafting river. There are three Pennsylvania State Parks in Carbon County (Beltzville State Park, Lehigh Gorge State Park, and Hickory Run State Park) which offer recreational amenities. The Delaware and Lehigh Canal National Heritage Corridor runs from a north to south direction through the County also drawing visitors.

2.3. Population and Demographics

According to the 2010 Census, the population of Carbon County is 65,249. Between 2000 and 2010, Carbon County's population increased by 11%. Table 2.3-1 provides a distribution of County population per municipality obtained from the U.S. Census Bureau using 2000 and 2010 Decennial Census data. Population density, measured in the population per square mile (of land area), is highest in Lehigh and Beaver Meadows Boroughs with a 2010 Census population density of 3,389 and 3,366, respectively. Total housing density, represented by the total number of housing units per acre of land, is also highest in Beaver Meadows and Lehigh Boroughs, with a total of 2.7 and 2.4 housing units per acre of land, respectively. Table 2.3-1 provides the population and housing density and the percent of unoccupied housing by municipality in Carbon County.

Table 2.3-1 List of municipalities in Carbon County with associated populations (U.S. Census, 2010)			
MUNICIPALITY	2000 POPULATION	2010 POPULATION	PERCENT CHANGE (%)
Banks Township	1,359	1,262	-7%
Beaver Meadows Borough	968	869	-10%

Table 2.3-1 List of municipalities in Carbon County with associated populations (U.S. Census, 2010)			
MUNICIPALITY	2000 POPULATION	2010 POPULATION	PERCENT CHANGE (%)
Bowmanstown Borough	895	937	5%
East Penn Township	2,461	2,881	17%
East Side Borough	290	317	9%
Franklin Township	4,243	4,262	0%
Jim Thorpe Borough	4,804	4,781	0%
*Kidder Township	1,185	1,935	63%
Lansford Borough	4,230	3,941	-7%
Lausanne Township	218	237	9%
Lehigh Township	527	479	-9%
Lehighon Borough	5,537	5,500	-1%
Lower Towamensing Township	3,173	3,228	2%
Mahoning Township	3,978	4,305	8%
Nesquehoning Borough	3,288	3,349	2%
Packer Township	986	998	1%
Palmerton Borough	5,248	5,414	3%
Parryville Borough	478	525	10%
Penn Forest Township	5,439	9,581	76%
Summit Hill Borough	2,974	3,034	2%
Towamensing Township	3,475	4,477	29%
Weatherly Borough	2,612	2,525	-3%
Weissport Borough	434	412	-5%
TOTAL	58,802	65,249	11%

*According to the Carbon County Office of Planning and Development, the population of Kidder Township increases substantially Thursday through Sunday of each week as a result of an influx of tourists and people with vacation homes in the area. The municipality's population increases to approximately 20,000 each extended weekend year-round with those who take advantage of tourist and recreational amenities in the community including skiing, sightseeing, white-water rafting etc. These temporary increases in population are not taken into account in the above table's population numbers.

Table 2.3-2 Population and Housing Density in Carbon County (U.S. Census, 2010)				
MUNICIPALITY	POPULATION DENSITY (POPULATION PER SQ. MILE)	TOTAL HOUSING UNITS	PERCENT UNOCCUPIED HOUSING UNITS	HOUSING DENSITY (HOUSING UNIT PER ACRE OF LAND)
Banks Township	109	611	11.1%	0.08
Beaver Meadows Borough	3,366	446	15.2%	2.70
Bowmanstown Borough	1,218	429	4.9%	0.87
East Penn Township	127	1,253	7.6%	0.09
East Side Borough	276	150	9.3%	0.20
Franklin Township	281	1,873	9.3%	0.19
Jim Thorpe Borough	328	2,290	13.1%	0.25
*Kidder Township	28	2,845	68.3%	0.06
Lansford Borough	2,565	2,161	20.8%	2.20
Lausanne Township	40	117	17.9%	0.03
Lehigh Township	18	227	11.5%	0.01
Lehighon Borough	3,389	2,499	8.1%	2.41
Lower Towamensing Township	152	1,407	7.5%	0.10
Mahoning Township	182	1,860	10.3%	0.12
Nesquehoning Borough	158	1,701	15.3%	0.13
Packer Township	36	440	10.0%	0.02
Palmerton Borough	2,179	2,436	6.7%	1.53
Parryville Borough	326	270	16.3%	0.26
Penn Forest Township	130	6,676	43.8%	0.14
Summit Hill Borough	349	1,458	11.7%	0.26
Towamensing Township	165	1,840	9.0%	0.11
Weatherly Borough	848	1,123	12.2%	0.59
Weissport Borough	3,050	187	11.2%	2.16
TOTAL	171	34,299	22.2%	0.14

As income and financial characteristic data is no longer provided in the Decennial Census, the American Community Survey (ACS) was used to garner income data. According to the 2013 ACS 5-Year estimates, the median income of households in Carbon County is \$48,900. This is approximately \$4,000 less than the national median household income (U.S. Census, ACS 2009-2013). Approximately eleven percent of the Carbon County population lives in poverty.

Per the 2010 Decennial Census, the median age of the County population is 43.9 years with almost eighty percent of the population over 18 years of age and seventeen percent 65 years or older. Additionally, 95.8 percent of the County population identifies as White, 1.5 percent is Black, and 1.5 percent is African-American, Asian, American Indian, or some other race. Of the total County population, 3.3 percent identify as Hispanic. There are a total of 34,299 housing units, 77.8 percent of which are occupied with 22.2 percent unoccupied (U.S. Census, 2010). The median value of an owner occupied home in the County is \$146,700 (U.S. Census, ACS 2009-2013).

2.4.Land Use and Development

As seen in Table 2.3-1, Carbon County grew by 11% from 2000 to 2010. This is higher than the rate at which the County grew between 1990 and 2000 which was only 3.4%. Major factors contributing to growth in Carbon County are access to major highways, outdoor recreation amenities, increase in resort style and second home housing, and an influx of New York and New Jersey residents.

As seen in Section 4.4.4, most of the growth and development in the County has occurred east of the Lehigh River in Kidder Township, Penn Forest Township, and Towamensing Township. The northern and western portions of the County have experienced the slowest growth, as rugged terrain has inhibited development (DCED, 2005).

Figure 2.4.1 displays the current land use in Carbon County. As seen from the map, forest is the primary land cover, making up nearly three-quarters of the County's total land area. Of this, nearly 80 square miles of the County is state game land, state forest, and state park land. Forest acreage that is not part of a state park or state game land is primarily comprised of second-growth oak and northern hardwood forests.

Residential land uses are generally low density, single-family homes. The boroughs tend to have higher population densities. A growing number of housing units in the County are seasonal housing. There are several major highways that traverse the County. Interstate 80 crosses the highway from east to west and the northeast extension of the Pennsylvania Turnpike (I-476) connects the County to the Wilkes-Barre-Scranton-Hazleton and Allentown-Bethlehem-East metropolitan areas.

2.5.Data Sources and Limitations

The Carbon County tax assessment database was used as an inventory of parcels throughout the County and provided both building and land assessment values; the building assessment value was used to estimate losses. The list of critical facilities provided in **Appendix E – Critical Facilities** was developed based on information available from the Carbon County Emergency Management Agency (EMA) and the Carbon County GIS Department.

The countywide Digital Flood Insurance Rate Map (DFRIM), published on June 3, 2002, was downloaded from the FEMA Map Service Center. This data provides flood frequency and elevation information used in the flood hazard risk assessment. Other GIS datasets including *major streams, pipeline locations, land use, and state-owned lands* were provided by the Carbon County GIS Department. Population data from the 2000 and 2010 Census and 2013 American Community Survey results were obtained from the U.S. Census Bureau in 2015. Additional data for the base map was provided by the Pennsylvania Department of Transportation, Pennsylvania Game Commission, and the Pennsylvania Department of Conservation and Natural Resources.

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

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

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

uses information determined by FEMA's RiskMAP program calculating the Total Exposure in Floodplain (TEIF) using Census Block Total Exposure values that intersect with the Special Flood Hazard Area.

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

Table 2.5-1 Summary of Critical Facilities by Type and Municipality.

Municipality	Critical Facility Type									
	Airport	Cell Towers	County Facilities	Emergency Medical Services	Fire Departments	Hospital	Municipal Buildings	Police Department	Schools	Grand Total
Banks Township	0	3	0	0	1	0	2	0	0	6
Beaver Meadows Borough	0	0	0	0	1	0	0	1	0	2
Bowmanstown Borough	0	0	0	0	1	0	1	0	0	2
East Penn Township	0	3	0	0	1	0	1	1	1	7
East Side Borough	0	0	0	0	0	0	1	0	0	1
Franklin Township	2	2	0	1	1	0	1	2	1	10
Jim Thorpe Borough	0	4	2	1	3	0	1	2	4	17
Kidder Township	0	11	0	1	3	0	1	1	1	18
Lansford Borough	0	0	0	1	1	0	1	1	1	5
Lausanne Township	0	1	0	0	0	0	1	0	0	2
Lehigh Township	3	0	0	1	1	0	1	0	1	7
Lehighton Borough	1	1	0	2	1	1	1	0	4	11
Lower Towamensing Township	1	1	0	0	1	0	1	0	2	6
Mahoning Township	1	3	0	3	1	0	1	1	1	11
Nesquehoning Borough	0	3	3	1	3	0	1	1	2	14
Packer Township	2	1	0	0	0	0	1	0	0	4
Palmerton Borough	0	1	0	1	2	1	1	1	4	11

Table 2.5-1 Summary of Critical Facilities by Type and Municipality.										
MUNICIPALITY	CRITICAL FACILITY TYPE									
	AIRPORT	CELL TOWERS	COUNTY FACILITIES	EMERGENCY MEDICAL SERVICES	FIRE DEPARTMENTS	HOSPITAL	MUNICIPAL BUILDINGS	POLICE DEPARTMENT	SCHOOLS	GRAND TOTAL
Parryville Borough	0	1	0	0	1	0	1	0	0	3
Penn Forest Township	0	8	0	1	2	0	1	0	0	12
Summit Hill Borough	0	2	0	1	1	0	1	1	2	8
Towamensing Township	0	4	0	1	1	0	1	0	2	9
Weatherly Borough	0	0	0	1	1	0	1	1	2	6
Weissport Borough	0	0	0	0	0	0	1	1	1	3
Grand Total	10	49	5	16	27	2	23	14	29	175

Several data limitations were encountered during development of the 2015 HMP update. The land value of parcels were used in order to account for structure value as well as the value of land. Land use of each of the identified structure points was determined by aligning the Carbon County land use data with the parcels with identified structures in them.

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

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

3. PLANNING PROCESS

3.1 Update Process and Participation Summary

To begin the 2015 HMP process, the Hazard Mitigation Steering Committee (HMSC) identified individuals and organizations to invite to be a part of the HMPT. The Carbon County Emergency Management Agency and the Office of Planning and Development provided the contact information for municipal and county officials, agency representatives, and adjacent county stakeholders and a HMPT mailing list was created from this contact information. Meeting invitations and notification of the planning process were sent to the Chief Executive Officer (CEO) and Emergency Management Coordinator (EMC) in each municipality as well as to adjacent county commissioners and other relevant stakeholders such as agency representatives and non-profit organizations. The HMPT first assembled in April of 2015 to construct a plan in order to identify hazards that affect the County, assess potential damages from those hazard events, select actions to address the County's vulnerability to such hazards, and develop an implementation-strategy action plan in order to mitigate potential losses. Section 3.2 provides a discussion of the HMPT as well as a table of members with their corresponding organization.

Municipal officials continued to receive written notification regarding all HMP meetings and other stakeholders were notified via email. A brief description of each meeting that was held is available in Section 3.3. In addition, meeting minutes, describing in detail, events of each meeting are available in **Appendix C – Meeting and Other Participation Documentation**.

In order to obtain information from municipalities and other stakeholders, forms and surveys were distributed and collected throughout the planning process. Some forms were completed during planning meetings while others were sent via mail and email and completed and returned in between scheduled meetings. All municipalities were required to have a representative attend at least one meeting and provide pertinent information for the HMP. Table 3.1-1 lists each municipality along with their specific participation and contributions to the planning process. Sign-in sheets for each meeting with individual names are available in **Appendix C** along with all completed forms and surveys.

Table 3.2-1 Summary of participation from local municipalities during the 2015 Hazard Mitigation Planning Process.

MUNICIPALITY	MEETING			WORKSHEETS/SURVEYS/FORMS			
	KICK-OFF APRIL 1, 2015	RISK ASSESSMENT- MITIGATION SOLUTIONS WORKSHOP MAY 13, 2015	PUBLIC MEETING JULY 1, 2015	HAZARD IDENTIFICATION FORM	CAPABILITY ASSESSMENT SURVEY	MITIGATION STRATEGY REVIEW	JURISDICTIONAL RISK EVALUATION
Banks Township	✓		✓	✓	✓		
Beaver Meadows Borough					✓		
Bowmanstown Borough							
East Penn Township							
East Side Borough	✓			✓	✓		
Franklin Township	✓	✓	✓	✓			✓
Jim Thorpe Borough							
Kidder Township	✓	✓		✓	✓	✓	✓
Lansford Borough	✓			✓			
Lausanne Township							
Lehigh Township			✓	✓			
Lehighton Borough	✓			✓			
Lower Towamensing Township		✓				✓	✓
Mahoning Township	✓	✓		✓			
Nesquehoning Borough	✓		✓	✓			
Packer Township							
Palmerton Borough	✓	✓	✓	✓	✓	✓	✓
Parryville Borough							
Penn Forest Township	✓			✓	✓		✓
Summit Hill Borough			✓				

Table 3.2-1 Summary of participation from local municipalities during the 2015 Hazard Mitigation Planning Process.

MUNICIPALITY	MEETING			WORKSHEETS/SURVEYS/FORMS			
	KICK-OFF APRIL 1, 2015	RISK ASSESSMENT- MITIGATION SOLUTIONS WORKSHOP MAY 13, 2015	PUBLIC MEETING JULY 1, 2015	HAZARD IDENTIFICATION FORM	CAPABILITY ASSESSMENT SURVEY	MITIGATION STRATEGY REVIEW	JURISDICTIONAL RISK EVALUATION
Towamensing Township	✓	✓	✓	✓	✓	✓	✓
Weatherly Borough	✓	✓	✓	✓	✓	✓	✓
Weissport Borough							

With funding support from PEMA, Michael Baker Incorporated, a full-service engineering firm that provides hazard mitigation planning guidance and technical support, assisted the County through the HMP process. The 2015 Carbon County HMP was completed in July 2015. The 2015 HMP follows an outline developed by PEMA in 2013 which provides a standardized format for all local HMPs in the Commonwealth of Pennsylvania.

3.2.The Planning Team

The Hazard Mitigation Steering Committee for the 2015 HMP included:

Mark Nalesnik, Director, Carbon County EMA

David Bodnar, Director, Carbon County Office of Planning and Development

Jason Shellhammer, GIS Analyst, Carbon County Office of Planning and Development

The HMSC developed a well-diversified list of potential HMPT members which included municipal officials, state and Carbon County government representatives, adjacent county representative and other non-profit organizations. These individuals were invited to participate in the HMP process. The HMSC worked throughout the process to plan and hold meetings, collect information and conduct public outreach.

The stakeholders listed in Table 3.2-1 served on the 2015 countywide HMPT and actively participated in the planning process through attendance at meetings, completion of assessment surveys, or submission of comments. The HMPT consisted of state, county and local officials including municipal supervisors and council members, emergency management coordinators, as well as constables, firefighters, and conservation district representatives. Participants representing multiple jurisdictions are listed more than once.

Table 3.2-1 Stakeholders who participated in the planning process.	
MUNICIPALITY/ORGANIZATION	PARTICIPANT(S)
Banks Township	Joe Clark
Beaver Meadows Borough	Jeff Bobish, Stephanie Gillette
East Side Borough	Meri Jones
Franklin Township	Larry Diehl
Kidder Township	Robert Dobosh
Lansford Borough	Jack Soberick
Lehigh Township	Charles Puzzetti
Lehighton Borough	Brenda Koons Joseph Flickinger"
Lower Towamensing Township	Rory Koons
Mahoning Township	Debbie Bender
Nesquehoning Borough	Samuel Kitchko John McArdle
Palmerton Borough	Rodger Danielson Michael Kerckmar
Penn Forest Township	Richard Walck
Summit Hill Borough	Kevin Steber

Table 3.2-1 Stakeholders who participated in the planning process.

MUNICIPALITY/ORGANIZATION	PARTICIPANT(S)
Towamensing Township	Tom Newman
Weatherly Borough	James Wetzel
Carbon County Office of Planning and Community Development	David Bodnar
Carbon County Emergency Management Agency	Mark Nalesnik
PA Department of Conservation and Natural Resources (DCNR)-Bureau of Forestry	Wesley Keller
Pennsylvania Emergency Management Agency (PEMA)	Ernie Szabo
US Army Corps of Engineers (USACE)	George Sauls

3.3.Meetings and Documentation

The following meetings were held during the planning process. Invitations, agendas, sign-in sheets, and minutes for these meetings are included in **Appendix C**.

January 28, 2015 – Internal Hazard Mitigation Steering Committee meeting held to discuss project scope, schedule, goals and available resources.

April 1, 2015 – Community Kick-Off Meeting held at the Carbon County EMA to introduce the project to local municipalities, inform community representatives of the HMP process and schedule, and evaluate hazards and risk within the County.

May 13, 2015 – Mitigation Strategy Workshop Meeting held at the Carbon County EMA to review preliminary risk assessment results and develop mitigation goals, objectives, actions, and projects to be included in the HMP. A press release was issued and published in the Times News on May 12, 2015 to inform the public about the meeting and opportunity to participate in the planning process.

July 1, 2015 – Final Public Meeting – This public meeting was held to update the public about the HMP process and findings. The meeting was advertised as a legal ad in the local newspaper and announced on the project website. Meeting attendees participated in a mapping exercise using numbered dots to provide information on mitigation opportunities or the location of several hazards in the County. Several verbal comments were noted in

Figure 3.3-1 Public Meeting mapping exercise.



the meeting minutes and attendees were informed about the timeline and their opportunity to review the entire plan on the County's website and provide written comments.

3.4. Public and Other Stakeholder Participation

Each municipality was given multiple opportunities to participate in the HMP process through invitation to meetings, review of risk assessment results and mitigation actions, and an opportunity to comment on the draft HMP. The four tools listed below were distributed with meeting invitations or at meetings to solicit data, information, and comments from local municipalities in Carbon County. Responses to these worksheets and surveys are included in **Appendix C**:

- 1) **Hazard Evaluation Form**: Allows communities to provide information on the status of hazards in their community and nominate new hazards for inclusion in the 2015 HMP Update.
- 2) **Capability Assessment Survey**: Collects information on local planning, regulatory, administrative, technical, fiscal, political, and resiliency capabilities that can be included in the countywide mitigation strategy.
- 3) **Jurisdictional Risk Review Form**: Allows communities to provide information on the perceived risk of hazards in their municipality compared to the ranked hazards for the County. Communities list whether the jurisdictional risk is greater, equal to, or less than the County's risk.
- 4) **Mitigation Action Form**: Allows communities to propose mitigation actions for the HMP and include information about each action such as a lead agency/department, implementation schedule, priority, estimated cost, and potential funding source(s).
- 5) **Mitigation Project Review Form**: Allows communities that submitted hazard mitigation projects for the 2010 HMP to re-evaluate them to determine if they are still viable or if they have been completed or discontinued.
- 6) **Hazard Mitigation Plan Comment Form**: Provides an opportunity for communities to comment on any part of the planning process, mitigation strategy, risk assessment or other aspect of the Hazard Mitigation Plan Update.

Figure 3.4-1 Public notice of HMP Public Meeting on July 1, 2015. Published on June 27, 2015 in the Times News (Enlarged copies available in Appendix C).

PUBLIC NOTICE
Hazard Mitigation Plan Review for Carbon County, Pennsylvania
Notice is hereby given that the Carbon County Emergency Management Agency, in cooperation with the Office of Planning and Development will hold a public meeting to review the Draft Carbon County Hazard Mitigation Plan on Wednesday, July 1, 2015 from 6:30 PM - 8:00 PM. This meeting is to be held at the Carbon County Emergency Management Agency, Training Room, 1264 Emergency Lane, Nesquehoning, Pennsylvania 18240. The Plan describes the hazards that can affect Carbon County and its municipalities and the actions that can be taken to reduce their impact on the community. Questions may be directed to Taryn Murray, Mitigation Planner, at 251-430-5514 or tmurray@mbakerintl.com. Interested persons may download and review an electronic copy of the Draft Plan at www.pennsylvaniahmp.com/carbon-hmp starting on July 8, 2015.
June 27

Figure 3.4-2 Public notice of HMP meetings on project website.



Community participation and comment was encouraged throughout the planning process. A newspaper notice was published in the Times News on May 12, 2015 and an announcement posted on the project website to notify the citizens of Carbon County of the public meeting held on July 1, 2015. Copies of these notices are shown in Figure 3.5-1 and 3.5-2. Additionally, notification of the HMP sent to representatives from neighboring counties is included in **Appendix C**.

The public meeting was attended by a local reporter and an article about the HMP update appeared in the Times News on July 2, 2015 with details about the plan purpose and opportunities to participate and comment on the document.

Figure 3.4-3 Newspaper coverage of the HMP Public Meeting. (Times News, 2015)



Carbon County posted the 2015 Draft HMP on their website beginning July 8, 2015 and held a public comment period for thirty days. The availability of the draft HMP was made public by placing a public notice in the Times News on June 27, 2015 and disseminating the information to the HMPT via email and on the project website. Comments were to be submitted in writing via the project website or via email to Taryn Murray of Michael Baker International. Copies of all comments received are located in **Appendix C**.

3.5.Multi-Jurisdictional Planning

This HMP was developed using a multi-jurisdictional approach. Though County level departments have resources such as technical expertise and data which local jurisdictions may lack; involvement from local municipalities is critical to the collection of local knowledge related to hazard events. Local municipalities also have the legal authority to enforce compliance with land use planning and development issues. The County undertook an intensive effort to involve all 23 municipalities in the planning process. Table 3.1-1 lists jurisdictional participation in the 2015 HMP.

Table 3.1-1 documents jurisdictional presence at the meetings described in Section 3.3 and other involvement from each jurisdiction throughout the planning process. Each municipality was emailed or mailed invitations to all meetings and if email addresses were available, received email reminders prior to each meeting. Surveys and forms were provided at meetings and mailed or emailed to jurisdictions along

with letters requesting that local information be provided. Sixteen municipalities in the County participated in the plan thus achieving approximately 70% participation.

There are numerous existing regulatory and planning mechanisms in place at the state, county, and municipal level of government which support hazard mitigation planning efforts. These tools include the Commonwealth of Pennsylvania Standard All-Hazard Mitigation Plan, local floodplain management ordinances, the Carbon County Comprehensive Plan & Greenway Plan, Carbon County Emergency Operations Plan, local Emergency Operation Plans, local zoning ordinances, local subdivision and land development ordinances, and local comprehensive plans. These mechanisms were discussed at community meetings and are described in Section 5.2. Information from several of these documents has been incorporated into this plan and mitigation actions have been developed to further integrate these planning mechanisms into the hazard mitigation planning process.

Information on identified development constraints and potential future growth areas was incorporated from the Carbon County Comprehensive Plan & Greenway Plan so that vulnerability pertaining to future development could be established. Floodplain management ordinance information was used to aid in the establishment of local capabilities in addition to participation in the NFIP.

4. RISK ASSESSMENT

4.1. Update Process Summary

This risk assessment provides a factual basis for activities proposed by the County in their mitigation strategy. Hazards that may affect Carbon County are identified and defined in terms of location and geographic extent, magnitude of impact, previous events, and likelihood of future occurrence. The Risk Assessment section of the Carbon County HMP update utilizes existing data and analysis from the previous FEMA-approved HMP, as well as more recent data and analysis on hazards occurring during the last five years.

The HMSC identified natural and human-made hazards which have the potential to impact Carbon County. The occurrence of a past hazard event in the County provided an indication of future possible incidence, but the fact that a hazard event has not previously occurred did not exclude the hazard from further investigation. Similarly, limited past occurrences of hazard events did not solely warrant a hazard's inclusion in the plan.

The HMSC reviewed all 34 hazards listed in PEMA's *Standard List of Hazards* from the Commonwealth of Pennsylvania's All-Hazard Mitigation Planning Standard Operating Guide (SOG) that might affect Carbon County in the first planning meeting. The HMSC was asked to complete the Evaluation of Identified Hazards and Risk form to review the impact of hazards addressed in the 2010 HMP and to select new hazards found to have an impact on Carbon County. Based on the results of this survey, information from the 2013 Pennsylvania State HMP update, and past disaster declarations, the HMPT determined that the 11 hazards identified in the 2010 plan – Dam Failure, Disorientation, Drought, Flood/Flash Flood/Ice Jam, Hurricane/Tropical Storm/Nor'easter, Landslide, Nuclear Incidents, Transportation Accident, Utility Interruption, Wildfire, and Winter Storm – were valid for the update, and determined the need to include the following six additional hazards: Hailstorm, Radon Exposure, Building and Structure Collapse, Drowning, Environmental Hazards, and Levee Failure.

Hazard profiles were then developed in order to define the characteristics of each hazard as they apply to Carbon County. Each municipality and the other stakeholders participating in the planning process then evaluated the impact of hazard profiled in their jurisdiction or organization using the Jurisdictional Risk Evaluation Exercise. This evaluation, together with the research and analysis of each hazard, allowed for an assessment of jurisdictional risk, discussed in Section 4.4.2.

Following hazard identification and profiling, a vulnerability assessment was performed to identify the impact of natural or human-caused hazard events on people, buildings, infrastructure, and the community. Each natural and human-made hazard is discussed in this plan in terms of its potential impact on individual communities in Carbon County, including the types of parcels and critical facilities that may be at risk. A vulnerability analysis was performed which identifies structures, critical facilities, and/or populations that may be impacted during hazard events and describes what events can do to physical, social, and economic assets. This information and analysis is captured in Sections 4.3 Hazard Profiles and Vulnerability Analysis and 4.4 Hazard Vulnerability Summary. The assessment allows the County and its

municipalities to focus mitigation efforts on areas most likely to be damaged or most likely to require early response to a hazard event. For more information on data sources and limitations, see Section 2.5.

Only the most current and credible sources were used to complete the hazard profiles included in Section 4.3; see citations and **Appendix A - Bibliography** for source details.

4.2. Hazard Identification

4.2.1. Table of Presidential Disaster Declarations

Presidential Disaster and Emergency Declarations are issued when it has been determined that state and local governments need assistance in responding to a disaster event. Table 4.2-1 identifies Presidential Disaster and Emergency Declarations issued between 1955 through 2015 that have affected Carbon County. Additional declarations beyond 2015 can be found on the FEMA website at: <http://www.fema.gov/disasters>.

Table 4.2-1 Presidential Disaster and Emergency Declarations affecting Carbon County.		
DECLARATION NUMBER	DATE	EVENT
3356	September 29, 2012	Emergency Declaration - Hurricane Sandy
3340	September 8, 2011	Emergency Declaration – Remnants of Tropical Storm Lee
1649	June, 2006	Proclamation of Emergency - Flooding
3235	September, 2005	Proclamation of Emergency - Hurricane Katrina
1557	September, 2004	Tropical Depression Ivan
1497	September, 2003	Hurricane Isabel/Henri
3180	February, 2003	Severe Winter Storms
1294	September, 1999	Hurricane Floyd
1085	January, 1996	Severe Winter Storms
1093	January, 1996	Flooding
1015	January, 1994	Severe Winter Storms
3105	March, 1993	Blizzard
737	September, 1985	Flood
340	June, 1972	Flood (Agnes)
273	August, 1969	Flood
206	August, 1965	Drought
40	August, 1955	Flood (Diane)

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

4.2.2. Summary of Hazards

As described in Section 4.1, at the initiation of the plan update process, the HMSC reviewed the Pennsylvania Standard List of Hazards to evaluate new and changing hazards in Carbon County for consideration of inclusion in the 2015 HMP update. Following a review of the hazards considered in the 2010 HMP, the 2013 Standard State All-Hazard Mitigation Plan, and the Standard List of Hazards, the HMSC decided that the 2015 plan update should identify, profile, and analyze 16 hazards as the most significant to Carbon County. The hazards include all eleven hazards profiled in the 2010 plan and the addition of five as hazards of concern. Table 4.2-2 contains a complete list of the hazards identified for hazard profiling in the 2015 HMP update as having potential to affect Carbon County as identified through previous occurrences, expected future significance and input from those that participated in the 2015 planning process. Hazard profiles are included in Section 4.3 for each of these hazards.

Table 4.2-2 List and description of natural and human-made hazards profiled in the 2010 HMP.		
HAZARD TYPE	HAZARD	HAZARD DESCRIPTION
Natural Hazards	Drought	Drought is a natural climatic condition which occurs in virtually all climates, the consequence of a natural reduction in the amount of precipitation experienced over a long period of time, usually a season or more in length. High temperatures, prolonged winds, and low relative humidity can exacerbate the severity of drought. This hazard is of particular concern in Pennsylvania due to the presence of farms as well as water-dependent industries and recreation areas across the Commonwealth. A prolonged drought could severely impact these sectors of the local economy, as well as residents who depend on wells for drinking water and other personal uses (National Drought Mitigation Center, 2015).
	Flood, Flash Flood, & Ice Jam	Flooding is the temporary condition of partial or complete inundation on normally dry land and it is the most frequent and costly of all hazards in Pennsylvania. Flooding events are generally the result of excessive precipitation. General flooding is typically experienced when precipitation occurs over a given river basin for an extended period of time. Flash flooding is usually a result of heavy localized precipitation falling in a short time period over a given location, often along mountain streams and in urban areas where much of the ground is covered by impervious surfaces. The severity of a flood event is dependent upon a combination of stream and river basin topography and physiography, hydrology, precipitation and weather patterns, present soil moisture conditions, the degree of vegetative clearing as well as the presence of impervious surfaces in and around flood-prone areas. Winter flooding can include ice jams which occur when warm temperatures and heavy rain cause snow to melt rapidly. Snow melt combined with heavy rains can cause frozen rivers to swell, which breaks the ice layer on top of a river. The ice layer often breaks into large chunks, which float downstream, piling up in narrow passages and near other obstructions such as bridges and dams. All forms of flooding can damage infrastructure (USACE, 2007).

Table 4.2-2 List and description of natural and human-made hazards profiled in the 2010 HMP.

HAZARD TYPE	HAZARD	HAZARD DESCRIPTION
	Hailstorm	In addition to flooding and severe winds, hail is another potential damaging product of severe thunderstorms. Hailstorms occur when ice crystals form within a low pressure front due to the rapid rise of warm air into the upper atmosphere and the subsequent cooling of the air mass. Frozen droplets gradually accumulate on the ice crystals until, having developed sufficient weight, they fall as precipitation in the form of balls or irregularly shaped masses of ice greater than 0.75 inches in diameter (FEMA, 1997). The size of hailstones is a direct function of the size and severity of the storm. High velocity updraft winds are required to keep hail in suspension in thunderclouds. The strength of the updraft is a function of the intensity of heating at the Earth's surface. Damage to crops and vehicles are typically the most significant impacts of hailstorms. Areas in eastern and central Pennsylvania typically experience less than 2 hailstorms per year while areas in western Pennsylvania experience 2-3 annually.
	Hurricane, Tropical Storm, & Nor'easter	Hurricanes, tropical storms, and Nor'easters are classified as cyclones and are any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise (in the Northern Hemisphere) and whose diameter averages 10-30 miles across. While most of Pennsylvania is not directly affected by the devastating impacts cyclonic systems can have on coastal regions, many areas in the state are subject to the primary damaging forces associated with these storms including high-level sustained winds, heavy precipitation and tornadoes. Nor'easters typically develop as extra-tropical storms and can produce winds equivalent to hurricane or tropical storm force with heavy precipitation, sometimes in the form of snow. Areas in southeastern Pennsylvania could be susceptible to storm surge and tidal flooding. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico during the official Atlantic hurricane season which extends from June through November (FEMA, 1997).
	Landslide	A landslide is the downward and outward movement of slope-forming soil, rock and vegetation reacting to the force of gravity. Landslides may be triggered by both natural and human-caused changes in the environment, including heavy rain, rapid snow melt, steepening of slopes due to construction or erosion, earthquakes and changes in groundwater levels. Mudflows, mudslides, rockfalls, rockslides and rock topples are all forms of a landslide. Areas that are generally prone to landslide hazards include previous landslide areas, the bases of steep slopes, the bases of drainage channels, developed hillsides, and areas recently burned by forest and brush fires (Delano & Wilshusen, 2001).
	Wildfire	A wildfire is a raging, uncontrolled fire that spreads rapidly through vegetative fuels, exposing and possibly consuming structures. Wildfires often begin unnoticed and can spread quickly, creating dense smoke that can be seen for miles. Wildfires can occur at any time of the year, but mostly occur during long, dry hot spells. Any small fire in a wooded area, if not quickly detected and suppressed, can get out of control. Most wildfires are caused by human carelessness, negligence, and ignorance. However, some are precipitated by lightning strikes and in rare instances, spontaneous combustion. Wildfires in Pennsylvania can occur in fields, grass, brush, and forests. 98 percent of wildfires in Pennsylvania are a direct result of people, often caused by debris burns (DCNR, 2015).

Table 4.2-2 List and description of natural and human-made hazards profiled in the 2010 HMP.

HAZARD TYPE	HAZARD	HAZARD DESCRIPTION
	Winter Storm	Winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. A winter storm can range from a moderate snowfall or ice event over a period of a few hours to blizzard conditions with wind-driven snow that lasts for several days. Many winter storms are accompanied by low temperatures and heavy and/or blowing snow, which can severely impair visibility and disrupt transportation. The Commonwealth of Pennsylvania has a long history of severe winter weather (NOAA, 2009).
Technological and Human-made Hazards	Building and Structure Collapse	Buildings and other engineered structures, including bridges, may collapse if their structural integrity is compromised, especially due to effects from other natural or human-made hazards. Older buildings or structures, structures that are not built to standard codes, or structures that have been weakened are more susceptible to be affected by these hazards.
	Dam Failure	A dam is a barrier across flowing water that obstructs, directs, or slows down water flow. Dams provide benefits such as flood protection, power generation, drinking water, irrigation, and recreation. Failure of these structures results in an uncontrolled release of impounded water. Failures are relatively rare, but immense damage and loss of life is possible in downstream communities when such events occur. Aging infrastructure, hydrologic, hydraulic, and geologic characteristics, population growth, and design and maintenance practices should be considered when assessing dam failure hazards. The failure of the South Fork Dam, located in Johnstown, PA, was the deadliest dam failure ever experienced in the United States. It took place in 1889 and resulted in the Johnstown Flood which claimed 2,209 lives (FEMA, 1997). Today there are approximately 3,200 dams and reservoirs throughout Pennsylvania (PADEP, 2008).
	Disorientation	Large numbers of people are attracted to Pennsylvania's rural areas for recreational purposes such as hiking, camping, hunting, and fishing. As a result, people can become lost or trapped in remote and rugged wilderness areas. Search and rescue may be required for people who suffer from medical problems or injuries and those who become accidentally or intentionally disoriented. Search and rescue efforts are focused in and around state forest and state park lands (DCNR, 2009).
	Drowning	Unintentional drowning can be a significant hazard in communities with numerous water bodies (e.g. ponds, lakes, rivers, etc.) and extensive outdoor recreational activity. Water related recreational opportunities such as fishing, boating, and swimming popular among visitors present more opportunities for residents and visitors to unintentionally drown.
	Environmental Hazards	Environmental hazards are hazards that pose threats to the natural environment, the built environment, and public safety through the diffusion of harmful substances, materials, or products. Environmental hazards include the following: • Hazardous material releases: at fixed facilities including toxic chemicals, infectious substances, biohazardous waste, and any materials that are explosive, corrosive, flammable, or radioactive (PL 1990-165, § 207(e)). • Coal Mining Incidents: including the release of harmful chemical and waste materials into water bodies or the atmosphere, explosions, fires, and other hazards and threats to life safety stemming from mining (Environmental Protection Agency, Natural Disaster PSAs, 2009).

Table 4.2-2 List and description of natural and human-made hazards profiled in the 2010 HMP.

HAZARD TYPE	HAZARD	HAZARD DESCRIPTION
		Oil and gas well incidents: including the release of harmful chemical and waste materials into water bodies or the atmosphere, explosions, fires, and other hazards and threats to life safety stemming from oil and gas extraction (Environmental Protection Agency, Natural Disaster PSAs, 2009).
	Levee Failure	A levee is a human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding (Interagency Levee Policy Review Committee, 2006). Levee failures or breaches occur when a levee fails to contain the floodwaters for which it is designed to control or floodwaters exceed the height of the constructed levee. 51 of Pennsylvania's 67 counties have been identified as having at least one levee (FEMA Region III, 2009).
	Nuclear Incidents	Nuclear incidents generally refer to events involving the release of significant levels of radioactivity or exposure of workers or the general public to radiation (FEMA, 1997). Nuclear accidents/incidents can be placed into three categories: 1) Criticality accidents which involve loss of control of nuclear assemblies or power reactors, 2) Loss-of-coolant accidents which result whenever a reactor coolant system experiences a break or opening large enough so that the coolant inventory in the system cannot be maintained by the normally operating make-up system, and 3) Loss-of-containment accidents which involve the release of radioactivity. The primary concern following such an incident or accident is the extent of radiation, inhalation, and ingestion of radioactive isotopes which can cause acute health effects (e.g. death, burns, severe impairment), chronic health effects (e.g. cancer), and psychological effects (FEMA, 1997).
	Radon Exposure	Radon is a cancer-causing natural radioactive gas that you can't see, smell, or taste. It is a large component of the natural radiation that humans are exposed to and can pose a serious threat to public health when it accumulates in poorly ventilated residential and occupation settings. According to the USEPA, radon is estimated to cause about 21,000 lung cancer deaths per year, second only to smoking as the leading cause of lung cancer (EPA 402-R-03-003: EPA Assessment, 2003). An estimated 40% of the homes in Pennsylvania are believed to have elevated radon levels (Pennsylvania Department of Environmental Protection, 2009).
	Transportation Accidents	Transportation accidents can result from any form of air, rail, water, or road travel. It is unlikely that small accidents would significantly impact the larger community. However, certain accidents could have secondary regional impacts such as a hazardous materials release or disruption in critical supply/access routes, especially if vital transportation corridors or junctions are present. Traffic congestion in certain circumstances can also be hazardous. Traffic congestion is a condition that occurs when traffic demand approaches or exceeds the available capacity of the road network. This hazard should be carefully evaluated during emergency planning since it is a key factor in timely disaster or hazard response, especially in areas with high population density (Federal Highway Administration, 2015).

Table 4.2-2 List and description of natural and human-made hazards profiled in the 2010 HMP.

HAZARD TYPE	HAZARD	HAZARD DESCRIPTION
	Utility Interruption	Utility interruption hazards are hazards that impair the functioning of important utilities in the energy, telecommunications, public works, and information network sectors. Utility interruption hazards include the following: • Fuel or Resource Shortage; resulting from supply chain breaks or secondary to other hazard events, for example (Mercer County, PA, 2005). • Electromagnetic Pulse; originating from an explosion or fluctuating magnetic field and causing damaging current surges in electrical and electronic systems (Institute for Telecommunications Sciences, 1996). • Information Technology Failure; due to software bugs, viruses, or improper use (Rainer Jr., et al, 1991). • Ancillary Support Equipment; electrical generating, transmission, system-control, and distribution-system equipment for the energy industry (Hirst & Kirby, 1996). • Public Works Failure; damage to or failure of highways, flood control systems, deepwater ports and harbors, public buildings, bridges, dams, for example (United States Senate Committee on Environment and Public Works, 2009). • Telecommunications System Failure; Damage to data transfer, communications, and processing equipment, for example (FEMA, 1997). • Transmission Facility or Linear Utility Accident; liquefied natural gas leakages, explosions, facility problems, for example (United States Department of Energy, 2005). • Major Energy, Power, Utility Failure; interruptions of generation and distribution, power outages, for example (United States Department of Energy, 2000). • Internet interruptions/internet failures; an increasingly important kind of utility interruption as more of the day-to-day business of the Commonwealth is conducted over the internet.

4.3. Hazard Profiles and Vulnerability Analysis

NATURAL HAZARDS

4.3.1. Drought

4.3.1.1. Location and Extent

Drought is a natural climatic condition which occurs in virtually all climates, the consequence of a natural reduction in the amount of precipitation experienced over a long period of time, usually a season or more in length. High temperatures, prolonged winds, and low relative humidity can exacerbate the severity of drought. This hazard is of particular concern in Pennsylvania due to the presence of farms as well as water-dependent industries and recreation areas across the Commonwealth. A prolonged drought could severely affect these sectors of the local economy, as well as residents who depend on wells for drinking water and other personal uses (National Drought Mitigation Center, 2015).

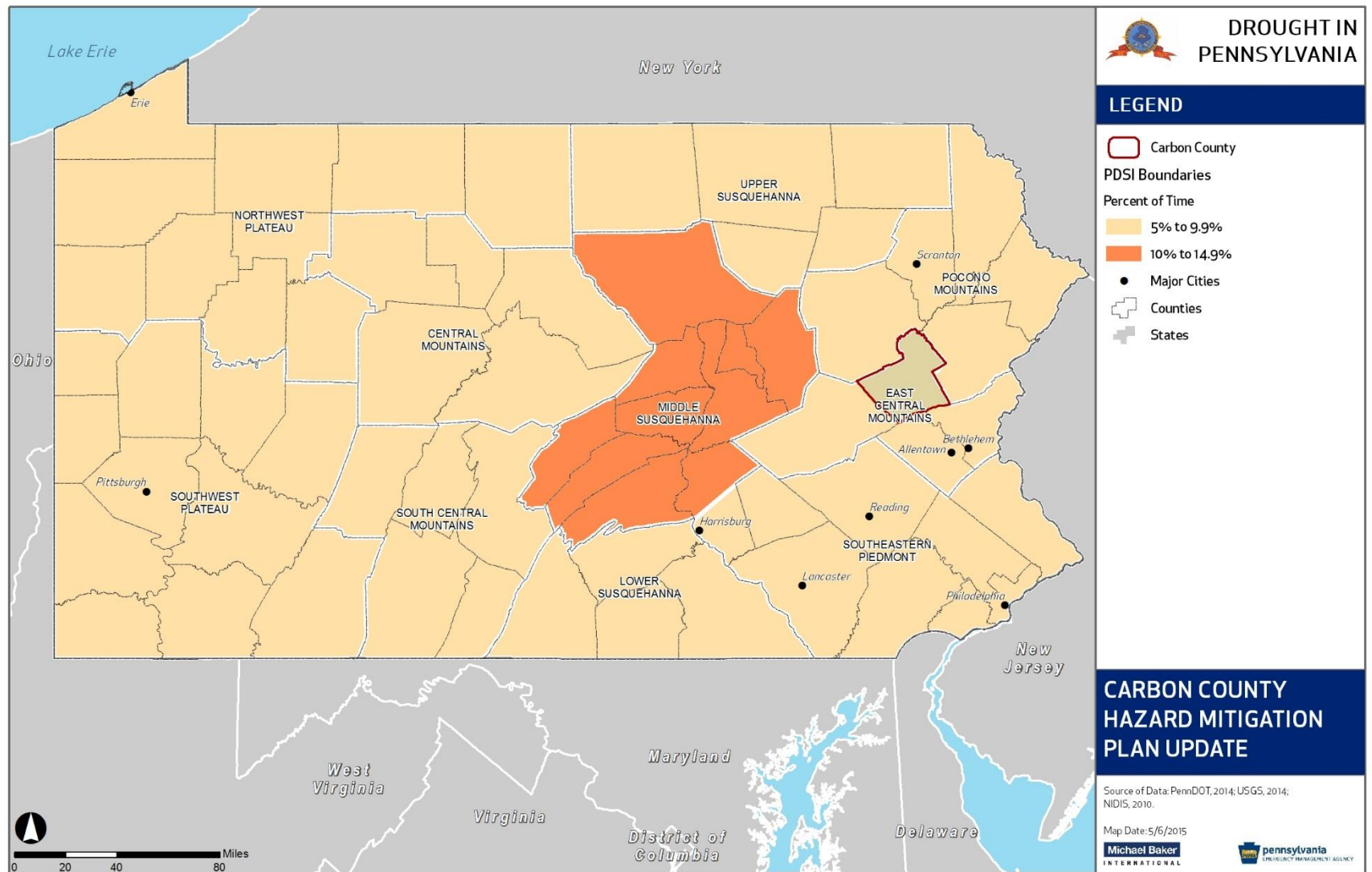
There are four types of droughts:

- **Meteorological Drought** – A deficiency in moisture in the atmosphere. This will have very little effect on the crops and water supply, depending on the preceding conditions.
- **Agricultural Drought** – Inhibits the growth of crops, because of a moisture deficiency in the soil. This type of drought, if persistent, can lead to a hydrologic drought.
- **Hydrologic Drought** – A prolonged period of time without rainfall that can have adverse effects on agriculture, streams, lakes, and groundwater levels. Results when there is a shift in normal weather patterns over an area causing the amount of precipitation to fall significantly below the long-termed average.
- **Water Management Drought** – Results not from a reduction in supply, but a disparity in supply versus demand. Poor water management practices and/or community planning generally cause this condition.

The main type of drought that affects Carbon County is a hydrological drought. Droughts are regional climatic events, so when these events occur in Carbon County, impacts are felt across the entire County as well as areas outside County boundaries. The spatial extent for areas of impact can range from areas of Pennsylvania to the entire mid-Atlantic region. Areas with extensive agricultural land use are most vulnerable to drought.

All of Carbon County has an equal occurrence of severe or extreme drought, which is illustrated in Figure 4.3.1-1.

Figure 4.3.1-1 Percent of time areas of the United States have PSDI values ≤ -3 (NIDIS, 2010).



4.3.1.2. Range of Magnitude

Droughts can have varying effects, depending upon what month they occur, severity, duration, and location. Most droughts cause direct impacts to aquatic resources. Even short term droughts, when coupled with extreme temperatures, can be devastating. Some droughts may have their greatest impact on agriculture. Others may impact water supply or other water use activities such as recreation.

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

Droughts can have adverse effects on farms and other water-dependent industries. This can result in a local economic loss. From a citizen's perspective, public safety is an issue in terms of consumable water not being available, as well as water for fire protection and emergency services.

Environmental impacts of drought include:

- Hydrologic effects – lower water levels in reservoirs, lakes and ponds; reduced stream flow; loss of wetlands; estuarine impacts; groundwater depletion and land subsidence; effects on water quality such as increases in salt concentration and water temperature
- Damage to animal species – lack of feed and drinking water; disease; loss of biodiversity; migration or concentration; and reduction and degradation of fish and wildlife habitat
- Damage to plant communities – loss of biodiversity; loss of trees from urban landscapes and wooded conservation areas
- Increased number and severity of fires
- Reduced soil quality and erosion issues
- Air quality effects – dust and pollutants
- Loss of quality in landscape
- Loss of water for navigation and recreation
- Increase in nitrate levels which can have health impacts on pregnant women and children.

The Commonwealth uses five parameters to assess drought conditions:

- 1) Stream flows (compared to benchmark records).
- 2) Precipitation deficits (measured as the departure from normal, 30 year average precipitation).
- 3) Reservoir storage levels in a variety of locations (especially three New York City reservoirs in upper Delaware River Basin).
- 4) Groundwater elevations in a number of counties (comparing to past month, past year and historic record).
- 5) The Palmer Drought Severity Index (PSDI) – a soil moisture algorithm calibrated for relatively homogeneous regions which measures dryness based on recent precipitation and temperature (see Table 4.3.1-1).

Table 4.3.1-1 Palmer Drought Severity Index classifications (NDMC, 2015b).	
SEVERITY CATEGORY	PSDI VALUE
Extremely wet	4.0 or more
Very wet	3.0 to 3.99
Moderately wet	2.0 to 2.99
Slightly wet	1.0 to 1.99
Incipient wet spell	0.5 to 0.99
Near normal	0.49 to -0.49
Incipient dry spell	-0.5 to -0.99
Mild drought	-1.0 to -1.99
Moderate drought	-2.0 to -2.99
Severe drought	-3.0 to -3.99
Extreme drought	-4.0 or less

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

- **Drought Watch**: A period to alert government agencies, public water suppliers, water users and the public regarding the potential for future drought-related problems. The focus is on increased monitoring, awareness and preparation for response if conditions worsen. A request for voluntary water conservation is made. The objective of voluntary water conservation measures during a drought watch is to reduce water uses by 5 percent in the affected areas. Due to varying conditions, individual water suppliers or municipalities may be asking for more stringent conservation actions.
- **Drought Warning**: This phase involves a coordinated response to imminent drought conditions and potential water supply shortages through concerted voluntary conservation measures to avoid or reduce shortages, relieve stressed sources, develop new sources, and if possible forestall the need to impose mandatory water use restrictions. The objective of voluntary water conservation measures during a drought warning is to reduce overall water uses by 10-15 percent in the affected areas. Due to varying conditions, individual water suppliers or municipalities may be asking for more stringent conservation actions.
- **Drought Emergency**: This stage is a phase of concerted management operations to marshal all available resources to respond to actual emergency conditions, to avoid depletion of water sources, to assure at least minimum water supplies to protect public health and safety, to support essential and high priority water uses and to avoid unnecessary economic dislocations. It is possible during this phase to impose mandatory restrictions on non-essential water uses that are provided in the Pennsylvania Code (Chapter 119), if deemed necessary and if ordered by the Governor of Pennsylvania. The objective of water use restrictions (mandatory or voluntary) and other conservation measures during this phase is to reduce consumptive water use in the affected area by fifteen percent, and to reduce total use to the extent necessary to preserve public water system supplies, to avoid or mitigate local or area shortages, and to assure equitable sharing of limited supplies.

In addition, local water rationing is an option for communities. Although not a drought phase, local municipalities may, with the approval of the PA Emergency Management Council, implement local water rationing to share a rapidly dwindling or severely depleted water supply in designated water supply service areas. These individual water rationing plans, authorized through provisions of the Pennsylvania Code (Chapter 120), will require specific limits on individual water consumption to achieve significant reductions in use. Under both mandatory restrictions imposed by the Commonwealth and local water rationing, procedures are provided for granting of variances to consider individual hardships and economic dislocations.

Seven Drought Emergencies have been declared in Carbon County since 1955. A worst case scenario for droughts occurred in 1985. The Governor declared a State of Drought Emergency from April until December in sixteen eastern Pennsylvania counties, including Carbon. The declaration placed mandatory restrictions on water use in the region and provided penalties for violators (CEEMA, 2009).

4.3.1.3. Past Occurrence

Declared drought status for Carbon County from 1980 to 20015 is shown in Table 4.3.1-2. Descriptions for drought status categories (i.e. *watch*, *warning*, and *emergency*) are included in Section 4.3.1.2. The Pennsylvania Department of Environmental Protection (DEP) is the agency responsible for collecting drought information. Data for all counties in the Commonwealth is available for the years 1980 through 2015.

DATE	DROUGHT STATUS	DATE	DROUGHT STATUS
Nov 6, 1980 - Nov 18, 1980	Emergency (Western portion only)	Dec 14, 1998 - Dec 16, 1998	Warning
Nov 19, 1980 - Apr 20, 1982	Emergency	Jan 15, 1999 - Mar 15, 1999	Warning
Nov 10, 1982 - Feb 8, 1983	Warning	Mar 15, 1999 - Jun 10, 1999	Watch
Feb 8, 1983 - Mar 28, 1983	Warning	Jun 10, 1999 - Jul 20, 1999	Warning
Jan 23, 1985 - Apr 26, 1985	Warning	Jul 20, 1999 - Sept 30, 1999	Emergency
Apr 26, 1985 - Dec 19, 1985	Emergency	Sept 30, 1999 - May 5, 2000	Watch
Jul 7, 1988 - Dec 12, 1988	Watch	Nov 6, 2001 - Dec 5, 2001	Watch
Mar 3, 1989 - May 15, 1989	Warning	Dec 5, 2001 - Feb 12, 2002	Warning
Jun 28, 1991 - Jul 24, 1991	Watch	Feb 12, 2002 - May 13, 2002	Emergency
Jul 24, 1991 - Apr 20, 1992	Emergency	May 13, 2002 - Nov 7, 2002	Watch
Apr 20, 1992 - Jun 23, 1992	Warning	Apr 11, 2006 - Jun 30, 2006	Watch
Sept 1, 1995 - Sept 20, 1995	Warning	Aug 8, 2007 - Sept 5, 2007	Watch
Sept 20, 1995 - Nov 8, 1995	Emergency	Oct 5, 2007 - Jan 11, 2008	Watch
Nov 8, 1995 - Dec 18, 1995	Warning	Sept 16, 2010 – Nov 10, 2010	Warning
Oct 27, 1997 - Jan 16, 1998	Warning	March 24, 2015 – Present (June 2015)	Watch
Dec 3, 1998 - Dec 14, 1998	Watch		

Carbon County also has record of a drought event prior to 1980. In 1964, two boroughs in Carbon County (Jim Thorpe and Weatherly) were affected by a drought. No drought declarations were issued by the Governor; however, emergency equipment was furnished to the two boroughs from the emergency stockpile at Fort Indiantown Gap (CCEMA, 2009). This included emergency generators and filtering systems since emergency sources of water had to be tapped and purified. Also, in 1965 a presidential disaster declaration was issued for the Delaware River Basin. In 1963 a Gubernatorial Proclamation was issued for numerous communities in the Commonwealth in response to drought.

Table 4.2-1 shows that since 1955, there has been one Presidential Disaster Declaration issued (1965) in response to drought conditions within Carbon County. In addition, there were five Gubernatorial Declarations or Proclamation and one declaration by the Small Business Administration in response to drought conditions within the County.

4.3.1.4. *Future Occurrence*

It is difficult to forecast the severity and frequency of future drought events in Carbon County. Based on national data from 1895 to 1995, Carbon County is in severe or extreme drought approximately 5-9.9 percent of the time (see Figure 4.3.1-1). This is equivalent to a PDSI value less than or equal to -3.

Carbon County has experienced droughts in the past and the potential exists for the County to experience droughts in the future. Additionally, increases in water usages and leakage may result in an increased deficiency in coming years. Therefore, the future occurrence of drought for Carbon County can be considered *possible* as defined by the Risk Factor methodology probability criteria (see Table 4.4-1).

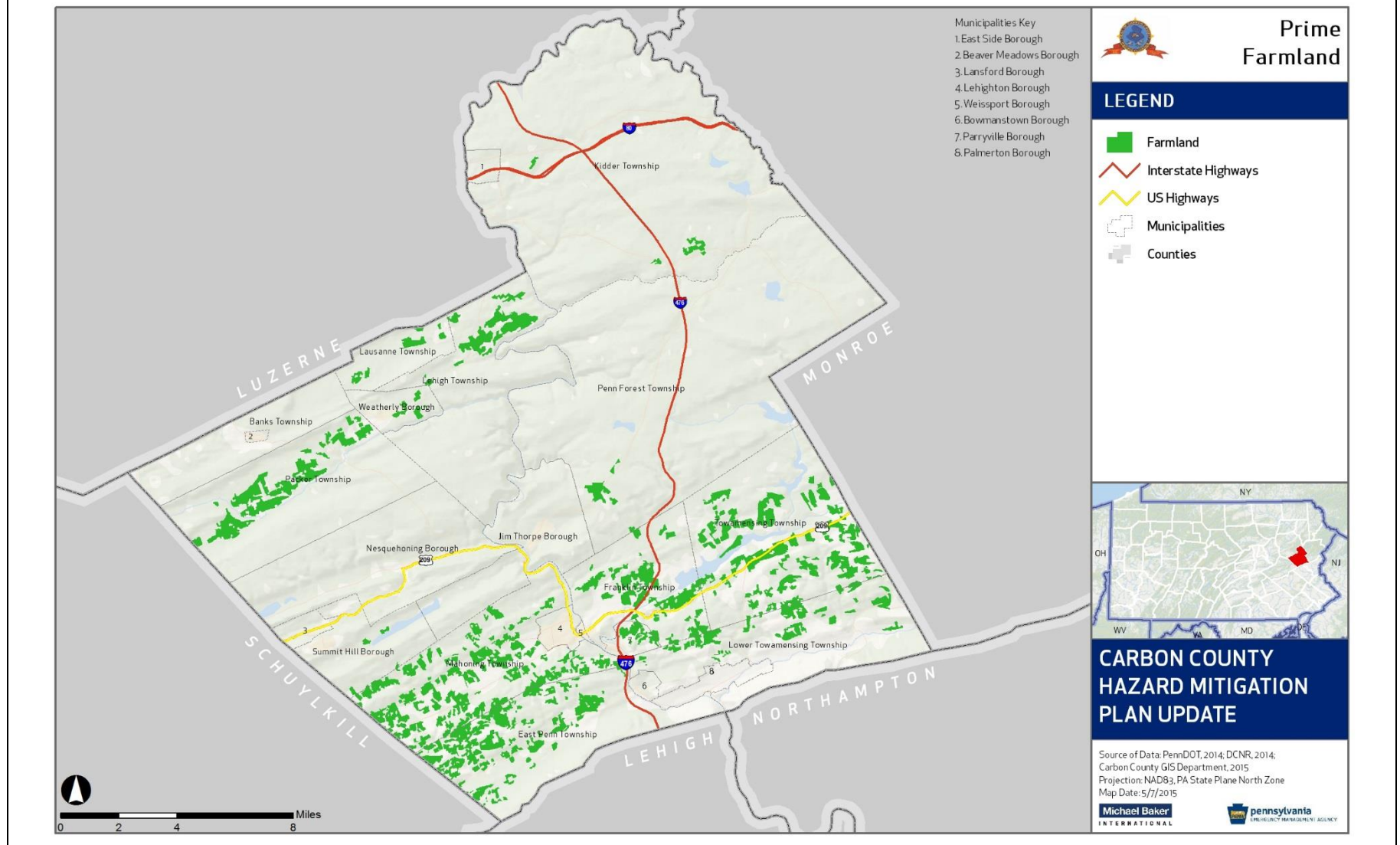
4.3.1.5. *Vulnerability Assessment*

The most significant losses resulting from drought events are typically found in the agriculture sector. In 1999 a Gubernatorial Proclamation was issued in part due to significant crop damage. Preliminary estimates by the United States Department of Agriculture (USDA) indicated possible crop losses across the Commonwealth in excess of \$500 million. This estimate did not include a 20 percent decrease in dairy milk production which also resulted in million dollar losses (NCDC, 2015).

While these were statewide impacts, they illustrate the potential for droughts to severely impair the local economy, especially since a prolonged drought can negatively impact the livelihood of residents within agricultural communities. Prime farmlands in Carbon County will be more susceptible to risks from drought, as will public and private water supplies.

As of the 2012 US Department of Agriculture's Census of Agriculture, Carbon County ranks 61st out of the 67 Commonwealth counties in agricultural production. There were 195 farms in Carbon County, with 21,162 acres of land in farms (an average farm size of 109 acres). The market value of all products sold was \$9.3 million; 91% of that value was derived from crop sales (USDA, 2012). Prime farmland in Carbon County is illustrated in Figure 4.3.1-2.

Figure 4.3.1-2 Areas of prime farmland in Carbon County (Carbon County GIS, 2015).



Carbon County residents that use private domestic wells are more vulnerable to droughts because their drinking water can dry up. Table 4.3.1-3 shows the number of domestic wells per municipality. The total number of wells in Carbon County has decreased slightly since the last update of the HMP from 3,942 domestic wells in 2010 to 3,139 in 2015. It is important to note that the well data was obtained from the Pennsylvania Groundwater Information System (PaGWIS). **PaGWIS relies on voluntary submissions of well record data by well drillers therefore it is not a complete database of all domestic wells in the County.** This is the only comprehensive data set of domestic wells available.

Table 4.3.1-3 Number of domestic wells per municipality in Carbon County (PAGWIS, 2015).	
MUNICIPALITY	DOMESTIC WELLS
Banks Township	4
Beaver Meadows Borough	1
Bowmanstown Borough	8
East Penn Township	142
East Side Borough	11
Franklin Township	188
Jim Thorpe Borough	100
Kidder Township	298
Lansford Borough	0
Lausanne Township	16
Lehigh Township	19
Lehighon Borough	11
Lower Towamensing Township	143
Mahoning Township	289
Nesquehoning Borough	57
Packer Township	49
Palmerton Borough	26
Parryville Borough	25
Penn Forest Township	1417
Summit Hill Borough	44
Towamensing Township	273
Weatherly Borough	17
Weissport Borough	1
TOTAL	3,139

In addition, public water suppliers are also vulnerable in periods of drought, particularly if they rely on groundwater wells and do not have backup water storage. As of 2013, there were ten public water suppliers in the County. These include four municipal run water suppliers, four authorities, and one joint authority. Figure 4.3.1-3 displays the water suppliers in the County and Table 4.3.1-4 includes the details about these water suppliers and their water source.

Figure 4.3.1-3 Public Water Suppliers (DEP, 2015b).

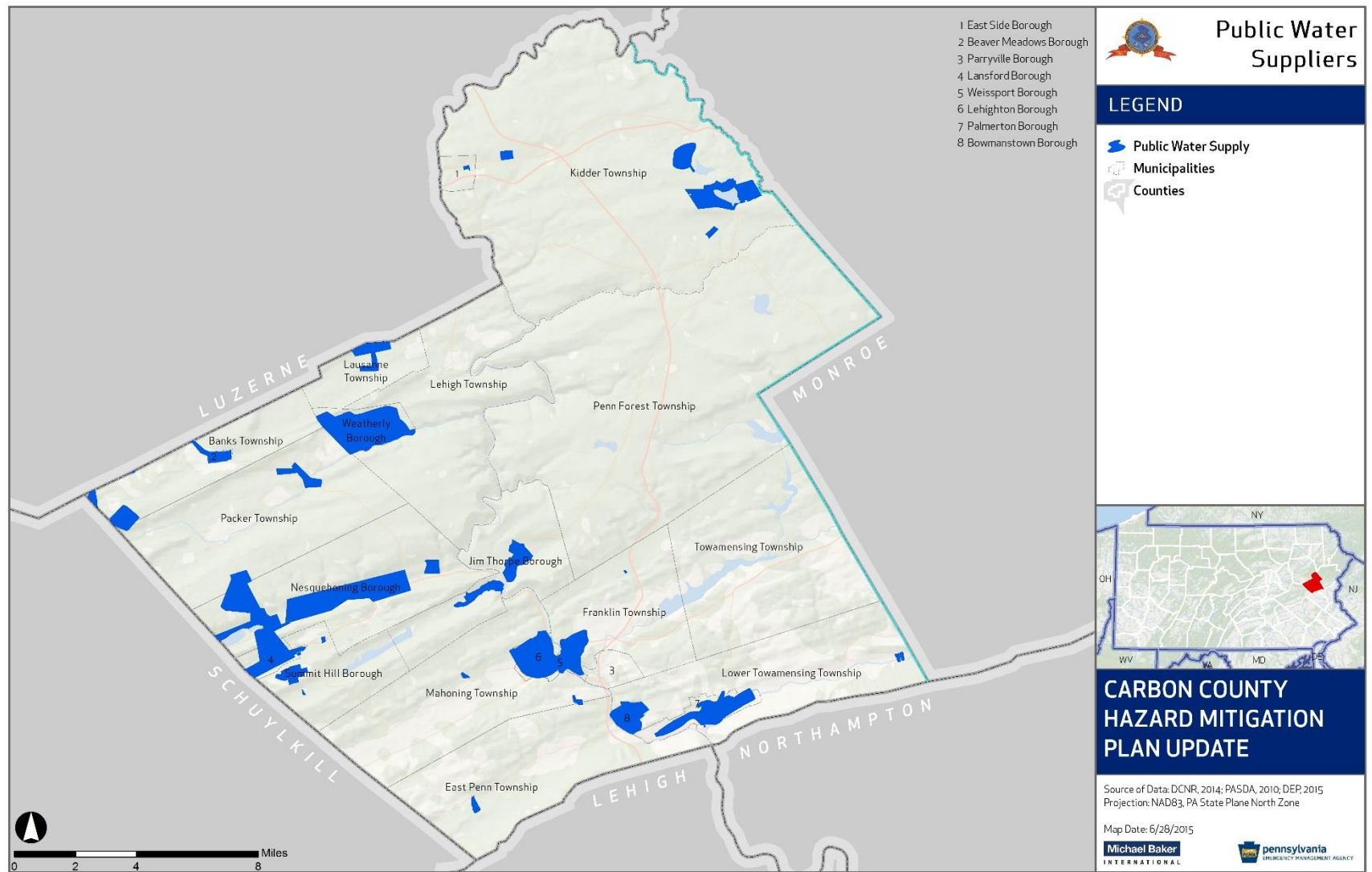


Table 4.3.1-4 Public Water Service in Carbon County (DEP, 2015b)			
NAME	OWNERSHIP	GROUND WATER SOURCE	SURFACE WATER SOURCE
Aqua PA Golden Oaks Development	Private Investor Owned	Yes	No
Beaver Meadows Municipal Authority	Auth Leases Bk To Mun(Pu)	No	No
Beaver Run Water Association	Association - Co-Op	Yes	No
Blue Mountain View	Mobile Home Park	Yes	No
Bowmanstown Borough Authority	Auth Leases Back To Mun	Yes	No
Carbon County Corrections	Institutional Correctional	Yes	No
Chestnut Ridge Mobile Home Park	Mobile Home Park	Yes	No
Creekside Manor Mobile Home Park	Mobile Home Park	Yes	No
Cross Lakes Community Trust Blue Heron Water System	Private Investor Owned	Yes	No
DS Water Co.	Private Investor Owned	Yes	No
Jim Thorpe Borough Water East	Municipal	Yes	No
Jim Thorpe Borough Water West	Municipal	No	Yes
Lansford-Coaldale Joint Water Authority	Authority	Yes	No
Lehighon Municipal Water Authority	Authority	Yes	Yes
Mahoning Valley Nursing and Rehabilitation Center	Institutional Health	Yes	No
McAdoo Industrial Park (CAN DO Inc.)	Private Investor Owned	Yes	No
Midlakes Water System	Private Investor Owned	Yes	No
Northside Heights Estates	Mobile Home Park	Yes	No
Nesquehoning Borough Authority	Auth Leases Back To Mun	Yes	Yes
Nis Hollow Estates Mobile Home Park	Mobile Home Park	Yes	No
Palmerton Municipal Water Authority	Authority	Yes	Yes
Springhill Mobile Home Park	Mobile Home Park	Yes	No
Summit Hill Municipal Water Authority	Authority	Yes	No
Summit Management and Utilities	Association - Co-Op	Yes	No
Weatherly Borough	Municipal	Yes	No
Weiner Mobile Estates	Mobile Home Park	Yes	No

In 2011, several water authorities identified the following drought mitigation measures; additional authorities or suppliers may also have taken mitigation actions, but that information is unknown:

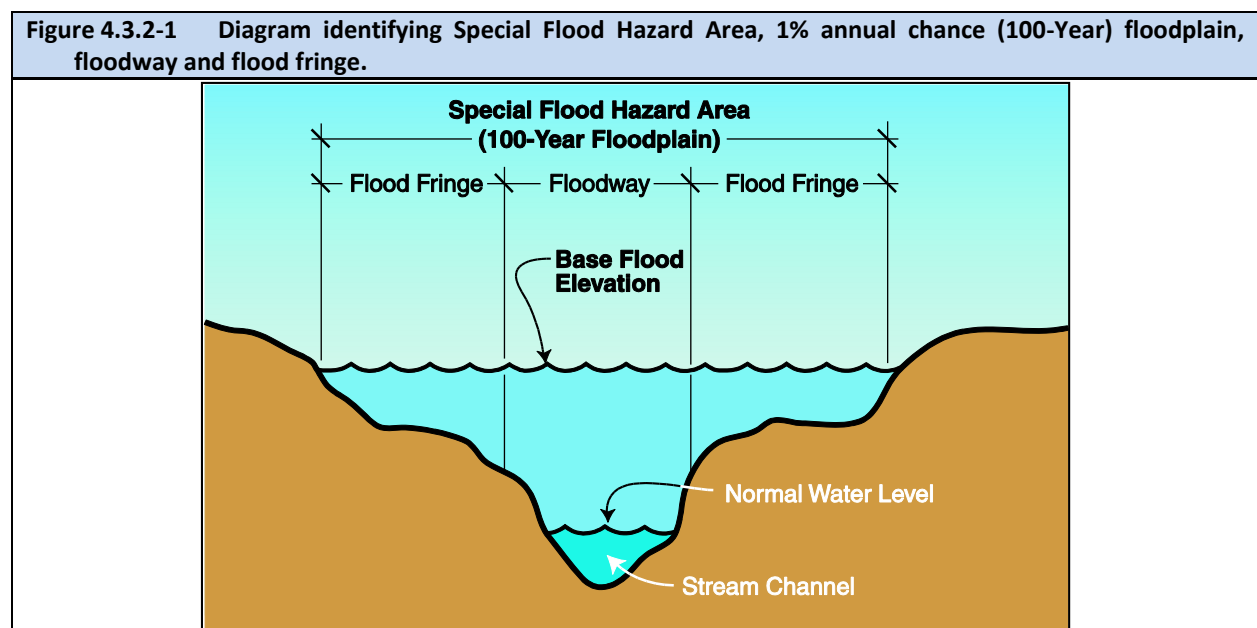
- Bowmanstown Borough has retained an abandoned mine tunnel as an emergency water supply to back up its wells.

- Jim Thorpe Borough Water Department added an additional water storage tank and are in the process of adding another storage tank and filtration plant.
- Lansford/Coaldale Joint Water Authority has installed deep wells with a filtration plant.
- Lehigh Water Authority completed a second pipeline across the Lehigh River which transmits water from the reservoir to the Borough.
- Nesquehoning Borough Water Authority built a filtration system with three wells and a 500,000 gallon tank and two additional wells in the Hauto area.
- Palmerton Borough has five deep wells in operation.

4.3.2. Flood, Flash Flood, Ice Jam

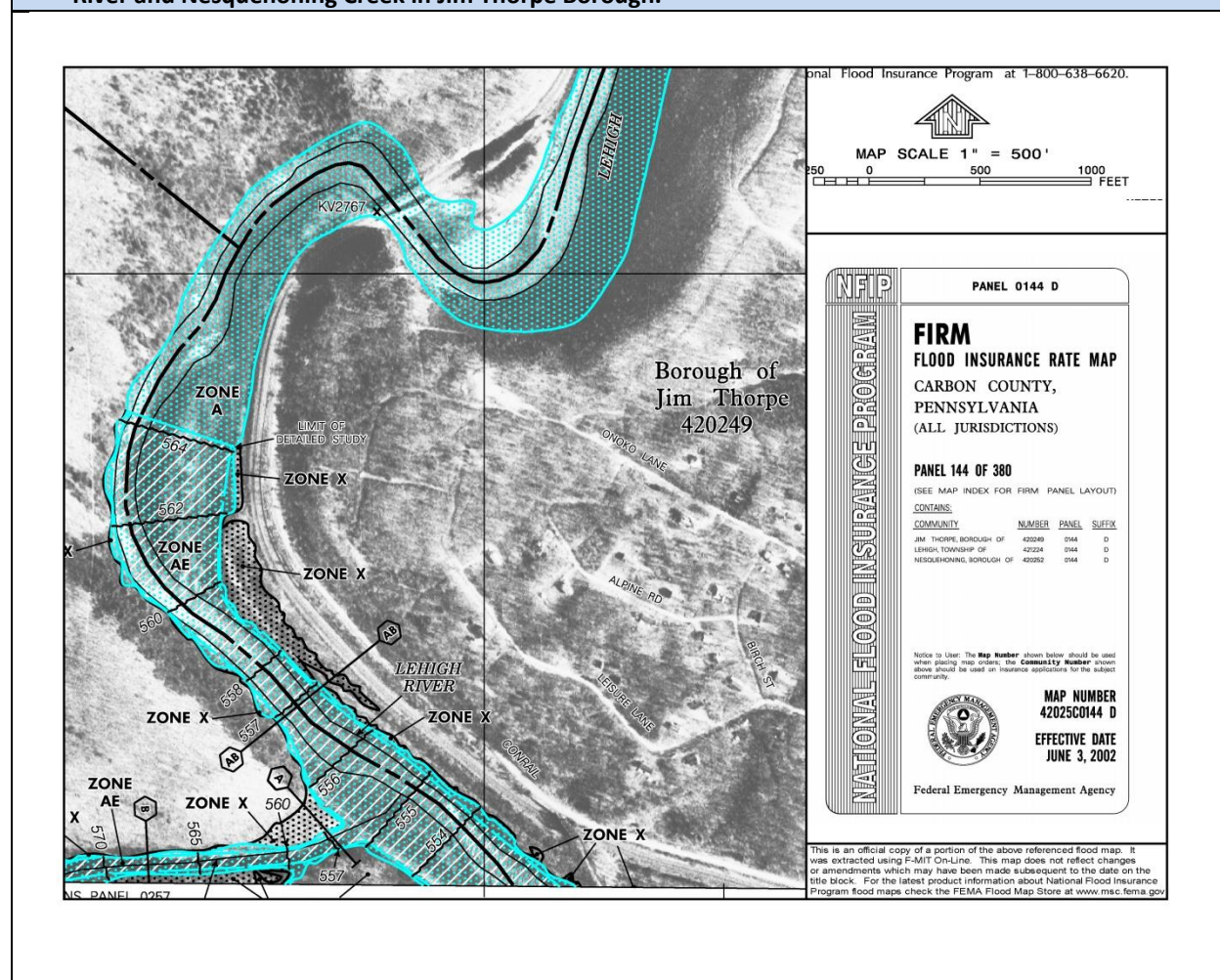
4.3.2.1. Location and Extent

Carbon County is located in the Central Delaware River Basin. This area, like many others in Pennsylvania, is flood prone because of the mountainous terrain and because most of the communities are located along streams and river valleys. In addition, community development of the floodplain has resulted in frequent flooding. For inland areas, excess water from snowmelt or rainfall accumulates and overflows onto stream banks and adjacent floodplains. Floodplains are lowlands adjacent to rivers, streams, and creeks that are subject to recurring floods. The size of the floodplain is described by the recurrence interval of a given flood. Flood recurrence intervals are explained in more detail in Section 4.3.2.4. However, in assessing the potential spatial extent of flooding it is important to know that a floodplain associated with a flood that has a 10 percent chance of occurring in a given year is smaller than the floodplain associated with a flood that has a 0.2% annual chance of occurring. The National Flood Insurance Program (NFIP), for which Flood Insurance Rate Maps (FIRM) are published, identifies the 1% annual chance flood. This 1% annual chance flood event is used to delineate the *Special Flood Hazard Area* (SFHA) and identify *Base Flood Elevations*. Figure 4.3.2-1 illustrates these terms. The SFHA serves as the primary regulatory boundary used by FEMA, the Commonwealth of Pennsylvania and Carbon County local governments.



Countywide DFIRMs were published for Carbon County on June 3, 2002. All communities within the County are now shown on a single set of countywide FIRMs. Previous FIRMs and Flood Boundary and Floodway Maps (FBFM) were digitized to produce a DFIRM that is compatible with GIS. Prior to the publication of this digital data, flood hazard information from FEMA was available through paper FIRMs and Q3 data. An example of the mapping products published is shown in Figure 4.3.2-2. FIRMs for the entire county can be obtained from the FEMA Map Service Center (<http://www.msc.fema.gov>). These maps can be used to identify the expected spatial extent and elevation of flooding from a 1% and 0.2% annual chance event. Twenty-two of the twenty-three municipalities in the County were determined to have special flood hazard areas (SFHA). Beaver Meadows Borough does not have any SFHA.

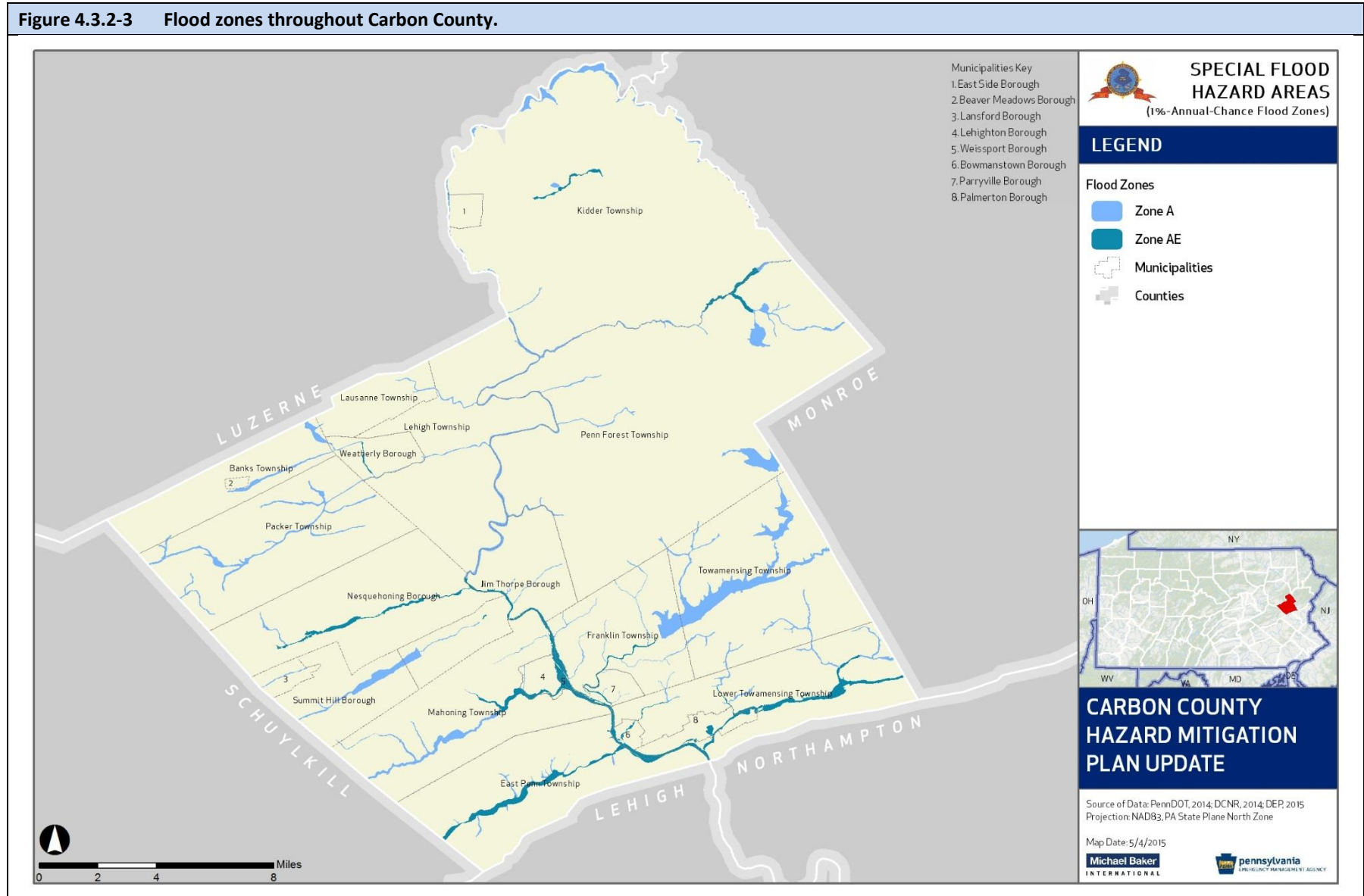
Figure 4.3.2-2 FIRM Panel 42025C0144, effective June 3, 2002, showing flood hazard areas along the Lehigh River and Nesquehoning Creek in Jim Thorpe Borough.



Flood sources identified in this mapping project include: Aquashicola Creek, Black Creek, Buckwha Creek, Dilldown Creek, Fireline Creek, Hazle Creek, Lehigh River, Lizard Creek, Mahoning Creek, Mauch Chunk Creek, Mill Creek, Mud Run, Nesquehoning Creek, Park Run, Pohopoco Creek, and Stewart Creek. Figure 4.3.2-3 shows the flood zones in Carbon County. The location of approximate and detailed (including Base

Flood Elevations) Special Flood Hazard Areas (1% annual chance zones) are shown. FEMA defines Flood Zone A as the areas of approximate 1% annual chance zones, since Base Flood Elevation data is not known for the area, and Zone AE shows areas in the 1% annual chance zones determined by Base Flood Elevation details.

Figure 4.3.2-3 Flood zones throughout Carbon County.



4.3.2.2. *Range of Magnitude*

Floods are the most prevalent type of natural disaster occurring in the Commonwealth of Pennsylvania. Pennsylvania is one of the most flood-prone states in the nation. From rural areas to suburban communities, floods (especially flash floods) are a constant concern. Floods, seasonal or flash, have been the cause of millions of dollars in annual property damages, loss of lives, and disruption of economic activities. The Commonwealth of Pennsylvania leads the nation on flood related losses. Over 94% of Pennsylvania's municipalities have been designated as flood-prone.

Floodplain management, flood control structures, and flood relief funds are strategies that have reduced the Commonwealth's annual flood damages significantly, but these structures cannot completely protect all existing and future flood plain development.

The impacts due to flooding, in terms of injuries, damages, and death, can vary in degrees from minor to catastrophic:

- **Minor** – Very few injuries, if any. Only minor property damage & minimal disruption on quality of life. Temporary shutdown of critical facilities.
- **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.
- **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.
- **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.

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

Several factors determine the severity of floods, including rainfall intensity and duration, topography, ground cover and rate of snowmelt. Water runoff is greater in areas with steep slopes and little to no vegetative ground cover. Since the County has mountainous terrain as a part of the Pocono Mountain region, this can contribute to more severe floods as runoff reaches receiving water bodies more rapidly over steep terrain. Also, erosion can occur following conversion of natural vegetation to agricultural land. Soil carried away in rain and irrigation water can lead to sedimentation and decreased stream capacity which can increase flooding. Urbanization typically results in the replacement of vegetative ground cover with asphalt and concrete, increasing the volume of surface runoff and stormwater, particularly in areas with poorly planned stormwater drainage systems.

In Carbon County there are seasonal differences in how floods are caused. In the winter and early spring (February to April), major flooding has occurred as a result of heavy rainfall on dense snowpack throughout contributing watersheds. Winter floods also have resulted from runoff of intense rainfall on frozen ground, and, on rare occasions, local flooding has been exacerbated by ice jams in rivers. Ice jam

floods occur on rivers that are totally or partially frozen. A rise in stream stage will break up a totally frozen river and create ice flows that can pile up on channel obstructions such as shallow riffles, log jams, or bridge piers. The jammed ice creates a dam across the channel over which the water and ice mixture continues to flow, allowing for more jamming to occur. Flood events caused by ice jams are limited primarily to the Lehigh River. Although specific data on ice jam incidents in the County is not available from the CCEMA or the National Climatic Data Center (NCDC), anecdotal evidence from county and municipal officials suggests that ice jams have occurred in the past on the river. The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) serves as a science and engineering research branch of the U.S. Army Corp of Engineers (USACE) to solve problems related to complex environments. The CRREL notes two ice jams that were recorded in Carbon County, included in Figure 4.3.2-4. Details pertaining to these events such as date and impact are not available.

Summer floods have occurred from intense rainfall on previously saturated soils. Summer thunderstorms deposit large quantities of rainfall over a short period of time that can result in flash flood events. Figure 4.3.2-5 includes the historical reports of flash floods in Carbon County. In addition, the County occasionally experiences intense rainfall from tropical storms in late summer and early fall.

A summer flood caused a worst case scenario flash flood on June 20, 2006 when several days of heavy rain throughout the Lehigh River Basin culminated with flooding along the main stem of the Lehigh River, causing Carbon County to be declared a disaster area. About 130 homes, 15 businesses and 80 bridges, culverts, and roads in the County were damaged from the flood. Storm event totals for the County averaged eight to fifteen inches of rainfall.

Although floods can cause damage to property and loss of life, floods are naturally occurring events that benefit riparian systems which have not been disrupted by human actions. Such benefits include groundwater recharge and the introduction of nutrient rich sediment improving soil fertility. However, the destruction of riparian buffers, changes to land use and land cover throughout a watershed, and the introduction of chemical or biological contaminants which often accompany human presence cause environmental harm when floods occur. Hazardous material facilities are potential sources of contamination during flood events. Other negative environmental impacts of flooding include: water-borne diseases, heavy siltation, damage or loss of crops, and drowning of both humans and animals.

Figure 4.3.2-4 Ice Jam Reports in Carbon County.

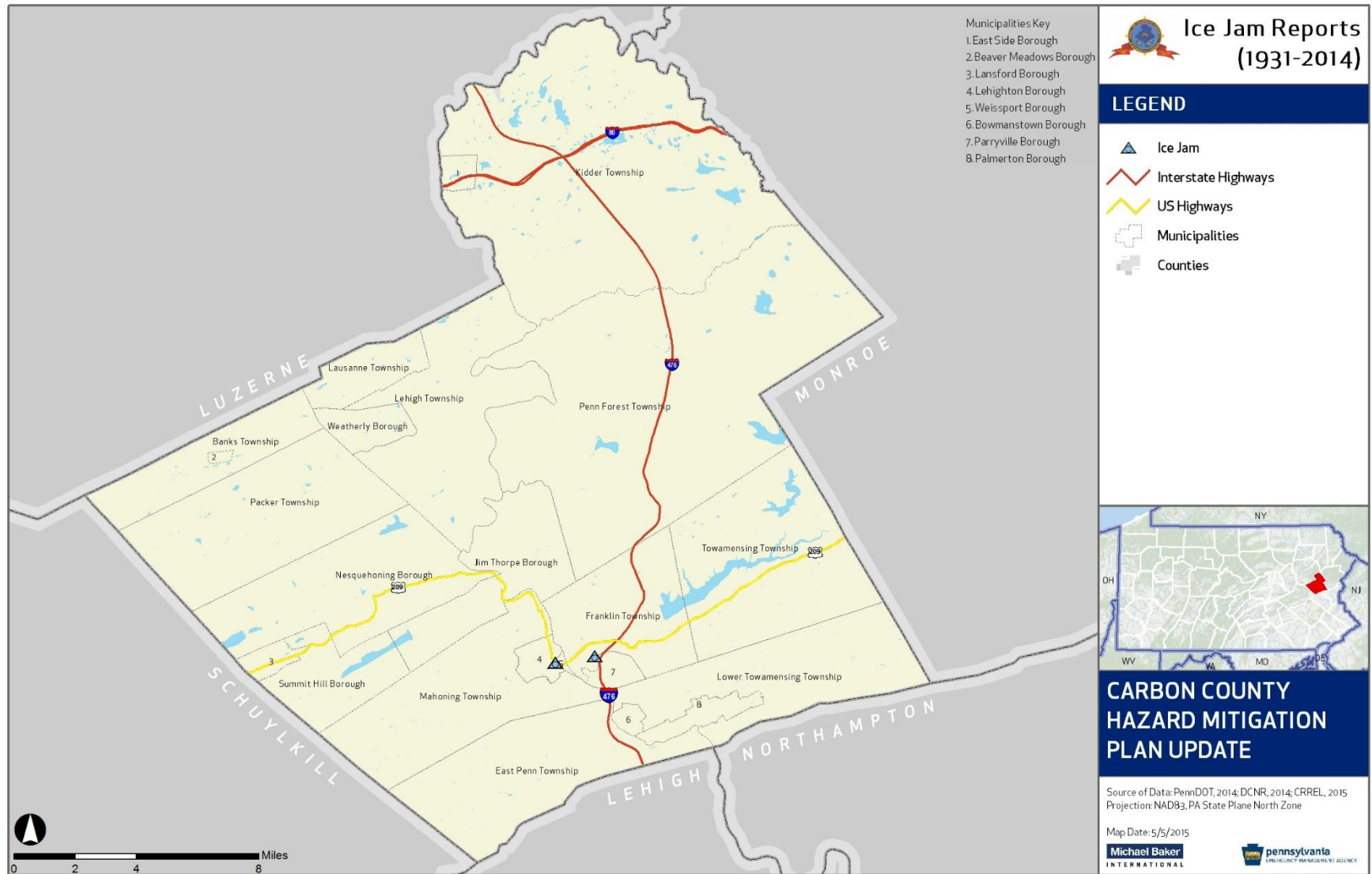
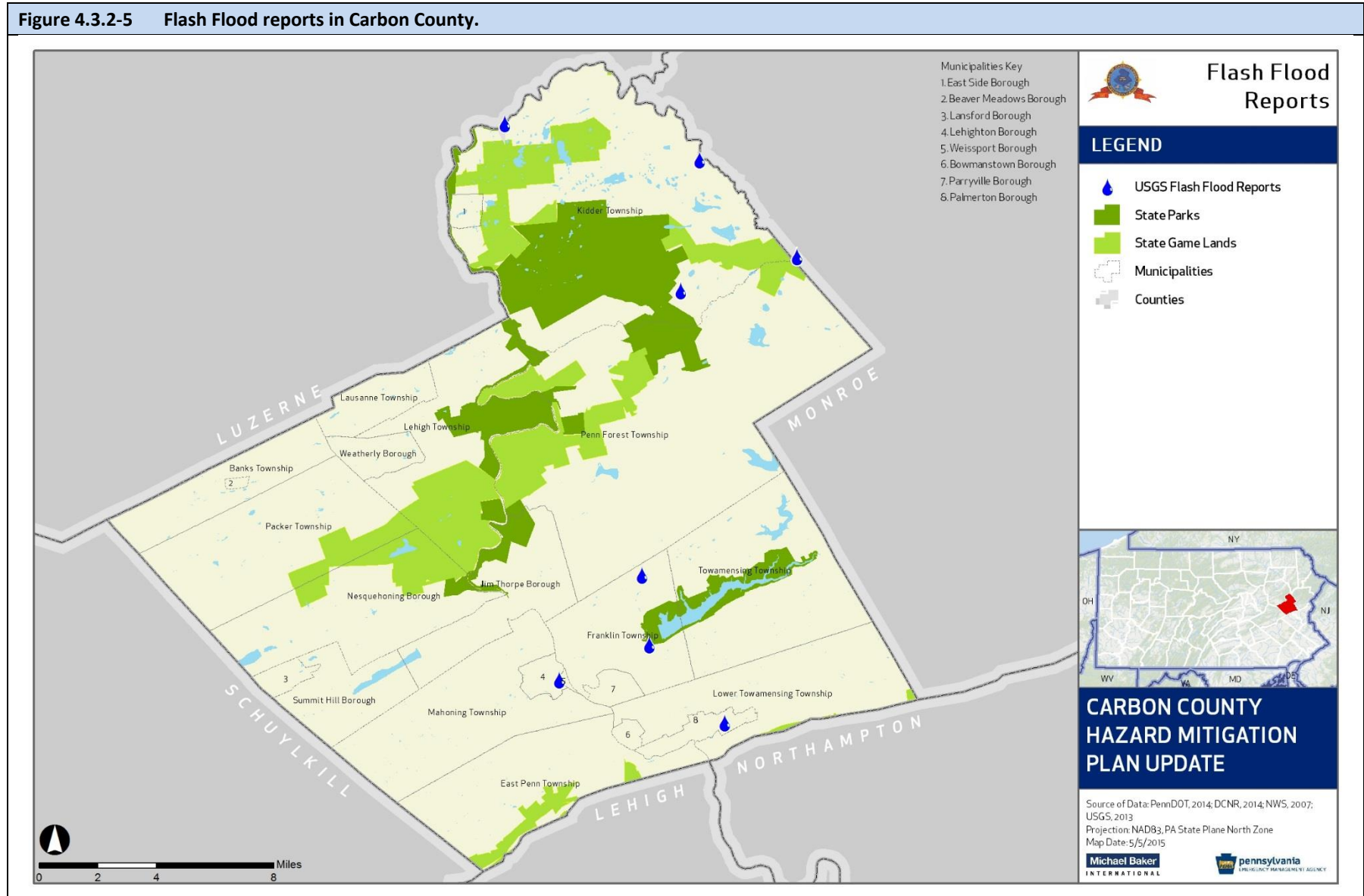


Figure 4.3.2-5 Flash Flood reports in Carbon County.



4.3.2.3. Past Occurrence

Carbon County has a long history of flooding events. Flash flooding is the most common type of flooding that occurs in the County. Eleven of the seventeen Presidential Disaster and Emergency Declarations affecting Carbon County have been in response to hazard events related to flooding (see Table 4.2-1). Table 4.3.2-1 lists flood event information from 1993 to 2015 obtained from the NCDC. The NCDC estimates that during this timeframe, the County experienced over \$5.1 million of property damage from flooding events. Other years with major flooding events prior to 1993 include 1933, 1935, 1936, 1942, 1946, 1955, 1967, 1971, and 1977 (CCEMA, 2009).

Table 4.3.2-1 Flood and flash flood events impacting Carbon County from 1993-2015 (NCDC, 2015). "Countywide" indicates several locations in the County were affected.	
DATE	LOCATION & DESCRIPTION
11/28/1993	Multiple Counties. Flood/Flash Flood.
6/26/1995	Franklin Township. Flood/Flash Flood – Heavy rain from thunderstorms forced the Long Run Creek out of its banks in Franklin Township. The stream flooded the yard of one home and washed out a section of Spruce Road onto Long Run Road.
1/19/1996	Multiple Counties. Flood/Flash Flood – All of Pennsylvania was declared a disaster area. Seventeen of 23 townships reported flood damage. In all 365 homes suffered major flood damage and 1,185 suffered minor flood damage. In addition 6 apartment buildings, 13 businesses, 34 roads, 51 sewer lines, 13 electrical systems and 3 parks were damaged by the flooding.
1/27/1996	Multiple Counties. Flood.
4/16/1996	Countywide. Flash Flood.
10/19/1996	Countywide. Flood - Heavy rain caused considerable highway and poor drainage flooding as well as flooding of some of the smaller creeks in Carbon County.
11/8/1996	Countywide. Flash Flood.
12/2/1996	Countywide. Flash Flood.
9/11/1997	Mahoning Township. Flood – Thunderstorms with heavy rain caused flooding along the tributaries of the Mahoning Creek within Mahoning Township.
6/21/1998	Southern Carbon County. Flash Flood - Nearly stationary thunderstorms with torrential downpours caused flash flooding in the southern part of Carbon County.
9/16/1999	Multiple Counties. Flash Flood – Hurricane Floyd caused widespread flash flooding throughout many Counties in the Commonwealth.
7/30/2000	Southeastern Carbon County. Flash Flood.
12/17/2000	Countywide. Flood - Widespread heavy rains of between 2.5 and 4.0 inches fell across the entire southern Poconos with Carbon County bearing the brunt of the flooding.
8/3/2001	Southwestern Carbon County. Flash Flood - Thunderstorms with torrential downpours caused flash flooding that damaged a bridge in East Penn Township.
6/19/2002	Northwestern Carbon County. Flash Flood.
6/26/2002	Northeastern Carbon County. Flood.
7/23/2002	Northeastern Carbon County. Flash Flood.
6/12/2003	Central and Eastern Carbon County. Flash Flood - A thunderstorm with torrential downpours caused flash flooding across east central Carbon County. Doppler Radar storm total estimates were between 3 and 4 inches, most of which fell within one hour.
6/20/2003	Countywide. Flood - Heavy rain led to poor drainage flooding and flooding of streams in the county.
6/22/2003	Countywide. Flood.

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Table 4.3.2-1 Flood and flash flood events impacting Carbon County from 1993-2015 (NCDC, 2015). "Countywide" indicates several locations in the County were affected.	
DATE	LOCATION & DESCRIPTION
8/5/2003	Southern Carbon County. Flash Flood - Thunderstorms with torrential downpours caused flash flooding of streams in extreme southern Carbon County and extreme northern Lehigh County.
8/6/2003	Northern Carbon County. Flash Flood - Nearly stationary thunderstorms dropped a Doppler Radar storm total estimate of between 3 and 5 inches in western parts of Kidder Township and caused flooding along smaller streams including the Fawn Run.
9/23/2003	Multiple Counties. Flood - The heavy runoff led to flooding along the Aquashicola Creek and down county along the Lehigh River.
9/18/2004-09/19/2004	Countywide. Flash Flood – Remnants from Hurricane Ivan Storm caused heavy rain. Storm totals average around 5 inches and caused poor drainage, creek and river flooding throughout Carbon County. A 44-year-old man drowned. President George W. Bush declared the county a disaster area. Eighty-nine homes and four businesses were damaged. Seven public buildings and structures were damaged.
3/29/2005	Countywide. Flood.
4/2/2005	Countywide. Flood - The Mahoning Creek flooded in Lehigh and Mahoning Township. Pennsylvania State Route 443 was closed across Mahoning Township. Flooding along Lizard Creek in East Penn Township forced the closure of Pennsylvania State Route 895. Property damage was limited to basement flooding.
10/8/2005	Countywide. Flood.
5/30/2006	Northern Carbon County. Flash Flood.
6/1/2006	Nesquehoning. Flash Flood - Thunderstorms with torrential rains caused creek flooding in western Carbon County. Creeks overflowed across a few roadways in Lansford. Water accumulated up to three feet on some roadways in Lansford.
6/27/2006	Multiple Counties. Flash Flood - Several days of heavy rain throughout the Lehigh River Basin culminated with flooding along the main stem of the Lehigh River. President George W. Bush declared Carbon County a disaster area. Event totals in Carbon County averaged eight to twelve inches. In Carbon County about 130 homes, 15 businesses and 80 bridges, culverts and roads were damaged.
11/16/2006	Franklin and Penn Forest Townships, Beaver Meadows Borough. Flash Flood - Runoff from heavy rain led to flooding of streams in the central part of Carbon County in Franklin and Penn Forest Townships and also in Beaver Meadows Borough in the northwest part of the county.
3/2/2007	Multiple Counties. Flood.
4/15/2007	Eastern Carbon County. Flood.
8/25/2007	Lehigh. Flash Flood.
6/14/2008	Albrightsville. Flash Flood.
12/12/2008	Lehigh. Flood.
6/13/2009	Summit Hill. Flash Flood.
7/29/2009	Christmans. Flash Flood.
8/12/2009	Hickory Run. Flash Flood.
10/01/2010	Bowmanstown. Flood - A series of low pressure systems that moved north along a slowly moving cold front brought heavy rain into Eastern Pennsylvania.
3/10/2011	Lehigh. Flood - Flooding along the Mahoning Creek covered walking paths in the Bear Creek Memorial Park. The Lehigh River at Lehigh had moderate flooding and was above its 10 foot flood stage.
4/28/2011	Weissport. Flash Flood - Thunderstorms with heavy rain caused flash flooding in Lehigh. Water rescues occurred along Pennsylvania State Route 248. No serious injuries were reported.

Table 4.3.2-1 Flood and flash flood events impacting Carbon County from 1993-2015 (NCDC, 2015). "Countywide" indicates several locations in the County were affected.	
DATE	LOCATION & DESCRIPTION
8/07/2011	Germans. Flash Flood - Thunderstorms with heavy rain caused flash flooding along the Lizard Creek in East Penn Township. Pennsylvania State Route 895 was flooded by the creek and closed.
8/28/2011	Albrightsville. Flood - Tropical Storm Irene produced heavy flooding rain, tropical storm force wind gusts with hundreds of thousands of outages, moderate tidal flooding along the Delaware River.
8/28/2011	Beaver Meadows. Flash Flood – Tropical Storm Irene.
9/07/2011	Palmerton. Flood - The remnants of Tropical Storm Lee that interacted with a stalled frontal boundary produced several days with periods of heavy rain across Eastern Pennsylvania. Event precipitation totals averaged 4 to 9 inches.
5/26/2012	Black Creek JCT. Flash Flood -Thunderstorms with torrential downpours caused flash flooding of smaller streams as well as poor drainage flooding in Nesquehoning Borough. The Wash Shanty Hill portion of U.S. Route 209 was closed because of significant water and debris runoff.
5/26/2012	Hauto. Flash Flood - Thunderstorms with torrential downpours caused flash flooding of smaller streams as well as extensive poor drainage flooding in Lansford and Summit Hill Boroughs and the northwest part of Mahoning Township. Roadways were closed and many basements were flooded
5/29/2012	Palmerton. Flash Flood - Thunderstorms with heavy rain caused poor drainage as well as creek flash flooding along the southern tier of Carbon County from Palmerton Borough through Lower Towamensing Township. The heavy rain caused a rock slide onto Maunch Chunk Road in Palmerton.
9/18/2012	Hauto. Flash Flood - Thunderstorms with heavy rain caused flash flooding and road closures across several locations in Carbon County.
6/28/2013	Normal. Flash Flood - Thunderstorms with very heavy rain caused poor drainage and small stream flash flooding in Carbon County from Lansford and Summit Hill Township east through Jim Thorpe.
7/02/2013	Trachsville. Flood - Event precipitation totals averaged 1 to 3 inches across southeast Carbon County

Table 4.3.2-2 provides further past occurrences of flood events from 1841-1987 from the County's HVA.

Table 4.3.2-2 Carbon County records of flood and flash flood events impacting the county from 1841-1987 (CEEMA, 2009).	
DATE	LOCATION AND/OR DESCRIPTION
June 9, 1841	Minor Flooding
August 1861	Minor Flooding
October 1869	Minor Flooding
August 1901	Minor Flooding
February 1901	Minor Flooding
February 1902	Minor Flooding
January 1925	Minor Flooding
August 23, 1933	Extensive damage and flooding occurred in Jim Thorpe which resulted in one fatality.
August 1955	A hurricane caused flooding and extensive damage in Weissport Borough. Several other areas incurred damages as a result of this flooding but not as extensive as Weissport Borough. A dike was constructed along the Lehigh River in Weissport as a result of this flood and an Emergency Declaration was issued.
September 22-23, 1955	Minor flooding occurred
August 1, 1969	A major flood occurred, causing extensive damage in Jim Thorpe. Other areas of the country were impacted including Nesquehoning's Green Acres Industrial Park.

Table 4.3.2-2 Carbon County records of flood and flash flood events impacting the county from 1841-1987 (CEMA, 2009).	
DATE	LOCATION AND/OR DESCRIPTION
June 1972	Extensive damage and flooding occurred throughout the County and an Emergency Declaration was filed and issued.
September 1985	Hurricane Gloria caused major flooding in several areas of the County and major flooding occurred in Palmerton. A Disaster Assistance Center was opened in Palmerton.
September 1987	Major flooding occurred throughout the County and the County EOC was activated. Damage assessment was conducted in the Palmerton area to determine impact.

In addition to the aforementioned past flood events, the 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. A property is considered a *severe repetitive loss property* either when there are at least four losses each exceeding \$5,000 or when there are two or more losses where the building payments exceed the property value. As of May 4, 2015, there were three repetitive loss properties in Carbon County, one of which was insured and all of which are identified as *single family* (FEMA CIS). These repetitive loss properties are located in East Penn Township, Lower Towamensing Township, and Palmerton Borough. Table 4.3.2-3 shows the number of repetitive loss properties by municipality. There are no severe repetitive loss properties in Carbon County.

Table 4.3.2-3 Summary of the number and type of Repetitive Loss properties by municipality (Data from FEMA RL & SRL Inventory, 2015)			
MUNICIPALITY	TYPE		SUM OF REPETITIVE LOSS PROPERTIES
	NON-RESIDENTIAL	SINGLE FAMILY	
Banks Township	0	0	0
Beaver Meadows Borough	0	0	0
Bowmanstown Borough	0	0	0
East Penn Township	0	1	1
East Side Borough	0	0	0
Franklin Township	0	0	0
Jim Thorpe Borough	0	0	0
Kidder Township	0	0	0
Lansford Borough	0	0	0
Lausanne Township	0	0	0
Lehigh Township	0	0	0
Lehighon Borough	0	0	0
Lower Towamensing Township	0	1	1
Mahoning Township	0	0	0
Nesquehoning Borough	0	0	0
Packer Township	0	0	0
Palmerton Borough	0	1	1

Table 4.3.2-3 Summary of the number and type of Repetitive Loss properties by municipality (Data from FEMA RL & SRL Inventory, 2015)			
MUNICIPALITY	TYPE		SUM OF REPETITIVE LOSS PROPERTIES
	NON-RESIDENTIAL	SINGLE FAMILY	
Parryville Borough	0	0	0
Penn Forest Township	0	0	0
Summit Hill Borough	0	0	0
Towamensing Township	0	0	0
Weatherly Borough	0	0	0
Weissport Borough	0	0	0
TOTAL	0	3	3

Floods are the most common and costly natural catastrophe in the United States. In terms of economic disruption, property damage, and loss of life, floods are “nature’s number-one disaster.” (FEMA 2005). For that reason, flood insurance is almost never available under industry-standard homeowner’s and renter’s policies. The best way for citizens to protect their property against flood losses is to purchase flood insurance through the NFIP.

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

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

Today, nearly 78 WYO insurance companies issue and service the NFIP under their own names (FEMA, 2015a). More than 5.2 million federal flood insurance policies are in force. These policies represent over 1.2 trillion in flood insurance coverage for homeowners, renters, and business owners throughout the United States and its territories. As of March 2015, Pennsylvania had a total of 68,936 policies in force across the state (FEMA, 2015b).

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

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

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

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

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

The minimum floodplain management requirements include:

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

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

Table 4.3.2-4 lists the Carbon County municipalities participating in the NFIP. Note that all municipalities in the County participate in the program.

Table 4.3.2-4 Carbon County Municipal Participation in the National Flood Insurance Program.				
COMMUNITY	PARTICIPATION STATUS	CID	INITIAL FIRM IDENTIFIED	CURRENT EFFECTIVE MAP DATE
Banks Township	Participating	421452	10/01/1986	06/03/2002
Beaver Meadows Borough	Participating	420247	06/03/2002	06/03/2002
Bowmanstown Borough	Participating	420248	09/03/1982	06/03/2002
East Penn Township	Participating	421013	06/15/1977	06/03/2002
East Side Borough	Participating	422360	09/01/1986	06/03/2002
Franklin Township	Participating	421014	08/01/1977	06/03/2002

Table 4.3.2-4 Carbon County Municipal Participation in the National Flood Insurance Program.				
COMMUNITY	PARTICIPATION STATUS	CID	INITIAL FIRM IDENTIFIED	CURRENT EFFECTIVE MAP DATE
Jim Thorpe Borough	Participating	420249	08/15/1977	06/03/2002
Kidder Township	Participating	421453	02/02/1989	06/03/2002
Lansford Borough	Participating	420250	02/21/1982	06/03/2002
Lausanne Township	Participating	421454	03/18/1983	06/03/2002
*Lehigh Township	Participating	421224	01/14/1983	06/03/2002
Lehighton Borough	Participating	420251	09/15/1977	06/03/2002
Lower Towamensing Township	Participating	421455	11/15/1989	06/03/2002
Mahoning Township	Participating	421041	09/29/1978	06/03/2002
Nesquehoning Borough	Participating	420252	07/03/1990	06/03/2002
Packer Township	Participating	421456	09/01/1986	06/03/2002
Palmerton Borough	Participating	420253	09/15/1978	06/03/2002
Parryville Borough	Participating	420254	03/01/1978	06/03/2002
Penn Forest Township	Participating	421457	02/02/1989	06/03/2002
Summit Hill Borough	Participating	421451	12/14/1979	06/03/2002
Towamensing Township	Participating	421458	11/01/1986	06/03/2002
Weatherly Borough	Participating	420255	12/05/1989	06/03/2002
Weissport Borough	Participating	420256	02/02/1990	06/03/2002
*Erroneously listed as Thornhurst Township in FEMA's CIS.				

4.3.2.4. Future Occurrence

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

The NFIP recognizes the 1% annual chance flood, also known as the base flood, as the standard for identifying properties subject to federal flood insurance purchase requirements. A 1% annual chance flood is a flood which has a 1 percent chance of occurring over a given year. The DFIRM published on June 3, 2002 can be used to identify areas subject to the 1- and 0.2 percent-annual-chance flooding. Areas subject to 2% and 10% annual chance events are not shown on maps; however, water surface elevations associated with these events are included in the flood source profiles contained in the Flood Insurance Study Report.

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

Table 4.3.2-5 Recurrence intervals and associated probabilities of occurrence.	
RECURRENCE INTERVAL	CHANCE OF OCCURRENCE IN ANY GIVEN YEAR (%)
10 year	10
50 year	2
100 year	1
500 year	0.2

4.3.2.5. Vulnerability Assessment

Carbon County is vulnerable to flooding that causes loss of lives, property damage, and road closures. For purposes of assessing vulnerability, the County focused on community assets that are located in the 1% annual chance floodplain. While greater and smaller floods are possible, information about the extent and depths for this floodplain is available for all municipalities countywide, thus providing a consistent basis for analysis. Flood vulnerability maps for each applicable local municipality, showing the 1% annual chance flood hazard area and addressable structures, critical facilities and transportation routes within it, are included in **Appendix D**. These maps were created using FEMA DFRIM data from the current effective FIRMs.

Table 4.3.2-6 lists the total structures, critical facilities, and population in Carbon County and those in the SFHAs. About three percent of the structures in Carbon County are in the SFHA; three municipalities have over nine percent of their structures and ten percent of their population in the SFHA: Palmerton Borough, Bowmanstown Borough, and Weissport Borough. Weissport Borough has the highest percentage, with almost 100 percent of structures – and 100 percent of critical facilities and population – in the SFHA. Three municipalities have zero structures in the SFHA: Beaver Meadows Borough, East Side Borough, and Lausanne Township. These municipalities do not have population in the SFHA, in addition to three others who have less than four structures in the SFHA – Summit Hill Borough, Lansford Borough, and Banks Township – and of these six municipalities, only Banks Township has a critical facility in the SFHA. Next to Weissport Borough, four municipalities have over 10 percent of their critical facilities in the SFHA: Banks Township, Lower Towamensing Township, Palmerton Borough, and Weatherly Borough. For more information on the flood vulnerability of each individual critical facility, please see **Appendix E**.

Table 4.3.2-6 Number of structures and critical facilities in the Special Flood Hazard Area (1% annual chance flood zone).

MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES IN SFHA	PERCENT (%) STRUCTURES IN SFHA	TOTAL CRITICAL FACILITIES	CRITICAL FACILITIES IN SFHA	PERCENT CRITICAL FACILITIES IN SFHA	TOTAL POPULATION	POPULATION IN SFHA	PERCENT (%) POPULATION IN SFHA
Banks Township	764	2	0.26	6	1	16.67	1,262	0	0.00
Beaver Meadows Borough	412	0	0.00	2	0	0.00	869	0	0.00
Bowmanstown Borough	555	54	9.73	2	0	0.00	937	101	10.78
East Penn Township	2,095	130	6.21	7	0	0.00	2,881	169	5.87
East Side Borough	195	0	0.00	1	0	0.00	317	0	0.00
Franklin Township	3,163	79	2.50	10	0	0.00	4,275	159	3.72
Jim Thorpe Borough	2,388	45	1.88	17	0	0.00	4,781	10	0.21
Kidder Township	3,040	25	0.82	18	0	0.00	1,935	3	0.16
Lansford Borough	1,603	4	0.25	5	0	0.00	3,941	0	0.00
Lausanne Township	218	0	0.00	2	0	0.00	237	0	0.00
Lehigh Township	396	6	1.52	7	0	0.00	479	0	0.00
Lehighton Borough	2,397	26	1.08	11	0	0.00	5,500	24	0.44
Lower Towamensing Township	2,116	133	6.29	6	1	16.67	3,163	88	2.78
Mahoning Township	2,632	67	2.55	11	0	0.00	4,305	53	1.23
Nesquehoning Borough	1,409	25	1.77	14	1	7.14	3,418	28	0.82
Packer Township	740	22	2.97	4	0	0.00	998	12	1.20
Palmerton Borough	2,734	263	9.62	11	3	27.27	5,479	737	13.45
Parryville Borough	347	17	4.90	3	0	0.00	512	15	2.93
Penn Forest Township	7,751	34	0.44	12	0	0.00	9,581	34	0.35
Summit Hill Borough	1,580	2	0.13	8	0	0.00	2,965	0	0.00
Towamensing Township	2,697	53	1.97	9	0	0.00	4,477	12	0.27
Weatherly Borough	1,234	18	1.46	6	2	33.33	2,525	4	0.16

Table 4.3.2-6 Number of structures and critical facilities in the Special Flood Hazard Area (1% annual chance flood zone).									
MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES IN SFHA	PERCENT (%) STRUCTURES IN SFHA	TOTAL CRITICAL FACILITIES	CRITICAL FACILITIES IN SFHA	PERCENT CRITICAL FACILITIES IN SFHA	TOTAL POPULATION	POPULATION IN SFHA	PERCENT (%) POPULATION IN SFHA
Weissport Borough	203	202	99.51	3	3	100.00	412	412	100.00
TOTAL	40,669	1,207	2.97	175	11	6.25	65,249	1861	2.85

It is important to note that according to the CCEMA, flood control projects in Weissport along the Lehigh River and in the Mauch Chunk Creek Watershed have served to greatly reduce damages and the threat to life and property loss (CCEMA, 2009). For example, when possible, both the Francis E. Walter and Beltzville dams will be operated to provide flood damage reduction benefits during ice jam events (USACE, 2015a).

Additional information on flood vulnerability and losses in Carbon County, including the 1 percent annual chance flood event results from HAZUS, is provided in Section 4.4.3, Potential Loss Estimates.

4.3.3. Hailstorm

4.3.3.1. Location and Extent

Hailstorms are not limited to any particular geographic area of Carbon County, outside of three notable storm trajectories illustrated in Figure 4.3.3-1, and neither the duration of the storm nor the extent of area affected by such an occurrence can be predicted. Hail precipitation is often produced at the front of a severe thunderstorm system or in conjunction with a tornado event. 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. Hailstones are formed most commonly in thunderstorms with intense updraft, high liquid water content, large vertical extent, large water droplets, and cloud layers below freezing.

4.3.3.2. Range of Magnitude

Hail is described qualitatively and quantitatively by its size and can range from 0.2 inches to 4.5 inches; the size of hail is dependent on the strength of the updraft, as shown in Table 4.3.3-1. Carbon County has experienced hail ranging in size from 0.75 to 3.00 inches in diameter.

Table 4.3.3-1 Hailstone size and relationship to updraft speed (NOAA, 2011).		
HAILSTONE SIZE	MEASUREMENT (INCHES)	UPDRAFT SPEED (MPH)
BB	< 0.25	< 24
Pea	0.25	24
Marble	0.50	35
Dime	0.70	38
Penny	0.75	40
Nickel	0.88	46
Quarter	1.00	49
Half Dollar	1.25	54
Walnut	1.50	60
Golf Ball	1.75	64
Hen Egg	2.00	69
Tennis Ball	2.50	77
Baseball	2.75	81
Tea Cup	3.00	84
Grapefruit	4.00	98
Softball	4.50	103

Hailstorms can cause significant damage to crops, livestock, and property. Damage is dependent on the size, duration, and intensity of hail precipitation. Those who do not seek shelter could face serious injury. Automobiles and aircraft are particularly susceptible to damage. Since hail precipitation usually occurs during thunderstorm events, the impacts of other hazards associated with thunderstorms (i.e. strong winds, intense precipitation, etc.) often occur simultaneously. Damage to trees, shrubbery, and other vegetation may occur during hailstorm events through defoliation. Unless there are compounding stresses, natural vegetation can typically recover over time following the event. However, crops such as corn and soybeans can be damaged to the point of total loss, particularly if an event occurs later in the growing season.

Storms carrying hail of over 2 inches occurring over a prolonged period in Carbon County can cause massive damage. Because hail can cause significant damage to crops and structures, a storm of this magnitude would potentially cause property damage, injures, and potentially destroy agricultural yields and result in significant lost revenue. A worst case scenario occurred in August 2007, when a hailstorm that affected multiple counties caused \$1 million of damage moving from Weatherly Borough into Palmerton Borough with tennis ball and baseball sized hail.

4.3.3.3. *Past Occurrence*

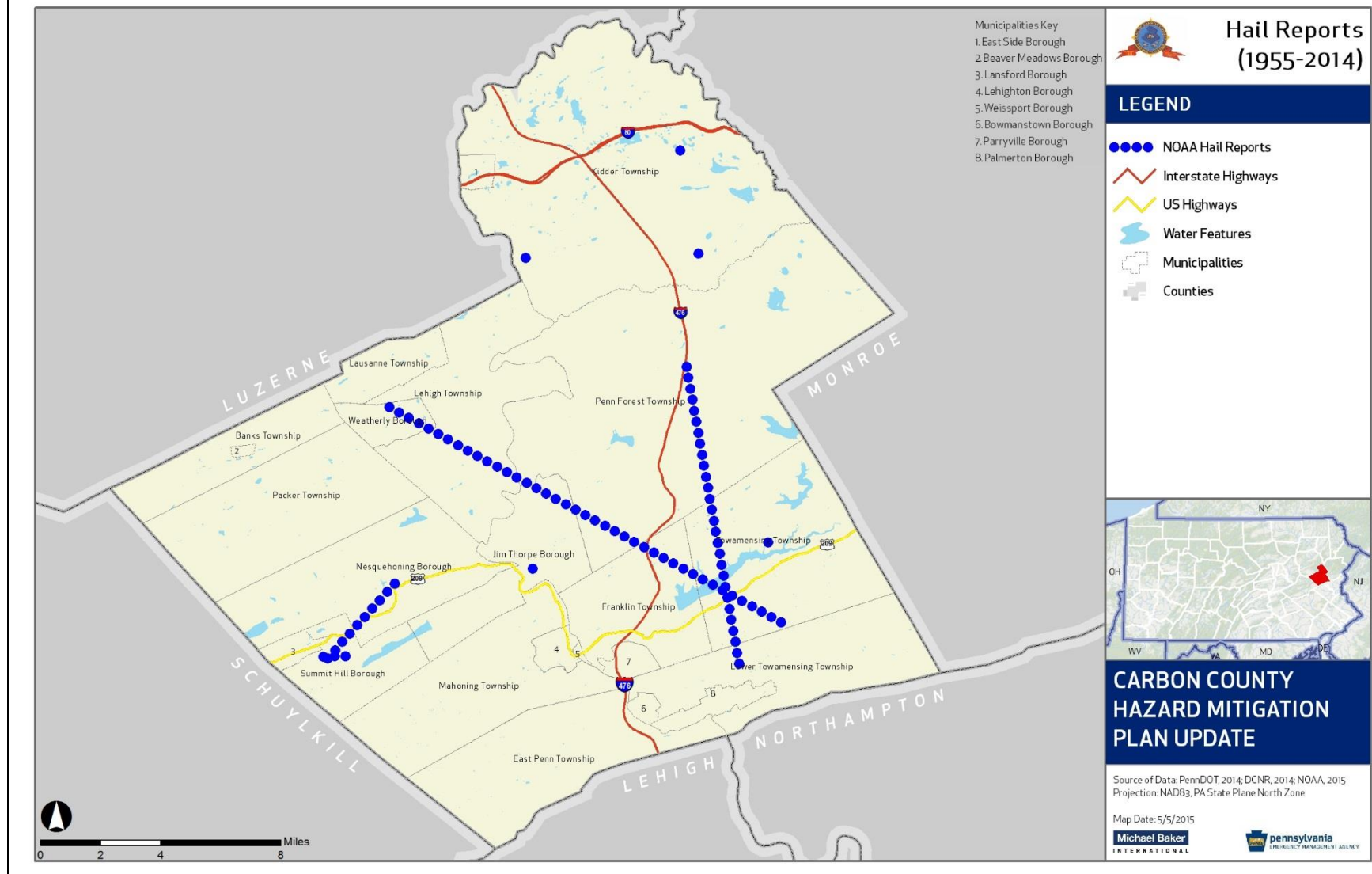
The NCDC reports 38 hail events in Carbon County from 1966-2014 causing over \$1 million in property damage. As is typical, most of these events occurred from April to August, and most events occurred in the afternoon/early evening.

LOCATION	DATE	SIZE (IN)	INJURIES/ FATALITIES	PROPERTY LOSSES	CROP LOSSES
Countywide	7/28/1966	1.00	0	\$0.00	\$0.00
Countywide	8/31/1973	0.75	0	\$0.00	\$0.00
Countywide	7/3/1975	0.75	0	\$0.00	\$0.00
Countywide	6/30/1976	1.75	0	\$0.00	\$0.00
Countywide	6/30/1976	1.75	0	\$0.00	\$0.00
Countywide	5/31/1985	1.75	0	\$0.00	\$0.00
Countywide	6/16/1985	1.00	0	\$0.00	\$0.00
Countywide	6/24/1985	2.00	0	\$0.00	\$0.00
Countywide	6/24/1985	1.75	0	\$0.00	\$0.00
Countywide	7/26/1987	1.50	0	\$0.00	\$0.00
Countywide	7/9/1990	0.75	0	\$0.00	\$0.00
Lansford	6/12/1994	0.75	0	\$0.00	\$0.00
Christmans	6/21/1995	0.75	0	\$0.00	\$0.00
Lehighton	6/4/1996	0.75	0	\$0.00	\$0.00

Table 4.3.3-2 Carbon County Hail Events (NCDC, 2015).					
LOCATION	DATE	SIZE (IN)	INJURIES/ FATALITIES	PROPERTY LOSSES	CROP LOSSES
Jim Thorpe	5/6/1997	0.75	0	\$0.00	\$0.00
Weatherly	9/7/1998	0.75	0	\$0.00	\$0.00
Jim Thorpe	5/10/2000	0.75	0	\$0.00	\$0.00
Lake Harmony	5/27/2001	1.50	0	\$0.00	\$0.00
Albrightsville	7/11/2001	0.75	0	\$0.00	\$0.00
Beaver Meadows	5/30/2006	1.00	0	\$0.00	\$0.00
Nesquehoning	7/9/2006	1.50	0	\$0.00	\$0.00
Weatherly	8/17/2007	2.50	0	\$750,000	\$0.00
Palmerton	8/17/2007	2.75	0	\$250,000	\$0.00
Lehighton	8/25/2007	0.75	0	\$0.00	\$0.00
Meckesville	7/27/2008	0.75	0	\$0.00	\$0.00
Stemlersville	8/10/2008	0.88	0	\$0.00	\$0.00
Lake Harmony	8/10/2008	0.75	0	\$0.00	\$0.00
Lansford	3/29/2009	1.50	0	\$0.00	\$0.00
Jim Thorpe	3/29/2009	0.88	0	\$0.00	\$0.00
Stemlersville	6/15/2009	0.88	0	\$0.00	\$0.00
Jim Thorpe	7/29/2009	1.00	0	\$0.00	\$0.00
Lansford	5/26/2011	3.00	0	\$50,000	\$0.00
Lansford	7/7/2011	0.75	0	\$0.00	\$0.00
Lehighton	7/28/2012	0.75	0	\$0.00	\$0.00
Christmans	5/22/2014	1.00	0	\$0.00	\$0.00
Stemlersville	5/22/2014	0.75	0	\$0.00	\$0.00
Lehighton	7/3/2014	1.25	0	\$0.00	\$0.00
Harry	7/3/2014	1.00	0	\$0.00	\$0.00

Figure 4.3.3-1 maps the recorded hailstorm events in Carbon County between 1955 and 2014. Hail events appear to be distributed primarily along three specific trajectories through the county.

Figure 4.3.3-1 Reported hailstorm events between 1955 and 2014 (NOAA, 2015a).



4.3.3.4. *Future Occurrence*

It is not possible to predict the formation of a hailstorm with more than a few days' lead time. The past occurrences in the County described above, however, indicate that this event is one that can happen several times in any given year, most likely during the late spring and summer months. Based on prior occurrences, the County can expect one to two recordable hailstorms each year. Therefore, the future occurrence of hailstorms in Carbon County can be considered *possible* as defined by the Risk Factor methodology probability criteria (see Table 4.4-1).

4.3.3.5. *Vulnerability Assessment*

All of Carbon County, including all critical infrastructure, is vulnerable to the effects of hail, as the storm cells that produce this hazard are spread over a large (multi-county) area. The area of damage due to these storms is relatively small, in that a single storm does not cause widespread devastation, but may cause damage in a focused area of the storm.

As a hazard, damage to crops and vehicles are typically the most significant impacts of hailstorms. Corn and soybean crops are particularly vulnerable, and the USDA Census of Agriculture reports that in 2012, corn for grain and soybeans were two of the top crop items by acres in Carbon County (USDA, 2012). As previously documented, Carbon County is also vulnerable to large hail, which has caused over \$1 million in property damage.

4.3.4. **Hurricane, Tropical Storm, Nor'easter**

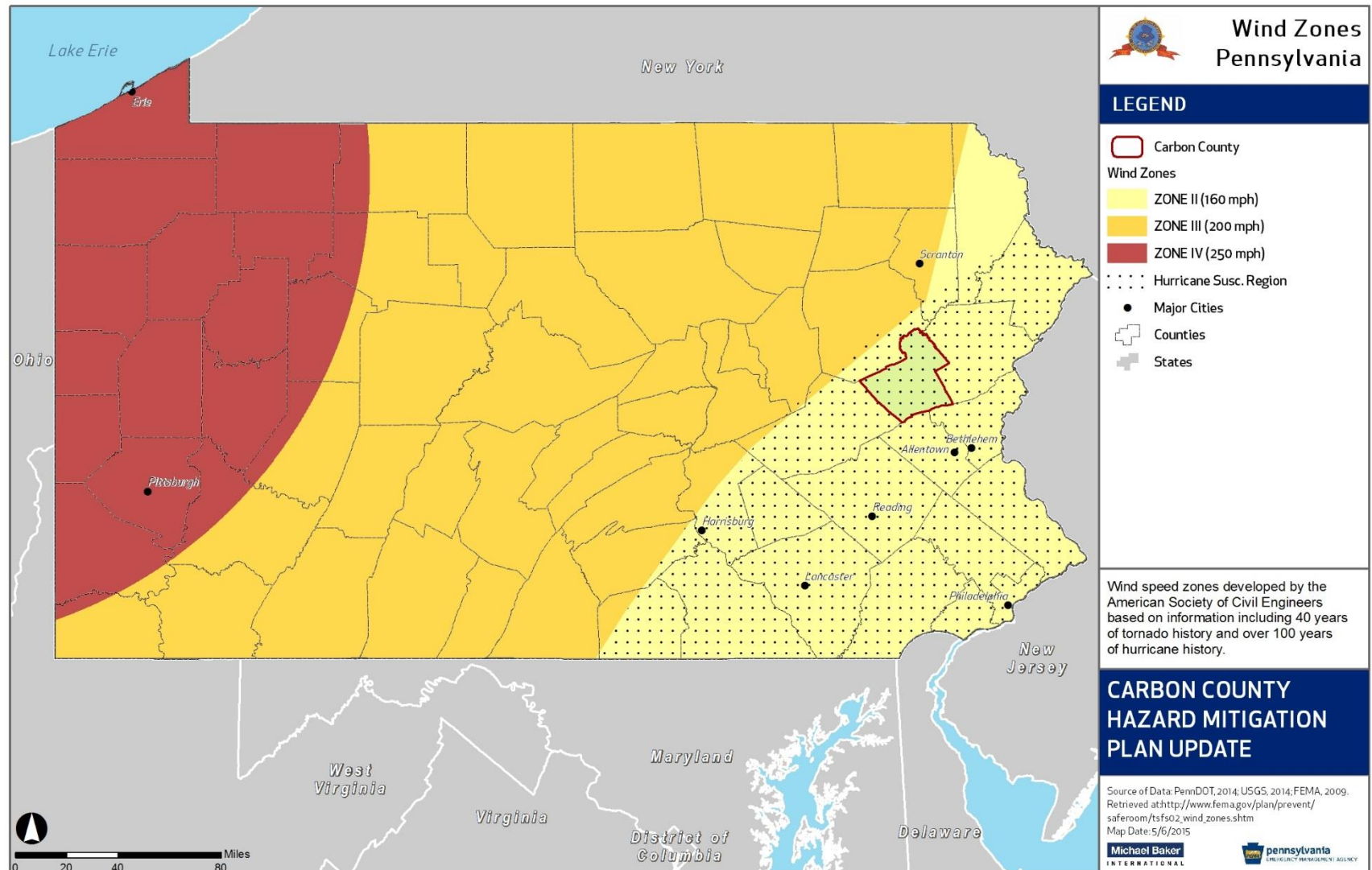
4.3.4.1. *Location and Extent*

While Carbon County is located about 80 miles from the Atlantic Coast, hurricanes, tropical storms, and Nor'easters can track inland causing heavy rainfall and winds. These storms are regional events that can impact very large areas hundreds to thousands of miles across over the life the storm. Therefore, all communities within Carbon County are equally subject to the impacts of hurricanes, tropical storms, and Nor'easters. Areas in Carbon County which are subject to flooding, wind, and winter storm damage are particularly vulnerable.

Figure 4.3.4-1 shows wind speed zones developed by the American Society of Civil Engineers based on information including 40 years of tornado history and over 100 years of hurricane history. It identifies wind speeds that could occur across the United States to be used as the basis for design and evaluation of the structural integrity of shelters and critical facilities.

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

Figure 4.3.4-1 Design wind speeds for community shelters across Pennsylvania (FEMA, 2009b).



4.3.4.2. Range of Magnitude

Tropical cyclones impacting Carbon County develop in tropical or sub-tropical waters found in the Atlantic Ocean, Gulf of Mexico, or Caribbean Sea. Tropical cyclones with maximum sustained winds of less than 39 miles per hour (mph) are called *tropical depressions*. A *tropical storm* is a cyclone with maximum sustained winds between 39-74 mph. These storms sometimes develop into *hurricanes* with wind speeds in excess of 74 mph. *Extra-tropical* is a term used to describe a hurricane or tropical storm whose cyclone has lost its “tropical” characteristics and has cold air at its core, rather than warm air. While an extra-tropical storm denotes a change in weather pattern and how a coastal storm is gathering energy, it may still have winds that are tropical storm or hurricane force. *Nor’easters* typically develop as *extra-tropical* storms and can produce winds equivalent to hurricane or tropical storm force with heavy precipitation, sometimes in the form of snow.

The impacts associated with hurricanes, tropical storms, and Nor’easters are primarily wind damage and flooding. It is not uncommon for tornadoes to develop during these events. Historical tropical storm, hurricane, and Nor’easter events have brought intense rainfall, sometimes leading to damaging floods, northeast winds, which, combined with waterlogged soils, caused trees and utility poles to fall.

The impact that tropical storms, hurricanes, and Nor’easters have on an area are typically measured in terms of wind speed. Expected damage from hurricane force winds is measured using the Saffir-Simpson Scale. The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential (characteristic of tropical storms and hurricanes, but not a threat to Carbon County), which are combined to estimate potential damage. Table 4.3.4-1 lists Saffir-Simpson Scale categories with associated wind speeds and expected damages. Categories 3, 4, and 5 are classified as “major” hurricanes. While major hurricanes comprise only 20 percent of all tropical cyclones making landfall, they account for over 70 percent of the damage in the United States. The likelihood of these damages occurring in Carbon County is assessed in Section 4.3.4.4, *Future Occurrence*.

STORM CATEGORY	WIND SPEED (MPH)	DESCRIPTION OF DAMAGES
1	74-95	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding, and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3	111-130	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.

Table 4.3.4-1 Saffir-Simpson Scale categories with associated wind speeds and damages (NHC, 2009).		
STORM CATEGORY	WIND SPEED (MPH)	DESCRIPTION OF DAMAGES
4	131-155	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5	>155	Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Wind impacts in Carbon County generally include downed trees and utility poles, which can spark widespread utility interruptions. Wind impacts can be particularly damaging to mobile homes and other manufactured housing; these structures are often not well-anchored and are highly susceptible to wind damage in a hurricane, tropical storm, or Nor'easter.

According to the NCDC, the largest magnitude winds recorded in Carbon County occurred in Lake Harmony, Kidder Township, in May 2001 and measured 69 knots with wind gusts estimated to be between 75 and 80 mph. This measurement falls within Storm Category 1 with expected damages being minimal and having no significant structural damage. This event was not associated with a tropical storm, but it serves as an example of the upper range of magnitude that can be expected to occur in the County. During this incident nineteen people were injured when a tent collapsed at a local festival, and dozens of trees were uprooted as well, damaging at least two vehicles, one of which was occupied; no deaths occurred.

It is also important to recognize the potential for flooding events during hurricanes, tropical storms, and Nor'easters; the risk assessment and associated impact of flooding events is discussed in Section 4.3.2. The impact of severe winter weather, which sometimes occurs during Nor'easter events, is addressed in Section 4.3.8.2.

The worst-case event for a tropical storm in Carbon County was Tropical Storm Lee/Hurricane Irene in 2011. Hurricane Irene made landfall in the US on August 27, 2011 and again on August 28, dumping between 2 and 8 inches of rain in eastern Pennsylvania, with its worst rain occurring in the Delaware River basin. One and a half weeks later, beginning on September 5, Tropical Storm Lee and its associated heavy rainfall moved through Pennsylvania and New York. With large portions of the Susquehanna River Basin already saturated by Hurricane Irene, Lee's rain caused flash flooding and riverine flooding in and east of the Susquehanna River Valley. The heavy rain broke previous precipitation records set by the former worst-case, Tropical Storm Agnes, and caused multiple new floods of record throughout the state. Lee caused flash flooding and flooding in Beaver Meadows and Albrightsville in Carbon County (NCDC, 2015).

Another notable event in Carbon County was when Hurricane Sandy went through eastern Pennsylvania on October 29, 2012. Carbon did not experience the same extent of flooding as it did in 2011; however,

the storm did cause wind gusts of up to 56 knots resulting in utility outages across the area. One man died in Carbon County due to carbon monoxide poisoning from running a generator after the power outage, and a firefighter was injured responding to the call for the man (NCDC, 2015).

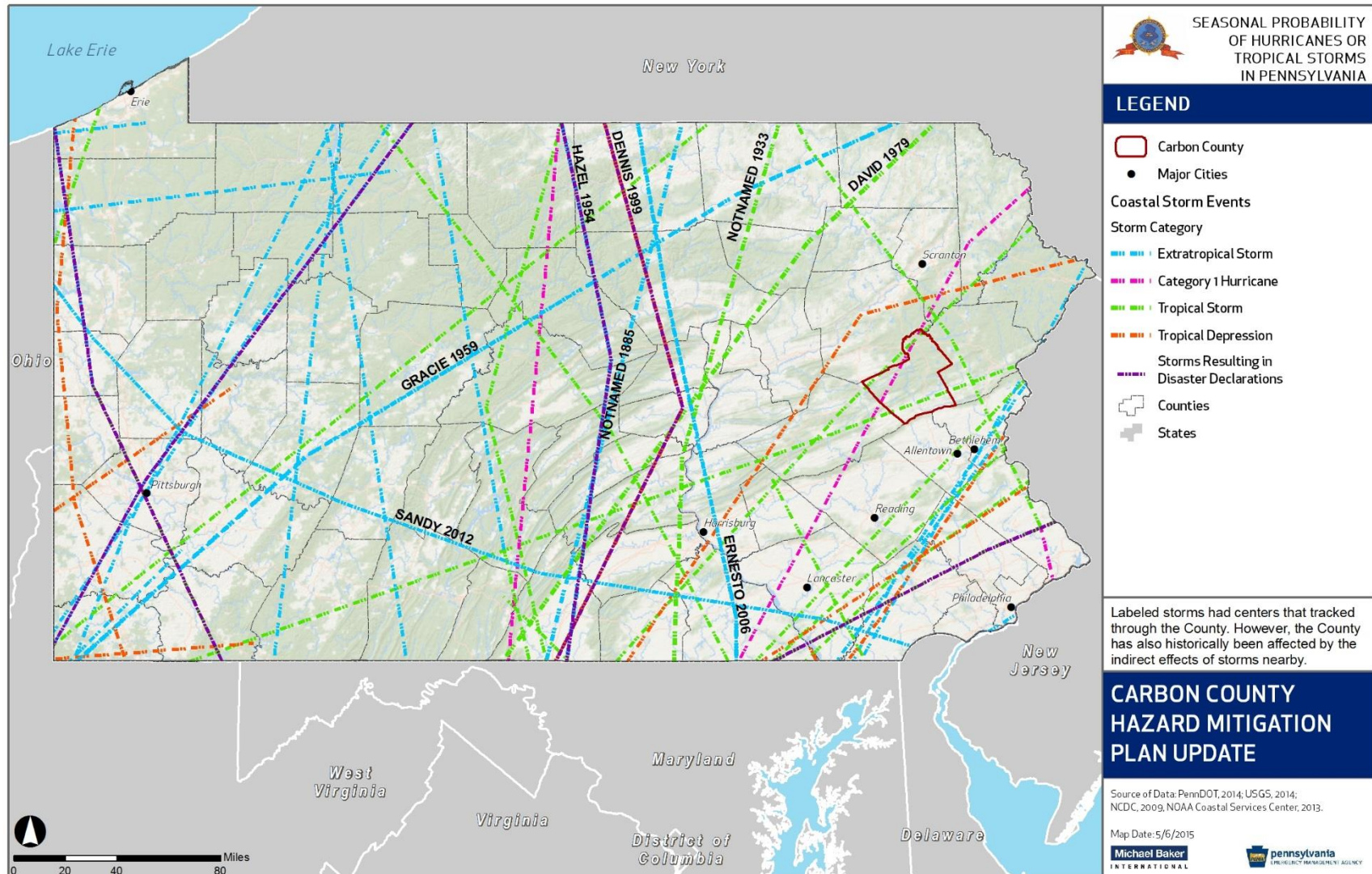
4.3.4.3. *Past Occurrence*

Figure 4.3.4-2 illustrates the historical coastal storms that have tracked through Pennsylvania. It is important to note that a number of hurricane, tropical storm, and Nor'easter events have impacted the County without tracking through or near it. Previous tropical storm and hurricane events that have impacted Carbon County are listed in Table 4.3.4-2 with descriptions where available. With the exception of Tropical Depression Ernesto, Hurricane Gloria, and the Nor'easter events, Presidential Disaster Declarations were issued for all of these events.

Table 4.3.4-2 Previous tropical storm events affecting Carbon County (NCDC, 2015).		
YEAR	EVENT	DESCRIPTION
2014	Winter Weather*	Snow wrapping around the Nor'easter dropped 1 to 4 inches of snow across the Poconos mainly during the morning of December 10 th , with 1.8 inches recorded in Jim Thorpe Borough.
2013	Winter Weather*	A Nor'easter that moved east of the state on March 25 th dropped 1 to 3 inches of snow across Eastern Pennsylvania, with 2.5 inches recorded in Summit Hill.
2012	Hurricane Sandy	As post-Tropical Storm Sandy tracked across Carbon County it caused massive wind gusts resulting in severe power outages. Power outages forced Carbon County 911 operations to default to back-up and emergency powers. A 66-year-old male died at a hospital due to carbon monoxide poisoning from a generator running in his garage; and a firefighter was injured responding to the incident. Five roadways were closed due to the effects of the storm.
2011	Tropical Storm Lee	The remnants of Tropical Storm Lee that interacted with a stalled frontal boundary produced several days with periods of heavy rain across Eastern Pennsylvania.
2011	Hurricane Irene	Tropical Storm Irene produced heavy flooding rain, tropical storm force wind gusts with hundreds of thousands of outages, moderate tidal flooding along the Delaware River.
2009	Winter Weather*	A major winter storm affected central and southeast Pennsylvania on December 19 th and 20 th . A lighter accumulating snow affected the Poconos. The Nor'easter responsible for the winter storm formed in the western Gulf of Mexico.
2009	Winter Weather*	A Nor'easter brought an early season measurable snow to the Poconos from the morning of October 15 th into the morning of the 16 th . Accumulations ranged from less than three inches in the valleys to around six inches over higher terrain. The weight of the snow plus leaves on trees caused scattered power outages in the higher terrain.

Table 4.3.4-2 Previous tropical storm events affecting Carbon County (NCDC, 2015).		
YEAR	EVENT	DESCRIPTION
2009	Winter Weather*	Snow fell across Eastern Pennsylvania from the evening of the March 1 st into the evening of the 2 nd . Snowfall averaged four to eight inches across the region. The heaviest snow associated with the Nor'easter occurred farther to the east. In the Poconos, two tractor-trailers collided on Interstate 80 westbound in Carbon County.
2007	Strong Wind*	In the wake of the departing Nor'easter, the combination of strong winds, snow on tree limbs and heavy rain loosening the ground caused many tree limbs, trees and wires to be knocked down on the 16th. Over 160,000 homes and businesses across Eastern Pennsylvania lost power. Carbon and Monroe Counties were among the hardest hit counties. In Carbon County, the downed trees caused most of the east side of Jim Thorpe to lose power for most of the daylight hours on April 16 th . The docket for the county courthouse was cancelled for the day. In Mahoning Township, part of the metal flashing on the roof of the Times News newspaper was torn away.
2007	Heavy Snow*	A Nor'easter caused heavy sleet to fall across the greater Philadelphia Metropolitan Area, heavy snow and sleet to fall across Berks County and the Lehigh Valley and heavy snow in the Poconos on March 16th into the early morning of the 17th. The winter storm caused scores of accidents. Snow and sleet totals included 18 inches in Albrightsville (Kidder Township and Penn Forest Township).
2006	Tropical Depression Ernesto	
2005	Hurricane Katrina	
2004	Tropical Depression Ivan	Countywide flooding and flash flooding with Palmerton Borough and Penn Forest, East Penn and Kidder Townships experiencing the most damage. One fatality.
2003	Hurricane Henri	
2003	Hurricane Isabel	
1999	Hurricane Floyd	Countywide flooding including flash flooding.
1997	Winter Storm*	A coastal storm or Nor'easter developed along the South Carolina coast and moved slowly northeast. Precipitation started during the late evening on November 13th and lasted about 24 hours ending as a period of light snow across much of the area, especially in the Poconos where 1 to 3 inches accumulated on top of the ice.
1985	Hurricane Gloria	Countywide flooding occurred with major damage in Palmerton Borough.
1972	Hurricane Agnes	
1955	Hurricane Diane	Countywide flooding occurred with extensive damage in Weissport Borough.
* NCDC's Storm Events Database does not differentiate Nor'easters from other storm events. Therefore, winter storm, winter weather, heavy snow, and strong wind events that included "Nor'easter" in the description were included in this table.		

Figure 4.3.4-2 Map showing historical coastal storm events which tracked through Carbon County (NOAA CSC, 2014).



4.3.4.4. Future Occurrence

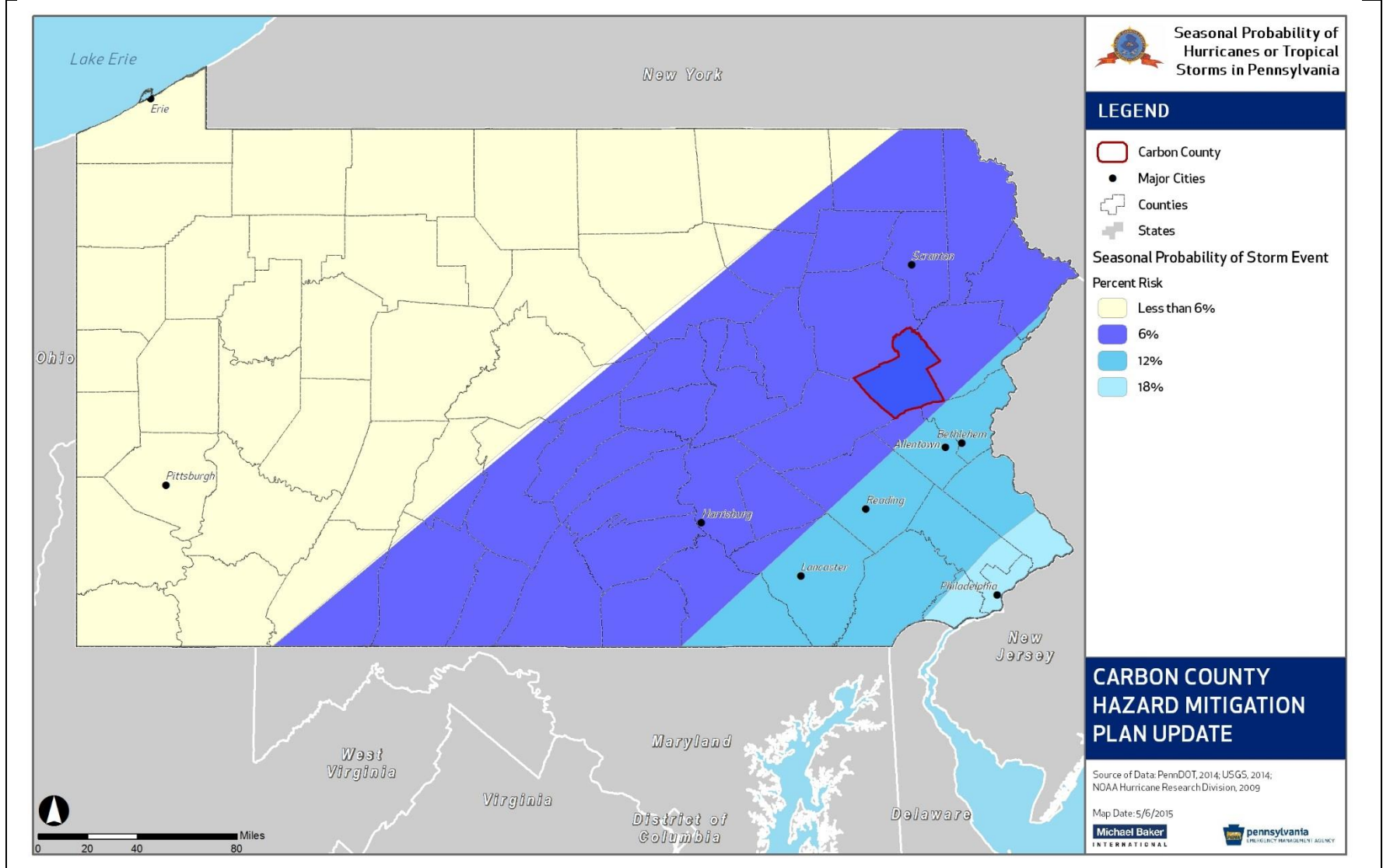
Although hurricanes, tropical storms, and Nor'easters can cause flood events consistent with 1 percent and 2 percent level frequency, their probability of occurrence is measured relative to wind speed. Table 4.3.4-3 shows the probability of winds that reach the strength of tropical storms and hurricane conditions in Carbon County and surrounding areas based on a statistical sample region of more than 30,000 square miles over a period of 46 years.

WIND SPEED (MPH)	CORRESPONDING SAFFIR-SIMPSON TROPICAL STORM/HURRICANE CATEGORIES	ANNUAL PROBABILITY OF OCCURRENCE (%)
45-77	Tropical Storms and Category 1 Hurricanes	91.59
78-118	Category 1 to 2 Hurricanes	8.32
119-138	Category 3 to 4 Hurricanes	0.0766
139-163	Category 4 to 5 Hurricanes	0.0086
164-194	Category 5 Hurricanes	0.00054
195+	Category 5 Hurricanes	0.00001

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

The National Oceanic and Atmospheric Administration Hurricane Research Division published the map included as Figure 4.3.3-3 showing the chance that a tropical storm or hurricane will affect a given area during the entire Atlantic hurricane season spanning from June to November. Note that this figure does not provide information on the probability of various storm intensities. However, based on historical data between 1944 and 1999, this map reveals there is approximately a 6 percent chance of experiencing a tropical storm or hurricane event between June and November of any given year in most of the County, or *possible* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1).

Figure 4.3.4-3 Seasonal Probability of a hurricane or tropical storm affecting Carbon County (NOAA HRD, 2009).



4.3.4.5. Vulnerability Assessment

A vulnerability assessment for hurricanes, tropical storms, and Nor'easters focuses on the impacts of flooding and severe wind; the assessment for flood-related vulnerability is addressed in Section 4.3.2.5.

In terms of severe wind-related vulnerabilities, the primary concern, as mentioned in Section 4.3.3.2, is manufactured, or mobile, housing. Additional loss estimation information from hurricane, tropical storm, and Nor'easters in Carbon County is provided in Section 4.4.3, Potential Loss Estimates.

4.3.5. Landslide

4.3.5.1. Location and Extent

A landslide is the downward and outward movement of slope-forming soil, rock, and vegetation reacting to the force of gravity. Landslides may be triggered by both natural and human-caused changes in the environment, including heavy rain, rapid snow melt, steepening of slopes due to construction or erosion, earthquakes, and changes in groundwater levels. Mudflows, mudslides, rockfalls, rockslides, and rock topples are all forms of a landslide. Landslides usually occur in areas of Carbon County in areas with moderate to steep slopes and during high precipitation. Figure 4.3.5-1 shows the susceptibility of areas of the County to landslides based on the slope of the land in the area. Many slope failures are associated with precipitation events – periods of sustained above-average precipitation, specific rainstorms, or snowmelt events. Areas experiencing erosion, decline in vegetation cover, and earthquakes are also susceptible to landslides. Human activities that contribute to slope failure include altering the natural slope gradient, increasing soil water content, and removing vegetation cover.

The USGS identifies Carbon County as falling into three distinct zones of landslide susceptibility and incidence. Figure 4.3.5-2 shows areas of low, moderate, and high landslide susceptibility as determined by the U.S. Geological Survey. The majority of Carbon County has a low to moderate susceptibility to landslides. However, the southeastern portion of the county and a small area along the Luzerne County border have a *Combo-High* susceptibility, meaning these areas have a high susceptibility to landslides with low incidence of occurrence. Over 42% of the total land area of the County is classified as Combo-High susceptibility and includes all or a portion of the jurisdictions listed in Table 4.3.5-1.

Table 4.3.5-1 Municipalities located partially or completely in Combo-High Landslide Zones (USGS, 2001).		
Banks Township	Lausanne Township	Palmerton Borough
Beaver Meadows Borough	Lehigh Township	Parryville Borough
Bowmanstown Borough	Lehigh Township	Penn Forest Township
East Penn Township	Lower Towamensing Township	Summit Hill Borough
Franklin Township	Mahoning Township	Towamensing Township
Jim Thorpe Borough	Nesquehoning Borough	Weatherly Borough
Lansford Borough	Packer Township	Weissport Borough

Specific areas in the county that are known to have experienced landslides are:

- Mansion House Hill;
- Maunch Chunk Road in Palmerton Borough;
- Route 209 in Jim Thorpe Borough and Mahoning Township;
- State Route 248 between Parryville Borough and Bowmanstown Borough
- State Route 248 between Palmerton Borough and Lehigh Gap; and,
- Along Turnpike and local roads in North Mountain Areas in Franklin Township and East Penn Township.

Figure 4.3.5-1 Map showing landslide susceptibility by slope.

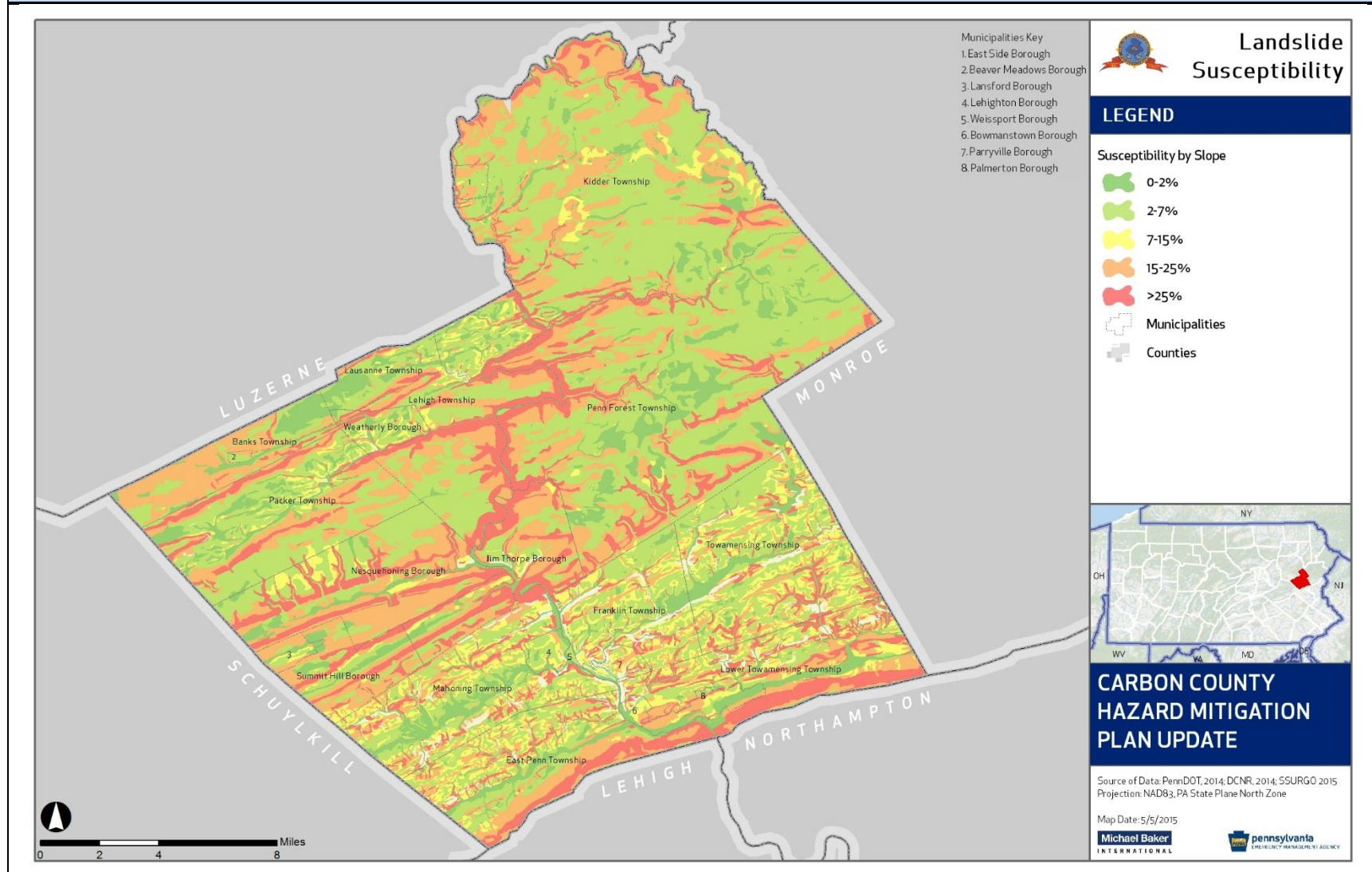
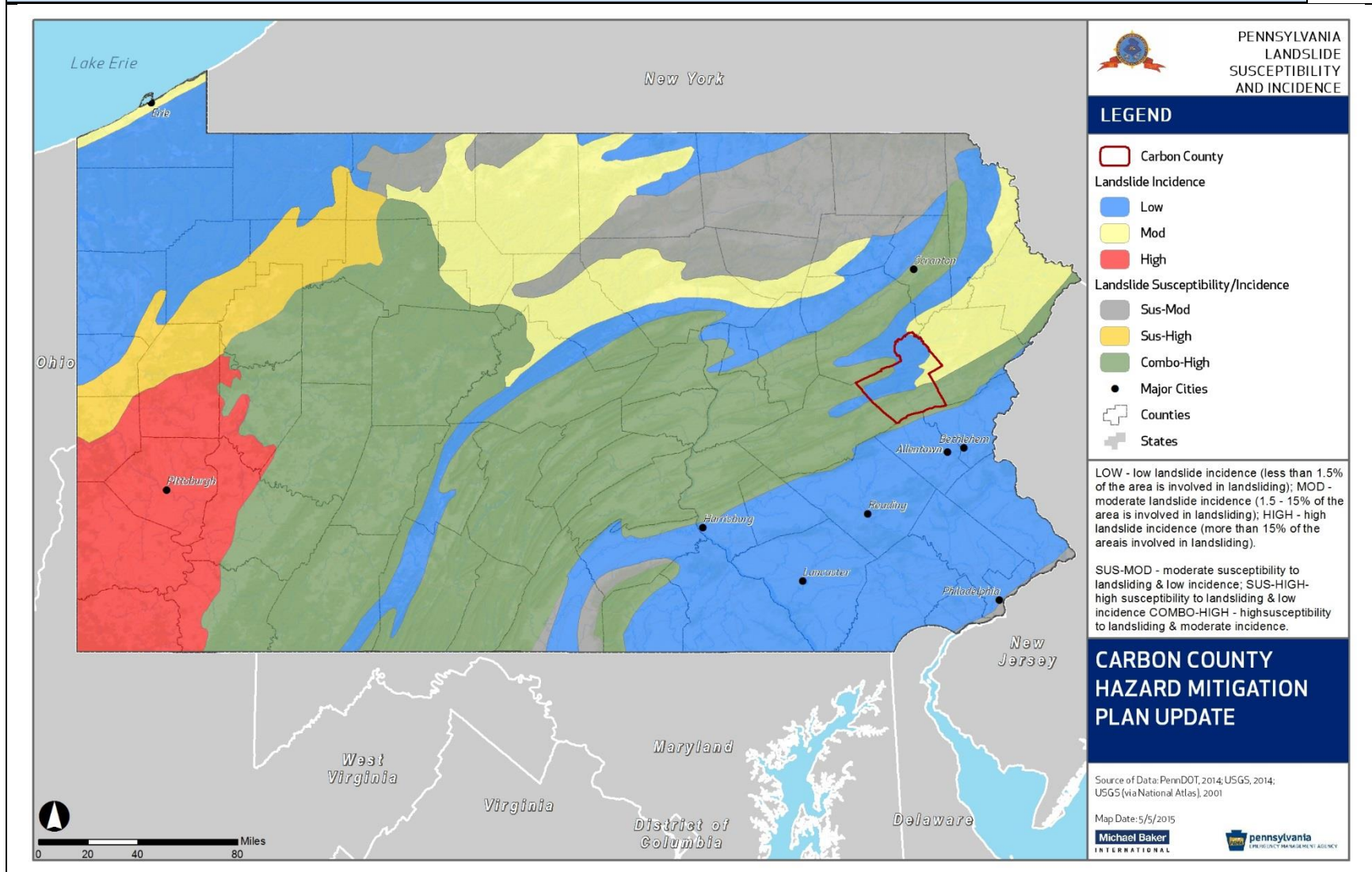


Figure 4.3.5-2 Map of general landslide hazard areas Pennsylvania.



4.3.5.2. *Range of Magnitude*

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

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

No serious injury, death or substantial property damage has occurred in Carbon County as a result of a landslide incident. Typically the worst level of damage caused by landslides in the county is minor property damage to vehicles, damage to roads resulting in temporary road closures, and minor personal injury. A possible worst-case scenario would occur if there was a large landslide on Route 209 in Jim Thorpe or Mahoning Township. This road is a main access point to the Pennsylvania Turnpike's Northeast Extension; a rockfall on Route 209 has the potential to cause material damage and injury as well as economic losses because the County's commerce would be interrupted for an unknown period of time.

4.3.5.3. *Past Occurrence*

No comprehensive list of landslide incidents is available at this time, as there is no formal reporting system in place in the County or the Commonwealth. Areas within the County that have a known history of landslides are listed in Section 4.3.5.1. Based on anecdotal information from the County and municipal officials, minor landslides occur each year, typically during periods of heavy rains. These events have caused minor damages and personal injuries, but no deaths.

4.3.5.4. *Future Occurrence*

Based on historical events, landslide events resulting in loss of life and property damage are unlikely in Carbon County. However, with mixed susceptibility to landslides, the future occurrence of landslides for Carbon County can be considered *possible* as defined by the Risk Factor methodology probability criteria (see Table 4.4-1).. Mismanaged intense development in steeply sloped areas could increase the frequency of occurrence.

4.3.5.5. *Vulnerability Assessment*

With the exception of the areas such as those mentioned in Section 4.3.5.1, communities in Carbon County are not particularly vulnerable to landslides. Additionally, transportation routes throughout the County located at the base or crest of cliffs should be considered vulnerable to this hazard. A comprehensive inventory of these areas is not available.

Table 4.3.5-2 details the amount of structures and critical facilities in each municipality that are in an area of landslide susceptibility over 15%. As the table shows, just over sixteen percent of all structures, and

over 21 percent of critical facilities, are in these areas of high susceptibility. There are three municipalities with over 25 percent of their structures in these areas: Kidder Township, East Side Borough, and Nesquehoning Borough. Penn Forest Township has the most structures in these areas – 970 structures – however, this is just over 12 percent of their total structures. Only Weissport Borough has no structures in these areas of high susceptibility, but Beaver Meadows Borough and Lansford Borough also have less than five percent of their structures in these areas.

There are four municipalities with fifty percent or more of their critical facilities in these areas of high susceptibility: Packer Township, Lausanne Township, Banks Township, and Nesquehoning Borough. Next to Nesquehoning Borough, Kidder Township has the highest number of critical facilities within these areas, 7 critical facilities, which is almost 39 percent of their total critical facilities. Nine municipalities have no critical facilities within these areas of high susceptibility. For a complete list of critical facilities and their vulnerability to landslide hazards, please see **Appendix E**.

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Table 4.3.5-2 Number of structures and critical facilities in areas of landslide susceptibility over 15%.						
MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES IN STEEP SLOPE AREA	PERCENT STRUCTURES IN STEEP SLOPE AREA	TOTAL CRITICAL FACILITIES	CRITICAL FACILITIES IN STEEP SLOPE AREA	PERCENT CRITICAL FACILITIES IN STEEP SLOPE AREA
Banks Township	764	144	18.85	6	3	50.00
Beaver Meadows Borough	412	10	2.43	2	0	0.00
Bowmanstown Borough	555	30	5.41	2	0	0.00
East Penn Township	2,095	343	16.37	7	3	37.50
East Side Borough	195	57	29.23	1	0	0.00
Franklin Township	3,163	466	14.73	10	2	20.00
Jim Thorpe Borough	2,388	516	21.61	17	4	23.53
Kidder Township	3,040	845	27.80	18	7	38.89
Lansford Borough	1,603	13	0.81	5	0	0.00
Lausanne Township	218	28	12.84	2	1	50.00
Lehigh Township	396	79	19.95	7	0	0.00
Lehighon Borough	2,397	445	18.56	11	0	0.00
Lower Towamensing Township	2,116	512	24.20	6	2	33.33
Mahoning Township	2,632	484	18.39	11	0	0.00
Nesquehoning Borough	1,409	548	38.89	14	8	57.14
Packer Township	740	91	12.30	4	2	50.00
Palmerton Borough	2,734	243	8.89	11	0	0.00
Parryville Borough	347	81	23.34	3	1	33.33
Penn Forest Township	7,751	970	12.51	12	1	8.33
Summit Hill Borough	1,580	106	6.71	8	1	12.50
Towamensing Township	2,697	365	13.53	9	2	22.22
Weatherly Borough	1,234	140	11.35	6	1	16.67
Weissport Borough	203	0	0.00	3	0	0.00
TOTAL	40,669	6,516	16.02	175	38	21.59

4.3.6. Radon Exposure

4.3.6.1. Location and Extent

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. In 1984, routine monitoring of employees leaving the Limerick nuclear power plant near Reading, PA while it was still under construction and not yet functional, showed that readings on a construction worker at the plant frequently exceeded expected radiation levels. However, only natural, nonfission-product radioactivity was detected on him.

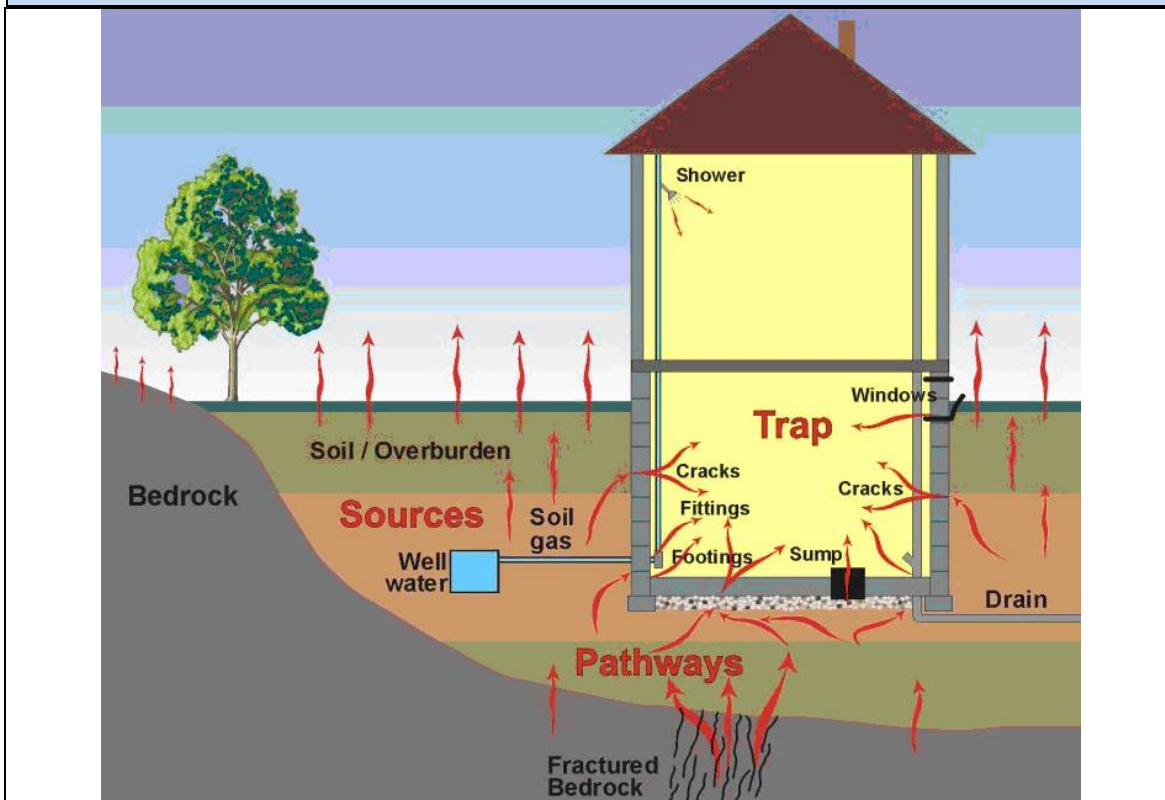
Subsequent testing of the employee's home in the Reading Prong section of Pennsylvania showed extremely high radon levels around 2,500 pCi/L (pico Curies per Liter). To put this amount in perspective, the Environmental Protection Agency (EPA) guidelines state that actions should be taken if radon levels exceed 4 pCi/L in a home, and uranium miners have a maximum exposure of 67 pCi/L. As a result of this event, the Reading Prong became the focus of the first large-scale radon scare in the world.

Radon is a gas that cannot be seen or smelled. It is a noble gas that originates by the natural radioactive decay of uranium and thorium. Like other noble gases (e.g., helium, neon, and argon), radon forms essentially no chemical compounds and tends to exist as a gas or as a dissolved atomic constituent in groundwater. Two isotopes of radon are significant in nature, ^{222}Rn and ^{220}Rn , formed in the radioactive decay series of ^{238}U and ^{232}Th , respectively. The isotope thoron (i.e. ^{220}Rn) has a half-life (time for decay of half of a given group of atoms) of 55 seconds, barely long enough for it to migrate from its source to the air inside a house and pose a health risk. However, radon (i.e. ^{222}Rn), which has a half-life of 3.8 days, is a widespread hazard. The distribution of radon is correlated with the distribution of radium (i.e. ^{226}Ra), its immediate radioactive parent, and with uranium, its original ancestor. Due to the short half-life of radon, the distance that radon atoms can travel from their parent before decay is generally limited to distances of feet or tens of feet.

Three sources of radon are now recognized in houses (shown in Figure 4.3.6-1):

- 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; and
- Radon emanating from uranium-rich building materials (e.g. concrete blocks or gypsum wallboard); this is not known to be a problem in Pennsylvania.

Figure 4.3.6-1 Sketch of radon entry points into a house (Arizona Geological Survey, 2006).



High radon levels were initially thought to be exacerbated in houses that are tightly sealed, but it is now recognized that rates of air flow 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 (radon concentration 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 (see Figure 4.3.6-1). 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.

The radon concentration of soil gas depends upon a number of soil properties, the importance of which is still being evaluated. In general, ten to fifty percent 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 air flow, 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.

Areas where houses have high levels of radon can be divided into three groups in terms of uranium content in rock and soil:

- Areas of very elevated uranium content (>50 ppm) around uranium deposits and prospects. Although very high levels of radon can occur in such areas, the hazard normally is restricted to within a few hundred feet of the deposit. In Pennsylvania, such localities occupy an insignificant area.
- Areas of common rocks having higher than average uranium content (5 to 50 ppm). In Pennsylvania, such rock types include granitic and felsic alkali igneous rocks and black shales. In the Reading Prong, high uranium values in rock or soil and high radon levels in houses are associated with Precambrian granitic gneisses commonly containing 10 to 20 ppm uranium, but locally containing more than 500 ppm uranium. In Pennsylvania, elevated uranium occurs in black shales of the Devonian Marcellus Formation and possibly the Ordovician Martinsburg Formation. High radon values are locally present in areas underlain by these formations.
- Areas of soil or bedrock that have normal uranium content but properties that promote high radon levels in houses. This group is incompletely understood at present. Relatively high soil permeability can lead to high radon, the clearest example being houses built on glacial eskers. Limestone-dolomite soils also appear to be predisposed for high radon levels in houses, perhaps because of the deep clay-rich residuum in which radium is concentrated by weathering on iron oxide or clay surfaces, coupled with moderate porosity and permeability.

Each county in Pennsylvania is classified as having a *low*, *moderate*, or *high* radon hazard potential. Carbon County is classified as having a high hazard, meaning there is a predicted indoor radon level greater than 4 pCi/L.

Figures 4.3.6-2 and 4.3.6-3 show the radon test data available for Carbon County by zip code. Most communities have average basement radon readings of over the threshold of action of 4 pCi/L. Communities with no data available did not have a sufficient sample size.

Figure 4.3.6-2 Carbon County Average Basement Radon Test Results.

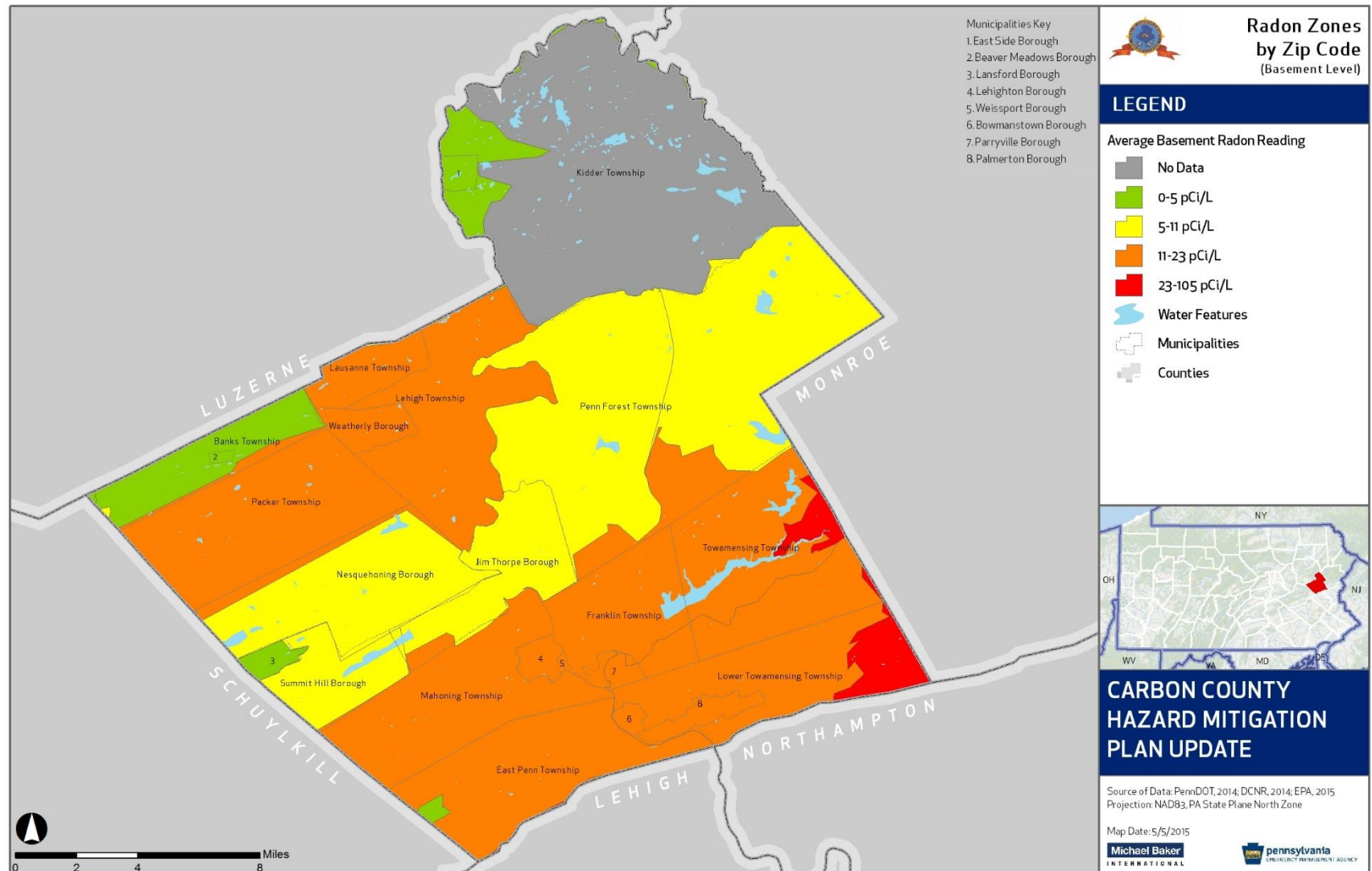
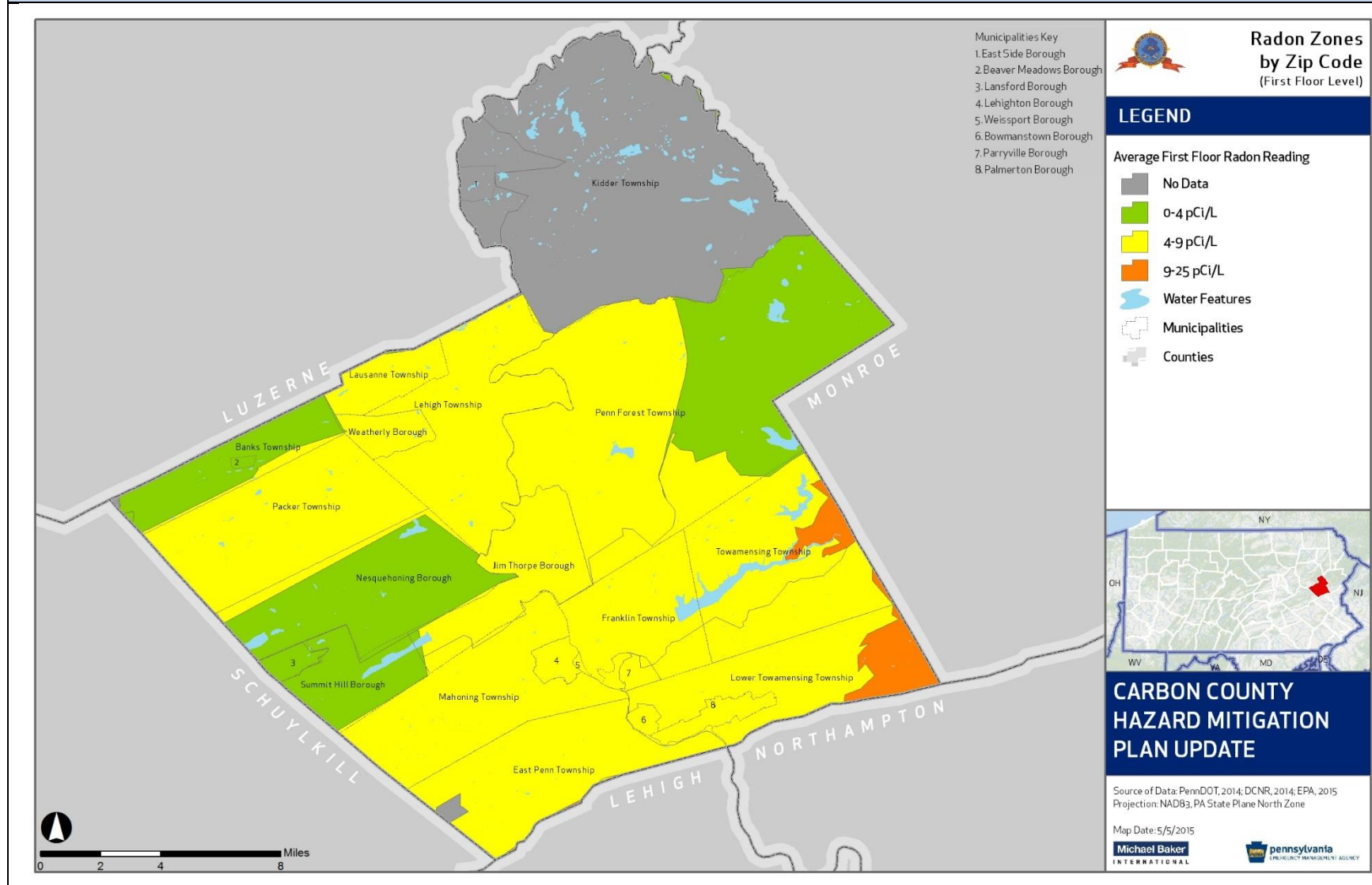


Figure 4.3.6-3 Carbon County Average First Floor Radon Test Results.



4.3.6.2. Range of Magnitude

Exposure to radon is the second leading cause of lung cancer after smoking. It is the number one cause of lung cancer among non-smokers. Radon is responsible for about 21,000 lung cancer deaths every year; approximately 2,900 of which occur among people who have never smoked. Lung cancer is the only known effect on human health from exposure to radon in air and thus far, there is no evidence that children are at greater risk of lung cancer than are adults (EPA, March 2010). The main hazard is actually from the radon daughter products (218Po, 214Pb, 214Bi), which may become attached to lung tissue and induce lung cancer by their radioactive decay.

According to the EPA, the average radon concentration in the indoor air of homes nationwide is about 1.3 pCi/L. The EPA recommends homes be fixed if the radon level is 4 pCi/L or more. However, because there is no known safe level of exposure to radon, the EPA also recommends that Americans consider fixing their home for radon levels between 2 pCi/L and 4 pCi/L. Table 4.3.6-1 shows the relationship between various radon levels, probability of lung cancer, comparable risks from other hazards, and action thresholds. As is shown in Table 4.3.6-1, a smoker exposed to radon has a much higher risk of lung cancer.

Table 4.3.6-1 Radon risk for smokers and non-smokers (EPA, March 2010).			
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	
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

Table 4.3.6-1 Radon risk for smokers and non-smokers (EPA, March 2010).			
RADON LEVEL (CCI/L)	IF 1,000 PEOPLE WERE EXPOSED TO THIS LEVEL OVER A LIFETIME*	RISK OF CANCER FROM RADON EXPOSURE COMPARES TO**	ACTION THRESHOLD
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.			

The worst-case scenario for radon exposure would be that a large area of tightly sealed homes provided residents high levels of exposure over a prolonged period of time without the resident being aware. This worst-case scenario exposure then could lead to a large number of people with cancer attributed to the radon exposure.

4.3.6.3. Past Occurrence

Current data on abundance and distribution of radon as it affects individual houses in the state of Pennsylvania in general is considered incomplete and potentially biased. Carbon County is not an exception. The EPA 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 (PADEP, 2014).

The Pennsylvania Department of Environmental Protection Bureau of Radiation Protection provides information for homeowners on how to test for radon in their houses. If a test results in radon concentrations over 4 pCi/L, then the Bureau works to help the homeowners make repairs to their houses to mitigate against high radon levels. The total number tests reported to the Bureau since 1990 and their results are provided by zip code on the Bureau's website. However, this information is only provided if over 30 tests total were reported in order to best approximate the average for the area.

In Carbon County, twelve zip codes had sufficient tests reported to the Bureau to list their findings, which are shown in Table 4.3.6-2. This table does not include the ZIP codes for which insufficient data was collected in both basements and first floors. The spatial distribution of this data across all ZIP codes is illustrated in Figures 4.3.6-2 and 4.3.6-3.

Table 4.3.6-2 Radon level tests and results in Carbon County zip codes (PADEP, 2015c).						
ZIP CODE	COMMUNITY	BASEMENT			FIRST FLOOR	
		NUMBER OF TESTS	MAXIMUM RESULT (pCi/L)	AVERAGE RESULT (pCi/L)	NUMBER OF TESTS	AVERAGE RESULT (pCi/L)
18058	Kunkletown	21	143.70	27.18	5	18.44
18071	Palmerton	288	93.40	13.32	28	7.29

Table 4.3.6-2 Radon level tests and results in Carbon County zip codes (PADEP, 2015c).						
ZIP CODE	COMMUNITY	BASEMENT			FIRST FLOOR	
		NUMBER OF TESTS	MAXIMUM RESULT (PCI/L)	AVERAGE RESULT (PCI/L)	NUMBER OF TESTS	AVERAGE RESULT (PCI/L)
18210	Albrightsville	316	152.00	7.45	162	2.10
18211	Andreas	1	0.90	0.90	0	NA
18216	Beaver Meadows	19	11.20	2.86	3	1.43
18229	Jim Thorpe	393	78.00	8.63	93	4.42
18232	Lansford	46	16.20	3.28	5	0.85
18235	Lehighton	741	362.60	17.62	96	7.03
18240	Nesquehoning	76	32.30	5.45	13	2.38
18250	Summit Hill	58	51.90	5.57	15	2.80
18255	Weatherly	162	87.30	12.16	27	6.34
18661	White Haven	1	2.80	2.80	0	NA

4.3.6.4. Future Occurrence

Radon exposure retains a significant probability given present soil, geologic, and geomorphic factors in Carbon County. Future occurrence of high radon level hazards can be considered *possible* as defined by the Risk Factor Methodology probability criteria (see Table 4.4.2-1).

Development in areas where previous radon levels have been significantly high will continue to be more susceptible to exposure. However, new incidents of concentrated exposure may occur with future development or deterioration of older structures. Exposure can be limited with proper testing for both past and future development and appropriate mitigation measures.

4.3.6.5. Vulnerability Assessment

Houses in Carbon County, particularly in high vulnerability areas as shown in Figures 4.3.6-2 and 4.3.6-3, could be susceptible to moderate levels of radon. 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 (see Table 4.3.6-1). Older houses that have crawl spaces or unfinished basements are more vulnerable as well because of the increased exposure to soils which could be releasing higher levels of radon gas. Additionally, houses that rely on wells for their water may face an additional risk, although this type of exposure is low and rare in Pennsylvania.

Proper testing for radon levels should be completed across Carbon County, especially in the areas of higher incidence levels and for vulnerable populations that face the contributing risks described above. This testing will determine the level of vulnerability that residents face in their homes, as well as in their businesses and schools. The Pennsylvania Department of Environmental Protection Bureau of Radiation Protection provides short and long term tests to determine radon levels as well as information on how to mitigate high levels of radon in a building. According to the PADEP, repairs to protect against radon can cost on average the same as routine house repairs (PADEP, 2014). As seen in Figures 4.3.6-2 and 4.3.6-3,

areas with the highest reported tests were primarily located in the northwestern and southern portions of the County.

4.3.7. Wildfire

4.3.7.1. *Location and Extent*

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

Because more than 70 percent of Carbon County is covered by either Northern Hardwood or Mixed Oak forests and state natural areas make up over 20% of the County's total land area (see Figure 2.4-2 for land cover illustration), the potential geographic extent of wildfires is quite large. In the fall, dried leaves are also fuel for fires. Ninety-eight percent of wildfires in Pennsylvania are caused by people, often by debris burns. Several fires have started in a private backyard and traveled through dead grasses and weeds into bordering woodlands. Under dry conditions or droughts, wildfires have the potential to burn forests as well as croplands. The greatest potential for wildfires is in the spring months of March, April, and May, and, to a lesser extent, the autumn months of October and November. In the spring, bare trees allow sunlight to reach the forest floor, drying fallen leaves and other ground debris. In the fall, dried leaves are also fuel for fires. The percentage of wildfires occurring each month in Pennsylvania is shown in Figure 4.3.6-1. This pattern is consistent with wildfires in Carbon County.

Figure 4.3.7-1 Percentage of wildfires occurring each month (PA DCNR, 2015).

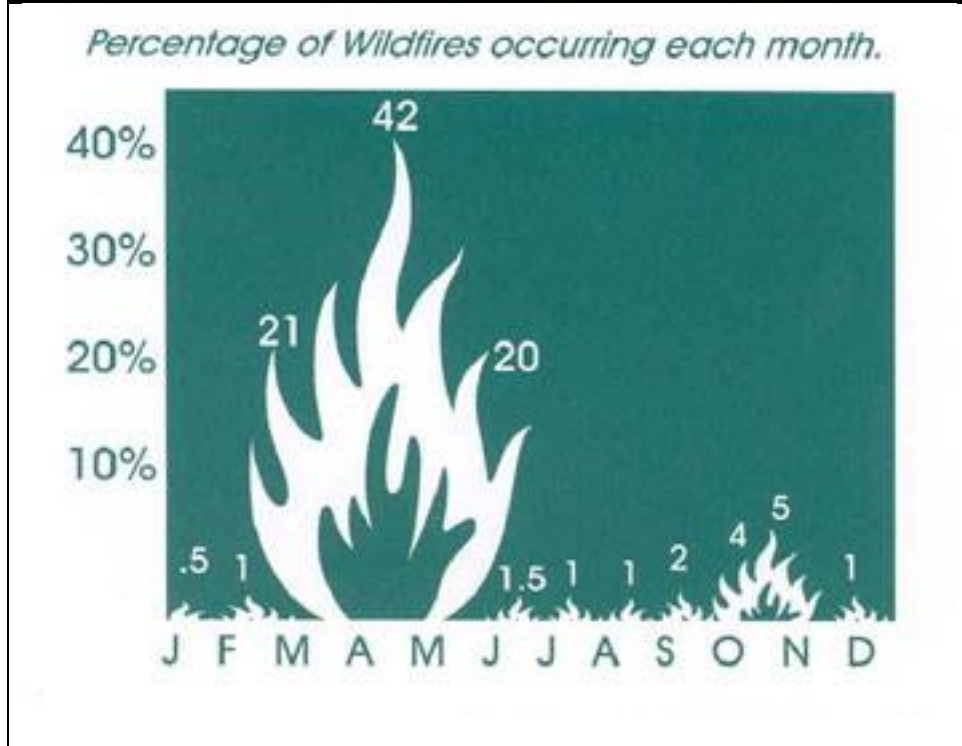
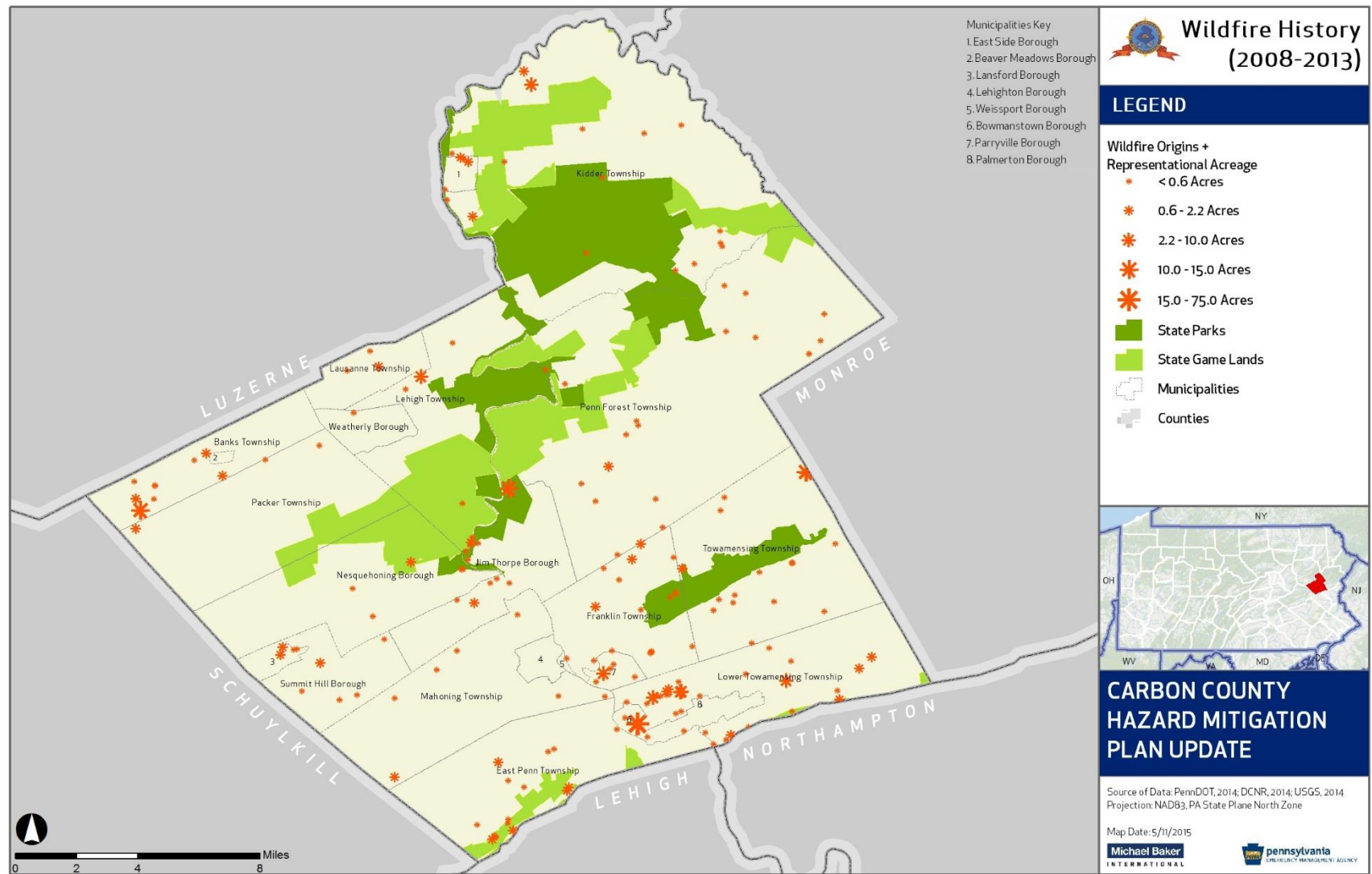


Figure 4.3.6-2 shows the origins of wildfires in the past as well in relation to State Parks and State Game Lands. As illustrated in the map, previous occurrences of wildfires have occurred throughout the entire County instead of concentrated in a single jurisdiction or area of the County. Any area with forest or brush is vulnerable to wildfires.

Figure 4.3.7-2 Map showing location of wildfire events with known locations reported to DCNR in Carbon County from 2008-2013 (PADCNR-BOF, 2013).



4.3.7.2. Range of Magnitude

Wildfire events can range from small fires that can be managed by local firefighters to large fires impacting many acres of land. The impact of a severe wildfire can be devastating. An uncontrolled fire (wildfire) is one of the most destructive fires caused by nature or man. It kills people, livestock, and wildlife. It destroys property, valuable timber, forage, and inestimable scenic and recreational value. Potential aftermath of wildfires includes severe erosion, silting of stream beds and reservoirs, and flooding due to a loss of ground cover. Large events may require evacuation from one or more communities and necessitate regional or national firefighting support.

Vegetation loss is often an environmental concern with wildfires, but it typically is not a serious impact since natural re-growth occurs with time. Wildfires also have a positive environmental impact in that they burn dead trees, leaves, and grasses to allow more open spaces for new and different types of vegetation to grow and receive sunlight. Another positive effect of a wildfire is that it stimulates the growth of new shoots on trees and shrubs and its heat can open pine cones and other seed pods. The most significant negative environmental impact is the potential for severe erosion, silting of stream beds and reservoirs, and flooding due to ground-cover loss following a fire event.

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

The worst case scenario for wildfires in Carbon County occurred in April 2015 when a wildfire in East Penn Township, named The Razor, destroyed over 800 acres of land (see Figure 4.3.7-3 and Figure 4.3.7-4). The rate of spread was extremely fast, averaging one acre every three minutes. Over 45 different fire departments from five counties responded to the fire.

4.3.7.3. Past Occurrence

Anecdotal accounts indicate that Carbon County has had a long history of wildfires. From the 1860s until the 1960s, many acres of the County burned yearly. The cause of these wildfires was usually either the engine sparks or overheated breaks of railroads (Carbon County Comprehensive Plan, 1998).

Figure 4.3.7-3 Newspaper clipping detailing the “Razor” wildfire in East Penn Township, April 2015 (DCNR-BOF, 2015b)



More recently, there have been 395 wildfire events reported to the Pennsylvania Department of Conservation and Natural Resources– Bureau of Forestry (DCNR-BOF) between 2002 and 2013 as show in Table 4.3.6-1 below. While this list does not include wildfires that were not reported to DCNR or that were controlled solely by the volunteer fire departments in the County, this is the most comprehensive list of wildfire occurrences available for Carbon County.

Table 4.3.7-1 List of wildfire events reported in Carbon County from 2002-2013					
YEAR	MUNICIPALITY	AREA (ACRES)	YEAR	MUNICIPALITY	AREA (ACRES)
2002	Summit Hill Borough	0.10	2007	Penn Forest Township	0.12
2002	Mahoning Township	4.00	2007	Penn Forest Township	0.06
2002	Lansford Borough	0.10	2007	Summit Hill Borough	0.25
2002	Penn Forest Township	0.10	2007	Lower Towamensing Township	0.50
2002	Lower Towamensing Township	0.75	2007	Lansford Borough	0.25
2002	Weatherly Borough	0.25	2007	Lower Towamensing Township	0.07
2002	Mahoning Township	0.25	2007	Packer Township	0.00
2002	Packer Township	0.25	2007	Nesquehoning Borough	0.50
2002	Penn Forest Township	0.75	2007	Lansford Borough	0.25
2002	Packer Township	0.25	2007	Jim Thorpe Borough	32.00
2002	East Penn Township	0.25	2008	Lower Towamensing Township	0.25
2002	East Penn Township	0.10	2008	Lower Towamensing Township	0.25
2002	Nesquehoning Borough	0.10	2008	Lower Towamensing Township	5.00
2002	Lausanne Township	0.50	2008	Lower Towamensing Township	0.50
2002	Jim Thorpe Borough	0.10	2008	Kidder Township	0.25
2002	Jim Thorpe Borough	0.75	2008	Lehigh Township	0.60
2002	Franklin Township	0.10	2008	Mahoning Township	0.75
2002	Nesquehoning Borough	3.50	2008	Lower Towamensing Township	0.50
2002	Packer Township	2.00	2008	Lower Towamensing Township	0.75
2002	Jim Thorpe Borough	2.50	2008	Lower Towamensing Township	0.75
2002	Nesquehoning Borough	0.10	2008	Lower Towamensing Township	0.10
2002	Penn Forest Township	0.10	2008	Lausanne Township	8.00
2002	Palmerton Borough	0.10	2008	Lansford Borough	0.25
2002	Kidder Township	0.10	2008	Franklin Township	0.10
2002	Weatherly Borough	1.50	2008	Kidder Township	0.10
2002	East Penn Township	0.10	2008	East Penn Township	0.50
2002	Lower Towamensing Township	0.10	2008	East Penn Township	0.10
2002	Lower Towamensing Township	1.00	2008	Lower Towamensing Township	7.50
2002	Lower Towamensing Township	2.00	2008	Lansford Borough	0.00
2002	Mahoning Township	0.10	2008	Penn Forest Township	0.50

Table 4.3.7-1 List of wildfire events reported in Carbon County from 2002-2013					
YEAR	MUNICIPALITY	AREA (ACRES)	YEAR	MUNICIPALITY	AREA (ACRES)
2002	Kidder Township	2.00	2008	Weatherly Borough	0.50
2002	Kidder Township	0.10	2008	Parryville Borough	0.50
2002	Lower Towamensing Township	0.10	2008	Franklin Township	0.25
2002	Mahoning Township	0.10	2008	Franklin Township	0.25
2002	Penn Forest Township	0.50	2008	Franklin Township	0.10
2003	Penn Forest Township	0.75	2008	Lower Towamensing Township	0.50
2003	Mahoning Township	5.00	2008	Jim Thorpe Borough	1.00
2003	East Penn Township	0.25	2008	Lower Towamensing Township	10.00
2003	Lower Towamensing Township	4.90	2008	Kidder Township	0.10
2003	Franklin Township	1.50	2008	East Penn Township	0.50
2003	Lower Towamensing Township	1.20	2008	East Penn Township	0.10
2003	Summit Hill Borough	0.75	2008	East Penn Township	0.75
2003	Penn Forest Township	0.50	2008	Towamensing Township	0.25
2003	Kidder Township	1.50	2008	Penn Forest Township	0.50
2003	Beaver Meadows Borough	0.01	2008	Towamensing Township	0.75
2003	Banks Township	0.02	2008	Towamensing Township	0.25
2003	Lower Towamensing Township	0.10	2008	Towamensing Township	0.50
2003	Penn Forest Township	1.00	2008	Towamensing Township	0.10
2003	Towamensing Township	0.10	2008	Penn Forest Township	0.50
2003	Palmerton Borough	0.10	2008	Penn Forest Township	1.00
2003	Banks Township	0.10	2008	Mahoning Township	0.25
2003	Penn Forest Township	0.10	2008	Banks Township	0.75
2004	Kidder Township	0.10	2008	Kidder Township	0.25
2004	Lower Towamensing Township	0.25	2008	Towamensing Township	0.10
2004	Kidder Township	0.25	2008	Lansford Borough	0.50
2004	Leighton Borough	0.10	2008	Banks Township	0.50
2004	Kidder Township	0.10	2008	Penn Forest Township	0.25
2004	Penn Forest Township	0.10	2008	Franklin Township	0.25
2004	Lower Towamensing Township	0.10	2008	Penn Forest Township	0.10
2004	Nesquehoning Borough	0.10	2008	Franklin Township	0.25
2004	Kidder Township	0.50	2008	Kidder Township	0.50
2004	Penn Forest Township	0.10	2008	Penn Forest Township	1.00
2004	Kidder Township	1.50	2008	Palmerton Borough	0.10
2004	Kidder Township	0.20	2008	Lehigh Township	0.25

Table 4.3.7-1 List of wildfire events reported in Carbon County from 2002-2013					
YEAR	MUNICIPALITY	AREA (ACRES)	YEAR	MUNICIPALITY	AREA (ACRES)
2004	Jim Thorpe Borough	0.02	2008	Jim Thorpe Borough	0.50
2004	Penn Forest Township	0.10	2008	Lausanne Township	2.00
2004	Palmerton Borough	0.10	2008	Beaver Meadows Borough	0.10
2004	Towamensing Township	0.25	2008	Summit Hill Borough	0.50
2004	Packer Township	0.55	2008	Towamensing Township	0.50
2004	Towamensing Township	0.25	2008	Lower Towamensing Township	0.50
2004	Lehigh Township	0.25	2008	Palmerton Borough	0.25
2004	Penn Forest Township	0.10	2008	Banks Township	0.25
2004	Lower Towamensing Township	2.00	2008	Beaver Meadows Borough	0.10
2005	Towamensing Township	0.10	2008	Lansford Borough	0.10
2005	Leighton Borough	0.10	2008	Packer Township	0.75
2005	Penn Forest Township	0.25	2008	Lower Towamensing Township	0.10
2005	Lehigh Township	0.50	2008	Nesquehoning Borough	0.50
2005	Mahoning Township	12.00	2008	Lower Towamensing Township	0.25
2005	Franklin Township	0.75	2009	Parryville Borough	4.75
2005	Franklin Township	0.25	2009	Parryville Borough	0.13
2005	Towamensing Township	0.24	2009	Banks Township	1.25
2005	Mahoning Township	0.75	2009	Lansford Borough	0.75
2005	Kidder Township	0.13	2009	Lansford Borough	1.00
2005	Banks Township	0.75	2009	Lower Towamensing Township	0.25
2005	Nesquehoning Borough	0.75	2009	Lower Towamensing Township	0.25
2005	Palmerton Borough	0.01	2009	Lower Towamensing Township	0.02
2005	Franklin Township	0.25	2009	Lower Towamensing Township	2.00
2005	Jim Thorpe Borough	0.25	2009	Bowmanstown Borough	75.00
2005	Penn Forest Township	0.13	2009	Towamensing Township	0.10
2005	Franklin Township	0.25	2009	Kidder Township	1.00
2005	Lower Towamensing Township	0.75	2009	Penn Forest Township	0.10
2005	Weatherly Borough	0.13	2009	Penn Forest Township	0.25
2005	Penn Forest Township	0.13	2009	Penn Forest Township	0.50
2005	Nesquehoning Borough	16.00	2009	Penn Forest Township	15.00
2005	Penn Forest Township	0.25	2009	Mahoning Township	0.25
2005	Lehigh Township	1.00	2009	Packer Township	0.13
2005	Summit Hill Borough	1.00	2009	Lehigh Township	0.25
2005	Towamensing Township	0.25	2009	Lehigh Township	0.25
2005	East Penn Township	0.25	2009	East Side Borough	1.00
2005	East Penn Township	0.10	2009	East Penn Township	0.75

Table 4.3.7-1 List of wildfire events reported in Carbon County from 2002-2013					
YEAR	MUNICIPALITY	AREA (ACRES)	YEAR	MUNICIPALITY	AREA (ACRES)
2005	Jim Thorpe Borough	0.75	2009	East Penn Township	1.00
2005	Penn Forest Township	0.25	2009	Jim Thorpe Borough	0.25
2005	Jim Thorpe Borough	0.50	2009	Jim Thorpe Borough	0.50
2005	Packer Township	0.75	2009	Franklin Township	1.50
2005	Franklin Township	0.10	2009	Summit Hill Borough	0.50
2005	Nesquehoning Borough	0.25	2009	Summit Hill Borough	0.75
2005	Kidder Township	0.10	2010	Parryville Borough	0.15
2005	Lower Towamensing Township	0.10	2010	Parryville Borough	0.10
2005	Lower Towamensing Township	0.10	2010	Banks Township	1.00
2005	Jim Thorpe Borough	0.10	2010	Banks Township	0.25
2005	Jim Thorpe Borough	0.15	2010	Banks Township	0.13
2005	East Penn Township	0.10	2010	Lansford Borough	0.25
2005	Kidder Township	0.50	2010	Lower Towamensing Township	0.50
2005	East Penn Township	0.10	2010	Lower Towamensing Township	0.13
2005	East Penn Township	0.10	2010	Bowmanstown Borough	0.25
2005	East Penn Township	0.10	2010	Bowmanstown Borough	0.25
2005	Lehighon Borough	0.10	2010	Towamensing Township	0.25
2005	Mahoning Township	0.10	2010	Towamensing Township	0.25
2005	Franklin Township	0.10	2010	Towamensing Township	0.28
2005	East Penn Township	0.10	2010	Towamensing Township	0.25
2005	Lower Towamensing Township	0.10	2010	Towamensing Township	0.25
2005	Lower Towamensing Township	0.10	2010	Kidder Township	0.20
2005	Lower Towamensing Township	1.60	2010	Kidder Township	0.25
2005	Nesquehoning Borough	0.10	2010	Kidder Township	0.25
2005	Lausanne Township	6.75	2010	Penn Forest Township	0.25
2006	Summit Hill Borough	0.13	2010	Penn Forest Township	0.25
2006	Jim Thorpe Borough	0.13	2010	Penn Forest Township	0.25
2006	Penn Forest Township	0.13	2010	Penn Forest Township	0.36
2006	Lower Towamensing Township	1.00	2010	Mahoning Township	0.25
2006	Lower Towamensing Township	0.13	2010	Mahoning Township	0.50
2006	Mahoning Township	1.00	2010	Lehigh Township	0.38
2006	Jim Thorpe Borough	0.25	2010	Lehigh Township	0.50
2006	Towamensing Township	0.25	2010	Lehigh Township	0.75

Table 4.3.7-1 List of wildfire events reported in Carbon County from 2002-2013					
YEAR	MUNICIPALITY	AREA (ACRES)	YEAR	MUNICIPALITY	AREA (ACRES)
2006	Packer Township	0.50	2010	East Penn Township	0.25
2006	Lower Towamensing Township	0.25	2010	Nesquehoning Borough	0.10
2006	Summit Hill Borough	0.13	2010	Nesquehoning Borough	0.10
2006	Franklin Township	0.13	2010	Nesquehoning Borough	0.10
2006	Nesquehoning Borough	1.00	2010	Jim Thorpe Borough	0.15
2006	Nesquehoning Borough	2.00	2010	Franklin Township	0.25
2006	Towamensing Township	0.50	2010	Franklin Township	1.00
2006	Penn Forest Township	1.00	2011	Lausanne Township	0.50
2006	Mahoning Township	15.50	2011	Banks Township	0.50
2006	Lausanne Township	0.50	2011	Lower Towamensing Township	0.25
2006	Jim Thorpe Borough	0.50	2011	Bowmanstown Borough	0.25
2006	Lower Towamensing Township	0.25	2011	Bowmanstown Borough	0.10
2006	Nesquehoning Borough	0.25	2011	Towamensing Township	0.25
2006	Mahoning Township	0.75	2011	Towamensing Township	0.25
2006	Packer Township	0.13	2011	Penn Forest Township	0.13
2006	East Penn Township	0.10	2011	Penn Forest Township	0.50
2006	East Penn Township	0.13	2011	East Penn Township	0.11
2006	Towamensing Township	0.13	2011	East Penn Township	0.05
2006	Bowmanstown Borough	1.80	2011	Jim Thorpe Borough	0.10
2006	Nesquehoning Borough	17.75	2011	Jim Thorpe Borough	0.50
2006	Mahoning Township	0.13	2012	Parryville Borough	0.01
2006	Penn Forest Township	0.13	2012	Banks Township	15.00
2006	Summit Hill Borough	2.00	2012	Lower Towamensing Township	0.25
2006	Towamensing Township	2.75	2012	Lower Towamensing Township	1.00
2006	Kidder Township	0.13	2012	Lower Towamensing Township	0.01
2006	Banks Township	0.13	2012	Lower Towamensing Township	0.01
2006	Leighton Borough	0.13	2012	Lower Towamensing Township	1.00
2006	Nesquehoning Borough	0.13	2012	Lower Towamensing Township	0.10
2006	Lehigh Township	250.00	2012	Lower Towamensing Township	0.01
2006	Weatherly Borough	0.13	2012	Lower Towamensing Township	1.80
2006	Kidder Township	0.06	2012	Palmerton Borough	0.25
2006	Kidder Township	0.06	2012	Towamensing Township	15.00
2006	Mahoning Township	0.13	2012	Kidder Township	5.50
2006	Franklin Township	0.13	2012	Kidder Township	0.10
2006	Penn Forest Township	0.13	2012	Kidder Township	0.25
2006	Mahoning Township	0.13	2012	Kidder Township	0.01

Table 4.3.7-1 List of wildfire events reported in Carbon County from 2002-2013					
YEAR	MUNICIPALITY	AREA (ACRES)	YEAR	MUNICIPALITY	AREA (ACRES)
2006	Packer Township	3.50	2012	Penn Forest Township	0.25
2006	Lehigh Township	10.00	2012	Penn Forest Township	0.01
2007	East Penn Township	0.25	2012	Penn Forest Township	0.50
2007	Mahoning Township	1.00	2012	Mahoning Township	0.50
2007	East Penn Township	0.25	2012	East Side Borough	0.50
2007	Lehigh Township	0.25	2012	East Side Borough	1.50
2007	Towamensing Township	0.32	2012	East Penn Township	0.25
2007	Kidder Township	0.32	2012	East Penn Township	0.25
2007	Towamensing Township	0.75	2012	Nesquehoning Borough	0.10
2007	Jim Thorpe Borough	0.12	2012	Jim Thorpe Borough	0.25
2007	Kidder Township	0.12	2012	Franklin Township	0.10
2007	Penn Forest Township	0.12	2012	Franklin Township	0.01
2007	Summit Hill Borough	6.00	2012	Franklin Township	0.25
2007	Weatherly Borough	0.25	2012	Franklin Township	2.20
2007	Jim Thorpe Borough	0.12	2012	Franklin Township	0.10
2007	Kidder Township	0.25	2012	Summit Hill Borough	0.01
2007	Jim Thorpe Borough	0.12	2012	Summit Hill Borough	0.25
2007	Franklin Township	1.00	2013	Lausanne Township	1.00
2007	Franklin Township	0.75	2013	Lower Towamensing Township	6.00
2007	Penn Forest Township	0.12	2013	Palmerton Borough	0.10
2007	Penn Forest Township	0.12	2013	Towamensing Township	0.25
2007	Lehigh Township	12.00	2013	Kidder Township	0.50
2007	Penn Forest Township	0.12	2013	Kidder Township	0.50
2007	Penn Forest Township	0.25	2013	Mahoning Township	0.50
2007	Penn Forest Township	0.12	2013	East Side Borough	0.25
2007	Penn Forest Township	0.12	2013	East Penn Township	0.25
2007	Banks Township	0.25	2013	Nesquehoning Borough	1.25
2007	Franklin Township	0.12	2013	Franklin Township	0.25
2007	Kidder Township	0.25			

Two fires not noted in the data set above have occurred in Carbon County in 2015. The two largest wildfires that have occurred in the Commonwealth this year, named Razor and Pipeline 1, were located in Carbon County. The Razor wildfire, pictured in figure 4.3.7-3, occurred in April 2015 and affected around 100 acres of Blue Mountain.

Figure 4.3.7-4 Images of “Razor” wildfire in East Penn Township, April 2015. (DCNR-BOF, 2015b)



Table 4.3.7-2 summarizes all of the past occurrence data. Lehigh Township has experienced the largest number of acres burned as a result of wildfires. 2006 saw the largest number of acres burned with over 316 acres burned.

Table 4.3.7-2 Acres burned by wildfires by year.													
MUNICIPALITY	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	TOTAL
Banks Township	0	0.1	0	0.8	0.1	0.3	1.5	1.3	1.4	0.5	15.0	0	20.9
Beaver Meadows Borough	0	0	0	0	0	0	0.2	0	0	0	0	0	0.2
Bowmanstown Borough	0	0	0	0	1.8	0	0	75.0	0.5	0.4	0	0	77.7
East Penn Township	0.5	0.3	0	0.9	0.2	0.5	2.0	1.8	0.3	0.2	0.5	0.3	7.1
East Side Borough	0	0	0	0	0	0	0	1.0	0	0	2.0	0.3	3.3
Franklin Township	0.1	1.5	0	1.7	0.3	1.9	1.2	1.5	1.3	0	2.7	0.3	12.3
Jim Thorpe Borough	3.4	0	0	1.8	0.9	32.4	1.5	0.8	0.2	0.6	0.3	0	41.6
Kidder Township	2.2	1.5	2.7	0.7	0.3	0.94	1.2	1.0	0.7	0	5.9	1.0	18.0
Lansford Borough	0.1	0	0	0	0	0.5	0.9	1.8	0.3	0	0	0	3.5
Lausanne Township	0.5	0	0	6.8	0.5	0	10.0	0	0	0.5	0	1.0	19.3
Lehigh Township	0	0	0.3	1.5	260	12.3	0.9	0.5	1.6	0	0	0	277.0
Lehighon Borough	0	0	0.1	0.2	0.1	0	0	0	0	0	0	0	0.4
Lower Towamensing Township	4.0	6.2	2.4	2.75	1.6	0.6	27.0	2.5	0.6	0.3	4.2	6.0	58.0
Mahoning Township	4.5	5.0	0	12.85	17.6	1.0	1.0	0.3	0.8	0	0.5	0.5	43.9
Nesquehoning Borough	3.7	0	0.1	17.1	21.1	0.5	0.5	0	0.3	0	0.1	1.3	44.7
Packer Township	2.5	0	0.6	0.75	4.1	0	0.8	0.1	0	0	0	0	8.8
Palmerton Borough	0.1	0.1	0.1	0.01	0	0	0.4	0	0	0	0.3	0.1	1.0
Parryville Borough	0	0	0	0	0	0	0.5	4.9	0.3	0	0	0	5.6
Penn Forest Township	1.5	2.4	0.4	1.01	1.4	1.2	3.9	15.9	1.1	0.6	0.8	0	29.9
Summit Hill Borough	0.1	0.8	0	1	2.3	6.3	0.5	1.3	0	0	0.3	0	12.4

Table 4.3.7-2 Acres burned by wildfires by year.													
MUNICIPALITY	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	TOTAL
Towamensing Township	0	0.1	0.5	0.59	3.6	1.1	2.5	0.1	1.3	0.5	15.0	0.3	25.5
Weatherly Borough	1.8	0	0	0.13	0.1	0.3	0.5	0	0	0	0	0	2.8
Weissport Borough	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	24.7	17.9	7.0	50.4	316.1	59.5	56.6	109.5	10.4	3.5	47.3	10.9	713.8

Figure 4.3.7-2 maps the origins of the wildfire events between 2008 and 2013 listed in Table 4.3.7-2.

4.3.7.4. Future Occurrence

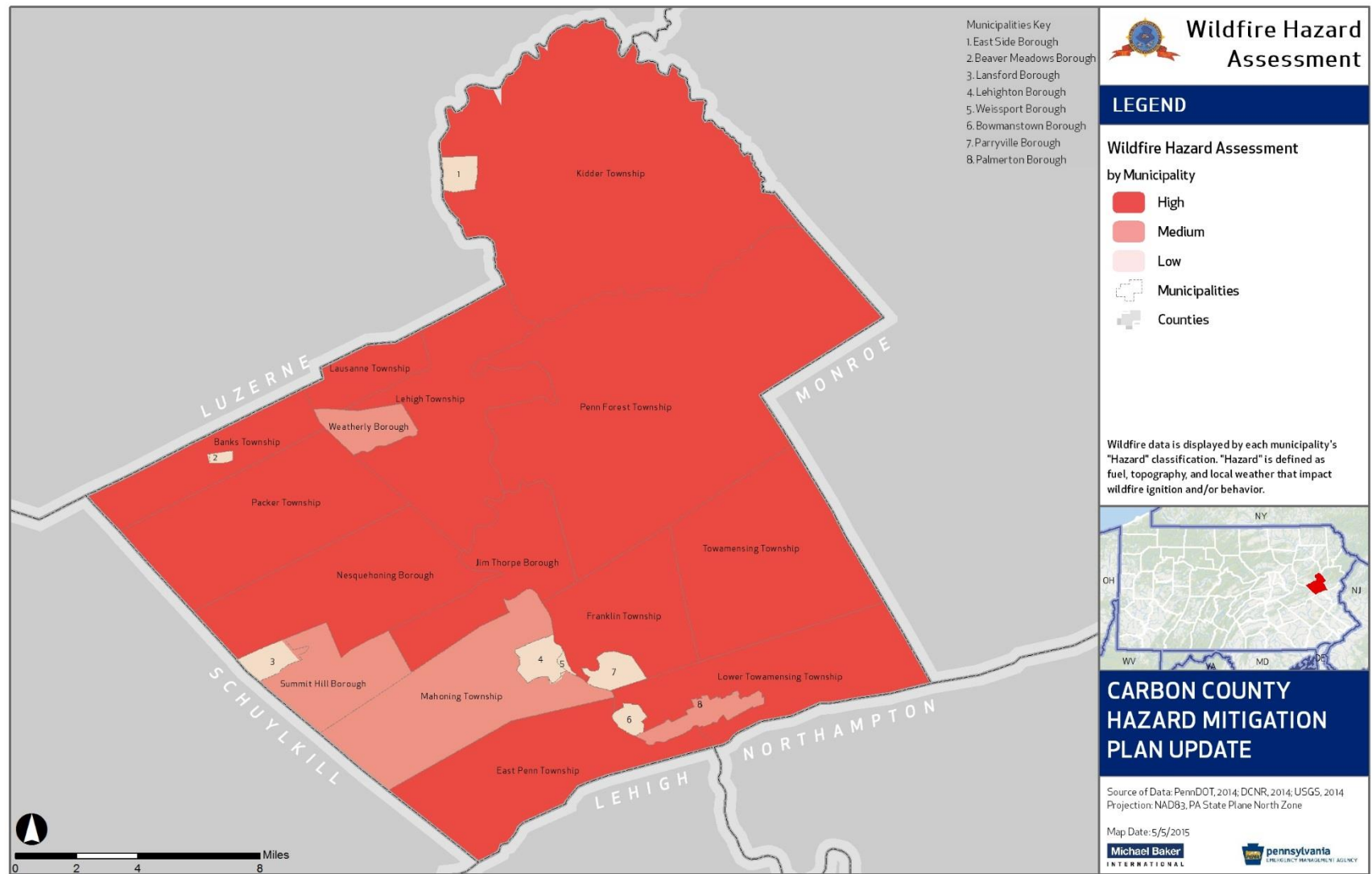
Previous events indicate that wildfire events will continue to occur yearly. Weather conditions like drought can increase the likelihood of wildfires occurring. Any fire, without the quick response or attention of fire-fighters, forestry personnel, or visitors to the forest, has the potential to become a wildfire.

The future occurrence of wildfires for Carbon County can be considered *highly likely* as defined by the Risk Factor methodology probability criteria (see Table 4.4-1). However, the likelihood of one of those fires attaining significant size and intensity is unpredictable and highly dependent on environmental conditions and firefighting response.

4.3.7.5. Vulnerability Assessment

The Pennsylvania Bureau of Forestry has conducted an independent wildfire hazard risk assessment for the various municipalities across Carbon County. Results of that assessment are shown in Figure 4.3.7-5. *Wildfire hazard* is defined based on conditions that affect wildfire ignition and/or behavior such as fuel, topography and local weather. Based on this assessment, the majority of municipalities within Carbon County have a *high wildfire hazard potential*. Weatherly Borough, Summit Hill Borough, Mahoning Borough, and Palmerton Borough are considered to have *medium wildfire hazard potential*. East Side Borough, Beaver Meadows Borough, Lansford Borough, Lehighton Borough, Weissport Borough, Parryville Borough, and Bowmanstown Borough are considered to have *low wildfire hazard potential*.

Figure 4.3.7-5 Wildfire hazard potential per municipality in Carbon County.



The vulnerability assessment for wildfires is based on the aforementioned wildfire hazard classification and the proximity to forest land use. For this assessment, all structures and critical facilities that are located within the jurisdictions identified by DCNR-Bureau of Forestry as being “High-Hazard” and in proximity to areas of forestland are considered most vulnerable to wildfire events. Table 4.3.7-3 illustrates the vulnerable structures and critical facilities. Penn Forest has the highest number of structures in this vulnerable area with 2,044 structures, however, there are seven municipalities with a higher percentage of their structures in vulnerable area: East Penn, Franklin, Kidder, Lehigh, Towamensing, Lausanne, and Packer Townships.

Approximately 26 percent of all critical facilities are in the vulnerable area. Six municipalities have over 50 percent of their critical facilities in the vulnerable area: Banks, East Penn, Lausanne, Penn Forest, Packer, and Kidder Townships. For a complete list of critical facilities and their vulnerability to wildfire hazards, please see **Appendix E**.

Table 4.3.7-3 Number of structures and critical facilities in proximity to forested land use located within Wildfire High-Hazard Area.

MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES IN WILDFIRE HAZARD AREAS	PERCENT STRUCTURES IN AREAS	TOTAL CRITICAL FACILITIES	CRITICAL FACILITIES IN WILDFIRE HAZARD AREAS	PERCENT CRITICAL FACILITIES IN AREAS
Banks Township	764	18	2.36%	6	3	50.00
Beaver Meadows Borough	412	1	0.24%	2	0	0.00
Bowmanstown Borough	555	0	0.00%	2	0	0.00
East Penn Township	2,095	587	28.02%	7	4	50.00
East Side Borough	195	0	0.00%	1	0	0.00
Franklin Township	3,163	920	29.09%	10	2	20.00
Jim Thorpe Borough	2,388	263	11.01%	17	1	5.88
Kidder Township	3,040	1,091	35.89%	18	14	77.78
Lansford Borough	1,603	0	0.00%	5	0	0.00
Lausanne Township	218	84	38.53%	2	1	50.00
Lehigh Township	396	148	37.37%	7	2	28.57
Lehighton Borough	2,397	0	0.00%	11	0	0.00
Lower Towamensing Township	2,116	420	19.85%	6	2	33.33
Mahoning Township	2,632	1	0.04%	11	0	0.00
Nesquehoning Borough	1,409	71	5.04%	14	6	42.86
Packer Township	740	295	39.86%	4	3	75.00
Palmerton Borough	2,734	3	0.11%	11	0	0.00
Parryville Borough	347	1	0.29%	3	0	0.00
Penn Forest Township	7,751	2,044	26.37%	12	7	58.33
Summit Hill Borough	1,580	1	0.06%	8	0	0.00

Table 4.3.7-3 Number of structures and critical facilities in proximity to forested land use located within Wildfire High-Hazard Area.						
MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES IN WILDFIRE HAZARD AREAS	PERCENT STRUCTURES IN AREAS	TOTAL CRITICAL FACILITIES	CRITICAL FACILITIES IN WILDFIRE HAZARD AREAS	PERCENT CRITICAL FACILITIES IN AREAS
Towamensing Township	2,697	1,037	38.45%	9	1	11.11
Weatherly Borough	1,234	0	0.00%	6	0	0.00
Weissport Borough	203	0	0.00%	3	0	0.00
TOTAL	40,669	6,985	17.18%	175	46	26.14

The CCEMA estimates that the numerous and ever-expanding private developments that are being built in heavily wooded areas, especially in Kidder and Penn Forest Townships, present a higher risk and vulnerability to residents and property. Fires that occur in these areas are especially hard to extinguish because there is no municipal water supply with which to fight fires in these outlying areas. Unpressurized water sources, such as lakes; ponds; and streams; accessed via “dry hydrants” provide a viable alternative to firefighting in areas where there is no municipal water supply. Dry hydrants are permanent installations that allow firefighters to draft water from a nearby stream or lake (NFPA, 2015). During the planning process, the HMSC stated that a dry hydrant was recently installed in Towamensing Township, which also benefits neighboring Franklin Township and Beltzville State Park. Additionally, the HMSC noted that if local municipal fire chiefs had the ability to declare burn bans if their geographic area is more susceptible at the time to wildfires than the rest of the county, that this may result in better prevention of future fires.

Carbon County is Pennsylvania’s most active jurisdiction in the Firewise Program. This program addresses the risk of homes in the wildland/urban interface to wildfire. It encourages building, landscape, and design standards that decrease the risk of ignition for homes in fire-prone areas. The HMSC indicated that the County hosts six Firewise Communities (DCNR-DOF, 2015):

- Bear Creek Lakes, Jim Thorpe, 2003
- Hickory Run Land & Homeowners Association, Jim Thorpe, 2004
- Penn Forest Streams, Jim Thorpe, 2003
- Towamensing Trails, Albrightsville, 2009
- Indian Mountain Lakes, Penn Forest Township
- Pleasant Valley West

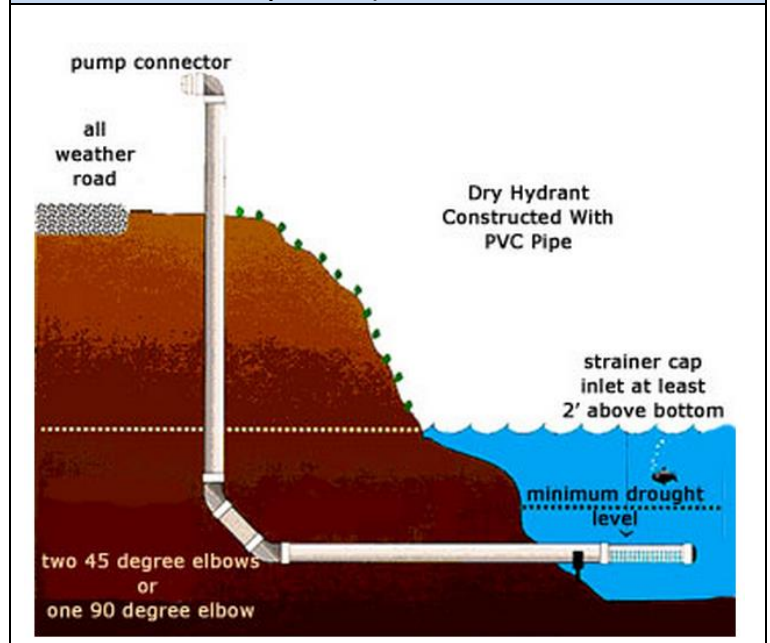
4.3.8. Winter Storm

4.3.8.1. Location and Extent

Winter storms are regional events that affect most of the Commonwealth on an annual basis. Every county in the Commonwealth is subject to severe winter storms, including Carbon. In many cases, surrounding states and even the larger northeastern U.S. region are affected.

Within Carbon County there are slight variations in the average amount of snowfall that is received throughout different parts of the County because of terrain differences. Generally, the average annual snowfall in the County increases from south to north (see Figure 4.3.7-1). From 1981-2010, annual

Figure 4.3.7-6 Illustration of Dry Hydrant (Miller Grove Volunteer Fire Department)



snowfall in Carbon County averaged between 31 and 40 inches in the southern part of the county, and between 41 and 50 inches in the northern part of the county. This is a reduction in average annual snowfall from the previous thirty-year average annual snowfall observation where areas in the southern part of the county averaged between 40 and 50 inches and areas in the northern part of the county could reach up to 70 inches.

4.3.8.2. Range of Magnitude

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

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

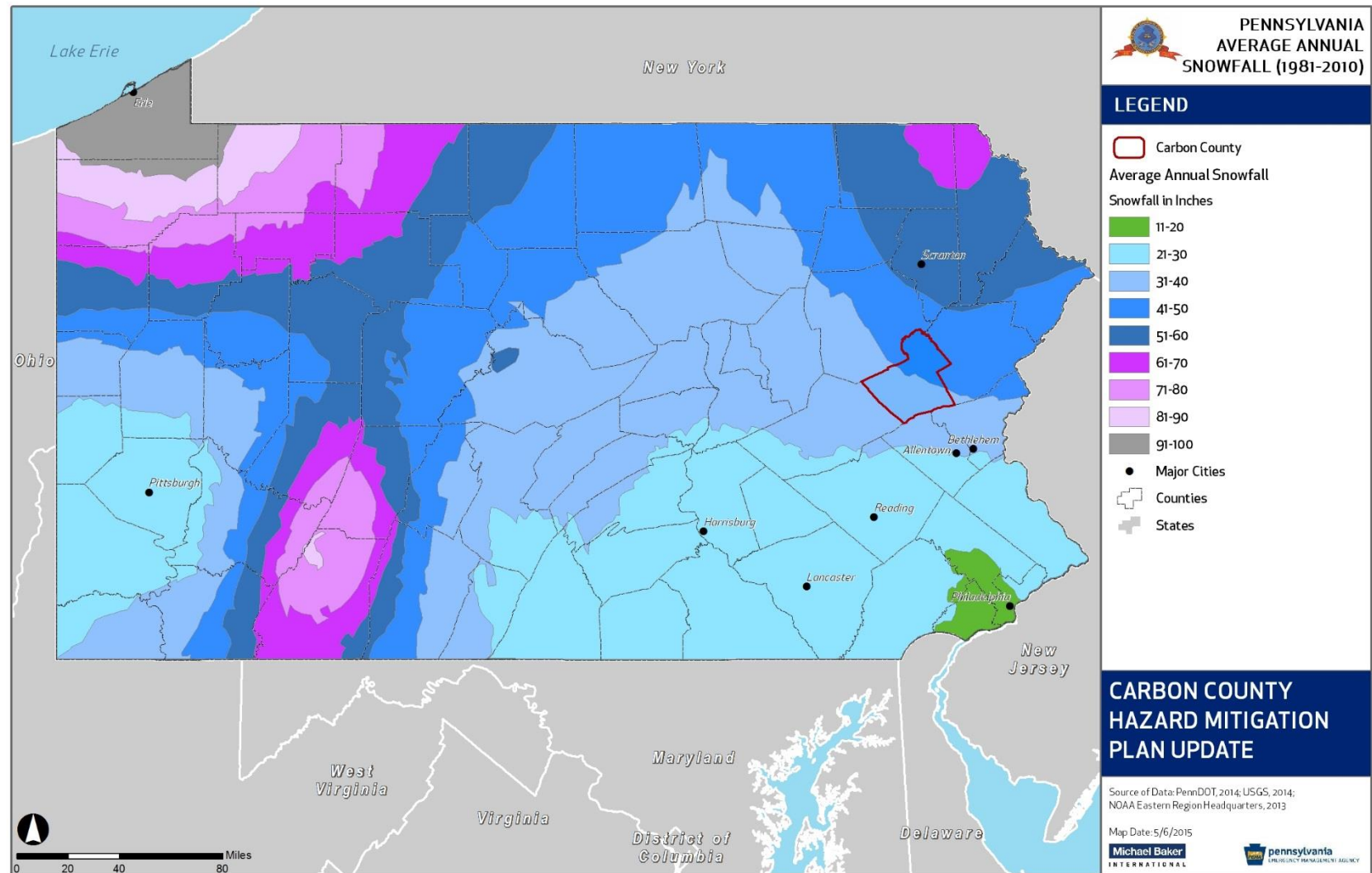
- **Heavy Snowstorm:** Accumulations of four inches or more in a six-hour period, or six inches or more in a twelve-hour period.
- **Sleet Storm:** Significant accumulations of solid pellets which form from the freezing of raindrops or partially melted snowflakes causing slippery surfaces posing hazards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

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

Figure 4.3.8-1 shows mean annual snowfall in Carbon County to range from 31 to 50 inches. Four of the seventeen Presidential Disaster and Emergency Declarations affecting Carbon have been in response to hazard events related to winter storms (see Table 4.2-1). In addition to the events described above, other winter storm events, including those associated with Disaster Declarations, are listed in **Appendix G**.

The worst case scenario of a winter storm in Carbon County occurred on January 5, 2005. A major winter storm hit Carbon County and a state of emergency was declared for Carbon and Monroe Counties. Heavy ice build-up resulted in power outages and nearly three-quarters of the County was without power at one point. Downed trees prevented work crews and emergency responders from getting to certain areas for several days to a week (CCEMA, 2009). The storm resulted in \$5 million of property damage. The County Emergency Operations Center was activated to coordinate shelters, essential travel, and evacuations.

Figure 4.3.8-1 Mean Annual Snowfall for Pennsylvania and Carbon County (NOAA –NWSFO).



4.3.8.3. Past Occurrence

Carbon County and the Commonwealth of Pennsylvania have a long history of severe winter weather. In the winter of 1993-1994, the commonwealth was hit by a series of protracted winter storms. The severity and nature of these storms combined with accompanying record-breaking frigid temperatures posed a major threat to the lives, safety, and well-being of Commonwealth residents and caused major disruptions to the activities of schools, businesses, hospitals and nursing homes.

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

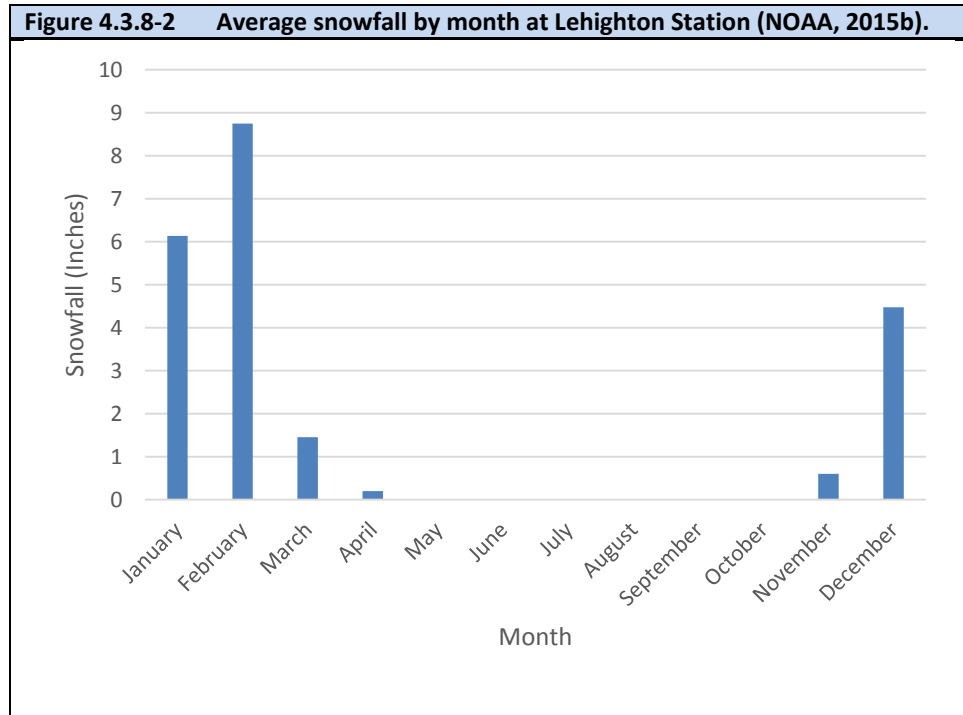
Serious power supply shortages continued through mid-January because of record cold temperatures at many places, causing sporadic power generation outages across the Commonwealth. The entire Pennsylvania-New Jersey-Maryland grid and its partners in the District of Columbia, New York and Virginia experienced 15-30 minute rolling blackouts, threatening the lives of people and the safety of buildings. Power and fuel shortages affecting Pennsylvania and the East Coast power grid system required the Governor to recommend power conservation measures be taken by all commercial, residential, and industrial power consumers.

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

Significant winter storm events that have affected Carbon County since 1996 are listed in **Appendix G – Carbon County Winter Storms**. The NCDC data on past occurrence for winter storm events since 1996 is the only comprehensive list of data available for the county aside from information from past disaster declarations. Many of the winter storms have been localized storms that have only affected Carbon County and Monroe County. This is because of the generally higher elevations and terrain of these two counties in the Pocono Mountain region of the Commonwealth. Prior to 1996, the County experienced significant winter storms in 1972, 1977, 1978, 1993, and 1996 (CCEMA, 2009).

4.3.8.4. Future Occurrence

Winter storms are a regular, annual occurrence in Carbon County and should be considered *highly likely* as defined by the Risk Factor methodology probability criteria (see Table 4.4-1). The chart in Figure 4.3.8-2 shows the average measured snowfall at the weather station in Lehighton for the last fifteen years.



4.3.8.5. Vulnerability Assessment

Based on the information available, all communities in Carbon County are essentially equally vulnerable to the direct impacts of winter storms. Residents of the mountainous areas of the County may be more susceptible, especially when emergency medical assistance is required. In addition, some rural areas of the County are susceptible to isolation caused by winter storms including: Lehigh, Lower Towamensing, Kidder, and Penn Forest Townships. Kidder and Penn Forest Townships have heavily wooded private developments which make emergency response to the areas difficult when roadways are blocked by downed trees and wires (CCEMA, 2009).

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

HUMAN-MADE HAZARDS

4.3.9. Building and Structure Collapse

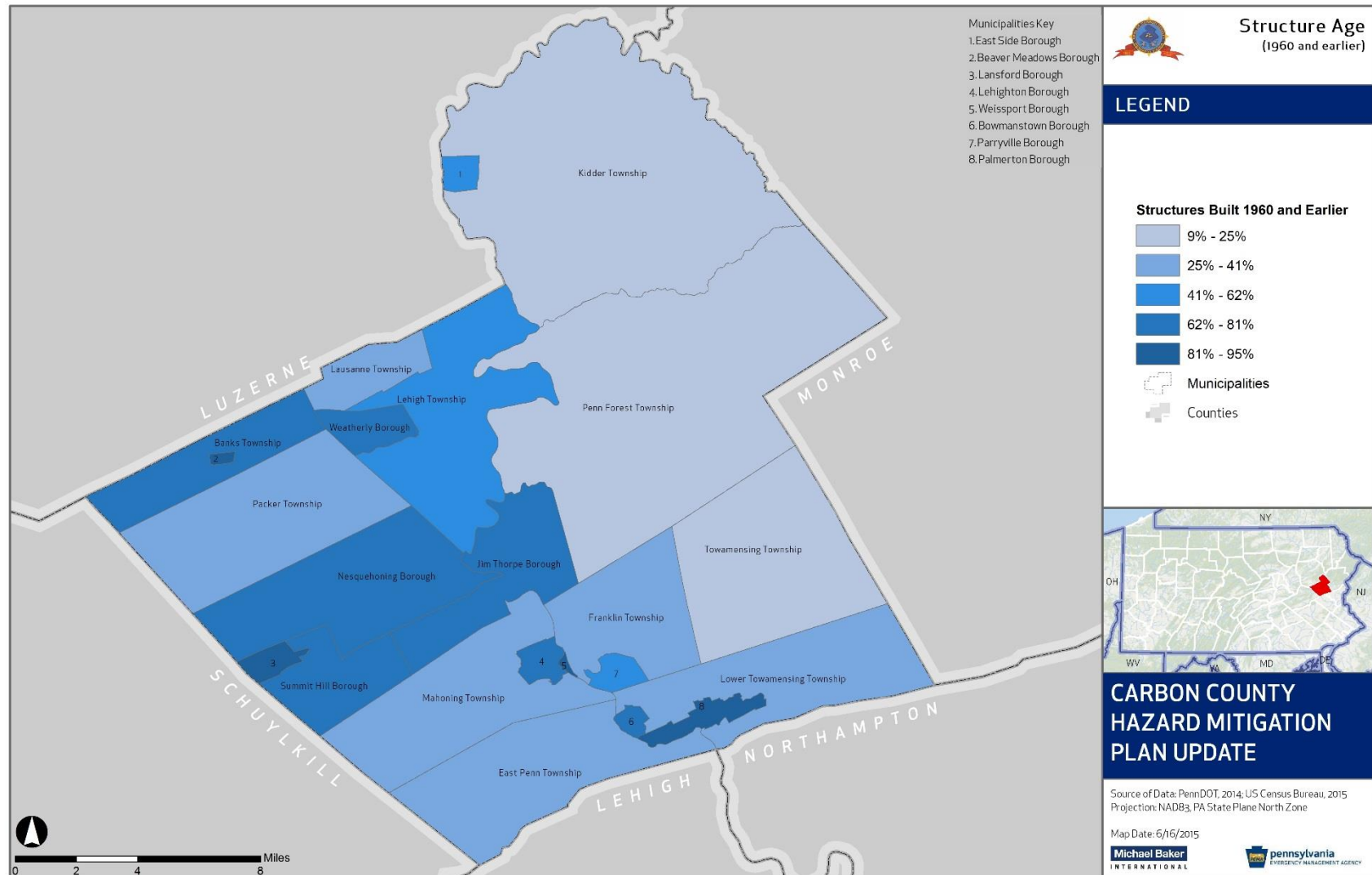
4.3.9.1. Location and Extent

Buildings and other engineered structures, including bridges, may collapse if their structural integrity is compromised, especially due to effects from other natural or human-made hazards. Older buildings or structures, structures that are not built to standard codes, or structures that have been weakened are more susceptible to be affected by these hazards.

Adherence to modern building codes can lower a building's risk to collapse. Building codes – developed by the International Code Council in partnership with FEMA and other federal, state, local, and private authorities – specify the minimum legal design and construction requirements for structural integrity, construction materials, and fire protection (FEMA, 2014). Most buildings constructed after 1961 in Carbon County were built under modern building codes as adopted in the Pennsylvania Uniform Construction Code. Figure 4.3.8-1 shows proportionally which municipalities have higher percentages of buildings constructed before 1961 in Carbon County.

Bridges serve to connect both large and small roadways and communities throughout the County. Whether they span another roadway or a body of water, bridges are a crucial part of every transportation system. However, many of Pennsylvania's bridge structures are aging and in great need of repair. Inspection and maintenance are necessary to observe and mitigate the extent of the disrepair, especially on older structures.

Figure 4.3.9-1 Buildings Constructed Before 1960.



4.3.9.2. *Range of Magnitude*

There are different effects of a collapse, depending on the type and cause of the collapse and the type of structure that collapses. A building collapsing in on itself will likely result in debris field which is dense but has a small footprint. However, if a building collapses in an outward direction, the debris field will be more widely scattered (University of Michigan, 2011). Both of these types of collapses can cause injury to and endanger the lives of those inside or near to the structure and can result in damages to nearby property, especially if the collapse causes a large amount of debris near a populated area. Though occupied buildings are less likely to collapse since they would generally be maintained, more risk of death or injury would be likely with the sudden collapse of an occupied building.

Disrepair can critically affect the integrity of the bridge structure. The level of disrepair depends on how much of the structure is damaged and how critical that portion of the structure is to the safety of drivers. Some structures only need deck replacement or a new superstructure, while others have substructure problems and should be entirely replaced. There is one closed bridge in Carbon County due to structural integrity (PennDOT, 2015).

A worst case scenario for a bridge structure collapse is for a high traffic bridge to collapse during rush hour causing many injuries and several deaths. A worst case scenario for a building collapse would be for a building with multiple people in it to collapse in a denser area causing injuries and possible death to those in the building as well as around the area.

4.3.9.3. *Past Occurrence*

A notable collapse occurred at a residence in Penn Forest Township in July 2014. A deck collapsed during a child's birthday party injuring six of the attendees. No additional hazards were identified as contributing to the collapse, and the cause of the structural deficiency was not immediately identified (Miller, 2014).

4.3.9.4. *Future Occurrence*

Structures and buildings can collapse due to deterioration of bridge critical load bearing members and building structural integrity, but external occurrences can also impact bridges and buildings. Pennsylvania has the third-largest number of bridges in the nation, but the most bridges classified as "structurally deficient" (PennDOT, 2015). Consequently, the entire state will see an increased focus on prevention of structure collapse. With at least 25 percent of its bridges in need of repair, Carbon County will continue to face deteriorating structures in the future if these are not addressed.

There have not been many notable issues with building structural integrity in Carbon County, but without proper maintenance and code enforcement this risk can grow. The HMPT noted the anecdotal increase in the amount of blighted and abandoned buildings, which increases the risk of a building collapse in Carbon County. The future occurrence of building and structure collapse can be considered *unlikely* as defined by the Risk Factor methodology probability criteria (see Table 4.4-1).

4.3.9.5. *Vulnerability Assessment*

The most vulnerable areas of the County are those with the highest concentration of deteriorating structures. Structures can either collapse into themselves or in an outward direction depending on the cause of the collapse. Construction activities, earthquakes, and subsidence can lead to a structure

collapsing in on itself. Weather related hazards, including snowfall and wind, and terrorism can cause a building to collapse in an outward direction (University of Michigan, 2011). Since the HMPT determined that Carbon County was not at great risk to earthquakes, subsidence, or terrorism, the greatest risk for collapse is from cascading effects on structures, especially those with lower pre-existing structural integrity, by construction activities, from heavy snowfall during winter storms, from an imbalance of water forces on either side of a structural wall, and from high winds during storms.

In Carbon County, the majority of bridges, over 80%, are owned and maintained by the state, the rest are owned and maintained by the County or local municipalities. PennDOT defines the following bridge terminology for the operational status of bridges:

- Open – bridge is open to traveling public
- Closed – bridge is closed to vehicular traffic (barriers and signs put in place); pedestrian traffic may or may not be allowed
- Posted – bridge is open but signs have been placed stating a weight limit that can travel across the bridge

Additionally, PennDOT defines Structurally Deficient as an indication of the bridge's overall status in terms of structural soundness and ability to service traveling public. If a bridge is marked as structurally deficient, that indicates that the bridge has deterioration to one or more of its major components (PennDOT, 2011).

Table 4.3.9-1 shows the numbers of closed and structurally deficient bridges owned by the state and the County and local municipalities. Countywide, over 25 percent of the bridges are structurally deficient. Structurally deficient bridges are often still safe for vehicles to cross over, but will need work in the near future. One bridge was closed to vehicular traffic due to its structural deficiencies (PennDOT, 2015).

Table 4.3.9-1 The state of bridge structure deterioration in Carbon County (PennDOT, 2015).					
BRIDGE OWNER	TOTAL BRIDGE STRUCTURES	CLOSED BRIDGES	POSTED	STRUCTURALLY DEFICIENT BRIDGE STRUCTURES	% STRUCTURALLY DEFICIENT
State Owned	136	0		31	22.79
County and Local Owned	29	1		11	37.93
TOTAL	165	1		42	25.45

In Table 4.3.9-2, the numbers of structurally deficient and functionally obsolete structures owned by the state and by the County or local municipalities are given, broken down by municipality, along with the total number of bridges in each municipality.

Table 4.3.9-2 The state of bridge structure deterioration in Carbon County (PennDOT, 2015).

COMMUNITY	TOTAL BRIDGE STRUCTURES	TOTAL LOCAL & COUNTY OWNED	LOCAL & COUNTY FUNCTIONALLY OBSOLETE	LOCAL & COUNTY STRUCTURALLY DEFICIENT	TOTAL STATE OWNED	STATE FUNCTIONALLY OBSOLETE	STATE STRUCTURALLY DEFICIENT
Banks Township	6	1	0	0	5	1	1
Beaver Meadows Borough	6	0	0	0	6	2	1
Bowmanstown Borough	1	0	0	0	1	0	1
East Penn Township	14	1	0	0	13	1	2
East Side Borough	8	2	0	1	6	0	2
Franklin Township	13	4	0	2	9	1	3
Jim Thorpe Borough	8	3	0	2	5	0	3
Kidder Township	6	0	0	0	6	0	3
Lansford Borough	22	2	0	0	20	3	5
Lausanne Township	20	3	2	0	17	4	5
Lehigh Township	21	4	0	2	17	5	5
Lehighton Borough	10	5	0	4	5	2	0
Lower Towamensing Township	11	0	0	0	11	3	0
Mahoning Township	1	0	0	0	1	0	0
Nesquehoning Borough	1	0	0	0	1	0	0
Packer Township	2	0	0	0	2	0	0
Palmerton Borough	7	4	0	0	3	0	0
Parryville Borough	4	0	0	0	4	0	0
Penn Forest Township	4	0	0	0	4	0	0
Summit Hill Borough	0	0	0	0	0	0	0
Towamensing Township	0	0	0	0	0	0	0
Weatherly Borough	0	0	0	0	0	0	0
Weissport Borough	0	0	0	0	0	0	0
TOTALS	165	29	2	11	136	22	31

4.3.10. Dam Failure

4.3.10.1. Location and Extent

The Dam Failure profile can be found in **Appendix H**.

4.3.10.2. *Range of Magnitude*

The Dam Failure profile can be found in **Appendix H**.

4.3.10.3. *Past Occurrence*

The Dam Failure profile can be found in **Appendix H**.

4.3.10.4. *Future Occurrence*

The Dam Failure profile can be found in **Appendix H**.

4.3.10.5. *Vulnerability Assessment*

The Dam Failure profile can be found in **Appendix H**.

4.3.11. **Disorientation**

4.3.11.1. *Location and Extent*

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

Carbon County is largely rural and heavily wooded with steep mountains and numerous rivers and streams. Popular outdoor recreational activities include biking, rock-climbing, hiking hunting, fishing, and boating. Nearly 25 percent of Carbon County's land area is forested and includes 80 square miles that the County has designated as state game land, state forest, and state park land as shown in Figure 4.3.11-1. A section of the Appalachian Trail also passes through the County, specifically through East Penn Township, Lower Towamensing, and Palmerton Borough. The HMSC noted that there has been an increasing number of search and rescue operations in the eastern side of Franklin Township due to the new clubs and vacation destinations, including campgrounds, in the Beltzville area.

Another factor leading to people becoming lost or trapped in wilderness areas is their access to communication or wayfinding measures with devices over data or cellular networks. With multiple cellular networks and coverage plans available to the user, OpenSignal is a company that collects data from phone applications to identify cellular cover, signal strength, and nearby towers in relation to a phone's geographic location. According to OpenSignal, cellular reception in Carbon County is primarily limited to Jim Thorpe, Lehigh, and along the major roadways: Interstate 80, Interstate 476, and limitedly along U.S. 209. A map displaying the cellular signal in Carbon County can be seen in Figure 4.3.11-2.

Figure 4.3.11-1 Carbon County areas potentially vulnerable to disorientation.

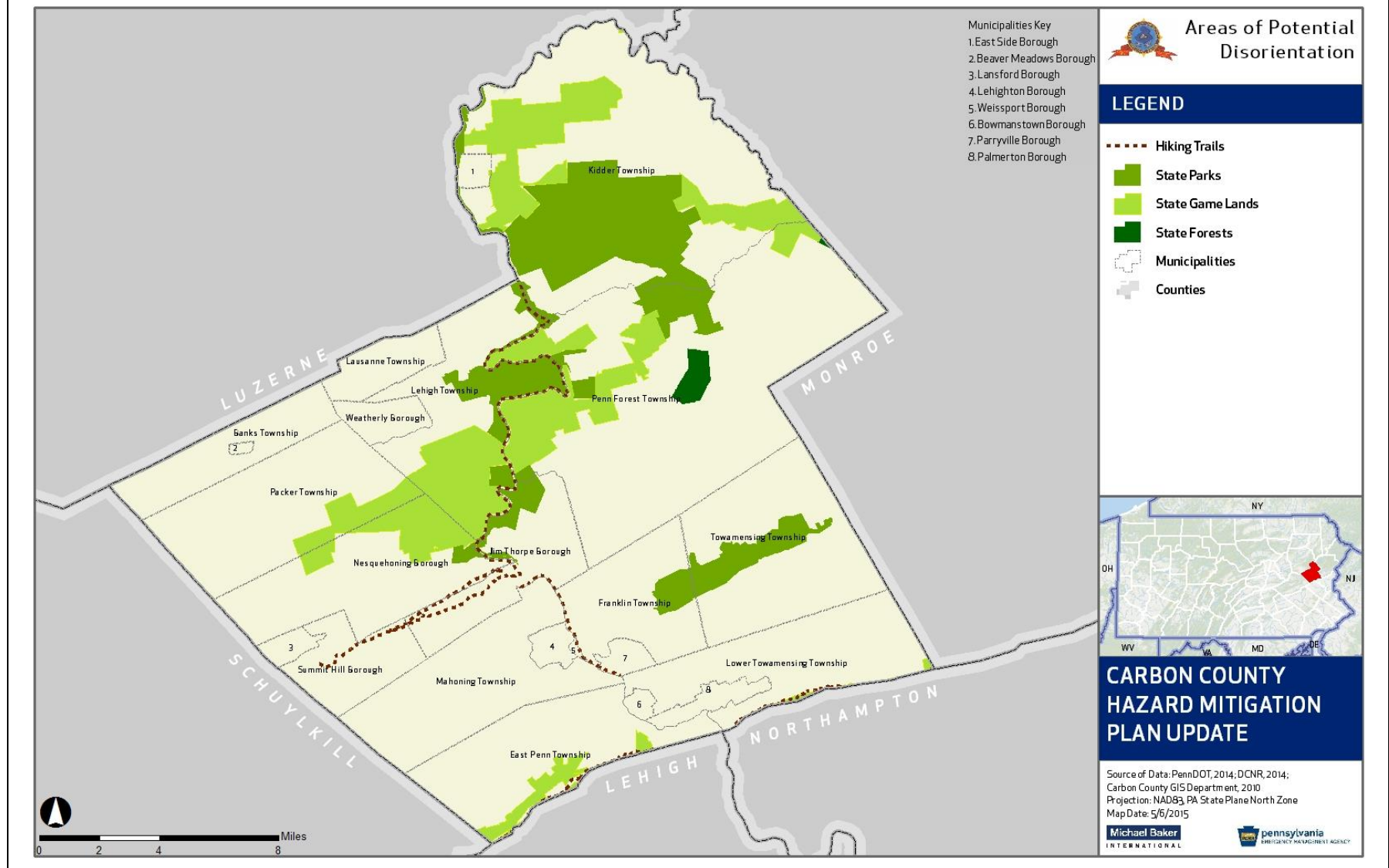
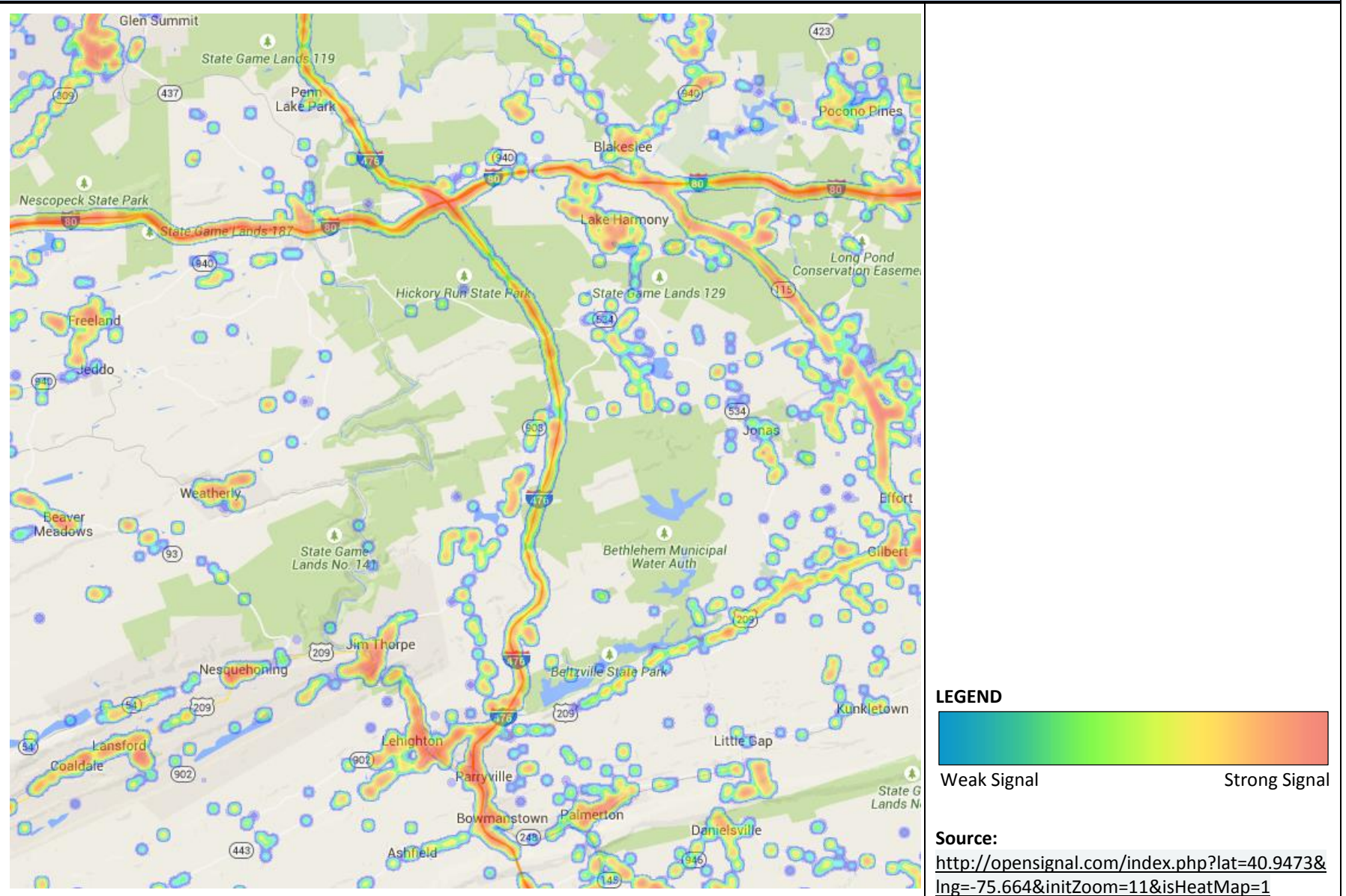


Figure 4.3.11-2 Map from OpenSignal showing cellular signal in Carbon County (OpenSignal, 2014).



4.3.11.2. Range of Magnitude

A wide variety of factors can contribute to outcome of a search and rescue mission but the most common dangers associated with disorientation are lack of food, water, shelter, and medical care. Carbon County generally has a constant abundance of water and during the warmer summer months shelter is less of a necessity than during winter months when extreme temperatures can pose a more serious threat. Age, physical fitness, and familiarity with the area can also have a bearing on the outcome. The worst case scenario associated with disorientation involves serious injury or death.

4.3.11.3. Past Occurrence

Each year several people become lost in Carbon County's wilderness areas. Associated Search and Rescue (SAR) operations use resources such as man-hours and equipment. According to available information no deaths have been reported as a result of disorientation in the County.

While a detailed, comprehensive list of incidents involving disorientation and SAR is not available, Valley Search & Rescue, a volunteer SAR organization has made available a call history that includes numerous events in Carbon County between 2005 and 2015. These events are listed below in Table 4.3.11-1.

Table 4.3.11-1 SAR events in Carbon County between 2005 and 2015 involving Valley Search & Rescue (VSAR, 2015).		
LOCATION	DATE	VSAR DESCRIPTION
Summit Hill Borough	7/1/2014	Missing 10 year old.
Nesquehoning Borough	6/5/2013	Missing teenage female.
Carbon County	12/13/2012	VSAR put on standby to assist Carbon County.
Carbon County	10/6/2011	VSAR put on standby to assist Carbon County.
Bowmanstown Borough	3/14/2011	Full team responded to search for a missing male.
Palmerton Borough	5/9/2010	Missing 20 year old male last seen on an ATV. Resources included equipment trailer, ATV, 4 K-9 and 13 support personnel. Subject found in good health.
Indian Mountain Lakes	10/14/2009	Two missing teenagers. Resources included 1 K-9 and 2 support personnel.
Indian Mountain	10/14/2010	Two missing teenagers. Resources included full team dispatch: multiple support personnel and K-9 units and command trailer.
Hickory Run State Park	9/30/2008	Subject located.
Jim Thorpe Borough	9/25/2008	Missing 57 year old male camper. Resources included 2 support personnel and 4 standby.
Towamensing Township	9/19/2008	Missing 4 year old male. Resources included 6 support personnel.
Franklin Township, Beltzville Lake	3/9/2008	Missing 11 year old male.
Weatherly Borough, Eurana Park	2/25/2008	Missing 52 year old male, 5 days. Resources included 6 support personnel and K-9. Subject found.

Table 4.3.11-1 SAR events in Carbon County between 2005 and 2015 involving Valley Search & Rescue (VSAR, 2015).		
LOCATION	DATE	VSAR DESCRIPTION
Jim Thorpe Borough	2/22/2008	Unknown subject data. Resources included 4 support personnel.
Mahoning Township, Summit Hill	1/4/2008	Missing 40 year old male. Unknown psychological disorder. Resources included 6 support personnel.
Jim Thorpe, Mauch Chunk Lake	7/12/2007	Missing male hiker, 10 days. Resources included 2 support personnel.
Nesquehoning Borough	7/25/2005	Missing young male hiker, possible injury. Resources included 4 support personnel

4.3.11.4. Future Occurrence

It is impossible to predict when and where disorientation may occur. During times when activities such as hunting, hiking, biking, and camping increase, so does the likelihood of individuals becoming disoriented. Carbon County continues to gain popularity as a tourist and recreational destination and therefore the probability of future occurrence is expected to increase proportionately. Based on available past occurrence data the probability of the County experiencing a disorientation incident is *likely* as defined by the Risk Factor methodology probability criteria (see Table 4.4-1).

4.3.11.5. Vulnerability Assessment

Individuals are most likely to become disorientated in areas of vast, open wilderness. Children and the elderly are more vulnerable to the exposure of elements. Bikers, hunters, hikers, and All-terrain vehicle (ATV) riders have been the most common victims of disorientation according to the CCEMA. Many outdoor, recreational activities commonly associated with disorientation take place during the warmer months of spring and summer and pose a somewhat lesser risk because of the average temperature range during these seasons. The most dangerous period to become lost outdoors is during the winter months when heat and shelter are vital. Carbon County often experiences winter storms and temperatures below freezing.

CCEMA estimates that the cost of disorientation and associated SAR is between \$50,000 and \$60,000 each year.

While prevention is the best solution to disorientation, lessening the impacts of this hazard by identifying and quickly locating individuals that have become lost or injured is equally important. There are several resources available on a state and local level for responding to SAR events. The DCNR is the primary coordinator for SAR operations efforts on state lands within Pennsylvania. The agency is responsible for over two million acres of forest land (DCNR, 2009).

Valley Search & Rescue is a volunteer organization based in Lehigh Valley, Pennsylvania just outside Carbon County that provides training and SAR assistance upon request. Additionally, the Pennsylvania Search and Rescue Council (PSARC) is made up of representatives from DCNR, PEMA, law enforcement, emergency managers and responders, and others. PSARC sets training and operational standards to SAR

teams throughout the Commonwealth in addition to mission response coordination, and providing SAR prevention and response education to local officials and the public (PSARC, 2010).

4.3.12. Drowning

4.3.12.1. Location and Extent

Drowning accidents can be categorized as unintentional, suicide, homicide, or undetermined depending on the circumstances (PA DOH, 2015). Unintentional drowning can be a significant hazard in communities with numerous water bodies (e.g. ponds, lakes, rivers, etc.) and extensive outdoor recreational activity. In addition, drowning accidents can occur in swimming pools at private residences as above ground pools such as “kiddie pools” and inflatable pools become more popular.

Carbon County has been and continues to grow in popularity as a tourist destination. Water related recreational opportunities such as fishing, boating, and swimming are popular among visitors. Carbon County is most concerned with the consistent drownings occurring in Beltzville Lake in Franklin Township; Mauch Chunk Lake Park; and in the Lehigh River, including in the canal in Franklin Township. There have also been notable but more infrequent drownings in the Francis E. Walter Dam and in the Lake Harmony resort community in Kidder Township.

4.3.12.2. Range of Magnitude

By definition, drowning generally results in death. However, non-fatal drownings can cause brain damage that may result in long-term disabilities including memory problems, learning disabilities, and loss of basic nervous system functions. In a typical year, counties in Pennsylvania can range from having zero to a hundred drowning incidents, depending on factors such as the physical environment (access to water bodies) and a combination of social and cultural issues (wanting to learn how to swim and interest in recreational water-related activities).

Drowning rates are particularly high for children between ages one and fourteen according to the Center for Disease Control (CDC, 2011). Across the state, thirty-three percent of residents who died from drowning were under 20 years of age (PA DOH, 2004). Approximately seventy-six percent of drowning accidents in Pennsylvania from 2001 to 2005 were unintentional, another fourteen percent were suicides, eight percent were from undetermined causes, and less than two percent were deemed homicides.

A worst case scenario would be if one or multiple deaths resulted from drowning. In 2001 two seventeen-year-old males drowned together while swimming at the Francis E. Walter Dam. One of the males was a trained lifeguard, who tried to save his friend who experienced cramping while swimming at the dam (The Morning Call, 2001).

4.3.12.3. Past Occurrence

There is no official federal, state, or county reporting system for drownings; however, Carbon County 911 tracked the amount of drownings that occurred between 2009 and 2014. In August 2015, a 15-year-old boy drowned at the Camp Shehaqua pool in Hickory Run State Park.

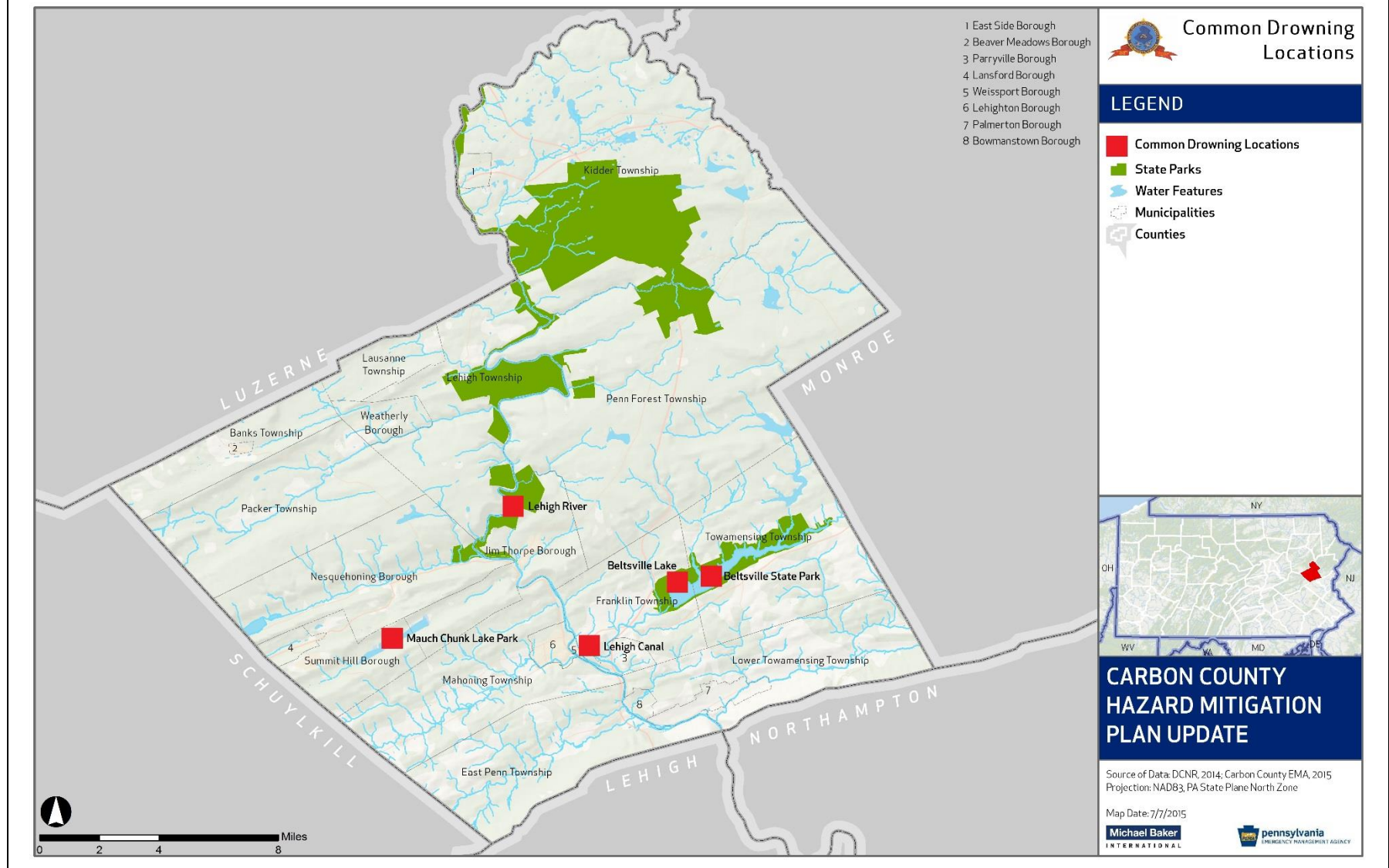
Table 4.3.12-1 shows the amount of recorded drownings in each of these years; the exception is 2012 which includes the total number of water rescues performed in addition to the amount of drownings.

Table 4.3.12-1 Incidents of drowning recorded in Carbon County (Carbon County 911, 2015).	
YEAR	NUMBER OF DROWNINGS
2009	4
2010	7
2011	5
2012	24 (Number includes water rescues in addition to drownings)
2013	11
2014	4
2015 (through Aug 2015)	2

4.3.12.4. Future Occurrence

It is impossible to predict when and where drowning may occur; however, given past occurrences of drownings in Carbon County, the majority have occurred at Beltzville State Park and Mauch Chunk Lake Park and in the Lehigh River, see Figure 4.3.12-1. During the warm summer months, as activities such as swimming, boating and fishing increase so does the likelihood of drowning. The future occurrence of drowning for Carbon County can be considered *unlikely* as defined by the Risk Factor methodology probability criteria (see Table 4.4-1).

Figure 4.3.12-1 Identified Locations of Common Drowning Incidents.



4.3.12.5. *Vulnerability Assessment*

As tourism continues to increase in the County and number of visitors grows, drowning is likely to continue without mitigation actions in place. Municipalities that border Beltzville State Park, Mauch Chunk Lake Park, and the Lehigh River are more vulnerable to drownings as their residents have easiest access to the water bodies, see Figure 4.3.12-1. However, residents from other municipalities and from outside the County also frequent the facilities.

4.3.13. **Environmental Hazards**

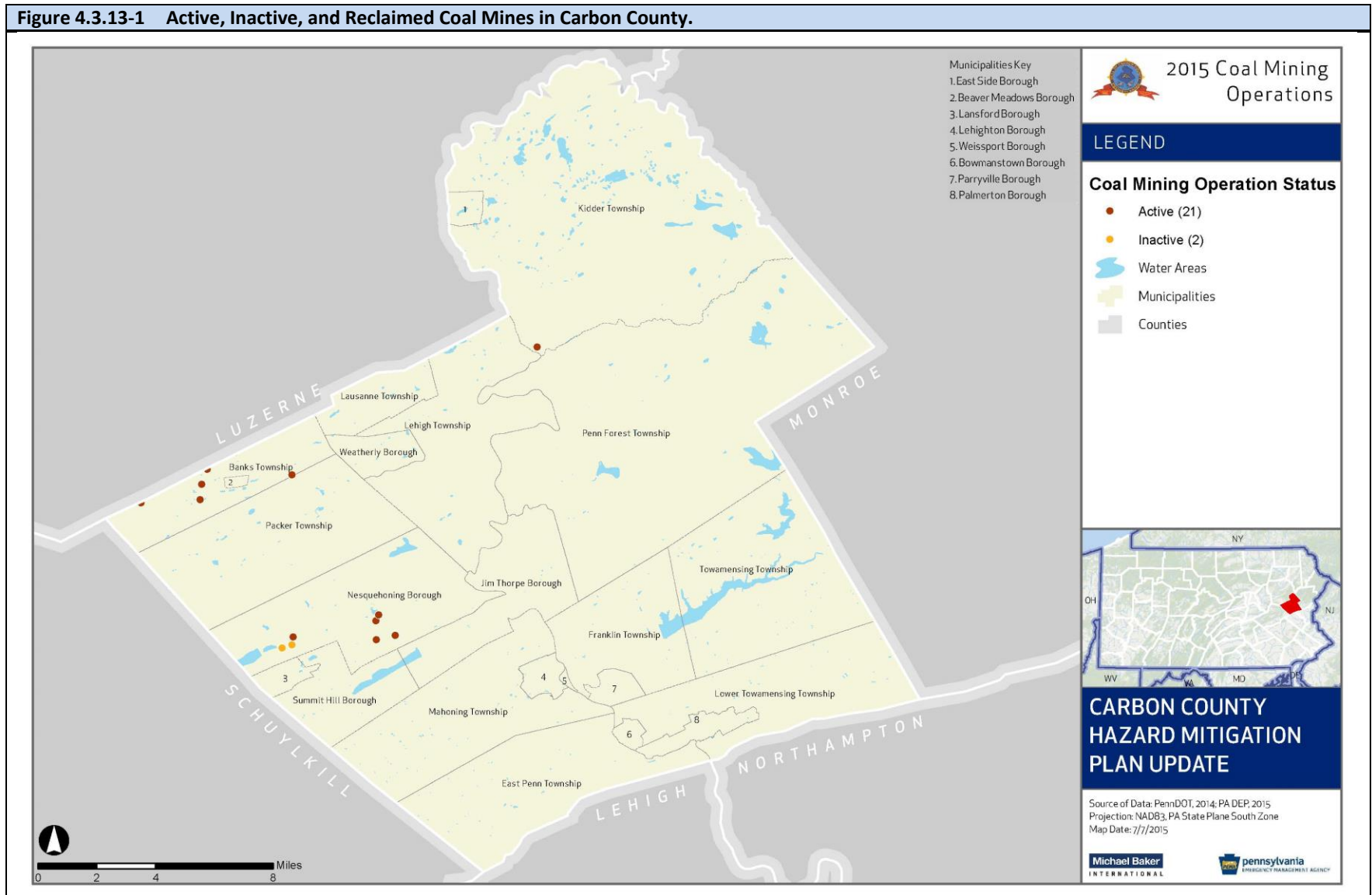
4.3.13.1. *Location and Extent*

Environmental hazards in Carbon County focus solely on coal mining. This hazard results from human activities and industries and can result in injury and death to humans and damage to property. Additional environmental hazards include hazardous material release, oil and gas well drilling, superfund facilities, manure spills, and product defect or contamination.

Mining, including surface, underground, and open-pit operations, was conducted in Pennsylvania before the 1680s and was instrumental in the development of the Commonwealth. As such, Pennsylvania was one of the first states to initiate, promulgate, and enforce environmental regulations related to mining, including mine reclamation. Active mining continues in Carbon County, which is located over Pennsylvania's anthracite coal field. Figure 4.3.13-1 shows the location of mining operations in the county. Of the mapped operations, 21 are active and 2 are inactive.

There remains a legacy of abandoned mines, waste piles, and degraded groundwater and surface water in the Commonwealth. The EPA estimates that over 3,000 miles of streams in Pennsylvania have been contaminated by acid mine drainage which occurs when metal sulfides in rock oxidize and generate acidity in water that comes in contact with them.

Figure 4.3.13-1 Active, Inactive, and Reclaimed Coal Mines in Carbon County.



4.3.13.2. Range of Magnitude

Major impacts from mining include surface-elevation changes and subsidence, modification of vegetation, the chemical degradation and flow redistribution of surface water and groundwater, the creation of mine voids and entry openings, adverse aesthetic impacts, and changes in land use.

In addition, active and abandoned mines can also result in injury and loss of human life. This can occur in active mines where workers are injured or killed by mine collapse, entrapment, poisonous gases, inundation, explosions, fires, equipment malfunction, and improper ventilation. Injuries and death, such as All-Terrain Vehicle (ATV) accidents and drowning, can also occur in abandoned mines.

The mineral-waste disposal from coal mining also is a hazard. Past disposal practices have dotted Pennsylvania's landscape with unsightly refuse piles. Many of the refuse piles contain combustible materials that cause long-term air-quality problems if ignited. Burning refuse piles have also been linked to major underground coal fires, such as those at Centralia and Shamokin in the Anthracite region of Pennsylvania.

Also as potentially dangerous are slurry ponds or tailings dams. Mineral byproducts from coal mining are pumped to slurry or tailings dams for removal by sedimentation. If the dams or structures supporting the slurry ponds fail, they pose hazards similar to dam failure (see Appendix H – Dam Failure Profile).

Reject wastes from coal mining that contain sulfide minerals can also degrade groundwater and surface water that comes into contact with them. Coal refuse piles have historically been prolific sources of acid mine drainage which has impaired many streams in Pennsylvania.

Pennsylvania has a long history of mining, and there have been numerous mining accidents. The worst case scenario event in Pennsylvania mining history occurred in 1962 in Centralia, Pennsylvania, when an underground fire began in the coal mines underneath the town. The federal government offered buyouts of homes of residents so they could relocate from Centralia, resulting in a cost of over \$40 million to carry this out and demolish homes. In 1992, Pennsylvania claimed eminent domain on all properties in the town and condemned all of the buildings. In 1981 the town had over 1,000 residents, but today only a few remain.

One of the worst mining accidents in the United States since 1950 occurred in nearby West Virginia. On April 5, 2010, twenty-nine miners were killed at the Upper Big Branch Mine by an explosion.

The environmental impacts of coal mining are many. Mining activities and acid mine drainage can contaminate surface and groundwater, create acid mine drainage, and cause changes in water temperature and damage to streams, lakes, ponds, estuaries, and wetland ecosystems. Mine explosions or burning refuse piles can cause air quality problems. Although mine reclamation is required for much surface mining activity, there is still a loss of quality in landscape, damage to vegetation, and habitat.

4.3.13.3. Past Occurrence

Although state and federal (U.S. Department of Labor, EPA, and the Office of Surface Mining and Reclamation) laws require occupational health, safety, and environmental protection in all mining activities, mining accidents still occur. The U.S. Department of Labor Mine Safety and Health

Administration tracks mining accidents and injuries. From 2006 to 2011, there were 1,347 operator injuries (including 5 deaths) reported in Pennsylvania resulting from surface and underground coal mining activities (MSHA, 2013). In addition, the PA DEP Bureau of Mine Safety tracks fatalities for both the anthracite and bituminous regions of Pennsylvania. In the bituminous region the most recent fatality was in February, 2015. It is unclear where in the region the fatality occurred, but it was in Southwestern Pennsylvania and illustrates that coal mining accidents still occur. There is no comprehensive database that tracks the data. Beyond operator accidents, there can be incidents that are a result of falls, drowning, electrocution, and ATV crashes.

The DEP Bureau of Mine Safety is required by law to investigate all fatal and serious accidents that occur at underground Commonwealth mines. According to the Bureau, there have been four major mine emergencies in Pennsylvania coal mines. They define a mine emergency as a serious situation or occurrence that happens unexpectedly and demands immediate action or a condition of urgent need for action or assistance such as a state of emergency. Two of these were mine fires and two were inundations (PADEP, 2010).

A recent mine fire in the County has impacted communities in Banks Township and Beaver Meadows. As of July 2015, a fire was ongoing both on abandoned and actively mined land at the Jeansville Mine off of Route 93 near the Luzerne County line. Smoke from the fire is emitting an intense sulfur smell in the area, which has caused concern among area residents about the impact to air quality. The Department of Environmental Protection is currently investigating the fire, meeting with local residents and conducting air quality testing (Dolgos-Kramer, 2015; Lee, 2015).

4.3.13.4. *Future Occurrence*

It is difficult to forecast the severity and frequency of coal mining accidents and environmental damage in Pennsylvania. Although throughout time, the government has strengthened mining and reclamation operation and environmental regulations, permitting, and inspection criteria, this has not prevented mining accidents and environmental damage from occurring.

Surface subsidence resulting from underground mining continues to be a major concern of those impacted by the mining industry. Despite the use of deep mine roof-support methods, some subsidence will eventually occur.

It is likely that Pennsylvania will continue to modify its laws to reflect additional environmental awareness. Stricter controls on reclamation, perhaps specifically addressing the disposal of mining residuals, are likely. State and federal laws and programs have historically placed an emphasis on environmental preservation and reclamation. As in the past, it seems likely that Pennsylvania will be at the forefront of these programs and future occurrence will decrease.

4.3.13.5. *Vulnerability Assessment*

The vulnerability of jurisdictions to coal mining incidents is defined as populations living within 1.5 miles of active coal mines. Table 4.3.13-1 provides this vulnerability information by community. As seen from the table, municipalities in the County that are most vulnerable to coal mining are Beaver Meadows Borough, Banks Township, and Nesquehoning Borough.

Table 4.3.13-1 Populations Vulnerable to Coal Mining			
MUNICIPALITY	2010 POPULATION	ESTIMATED POPULATION WITHIN 1.5 MILES OF AN ACTIVE COAL MINE	PERCENT POPULATION WITHIN 1.5 MILES OF AN ACTIVE COAL MINE
Banks Township	1,262	1,252	99.2%
Beaver Meadows Borough	869	869	100.0%
Bowmanstown Borough	937	0	0.0%
East Penn Township	2,881	0	0.0%
East Side Borough	317	0	0.0%
Franklin Township	4,262	0	0.0%
Jim Thorpe Borough	4,781	4	0.1%
*Kidder Township	1,935	2	0.1%
Lansford Borough	3,941	1,837	46.6%
Lausanne Township	237	0	0.0%
Lehigh Township	479	27	5.6%
Lehigh Township	5,500	0	0.0%
Lower Towamensing Township	3,228	0	0.0%
Mahoning Township	4,305	0	0.0%
Nesquehoning Borough	3,349	2,998	89.5%
Packer Township	998	399	40.0%
Palmerton Borough	5,414	0	0.0%
Parryville Borough	525	0	0.0%
Penn Forest Township	9,581	0	0.0%
Summit Hill Borough	3,034	91	3.0%
Towamensing Township	4,477	0	0.0%
Weatherly Borough	2,525	0	0.0%
Weissport Borough	412	0	0.0%
TOTAL	65,249	7,479	11.5%

4.3.14. Levee Failure

4.3.14.1. Location and Extent

Levees are structures designed to provide protection from temporary flooding. Breaches of these structures occur when they are overtopped or physically incapable of containing the pressure exerted by the floodwaters.

The R3levees website supports the implementation of the Guidelines for Identifying Provisionally Accredited Levees established in a FEMA procedure memorandum and tracks documentation demonstrating that levees provide protection from base – 1-percent-annual-chance – floods. According to RiskMAP3.com, there is only one levee in Carbon County located in Weissport Borough along the Lehigh River.

This levee project consists of an earth levee along 3,700 feet of the river edge, and includes a ponding area and various drainage structures as well as slope protection of the levee. This levee does not provide protection from 1%-annual-chance floods. Figure 4.3.13-1 shows the levee system and the flood zones along the Lehigh River and Figure 4.3.14-2 provides details of the base flood elevation and the 0.2%-annual-chance flood area, demonstrated in the X shaded area of the map.

Figure 4.3.14-1 Levee system in Carbon County along the Lehigh River.

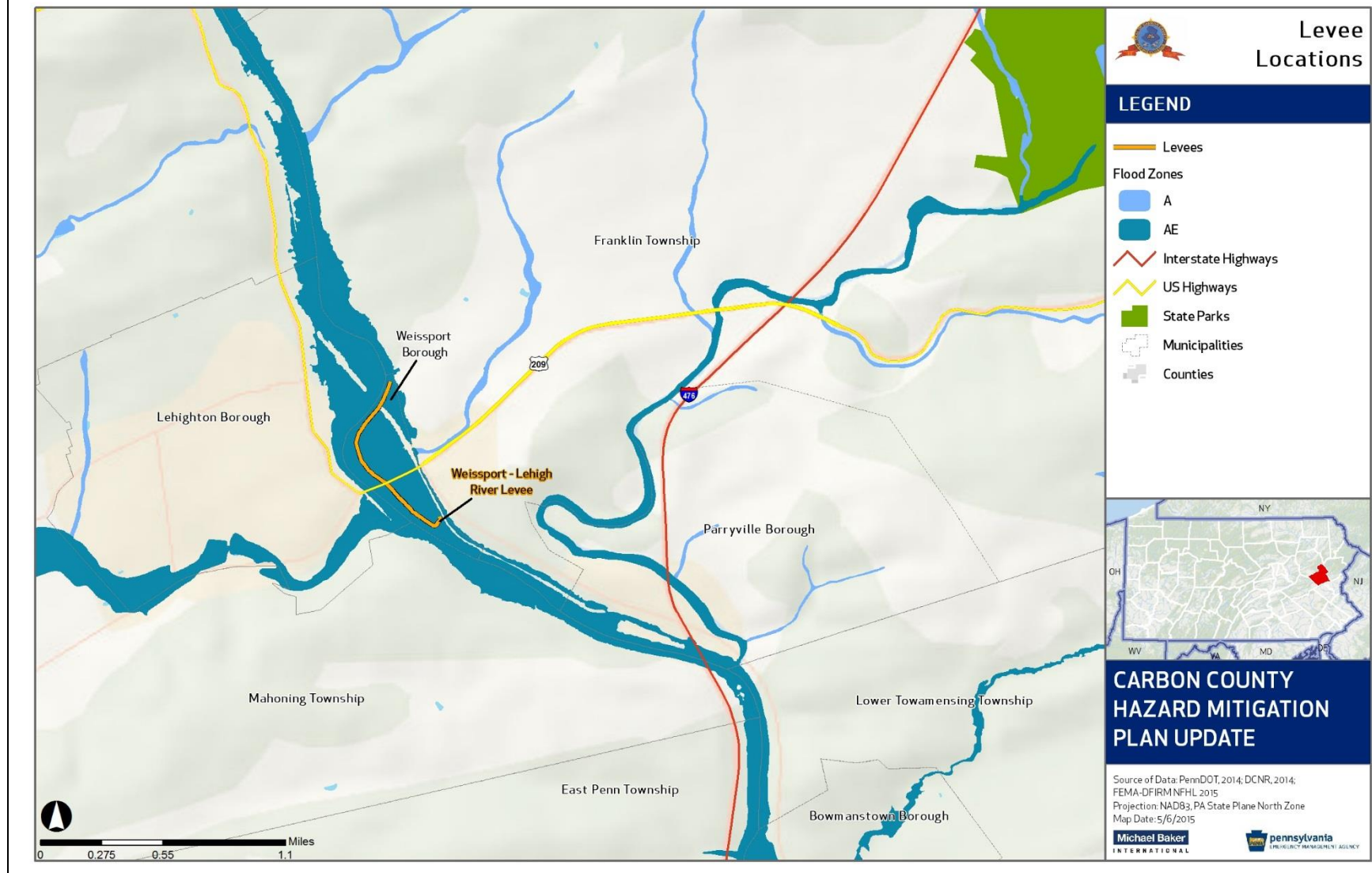
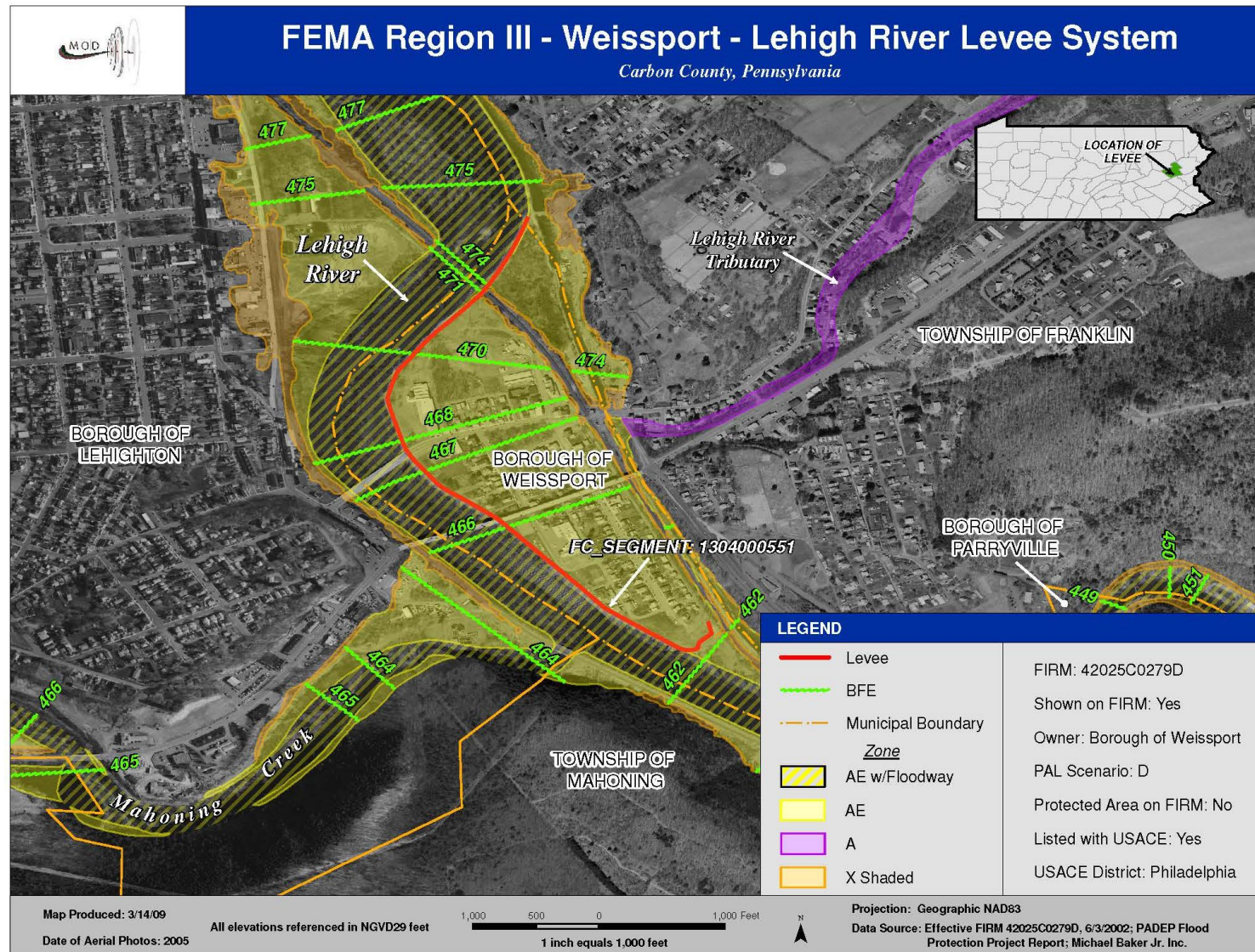


Figure 4.3.14-2 Levee system in Carbon County along the Lehigh River.



4.3.14.2. *Range of Magnitude*

A levee failure or breach causes flooding in landward areas adjacent to the structure. The failure of a levee or other flood protection structure could be devastating depending on the level of flooding for which the structure is designed and the amount of landward development present. In some instances, the magnitude of flooding could be more severe under a levee failure event compared to a normal flooding event. If an abrupt failure occurs, the rushing waters of a flood wave could result in catastrophic losses.

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

The worst-case levee failure is one which occurs abruptly with little warning and results in deep, fast-moving flood waters through a developed or populated area. The potential for this worst case scenario to occur in Carbon County is possible since the levee is located in a populated area of Weissport Borough.

4.3.14.3. *Past Occurrence*

There are no known previous levee failures in Carbon County.

4.3.14.4. *Future Occurrence*

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

4.3.14.5. *Vulnerability Assessment*

The Weissport Borough levee does not provide protection to the 1%-annual-chance event. However, this levee may provide some measure of protection during a lesser storm to structures in Weissport Borough, Banks Township, Franklin Township, and Lehigh Township. The HMP identifies the structures and critical facilities within 2,000 feet of the identified levee and floodwall system, shown in Table 4.3.14-1. This should be considered a broad estimate of structures potentially vulnerable to levee failures.

Table 4.3.14-1 Structures and Critical Facilities Vulnerable to Levee Failure.

MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES IN LEVEE PROTECTED AREA	PERCENT STRUCTURES IN PROTECTED AREA	TOTAL CRITICAL FACILITIES	CRITICAL FACILITIES IN LEVEE PROTECTED AREA	PERCENT CRITICAL FACILITIES IN PROTECTED AREA
Banks Township	764	17	2.23	6	0	0.00
Franklin Township	3163	482	15.24	10	1	10.00
Lehighon Borough	2397	553	23.07	11	1	9.09
Weissport Borough	203	203	100.00	3	3	100.00

4.3.15. Nuclear Incidents

4.3.15.1. Location and Extent

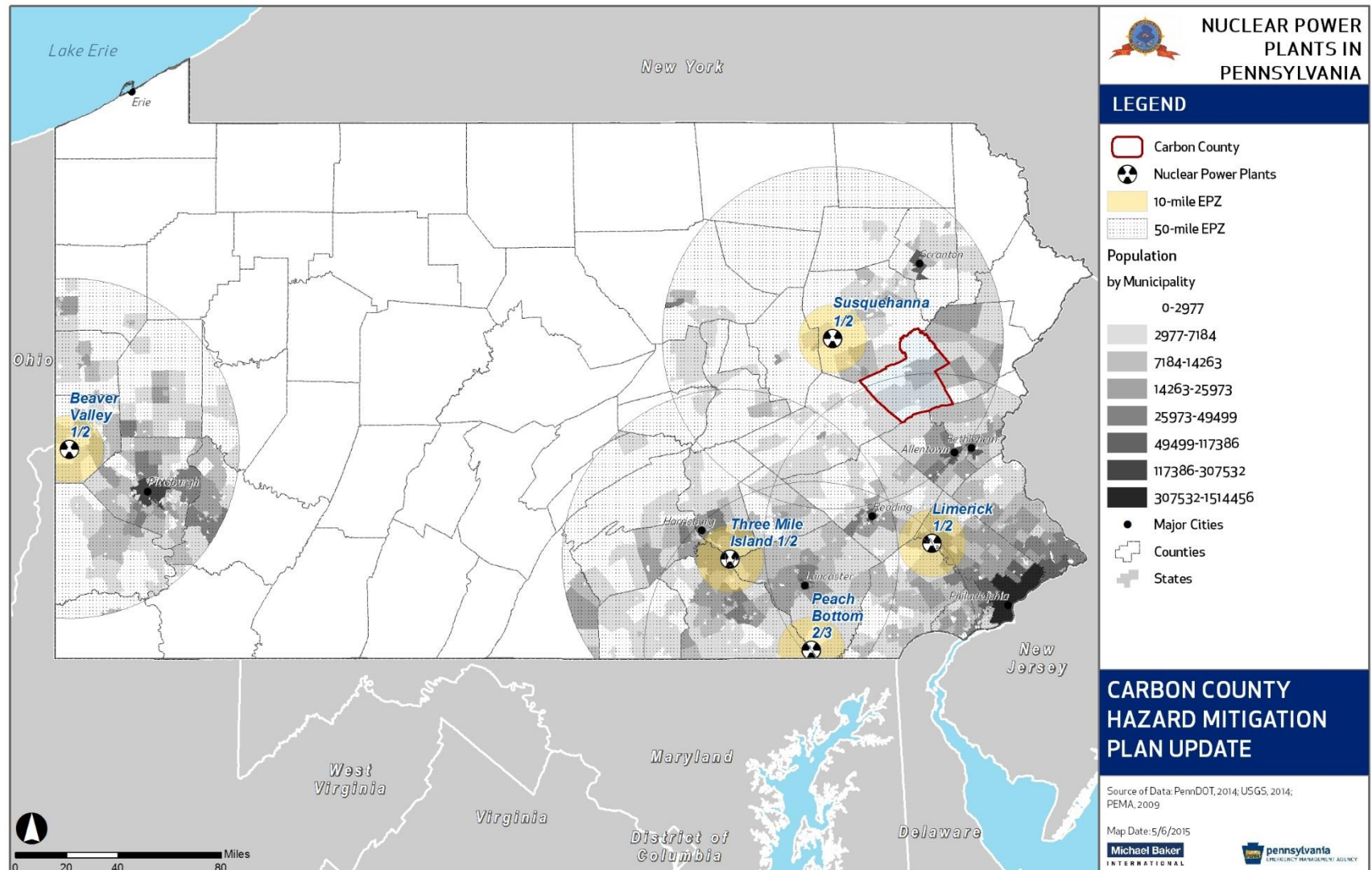
Nuclear Incidents generally refer to events involving the release of significant levels of radioactivity or exposure of workers or the general public to radiation. The primary concern following such an incident or accident is the extent of radiation, inhalation, and ingestion of radioactive isotopes which can cause acute health effects (e.g. death, burns, severe impairment), chronic health effects (e.g. cancer), and psychological effects (FEMA, 1997).

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

As seen in Figure 4.3.15-1, Carbon County is not located within the ten-mile Plume Exposure Pathway EPZ of any nuclear facility. However, it is completely within the fifty-mile Ingestion Exposure Pathway EPZ for the Susquehanna Steam Electric Station, located approximately twenty miles northwest of the County border, in Salem Township, Luzerne County, Pennsylvania. In addition, the bottom portion of the County's land area is located within the Ingestion Exposure Pathway EPZ of the Limerick Generating Station, located approximately forty miles to the southeast in Limerick Township, Montgomery County, PA. The remaining three nuclear plants in Pennsylvania are more than fifty miles away from Carbon County. This distance exceeds the Plume Exposure and Ingestion Exposure Pathway EPZs for nuclear emergencies; therefore,

these facilities are considered a minimal threat to the County. However, in the event of an emergency, evacuees from distant EPZs may seek shelter in Carbon County.

Figure 4.3.15-1 Carbon County's location in relation to the 10-mile and 50-mile EPZs of Pennsylvania Nuclear Power Plants.



4.3.15.2. Range of Magnitude

Nuclear accidents/incidents can be placed into three categories:

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

The magnitude of a nuclear incident differs for those within the Plume Exposure Pathway EPZ and those within the Ingestion Exposure Pathway EPZ. The Plume Exposure Pathway EPZ refers to whole-body external exposure to gamma radiation from a radioactive plume and from deposited materials and inhalation exposure from the passing radioactive plume. The duration of primary exposures could range in length from hours to months depending on the proximity to the point of radioactive release; however, the Plume Exposure Pathway EPZ is not a significant concern for Carbon County because it is located more than 10 miles from any nuclear facility.

Carbon County focuses on the impact of the Ingestion Exposure Pathway EPZ. This EPZ refers to exposure primarily from ingestion of water or foods such as milk and fresh vegetables that have been contaminated with radiation. This kind of exposure can stem from any of the three categories of nuclear accident.

Potential environmental impacts specific to the 50-mile Ingestion Exposure Pathway EPZ, and therefore of most concern to Carbon County, include the long-term effects of radioactive contamination in the environment and in agricultural products. Carbon County can expect some radioactive contamination in very small amounts in the case of a nuclear incident. This is not a significant concern in terms of external exposure and immediate health risks, but even a small amount of radiation will require the protection of the food chain, particularly milk supplies (CCEMA, 2009). Small amounts of radiation ingested over time could lead to future health issues in humans. In particular, there is an increased cancer risk over decades for people who have ingested radiation. The damage to cells and internal organs may be mild to severe, depending on the amount of radiation ingested and the number of years over which the ingestion occurred. As a result, in the case of a nuclear incident, foodstuffs, crops, milk, livestock feed and forage, and farm water supplies will need to be protected from and tested for contamination. Additionally, spills and releases of radiologically active materials from accidents can result in the contamination of soil and public water supplies. Areas underlain by limestone and some types of glacial sediments are particularly susceptible to contamination.

Nuclear facilities must notify the appropriate authorities in the event of an accident. NRC uses four classification levels for nuclear incidents (NRC, 2014):

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

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

4.3.15.3. *Past Occurrence*

To date, Carbon County has not been directly affected by a nuclear incident. There has been one nuclear incident above the *Alert* classification in the United States. In March 1979, a *General Emergency* event occurred at Three Mile Island - Unit 2. This event is the most serious commercial nuclear accident in United States history. During this incident, equipment malfunctions, design-related problems, and worker errors led to a partial meltdown of the Three Mile Island Unit 2 reactor core at Three Mile Island. The resulting contamination and state of the reactor core led to the development of a ten-year cleanup and scientific effort. Despite the severity of the damage, no injuries due to radiation exposure occurred. There were however, significant health effects reported due to the psychological stress on the individuals living in the area.

4.3.15.4. *Future Occurrence*

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

Across the United States, a number of *Unusual Event* and *Alert* classification level events occur each year at the 100+ nuclear facilities that warrant notification of local emergency managers. Of these, *Alert* emergencies occur less frequently. For example, in 1997, there were forty notifications of *Unusual Events*

and three *Alert* events nationwide. Based on historical events, *Site Area Emergency* and *General Emergency* incidents are very rare. Therefore, the future occurrence of nuclear incidents that affect Carbon County can be considered *unlikely* as defined by the Risk Factor methodology probability criteria (see Table 4.4-1).

4.3.15.5. Vulnerability Assessment

Carbon County is located entirely within the Ingestion Pathway EPZ of the Susquehanna Steam Electric Station, and 75% of the County's population is located within the Ingestion Pathway EPZ of the Limerick Generating Station. As a result, the entire County is vulnerable to the contamination effects possible in a nuclear incident.

As stated in Section 4.3.9.2, the County's primary vulnerability to nuclear incidents comes in the form of food, soil, and water contamination. In terms of vulnerable land, the 21,162 acres of farmland held in Carbon County's 195 farms is vulnerable to radiological contamination in a nuclear incident. In 2007, the market value of all agricultural products of these farms exceeded \$9.3 million. Additionally, Carbon County hosts 32,576 acres of what the National Resources Conservation Service (NRCS) considers "Prime Farmland," whether or not this land is currently being used to grow crops, which could become contaminated.

Water contamination is also a concern in nuclear incidents. There are twelve public water suppliers that operate in the County or provide water to municipalities in the County. These include: Beaver Borough Municipal Authority, Beaver Run Water Association, Bethlehem Water and Sewer Department, Bowmanstown Water Authority, Hazleton City Water Authority, Jim Thorpe Borough Water Department, Lansford-Coaldale Joint Water Authority, Lehigh Valley Water Authority, Nesquehoning Borough Water Authority, Palmerton Water Authority, Summit Hill Water Authority, and Weatherly Borough Water Authority. These water supplies, coupled with the County's 6,104 domestic drinking water wells, are all vulnerable to the effects of a nuclear incident.

While unlikely that all agricultural products would be lost in the event of a nuclear incident, the County can expect some portion of the \$9.3 million in agricultural products to be lost. Time of year also impacts the vulnerability and losses estimated for a nuclear incident; an incident that occurs during the prime growing and harvesting season will have a larger impact on the County. For example, the incident at Three Mile Island occurred in the off-season; as a result, the Pennsylvania Department of Agriculture estimated that agricultural losses for the entire Commonwealth were not more than \$1 million.

4.3.16. Transportation Accident

4.3.16.1. Location and Extent

For the purposes of this plan, transportation accidents are defined as incidents involving highway, air, and rail travel, as well as transportation of oil, natural gas, and hazardous materials over rail and through pipelines.

There are three pipelines that run through Carbon County: a gas transmission pipeline which runs east-west through the northern part of the county and two hazardous liquid pipelines which run north-south through the eastern part of the county (see Figure 4.3.16-1). In addition to these established routes, a

new pipeline has been proposed which would transect Carbon County. The 105 mile PennEast pipeline would originate in Luzerne County, passing through Carbon, Northampton, and Bucks Counties in Pennsylvania and Hunterdon and Mercer Counties in New Jersey. As illustrated in maps released by Carbon County (Figure 4.3.16-2), the proposed route of the pipeline would run north to south entering the County in Kidder Township and passing through Penn Forest, Towamensing, and Lower Towamensing Townships (CCAP, 2015).

Within Carbon County, there are over 27 miles of turnpike, 289 miles of state and federal highway, 404 miles of secondary and municipal roads, 70 miles of rail line, and 165 bridges in the County (PennDOT, 2015; Carbon County, 2013). The major transportation networks most important for the movement of goods and people in Carbon County include Interstates 476 and 80, US Route 209, State Routes 54, 93, 248, 443, 534, 895, 902, 903, and 940 (Figure 4.3.16-3). Figure 4.3.16-4 illustrates the average annual daily traffic for Carbon County major roads.

There are also several railroads that operate in the County, many of which that transport freight of all types including hazardous materials through the County. The Reading Blue Mountain and Northern Railroad Company operates a line along the Lehigh Gorge and provides passenger service through Lehigh Gorge Scenic Railway passenger train rides. The Norfolk Southern Railway Company also operates a line that runs through the County from Weatherly Borough, along the Lehigh River to Palmerton. The Chestnut Ridge Railway Company runs a private railway line that begins in Palmerton. The Carbon County Railroad Commission also oversees a short railroad line, the C&S Railroad, which services local industries. There is potential for major accidents on any of these railways.

Carbon County has two small airports: the Carbon County Airport Authority (Jake Arner Memorial Airport) located in Mahoning Township and the privately owned Beltzville Airport located in Franklin Township. Since the 2010 HMP, the privately owned Neeb Airport in Franklin Township has closed. It is displayed in Table 2.5-1 and Figure 4.3.16-3, as the County still maintains this infrastructure in its land use data. Additionally, there are private airfields in East Penn Township, Lower Towamensing Township, Packer Township, and Lehigh Township. There is a heliport at the Gnadon Huetten Hospital in Lehigh Township as well as additional heliports in Lehigh Township, Lehigh Township, and Penn Forest Township. Aviation accidents typically occur within 5 miles of take-off or landing, but can occur countywide.

Traffic accidents and rail accidents can occur anywhere along their respective corridors in Carbon County. Table 4.3.16-1 lists the different types of identified traffic and rail accidents.

Table 4.3.16-1 Identified Types of Traffic and Rail Accidents (PennDOT, 2013; Federal Railway Administration, 2011).		
MODE	TYPE OF ACCIDENT	DESCRIPTION
Traffic	Non-collision	A harmful event that does not involve a collision, such as a fire, explosion, or overturn.
	Angle	A crash in which two vehicles on opposite roadways collide at an intersection, driveway, or ramp.
	Rear-end	A crash in which vehicles traveling in the same direction on the same road collide.
	Head-on	A crash in which vehicles traveling in opposite directions, on the same road collide.

Table 4.3.16-1 Identified Types of Traffic and Rail Accidents (PennDOT, 2013; Federal Railway Administration, 2011).		
MODE	TYPE OF ACCIDENT	DESCRIPTION
	Sideswipe	A crash between two vehicles in which the sides of the vehicles engage.
	Hit fixed object	A collision in which a vehicle hits a stationary object on or adjacent to the roadway.
	Hit pedestrian	A collision between a motor vehicle and any person not in or upon the vehicle.
Rail	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.

A hazardous material release can occur wherever these materials are transported. Such releases can affect the nearby population and contaminate critical or sensitive environmental areas. There are increasingly large numbers of chemicals, oils, radioactive materials and other hazardous substances spilled as the result of highway and rail and waterway accidents or in a pipeline break. On occasion, these events become a major disaster and force people to evacuate and/or lose their homes and businesses.

Figure 4.3.16-1 Gas and hazardous material pipelines in Carbon County.

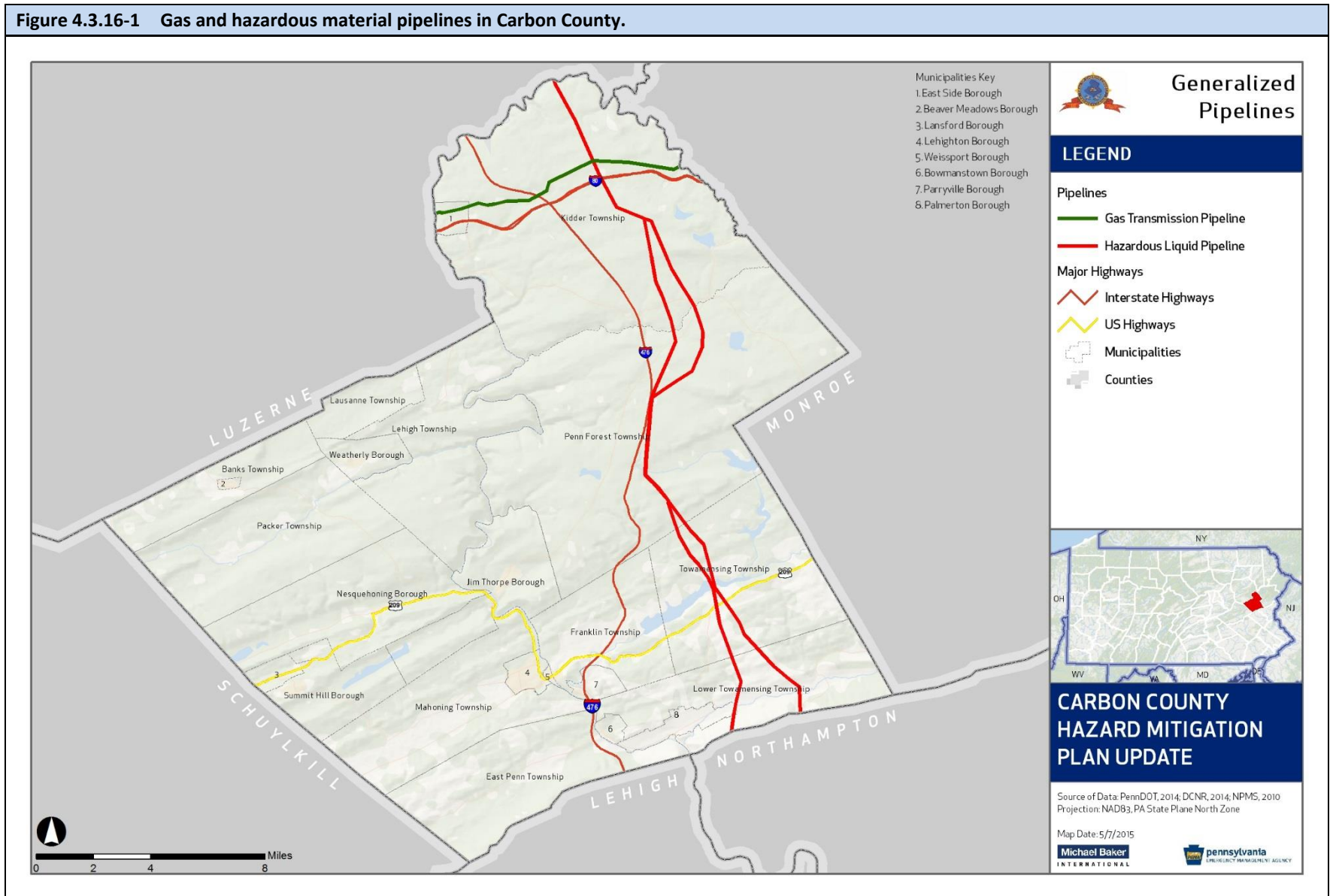


Figure 4.3.16-2 Proposed PennEast Pipeline (Carbon County GIS, 2014)

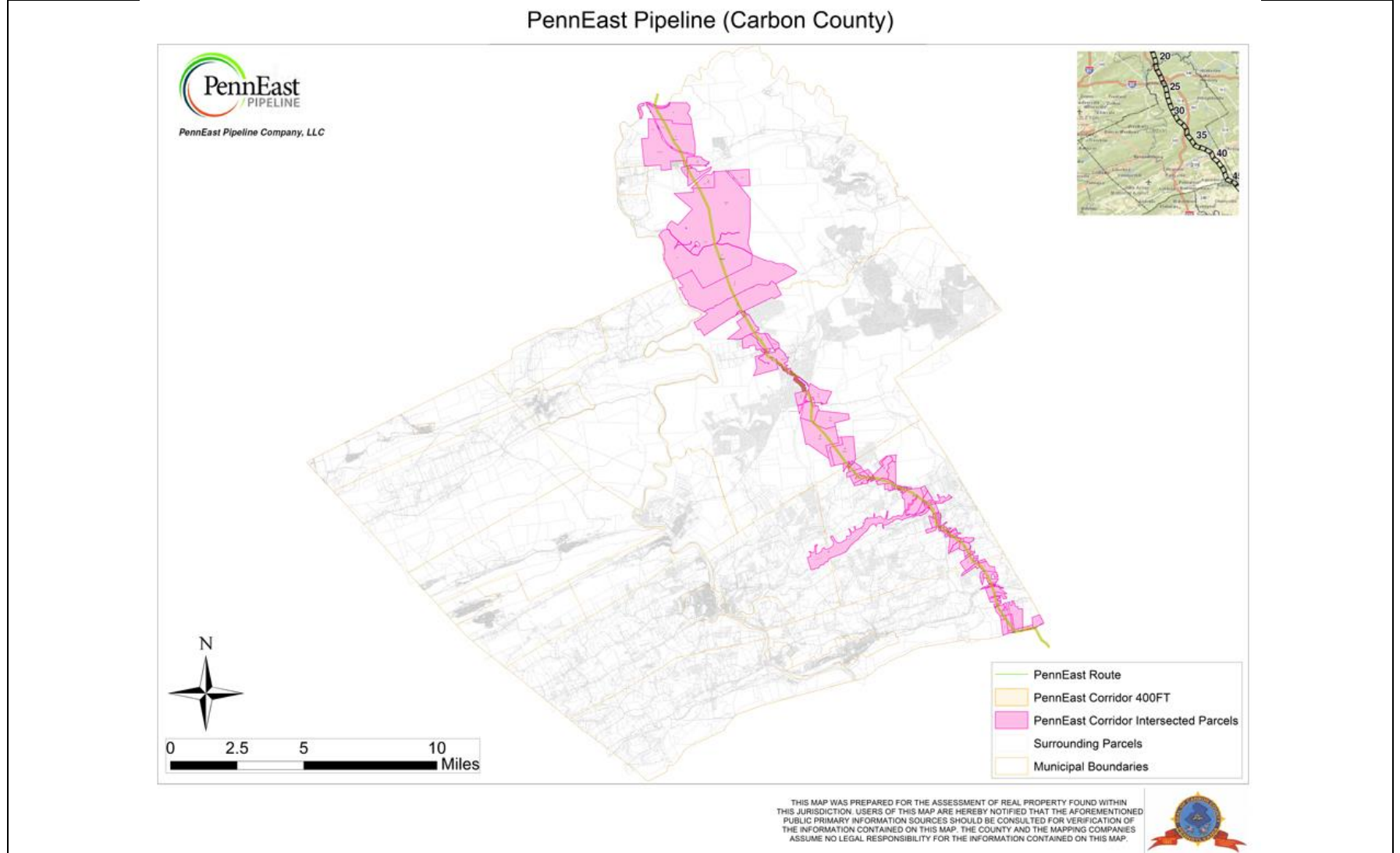


Figure 4.3.16-3 Carbon County transportation infrastructure.

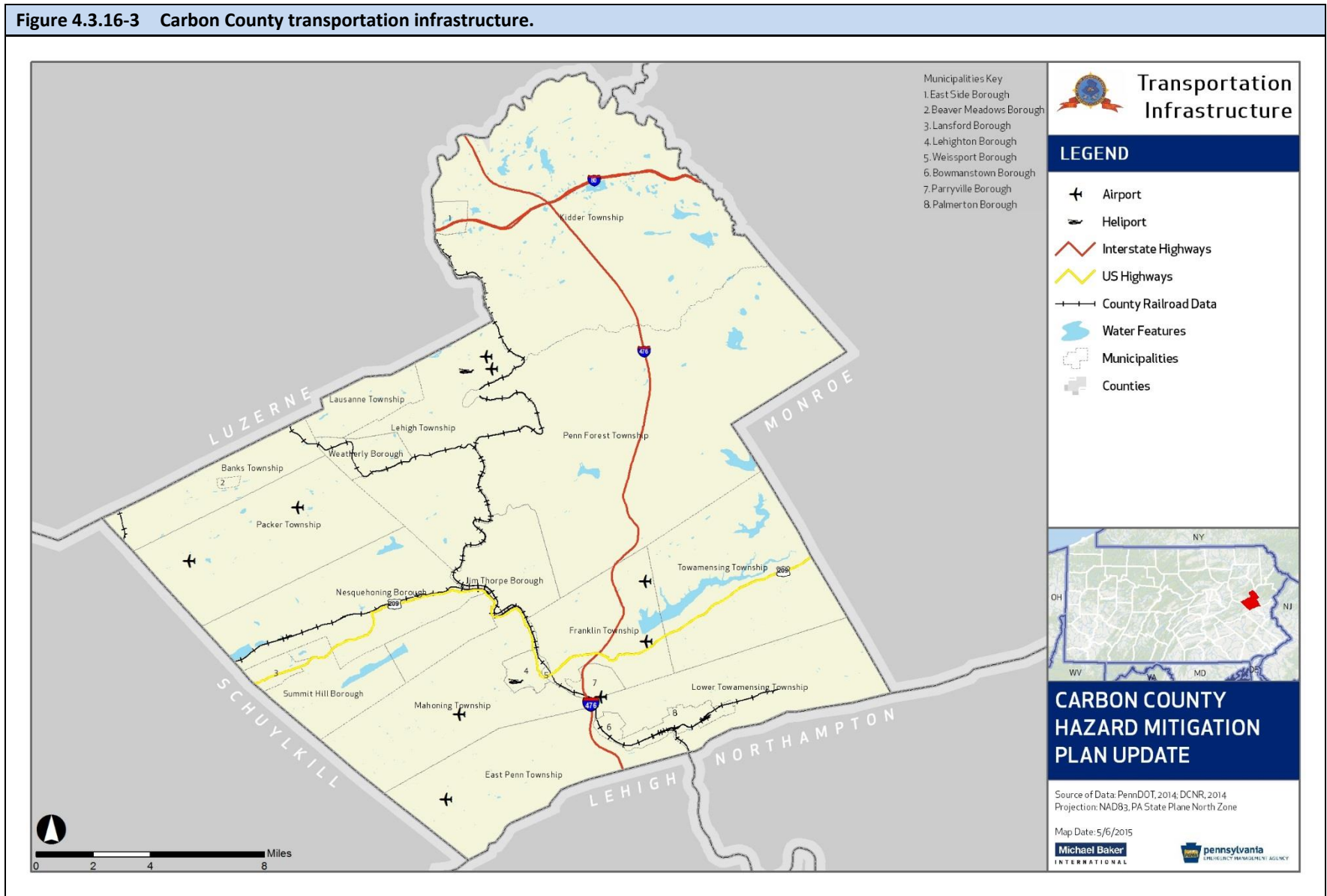
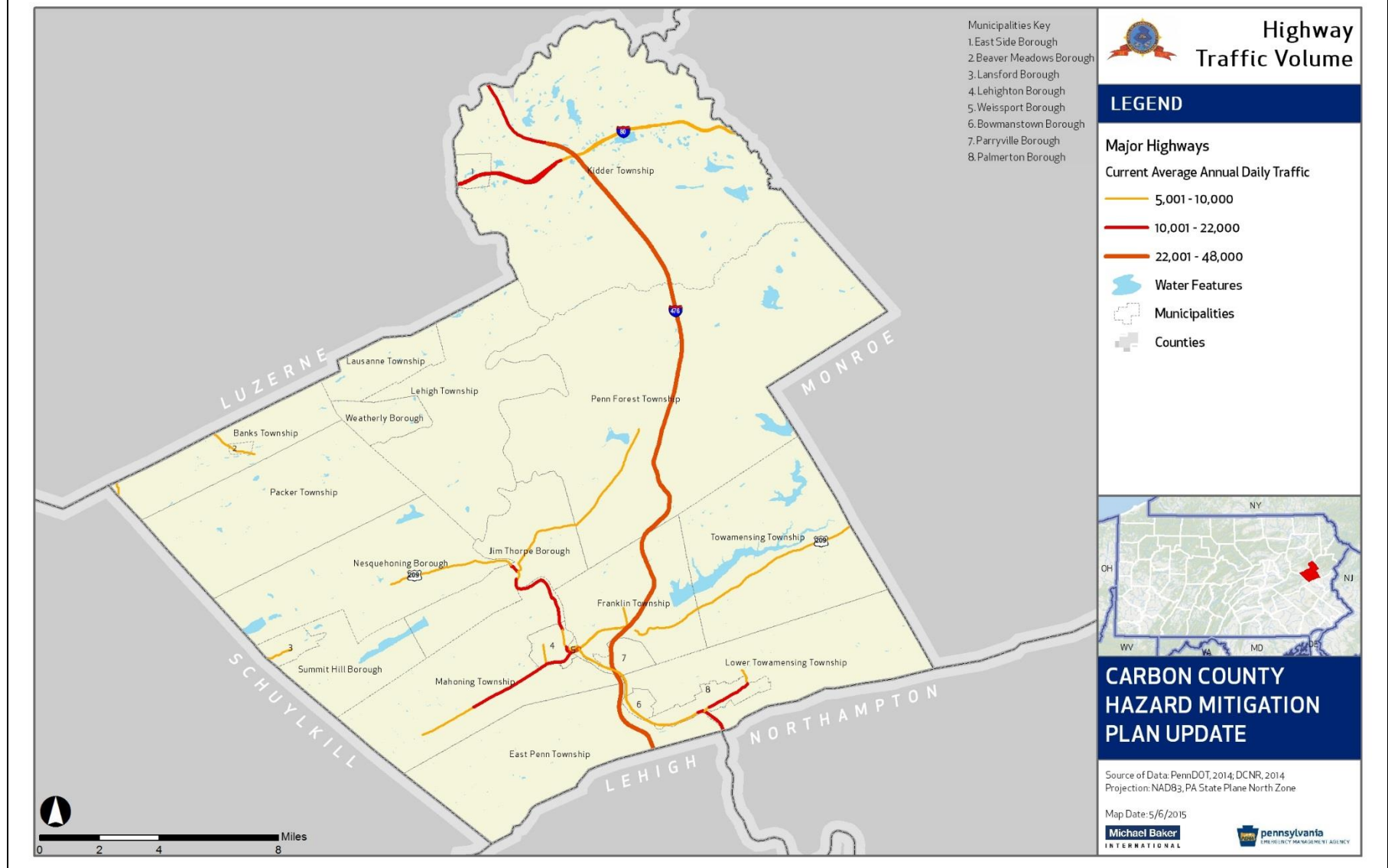


Figure 4.3.16-4 Average annual daily traffic on key roadways in Carbon County.



4.3.16.2. Range of Magnitude

Significant transportation accidents can result in death or serious injury or extensive property loss or damage. Transportation accidents can also result in broader infrastructure damage. Like the range of magnitude, the environmental impacts of transportation accidents can vary greatly. In the case of a simple motor vehicle crash, train derailment, or aviation accident, the environmental impact is minimal. However, if the accident involves any type of vehicle moving chemicals or other hazardous materials, the impact will be considerably larger and may include an explosion or the release of potentially hazardous material.

Hazardous material releases can occur as a result of a pipeline burst, as well as a result of a road or railway accident. Hazardous material releases can contaminate air, water, and soils, resulting in property damage, injuries, and death. Dispersion can take place rapidly when transported by water and wind. Response time and quantity and type of material release also impact the severity of an accident. Additionally, the HMSC identified that there is an increased risk to exacerbate fires if there is a gas or hazardous material release near an existing wildfire. This is especially the case in areas like Towamensing Township where two pipelines run through large areas of state forests.

A worst case scenario for transportation accidents occurred in the County on November 21, 1999 when a bus carrying Penn State students crashed on Interstate 80 in Kidder Township. Over 200 passengers were involved in the accident which resulted in 107 injuries and 2 fatalities.

4.3.16.3. Past Occurrence

The most common transportation accidents in the County are highway incidents involving motor vehicles. The County's most serious transportation concerns involve Interstates 476 and 80 which have the highest average annual daily traffic.

Table 4.3.16-2 below summarizes vehicular crash data from 2004-2013 for Carbon County.

Table 4.3.16-2 Total number of crashes, traffic deaths, and pedestrian deaths for Carbon County from 2004 – 2013 (PennDOT, 2015).			
YEAR	TOTAL CRASHES	TOTAL TRAFFIC DEATHS	TOTAL PEDESTRIAN DEATHS
2004	758	13	0
2005	795	14	1
2006	763	17	2
2007	731	13	0
2008	704	16	0
2009	660	11	1
2010	744	12	0
2011	712	8	1
2012	702	6	0
2013	722	15	1
2014	690	6	1

Transportation-related hazardous material release incidents are tracked by the federal government. The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) maintains information on hazardous material releases by highway, freight, air, rail, and pipeline incidents. Table 4.3.16-3 shows the amount of reported hazardous material release incidents by municipality in Carbon County between 1972 and 2014.

Table 4.3.16-3 Total number of transportation related hazardous material releases in Carbon County, 1972 – 2015 (PHMSA, 2015a).			
MUNICIPALITY	HIGHWAY RELEASES	RAIL RELEASES	TOTAL RELEASES
Carbon County	1	0	1
Banks Township	0	0	0
Beaver Meadows Borough	0	0	0
Bowmanstown Borough	1	0	1
East Penn Township	0	0	0
East Side Borough	0	0	0
Franklin Township	0	0	0
Jim Thorpe Borough	1	1	2
Kidder Township	1	0	1
Lansford Borough	0	0	0
Lausanne Township	0	0	0
Lehigh Township	1	0	1
Lehighon Borough	11	2	13
Lower Towamensing Township	0	0	0
Mahoning Township	2	0	2
Nesquehoning Borough	4	0	4
Packer Township	0	0	0
Palmerton Borough	5	2	7
Parryville Borough	1	0	1
Penn Forest Township	0	0	0
Summit Hill Borough	0	0	0
Towamensing Township	0	0	0
Weatherly Borough	1	0	1
Weissport Borough	0	0	0
Total	29	5	34

Table 4.3.16-4 details the reported pipeline rupture incidents in Carbon County between 1968 and June 2015.

Table 4.3.16-4 Pipeline incidents in Carbon County, 1968 – 2015 (PHMSA, 2015b).					
YEAR	MATERIAL	INJURIES	FATALITIES	PROPERTY DAMAGE	DESCRIPTION
1969	Fuel Oil	0	0	\$1,800	N/A
1973	Fuel Oil	0	0	\$1,250	N/A
1995	Gasoline	0	0	\$50,000	Employees making repairs erroneously removed packing gland; 13 barrels of unleaded gasoline were released before fitting was replaced.
1996	Natural Gas	0	0	\$100,000	Bulldozer excavation ruptured a distribution line. About 2,000 customers were affected in Jim Thorpe and Lehigh Township

4.3.16.4. Future Occurrence

The County's population has increased slightly over the last decade so it can be assumed that local traffic has increased slightly as well. Additionally, the trucking industry is expected to continue to grow increasing the number of long haul trucks operating in the County on a daily basis. While hazardous material release incidents through transportation accidents have occurred in Carbon County in the past, they are generally considered difficult to predict. However, transportation incidents may increase slightly over the next five years without proper mitigation strategies in place. Based on this and past occurrences, the future occurrence of transportation accidents Carbon County can be considered *highly likely* as defined by the Risk Factor methodology probability criteria (see Table 4.4-1).

4.3.16.5. Vulnerability Assessment

A transportation related accident can occur on any stretch of road or railway in Carbon County. However, severe accidents are more likely along roadways that experience heavier traffic volumes including heavy freight vehicles. The combination of high traffic volume, severe winter weather in the County, and large numbers of hazardous materials haulers increase the chances of traffic accidents occurring. According to the 2009 Carbon County Hazard Vulnerability Assessment, major highways in Carbon County where accidents are most likely to occur are:

- Interstates:
 - 476 – Northeast Extension of the PA Turnpike; the HMSC identified that transportation accidents are especially likely along the Turnpike in Franklin Township
 - 80 – Kidder Township
- State Routes:
 - 93 – Nesquehoning, Packer Township, Beaver Meadows, Banks Township
 - 209 – Passes through the entire County
 - 902 – Mahoning Township, Summit Hill
 - 903 – Jim Thorpe, Kidder, Penn Forest

- 443 – Lehigh, Mahoning Township
- 248 – Franklin Township, Parryville, Bowmanstown, Palmerton
- 895 – East Penn Township

Like highway incidents, rail incidents can impact populations living near rail lines. Crude oil shipping across the United States has grown by a factor of seventeen in the last five years, increasing the risk for a derailment or rail accident to involve this material. Additionally, recent rail incidents from 2013 to 2015 have shown a high risk for trains carrying crude oil to explode upon derailment (FracTracker, 2015). The HMSC identified the areas of rail in Penn Forest and Lehigh Townships as being especially vulnerable to rail incidents, including in the areas around Penn Haven Junction and tunnels.

Carbon County is also susceptible to airplane accidents due to the proximity of several International Airports. Carbon County is in the Air Traffic Patterns for landing approaches and take-offs for Lehigh Valley, Wilkes Barre/Scranton and Newark International Airports (CCEMA, 2009). The average rate of aviation accidents nation-wide is 8.47 accidents per 100,000 flight hours. Therefore, the likelihood of a serious aviation incident in the County is considered low.

Utilizing Census Block data and proximity to modes of transportation, Tables 4.3.16-5 and 4.3.16-6 identify the structures and critical facilities respectively within a half-mile of a major highways and rail lines, within a 5-mile buffer of an airport, and within a quarter-mile buffer of a pipeline. The half-mile buffer represents the recommended evacuation zone around a highway or rail line in the event of a hazardous material release in transit, the 5-mile buffer represents the area where aviation accidents typically occur, and the quarter-mile buffer represents the area typically affected by a pipeline rupture.

Table 4.3.16-5 Structures vulnerable to transportation related hazards by municipality.									
MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES IN ROAD ACCIDENT AREA	PERCENT STRUCTURES	STRUCTURES IN RAIL ACCIDENT AREA	PERCENT STRUCTURES	STRUCTURES IN AIR ACCIDENT AREA	PERCENT STRUCTURES	STRUCTURES IN PIPELINE ACCIDENT AREA	PERCENT STRUCTURES
Banks Township	764	157	20.55	764	100.00	764	100.00	0	0.00
Beaver Meadows Borough	412	412	100.00	412	100.00	412	100.00	0	0.00
Bowmanstown Borough	555	447	80.54	452	81.44	555	100.00	0	0.00
East Penn Township	2,095	1,074	51.26	1,125	53.70	2,095	100.00	0	0.00
East Side Borough	195	195	100.00	1	0.51	5	2.56	172	88.21
Franklin Township	3,163	1,903	60.16	642	20.30	3,163	100.00	0	0.00
Jim Thorpe Borough	2,388	1,902	79.65	1,742	72.95	2,384	99.83	0	0.00
Kidder Township	3,040	1,035	34.05	70	2.30	238	7.83	571	5.66
Lansford Borough	1,603	1,603	100.00	1,603	100.00	454	28.32	0	0.00
Lausanne Township	218	0	0.00	189	86.70	218	100.00	0	0.00
Lehigh Township	396	0	0.00	104	26.26	392	98.99	0	0.00
Lehighton Borough	2,397	2,393	99.83	2,009	83.81	2,397	100.00	0	0.00
Lower Towamensing Township	2,116	83	3.92	813	38.42	1,480	69.94	252	8.13
Mahoning Township	2,632	1,608	61.09	392	14.89	2,632	100.00	0	0.00
Nesquehoning Borough	1,409	1,350	95.81	1,386	98.37	1,409	100.00	0	0.00
Packer Township	740	183	24.73	391	52.84	740	100.00	0	0.00
Palmerton Borough	2,734	1,060	38.77	2,707	99.01	2,734	100.00	0	0.00
Parryville Borough	347	263	75.79	206	59.37	347	100.00	0	0.00
Penn Forest Township	7,751	2,854	36.82	7	0.09	2,430	31.35	584	2.22
Summit Hill Borough	1,580	1,488	94.18	1,345	85.13	158	10.00	0	0.00
Towamensing Township	2,697	862	31.96	0	0.00	2,085	77.31	483	6.38
Weatherly Borough	1,234	0	0.00	1,213	98.30	1,234	100.00	0	0.00

Table 4.3.16-5 Structures vulnerable to transportation related hazards by municipality.									
MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES IN ROAD ACCIDENT AREA	PERCENT STRUCTURES	STRUCTURES IN RAIL ACCIDENT AREA	PERCENT STRUCTURES	STRUCTURES IN AIR ACCIDENT AREA	PERCENT STRUCTURES	STRUCTURES IN PIPELINE ACCIDENT AREA	PERCENT STRUCTURES
Weissport Borough	203	203	100.00	203	100.00	203	100.00	0	0.00
Total	40,669	21,075	51.82	17,776	43.71	28,529	70.15	2,62	0.42

Table 4.3.16-6 Critical Facilities vulnerable to transportation related hazards by municipality.									
MUNICIPALITY	TOTAL CRITICAL FACILITIES	CRITICAL FACILITIES IN ROAD ACCIDENT AREA	PERCENT CRITICAL FACILITIES	CRITICAL FACILITIES IN RAIL ACCIDENT AREA	PERCENT CRITICAL FACILITIES	CRITICAL FACILITIES IN AIR ACCIDENT AREA	PERCENT CRITICAL FACILITIES	CRITICAL FACILITIES IN PIPELINE ACCIDENT AREA	PERCENT CRITICAL FACILITIES
Banks Township	6	4	66.67	6	100.00	6	100.00	0	0.00
Beaver Meadows Borough	2	2	100.00	2	100.00	2	100.00	0	0.00
Bowmanstown Borough	2	2	100.00	2	100.00	2	100.00	0	0.00
East Penn Township	7	3	37.50	5	62.50	7	100.00	0	0.00
East Side Borough	1	1	100.00	0	0.00	0	0.00	1	100.00
Franklin Township	10	8	80.00	1	10.00	10	100.00	0	0.00
Jim Thorpe Borough	17	15	88.24	13	76.47	17	100.00	0	0.00
Kidder Township	18	10	55.56	1	5.56	2	11.11	0	0.00
Lansford Borough	5	5	100.00	5	100.00	1	20.00	0	0.00
Lausanne Township	2	0	0.00	1	50.00	2	100.00	0	0.00
Lehigh Township	7	0	0.00	2	28.57	7	100.00	0	0.00
Lehighton Borough	11	11	100.00	7	63.64	11	100.00	0	0.00
Lower Towamensing Township	6	1	16.67	2	33.33	5	83.33	0	0.00
Mahoning Township	11	11	100.00	2	18.18	11	100.00	0	0.00
Nesquehoning Borough	14	13	92.86	13	92.86	14	100.00	0	0.00
Packer Township	4	2	50.00	3	75.00	4	100.00	0	0.00
Palmerton Borough	11	4	36.36	11	100.00	11	100.00	0	0.00
Parryville Borough	3	3	100.00	3	100.00	3	100.00	0	0.00
Penn Forest Township	12	10	83.33	0	0.00	8	66.67	1	8.33
Summit Hill Borough	8	8	100.00	5	62.50	1	12.50	0	0.00
Towamensing Township	9	6	66.67	0	0.00	6	66.67	2	11.11
Weatherly Borough	6	0	0.00	6	100.00	6	100.00	0	0.00

Table 4.3.16-6 Critical Facilities vulnerable to transportation related hazards by municipality.									
MUNICIPALITY	TOTAL CRITICAL FACILITIES	CRITICAL FACILITIES IN ROAD ACCIDENT AREA	PERCENT CRITICAL FACILITIES	CRITICAL FACILITIES IN RAIL ACCIDENT AREA	PERCENT CRITICAL FACILITIES	CRITICAL FACILITIES IN AIR ACCIDENT AREA	PERCENT CRITICAL FACILITIES	CRITICAL FACILITIES IN PIPELINE ACCIDENT AREA	PERCENT CRITICAL FACILITIES
Weissport Borough	3	3	100.00	3	100.00	3	100.00	0	0.00
Total	175	122	69.32	93	52.84	140	79.55	4	0.57

4.3.17. Utility Interruption

4.3.17.1. Location and Extent

Utility interruptions include any impairment of the functioning of telecommunication, gas, electric, water, or waste networks. Interruptions or outages occur because of geomagnetic storms, fuel or resources shortage, electromagnetic pulses, information technology failures, transmission facility or linear utility accident, and major energy, power, or utility failure. Utility interruptions in Carbon County focus primarily on power failures, which are often a secondary impact of another hazard event. For example, severe thunderstorms or winter storms could bring down power lines and cause widespread disruptions in electricity service. Strong heat waves may result in rolling blackouts where power may not be available for an extended period of time. Local outages may be caused by traffic accidents or wind damage. Utility interruptions and power failures can take place throughout the County.

According to the 2013 5-year American Community Survey, in Carbon County, 48.8% of housing units use fuel oil as their heat source, followed by 25.2% of homes using electric heat and 8.7% using utility gas. As a result, an interruption in these utilities could affect a significant number of residents, especially during the winter. In addition, an increasing reliance on internet access and telecommunications could also a large number of residents at any given time.

4.3.17.2. Range of Magnitude

Most severe power failures or outages are regional events. With the loss of power, electrical powered equipment and systems will not be operational. Examples may include: lighting; HVAC and ancillary support equipment; communication (i.e. public address systems, telephone, computer servers, and peripherals); ventilation systems; fire and security systems; refrigerators, sterilizers, trash compactors, office equipment; and medical equipment. This can cause food spoilage, loss of heat or air conditioning, basement flooding (sump pump failure), lack of light, loss of water (well pump failure), lack of phone service, or lack of internet service. However, this is most often a short-term nuisance rather than a catastrophic hazard.

At a minimum, power outages can cause short term disruption in the orderly functioning of business, government, and private citizen functioning and activities. A worst case scenario for utility interruption in Carbon County occurred during the winter ice storm of 2005. Downed trees and wires from the heavy ice formation caused power outages throughout the entire County for prolonged periods of time and in some municipalities the power was out for over a week (CCEMA, 2009).

4.3.17.3. Past Occurrence

Utility interruptions are largely minor, routine events. In Carbon County minor power outages occur annually, about four or five times per year. They are most often associated with winter storms and wind storms. No complete/comprehensive list of utility interruptions exist for the county.

4.3.17.4. Future Occurrence

Minor power failure (i.e. short outage events) may occur several times a year for any given area in the County, while major (i.e. widespread, long outage) events take place once every few years. Power failures are often occurrences during severe weather and therefore, should be expected during those events. Therefore, the future occurrence of utility interruptions in Carbon County can be considered *highly likely*

as defined by the Risk Factor methodology probability criteria (see Table 4.4-1). These interruptions should be anticipated and first responders should be prepared during severe weather events.

4.3.17.5. *Vulnerability Assessment*

All jurisdictions are vulnerable on some level to utility interruptions, but because this hazard often occurs in conjunction with other hazards, jurisdictions that have been identified as more vulnerable to winter storms, flooding, and other natural hazard events may be more vulnerable to a utility interruption.

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

4.4. Hazard Vulnerability Summary

Risk and vulnerability to natural and human-made hazard events are not static. Risk will increase or decrease as states, counties, and municipalities see changes in land use and development as well as changes in population. For Pennsylvania, these changes in risk and vulnerability are likely to differ greatly from one area of the Commonwealth to another.

4.4.1. Methodology

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

RF values were obtained by assigning varying degrees of risk to five categories for each of the seventeen hazards profiled in the 2015 HMP. Those categories include: probability, impact, spatial extent, warning time and duration. Each degree of risk was assigned a value ranging from 1 to 4. The weighting factor is shown in Table 4.4-1. To calculate the RF value for a given hazard, the assigned risk value for each category was multiplied by the weighting factor. The sum of all five categories equals the final RF value, as demonstrated in the example equation:

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

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

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

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

4.4.2. Ranking Results

Using the methodology described in Section 4.4.1, Table 4.4-2 lists the Risk Factor calculated for each of the seventeen potential hazards identified in the 2015 HMP. Hazards identified as *high* risk have risk factors greater than 2.5. Risk Factors ranging from 2.0 to 2.4 were deemed *moderate* risk hazards. Hazards with Risk Factors 1.9 and less are considered *low* risk.

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

HAZARD RISK	HAZARD NATURAL (N) OR MAN-MADE (M)	RISK ASSESSMENT CATEGORY					RISK FACTOR
		PROBABILITY (1-4)	IMPACT (1-4)	SPATIAL EXTENT (1-4)	WARNING TIME (1-4)	DURATION (1-4)	
HIGH	Flood, Flash Flood, Ice Jam (N)	4	2	3	3	3	3.0
	Winter Storm (N)	4	2	4	1	3	3.0
	Wildfire (N)	4	1	3	4	2	2.7
MODERATE	Utility Interruption (M)	4	1	2	3	2	2.4
	Dam Failure (M)	1	3	2	4	4	2.4
	Nuclear Incident (M)	1	3	2	4	4	2.4
	Transportation Accidents (M)	4	1	1	4	1	2.2
	Drought (N)	2	1	4	1	4	2.2
	Hurricane, Tropical Storm, Nor'easter (N)	2	2	3	1	3	2.2
	Levee Failure (M)	1	3	2	3	2	2.1
LOW	Disorientation (M)	3	1	1	4	1	1.9
	Landslide (N)	2	1	2	4	1	1.8
	Hailstorm (N)	2	1	2	3	1	1.7
	Radon Exposure (N)	2	1	2	2	2	1.7
	Environmental Hazards (M)	2	1	1	1	4	1.6
	Drowning (M)	1	1	2	4	1	1.5
	Building or Structure Collapse (M)	1	1	1	3	1	1.2

Based on these results, there are three *high* risk hazards, seven *moderate* risk hazards and seven *low* risk hazards in Carbon 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 (i.e. disorientation and landslide).

A risk assessment result for the entire county does not mean that each municipality is at the same amount of risk to each hazard. Table 4.4-3 shows the different municipalities in Carbon County and whether their risk is greater than (>), less than (<), or equal to (=) the risk factor assigned to the County as a whole. This table was developed by the consultant team based on the findings in the hazard profiles of Section 4.3 and municipal input from the "Evaluation of Identified Hazards and Risk" and "jurisdictional Risk

Evaluation” worksheets distributed at the April 1st and May 13th HMP meetings. Those changes are reflected in the table.

Table 4.4-3 Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk																	
JURISDICTION	IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR																
	Flood, Flash Flood, Ice Jam (N)	Winter Storm (N)	Wildfire (N)	Utility Interruption (M)	Dam Failure (M)	Nuclear Incident (M)	Transportation Accident (M)	Drought (N)	Hurricane, Tropical Storm, Nor'easter (N)	Levee Failure (M)	Disorientation (M)	Landslide (N)	Hailstorm (N)	Radon Exposure (N)	Environmental Hazards (M)	Drowning (M)	Building or Structure Collapse (M)
	3	3	2.7	2.4	2.4	2.4	2.2	2.2	2.2	2.1	1.9	1.8	1.7	1.7	1.6	1.5	1.2
Banks Township	<	=	>	=	<	=	=	=	=	<	<	=	=	=	>	<	>
Beaver Meadows Borough	<	=	<	=	<	=	=	=	=	<	<	=	=	=	=	=	>
Bowmanstown Borough	=	=	<	=	=	>	=	=	=	<	<	=	=	=	>	=	>
East Penn Township	=	=	>	=	=	>	=	>	=	<	=	>	=	=	>	=	=
East Side Borough	<	>		=	<	=	=	=	=	<	<	=	=	=	=	=	=
Franklin Township	=	=	>	=	>	>	=	>	=	<	=	>	=	=	>	>	>
Jim Thorpe Borough	=	=	>	=	>	>	=	=	=	<	=	=	=	=	>	>	>
Kidder Township	=	>	>	=	>	=	=	=	=	<	=	=	=	=	>	>	>
Lansford Borough	<	=	<	=	<	>	=	=	>	<	=	=	=	=	>	=	>
Lausanne Township	<	>	>	=	<	=	<	>	=	<	<	=	=	=	=	=	=
Lehigh Township	<	>	>	=	<	>	=	>	=	<	=	=	=	=	>	>	=
Lehighton Borough	=	=	<	=	>	>	=	=	=	<	=	=	=	=	>	>	>
Lower Towamensing Township	=	=	>	=	<	>	=	=	=	<	=	>	=	=	>	=	=
Mahoning Township	=	=	=	=	=	>	=	>	=	<	<	>	=	=	=	=	=
Nesquehoning Borough	=	=	>	=	>	>	=	=	>	<	=	=	>	=	>	=	>
Packer Township	=	=	>	=	<	>	=	>	=	<	=	=	=	=	=	=	=
Palmerton Borough	=	=	=	=	=	>	=	=	=	<	<	>	=	=	>	=	>

Table 4.4-3 Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk																	
JURISDICTION	IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR																
	Flood, Flash Flood, Ice Jam (N)	Winter Storm (N)	Wildfire (N)	Utility Interruption (M)	Dam Failure (M)	Nuclear Incident (M)	Transportation Accident (M)	Drought (N)	Hurricane, Tropical Storm, Nor'easter (N)	Levee Failure (M)	Disorientation (M)	Landslide (N)	Hailstorm (N)	Radon Exposure (N)	Environmental Hazards (M)	Drowning (M)	Building or Structure Collapse (M)
	3	3	2.7	2.4	2.4	2.4	2.2	2.2	2.2	2.1	1.9	1.8	1.7	1.7	1.6	1.5	1.2
Parryville Borough	=	=	<	=	>	>	=	>	=	<	<	=	=	=	>	=	=
Penn Forest Township	=	>	>	=	>	>	=	=	=	<	=	=	=	=	>	=	>
Summit Hill Borough	<	=	=	=	<	>	<	=	=	<	<	=	=	=	>	>	>
Towamensing Township	=	>	>	=	=	>	=	>	=	<	=	>	=	=	>	>	=
Weatherly Borough	=	=	=	=	<	=	=	>	=	<	<	=	=	=	>	=	>
Weissport Borough	=	=	<	=	>	>	=	=	=	=	<	=	=	=	>	=	>

4.4.3. Potential Loss Estimates

The potential loss estimate data for the 2015 plan update is being completed with an enhanced HAZUS analysis. The analysis is not complete at the time of this review, but will be completed for the submission of the plan. The 2010 Hazard Mitigation Plan information is included in the interim in the current and modeled sections.

Potential loss estimates for hazard events help a community understand the monetary value of what might be at stake during a hazard event. 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.

Loss estimates provided in this section fall into three broad categories: historical losses, current-condition losses, and predictive losses. Historical loss estimates come from three primary sources: the NCDC storm events database, the NFIP, and the USDA's Risk Management Agency annual crop indemnities dating from 1980-2014. Current condition losses come from geospatial analysis of the value of buildings identified as vulnerable in the Vulnerability Assessment section of hazard profiles for floods, landslides, wildfires, dam failure, levee failure, and transportation accidents. Finally, predictive losses were generated using HAZUS-MH, version 2.1. Historical losses do not take into account any of the aforementioned components, but they do provide insight into what future losses might be. The current-condition losses take into account replacement value as well as exposure value. HAZUS modeling takes into account all four components and provides the most comprehensive description of potential losses.

Historical Losses

Historical losses were able to be determined for drought, flooding, hailstorms, coastal storms (hurricanes/tropical storms/tropical depressions), and winter storms from NCDC, USDA RMA, and the NFIP.

NCDC reports include property and crop damage estimates with their incident reports. As noted in many of the hazard profiles, though, many of the events have no damages reported. This does not mean that there were no damage; rather, it indicates that no damages were reported to NCDC. As a result, these should be considered low-end estimates of losses. The flood and flash flood events reported in NCDC list \$5.11 million in property damage and one fatality over the history of flooding in the county. Hailstorm

losses reported to the NCDL totaled over \$1 million. Historical losses for winter storms, including ice storms, freezing rain, sleet, and heavy snow, include two injuries and over \$7 million in property damage.

Agriculture is an integral part of Carbon County's economy, and agricultural production is highly vulnerable to natural hazard events. As previously mentioned, losses are available from the USDA RMA. The RMA operates and manages the Federal Crop Insurance Corporation, which provides crop insurance to American farmers. While not all crops are insured through RMA, their records provide strong insight into agricultural losses nationwide and in Carbon County. Table 4.4-4 illustrates the total amount of indemnities paid through RMA since 1948 in Carbon County by type of crop failure. Only crop failures related to the hazards discussed in this plan are listed. There has been about \$1.86 million in indemnity paid out due to crop loss between 1948 and 2014 in Carbon County. The greatest amount of indemnity paid out was due to crop loss from drought, which accounts for about 46 percent of the loss, followed by loss due to rain or excess moisture, which accounted for about 29 percent of the loss.

Table 4.4-4 Historic Insured Crop Losses, 1948-2014 (USDA RMA, 2015)	
REASON FOR LOSS	INDEMNITY AMOUNT
Cold Wet Weather	\$16,488.00
Cold Winter	\$46.00
Drought	\$854,573.80
Excess Moisture/Precipitation/Rain	\$536,166.80
Fire	\$619.00
Flood	\$3,260.00
Freeze	\$6,489.40
Hail	\$231,453.60
Hurricane/Tropical Depression	\$51,571.00
Wind/Excess Wind	\$3,589.00
Other	\$155,362.40
Total	\$1,859,619.00

The final set of historic losses relates solely to prior flood losses and comes from the NFIP's records of claims paid. Table 4.4-5 shows the total amount of claims paid in each municipality according to CIS. There has been just under \$400,000 paid to all municipalities in Carbon County; over half of which was paid to a total of 41 claims in Palmerton Borough.

Table 4.4-5 Carbon County Historic Flood Losses (FEMA CIS, 2014).		
COMMUNITY	PARTICIPATION STATUS	TOTAL AMOUNT OF PAID CLAIMS
Banks Township	Participating	\$0
Beaver Meadows Borough	Participating	\$0

Table 4.4-5 Carbon County Historic Flood Losses (FEMA CIS, 2014).

COMMUNITY	PARTICIPATION STATUS	TOTAL AMOUNT OF PAID CLAIMS
Bowmanstown Borough	Participating	\$8,355
East Penn Township	Participating	\$27,213
East Side Borough	Participating	\$0
Franklin Township	Participating	\$7,334
Jim Thorpe Borough	Participating	\$0
Kidder Township	Participating	\$11,203
Lansford Borough	Participating	\$0
Lausanne Township	Participating	\$0
Lehigh Township	Participating	\$0
Lehighon Borough	Participating	\$3,672
Lower Towamensing Township	Participating	\$21,227
Mahoning Township	Participating	\$21,993
Nesquehoning Borough	Participating	\$29,230
Packer Township	Participating	\$27,094
Palmerton Borough	Participating	\$208,007
Parryville Borough	Participating	\$0
Penn Forest Township	Participating	\$21,133
Summit Hill Borough	Participating	\$0
Towamensing Township	Participating	\$0
Weatherly Borough	Participating	\$0
Weissport Borough	Participating	\$7,761
TOTAL		\$394,222

Current Condition Losses

The current condition losses were derived using the total assessed value, including land and building values, from the Carbon County Tax Assessment Database. Table 4.4-6 details the total assessed values by municipality and type of land. Please note, the data received from Carbon County attributed values for buildings and land by parcels. If there was more than one structure on one parcel, then the values would be increased by the number of structures on the parcel; this may inflate the total assessed value, though this was not a common occurrence.

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Table 4.4-6 Total Assessed Value by Land Type and Municipality (Carbon GIS Department, 2015).								
MUNICIPALITY	LAND USE							
	AGRICULTURE	COMMERCIAL	FOREST	INDUSTRIAL	OPEN SPACE	RESIDENTIAL	OTHER	TOTAL
Banks Township	\$0	\$0	\$537,540	\$8,198,505	\$0	\$22,989,132	\$1,536,431	\$33,261,608
Beaver Meadows Borough	\$0	\$0	\$1,550,666	\$0	\$0	\$10,491,805	\$0	\$12,042,471
Bowmanstown Borough	\$0	\$0	\$513,803	\$772,130	\$0	\$27,526,534	\$0	\$28,812,467
East Penn Township	\$49,726,461	\$2,468,328	\$124,559,991	\$192,308	\$4,428,466	\$85,803,619	\$0	\$267,179,173
East Side Borough	\$0	\$541,035	\$8,057,180	\$0	\$37,200	\$6,076,375	\$0	\$14,711,790
Franklin Township	\$17,061,561	\$13,408,670	\$72,485,445	\$0	\$9,478,605	\$131,182,706	\$150,250	\$243,767,237
Jim Thorpe Borough	\$0	\$5,788,020	\$16,519,743	\$0	\$187,350	\$106,628,242	\$0	\$129,123,355
Kidder Township	\$1,137,554	\$165,139,946	\$221,710,312	\$0	\$3,873,888	\$110,188,569	\$13,672,949	\$515,723,218
Lansford Borough	\$0	\$0	\$448,353	\$0	\$0	\$33,878,176	\$2,176,840	\$36,503,369
Lausanne Township	\$934,977	\$0	\$5,051,173	\$0	\$727,073	\$5,692,253	\$0	\$12,405,476
Lehigh Township	\$2,324,938	\$0	\$6,972,566	\$0	\$970,596	\$10,031,086	\$114,116	\$20,413,302
Lehighon Borough	\$0	\$19,350,757	\$1,694,175	\$901,905	\$10,632,615	\$101,686,855	\$0	\$134,266,307
Lower Towamensing Township	\$7,089,272	\$27,216,781	\$34,364,183	\$2,242,365	\$8,068,385	\$71,851,690	\$0	\$150,832,676

Table 4.4-6 Total Assessed Value by Land Type and Municipality (Carbon GIS Department, 2015).								
MUNICIPALITY	LAND USE							
	AGRICULTURE	COMMERCIAL	FOREST	INDUSTRIAL	OPEN SPACE	RESIDENTIAL	OTHER	TOTAL
Mahoning Township	\$21,752,871	\$12,024,381	\$64,675,258	\$0	\$7,914,767	\$163,445,457	\$0	\$269,812,734
Nesquehoning Borough	\$0	\$0	\$25,472,478	\$10,533,561	\$152,020	\$49,131,257	\$601,270	\$85,890,586
Packer Township	\$12,577,134	\$0	\$14,239,700	\$0	\$120,245	\$11,380,361	\$0	\$38,317,440
Palmerton Borough	\$0	\$1,192,854	\$2,806,531	\$534,890	\$55,660	\$133,963,881	\$0	\$138,553,816
Parryville Borough	\$2,645,834	\$1,175,906	\$3,861,797	\$0	\$1,005,380	\$7,917,360	\$0	\$16,606,277
Penn Forest Township	\$1,697,662	\$0	\$126,007,363	\$0	\$3,409,819	\$277,921,204	\$13,710,260	\$422,746,308
Summit Hill Borough	\$68,600	\$0	\$7,097,374	\$0	\$53,842	\$48,310,574	\$30,527,413	\$86,057,803
Towamensing Township	\$65,520,234	\$72,000	\$68,737,694	\$0	\$8,368,912	\$55,199,043	\$506,350	\$198,404,233
Weatherly Borough	\$666,365	\$0	\$14,988,589	\$0	\$0	\$53,580,779	\$0	\$69,235,733
Weissport Borough	\$0	\$0	\$445,784	\$0	\$0	\$7,013,362	\$0	\$7,459,146
Grand Total	\$183,203,463	\$248,378,678	\$822,797,698	\$23,375,664	\$59,484,823	\$1,531,890,320	\$62,995,879	\$2,932,126,525

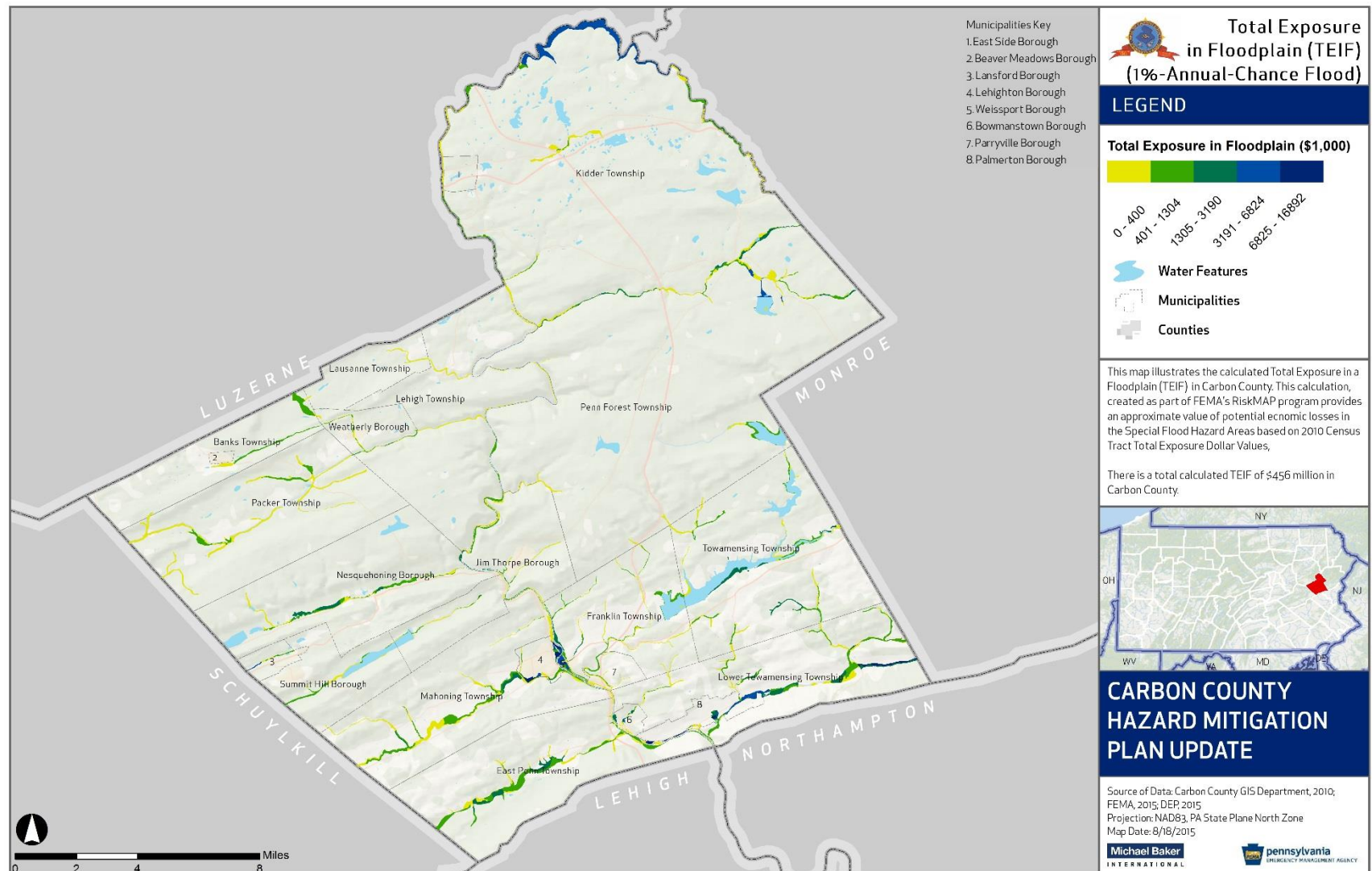
The current conditions were also assessed using the analysis completed by FEMA for the RiskMAP program to estimate the Total Exposure in Floodplain (TEIF). This analysis was completed to help provide communities additional information about the relative comparison in their communities of potential flood loss (FEMA, No Date). The analysis uses the Census Tract Total Exposure Dollar Values from the 2010 Census and calculates the intersection of the census tracts with the SFHA. This calculation also uses dasymetric census blocks using this information to better attribute areas of population geographically within the block.

The results of the TEIF calculation are detailed in Table 4.4-7 and illustrated in Figure 4.4-1. In addition to the TEIF calculation, Table 4.4-7 includes the ranking of the municipalities with a calculated TEIF over 0 compared to all other municipalities in Pennsylvania. This ranking provides context to the relative exposure of Carbon County municipalities as compared to other municipalities in Pennsylvania; the highest ranked municipality is Palmerton Borough, which has the 166th highest exposure of the 2,562 municipalities in Pennsylvania.

Table 4.4-7 Carbon County Total Exposure in Floodplain (FEMA Risk MAP, 2015)		
MUNICIPALITY	TOTAL EXPOSURE IN FLOODPLAIN	PENNSYLVANIA TEIF RANKING
Banks Township	\$1,768,004	2,243
Beaver Meadows Borough	\$0	NA
Bowmanstown Borough	\$17,121,989	994
East Penn Township	\$24,011,220	775
East Side Borough	\$551,542	2,379
Franklin Township	\$21,528,704	828
Jim Thorpe Borough	\$11,320,969	1,324
Kidder Township	\$18,824,947	907
Lansford Borough	\$6,106,843	1,742
Lausanne Township	\$384,536	2,401
Lehigh Township	\$2,558,959	2,142
Lehighton Borough	\$61,461,922	312
Lower Towamensing Township	\$47,089,785	422
Mahoning Township	\$22,185,428	815
Nesquehoning Borough	\$14,917,530	1,108
Packer Township	\$7,385,739	1,614
Palmerton Borough	\$97,670,453	166
Parryville Borough	\$4,258,532	1,935
Penn Forest Township	\$22,823,671	804
Summit Hill Borough	\$1,630,204	2,256
Towamensing Township	\$18,757,153	910
Weatherly Borough	\$6,023,928	1,752

Table 4.4-7 Carbon County Total Exposure in Floodplain (FEMA Risk MAP, 2015)		
MUNICIPALITY	TOTAL EXPOSURE IN FLOODPLAIN	PENNSYLVANIA TEIF RANKING
Weissport Borough	\$47,716,929	417
TOTAL	\$456,098,987	NA

Figure 4.4-1 Total Exposure in Floodplain in Carbon County (FEMA RiskMAP, 2015)



Modeled Losses

This plan employed an enhanced HAZUS analysis for floods. As opposed to basic analysis using only default data, enhanced analysis incorporates both up-to-date and specific data for inclusion in the hazard models. The enhanced data incorporated into this HMP update include:

- Updated demographic data from the 2010 Census,
- Updated essential facilities data from the County
- Dasymetric Census blocks to better attribute areas of population geographically within the block, and
- A user-delineated 100-year depth grid derived for Carbon County from the effective DFIRM data.

For more details on the HAZUS methodology used and additional results reports, see **Appendix F – HAZUS Reports**.

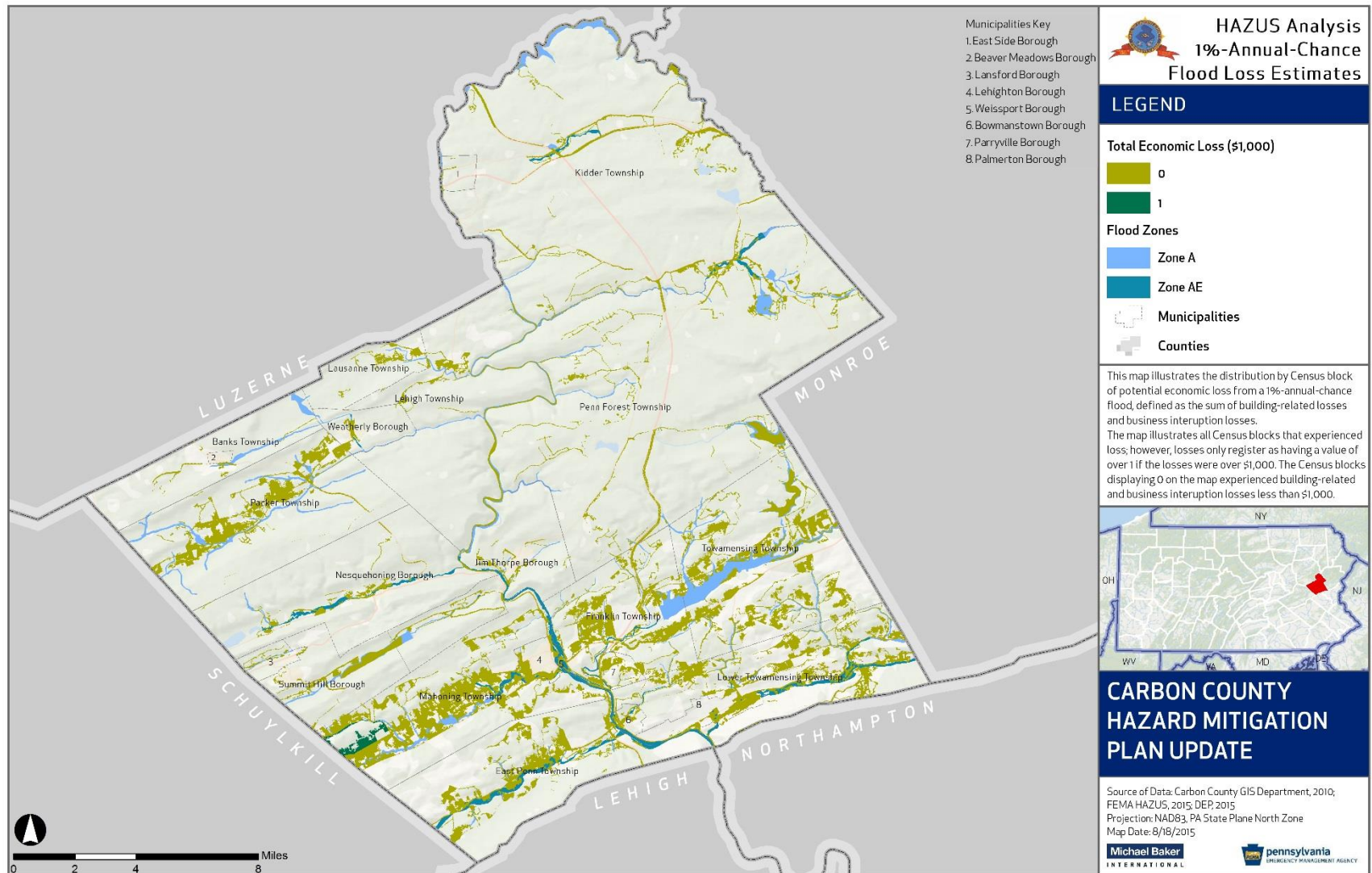
This model calculates loss, as opposed to the exposure calculations detailed in the Current Conditions Section derived by the TEIF analysis. The TEIF analysis includes all calculated losses in the floodplain, without consideration of the depth of the flood in different areas. Due to Carbon County's topography and geography, a building in the floodplain may not be at risk to high losses because of the level of inundation in that area. The HAZUS-MH modeling process includes the development of a depth grid analysis that details the depth of the predicted flood based on the water area, the flood area, and the topography of the area; this detail is not included in the TEIF calculations, which results in higher calculated TEIF losses than HAZUS modeled estimated losses.

The HAZUS datasets only report losses in each Census Block that are over \$1,000. Census Blocks that would experience less than \$1,000 in building-related or business losses have a reported value of \$0 in losses; however, these areas may experience minimal losses of less than \$1,000. Using these datasets in HAZUS-MH 2.1, total economic losses from a 1%-annual-chance flood in Carbon County are estimated at \$1,000. There were no reported building losses for non-critical facilities. Figure 4.4-2 shows the areas that would experience economic loss due to a 1%-annual-chance flood in Carbon County.

According to the model, there would be moderate damage to three police stations and three schools, and there would be loss of use for two police stations and two schools. Additionally, the HAZUS-MH model estimates the number of households that are expected to be temporarily displaced from their homes due to the flood. These numbers show that while the total building damage to the residences may be less than \$1,000, so not illustrated in the building losses, that the flood would impact households in the immediate aftermath of the incident. According to the model, an estimated 716 households will be displaced due to their proximity to inundated areas during the flood, which would result in an estimated number of 1,065 people seeking temporary shelter during the flood incident.

The full HAZUS results report can be found in **Appendix F**.

Figure 4.4-2 Distribution by Census block of the potential total economic loss expected from a 1% annual-chance flood event in Carbon County.



4.4.4. Future Development and Vulnerability

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

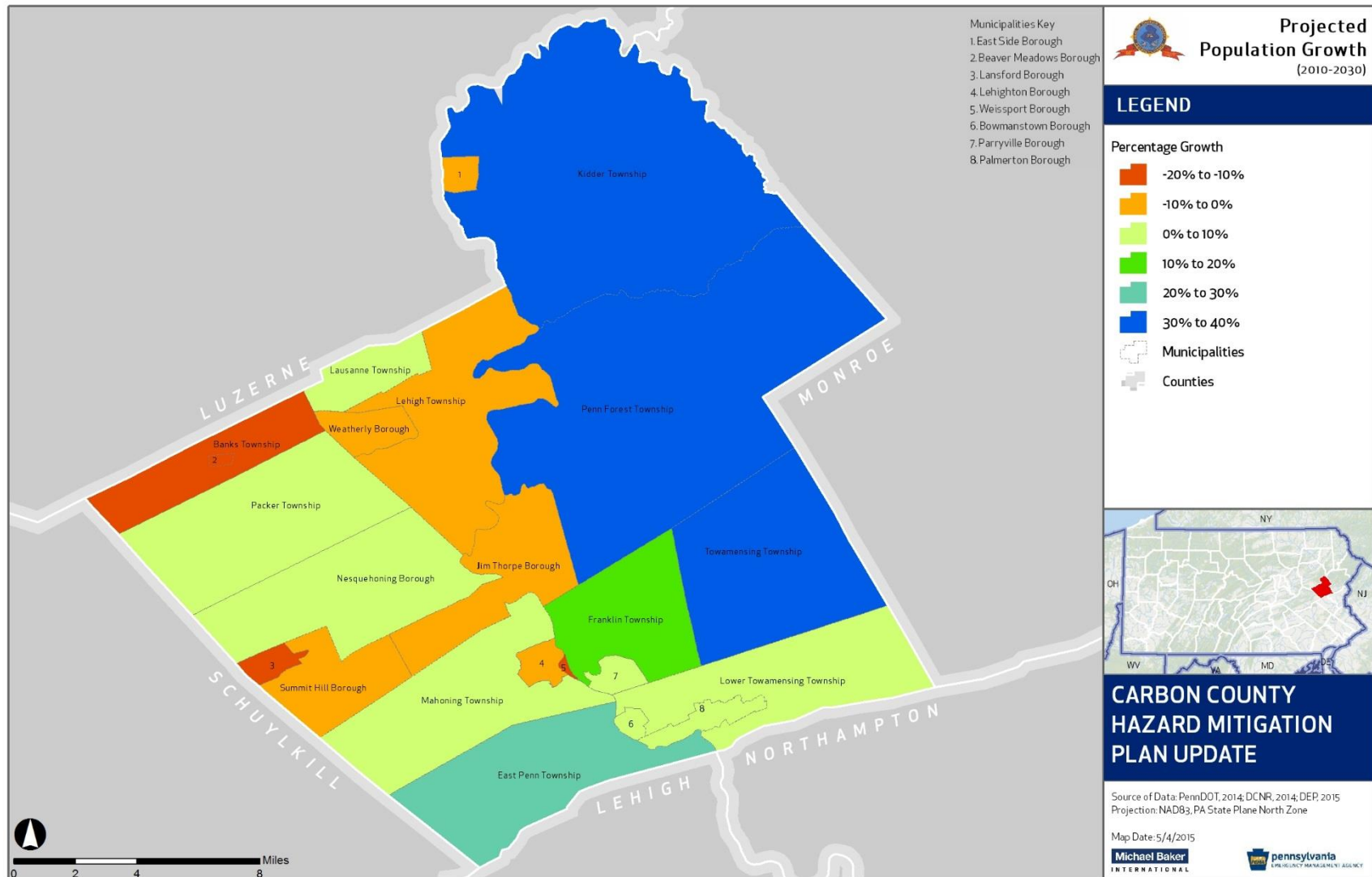
Population change is perhaps the most significant indicator of changes in vulnerability in the future. As discussed in Section 2.3., the total population of Carbon County has grown 11% from 2000-2010, over triple the 1990-2000 growth rate of 3.4%. This growth has largely been due to development pressure from New York and New Jersey to the west and increasing housing prices in the Lehigh Valley to the south. Population projections issued by the Pennsylvania Department of Environmental Protection (PADEP) estimate continued growth for the County from 2010 to 2030, with the County projected to increase in total population by nearly 9%. It is important to note that these population figures are projections only and are derived from birth rates, death rates, and migration information and may not fully capture population dynamics.

However, as can be seen in Figure 4.4-3, this growth is not projected to be evenly distributed in the County. The municipalities that are expected to experience the most growth are Kidder, Penn Forest, and Towamensing Townships with growth rates ranging from 30-40%. In addition, Kidder and Penn Forest Townships have a large weekender population, meaning that the populations of these townships have the potential to increase significantly from Thursday-Sunday, year-round. This population growth and its associated development will likely create increases in loss estimates, as more people will be living in areas prone to hazards, especially flooding, winter storms, and wildfires.

The Carbon County Office of Planning and Development expects that the Pennsylvania Turnpike Commission's addition of a Pennsylvania Turnpike Interchange in Penn Forest Township has the potential to spur growth and increase development around the access point. According to the Pennsylvania Turnpike Commission, this EZ-Pass only exit is located at Route 903 between Mile Marker 74 and 95, and is designed to shorten travel time for commuters, ease traffic congestion at nearby interchanges, and provide additional access to the recreational opportunities in northeastern Carbon County. The new interchange is now open, as of July 7, 2015 (PA Turnpike, 2015).

The smaller boroughs, like Beaver Meadows; Lansford; and Weissport; and Banks Township are projected to experience the greatest population losses in the County. These losses, coupled with physical development constraints in the western portion of the county like rugged terrain and steep slopes, cause risk to remain constant in these areas of the county. Additionally, the 20% of all County land held in state forests, state parks, and state gamelands will also stabilize some risks in the County.

Figure 4.4-3 Projected Population Growth (PADEP, 2015d)



In addition to population growth, historical building permit activity provides insight into ongoing development in the County. The Department of Housing and Urban Development (HUD) maintains data on the number of building permits issued for residential construction by jurisdictions across the U.S., data which is culled from the U.S. Census Bureau's Building Permits Survey. The number of building permits by municipality for Carbon County was obtained from HUD's State of the Cities Data Systems (SOCDS) database for years 2010 through 2014.

Table 4.4-8 displays the number of residential building permits issued by municipality for Carbon County over the last five years. This is the most complete dataset for building permits available, as Carbon County is completely covered by permitting systems.

Table 4.4-8 Building Permits Issued in Carbon County Between 2010-2014 (HUD, 2015)							
MUNICIPALITY	2010	2011	2012	2013	2014	TOTAL UNITS	PERCENT OF TOTAL UNITS IN COUNTY
BANKS TOWNSHIP	0	0	0	0	0	0	0%
BEAVER MEADOWS BOROUGH	0	0	0	0	0	0	0%
BOWMANSTOWN BOROUGH	2	1	0	0	0	3	0.63%
EAST PENN TOWNSHIP	2	3	1	0	0	6	1.27%
EAST SIDE BOROUGH	0	1	0	0	0	1	0.21%
FRANKLIN TOWNSHIP	9	0	2	2	1	14	2.95%
JIM THORPE BOROUGH	6	2	2	2	2	14	2.95%
KIDDER TOWNSHIP	19	12	12	11	16	70	14.77%
LANSFORD BOROUGH	0	0	0	0	0	0	0%
LAUSANNE TOWNSHIP	1	0	0	0	0	1	0.21%
LEHIGH TOWNSHIP	2	0	0	2	2	6	1.27%
LEHIGHTON BOROUGH	0	0	0	0	0	0	0%
LOWER TOWAMENSING TOWNSHIP	8	3	2	5	5	23	4.85%
MAHONING TOWNSHIP	6	6	10	5	5	32	6.75%
NESQUEHONING BOROUGH	3	1	0	2	1	7	1.48%
PACKER TOWNSHIP	6	1	0	1	2	10	2.11%
PALMERTON BOROUGH	3	2	1	19	3	28	5.91%
PARRYVILLE BOROUGH	1	0	0	0	0	1	0.21%
PENN FOREST TOWNSHIP	67	53	28	34	25	207	43.67%
SUMMIT HILL BOROUGH	4	2	1	2	2	11	2.32%
TOWAMENSING TOWNSHIP	8	9	4	7	4	32	6.75%
WEATHERLY BOROUGH	2	1	2	1	2	8	1.69%

Table 4.4-8 Building Permits Issued in Carbon County Between 2010-2014 (HUD, 2015)

MUNICIPALITY	2010	2011	2012	2013	2014	TOTAL UNITS	PERCENT OF TOTAL UNITS IN COUNTY
WEISSPORT BOROUGH	0	0	0	0	0	0	0%
GRAND TOTAL	149	97	65	93	70	474	100.00%

As seen from Table 4.4-8, the greatest share of growth in the County over the last five years has occurred in the Penn Forest Township, accounting for nearly 44% of all new residential construction. The second to largest growth area in the County is Kidder Township with roughly 15% of growth. As mentioned previously, these municipalities are also projected to experience the greatest percentage of population growth in the County in the coming decades.

In November 2013, Carbon County adopted a Comprehensive Plan and Greenways Plan. The Comprehensive Plan helps to better define where growth will occur in the County. Although no key growth areas are designated in the 2013 plan, there is an expectation about what future growth will occur in the county as displayed in Figure 4.4-4. As seen in the map, Carbon County is expected to continue to be primarily rural with growth and development occurring in the townships where population growth has been the highest and where there are growing resort communities, particularly Kidder and Penn Forest Townships. Additional growth is expected to occur around major transportation corridors in the County, specifically between Interstate 80 and Route 940; Route 903; and Route 534. Other areas designated for redevelopment include a 59-acre brownfield site in Lehighton Borough and Manhoning Townships east of Route 248 and the former Palmerton Zinc Company site in Palmerton Borough. The former Palmerton Zinc Company is a brownfield site with ongoing remediation. A portion of the site, the east site, has successfully been remediated and has active businesses onsite.

The 2013 Comprehensive Plan and Greenways Plan is the first countywide comprehensive plan to incorporate a greenways plan, thus solidifying the value and location of natural areas and green infrastructure that may serve to maintain or reduce the risk and vulnerability in the county. The greenways portion of the Comprehensive Plan places an emphasis on the maintenance of a variety of protected and recreational space. These areas can be seen in Figure 4.4-5.

Key greenways and green infrastructure identified by the County include:

- The main trails in the County, including the Appalachian Trail, Delaware and Lehigh Trail, The Lehigh River Water Trail, and Buckwha Rails to Trails; Delaware River Water Trail, Switchback Trail, and Glen Onoko Falls;
- Environmentally sensitive areas like the 1 percent annual chance floodplain, wetlands, surface water, and existing natural and conservation areas;
- Protected open space like State Forests, State Gamelands, State, County, and Municipal Parks;
- Federal recreation areas, including the Francis E. Walter Dam;
- Farmland, including protected easements, Agricultural Security Areas, and primary agricultural land;

- Steep slopes 15% or greater;
- Ridge tops and scenic viewsheds; and
- Important Natural Areas like Important Bird Areas, Important Mammal areas, and Wildlife habitat and migration patterns.

In the Greenways Plan, the County recommends that specific areas in the County be designated as recreational or conservation greenways. Recreational greenways identified by the County include the Appalachian Trail and the Blue Mountain/Kittatiny Ridge, Lehigh Gap Nature Center, Chestnut Ridge Greenway, Delaware & Lehigh Trail and Lehigh River Greenway, Switchback Railroad Trail, and Panther Valley Heritage Trail. Conservation greenways are focused on the of waterways and ridgelines to improve the quality and quantity of water in the County and include Mauch Chunk Ride; Nesquehoning Mountain; areas between State Game Lands 40 and the Lehigh River in Kidder Township; and Black Creek, Buck Mountain Creek, Lizard Creek, Mud Run, Nesquehoning Creek and Quakake Creek Greenways (Carbon County, 2013).

In addition, Carbon County recognizes the development pressure it is experiencing and has worked to preserve land through the PA Act 319, otherwise known as the Clean and Green Act (1074). This voluntary program allows owners of agricultural, agricultural reserve, or forest reserve land to apply for preferential assessment of their land. The landowners must preserve a minimum of ten acres of land and must maintain the original use of the land indefinitely or face a penalty of roll-back taxes. According to the Pennsylvania Department of Agriculture's Annual Farmland Preservation Report, 5,280 acres of land (1,185 parcels) representing 2.2% of all land area in Carbon County have been preserved using this legislation (PDA, 2014). The preserved land is geographically concentrated in the southern section of the County, especially in Summit Hill Borough, Mahoning Township, East Penn Township, Towamensing Township, and Lower Towamensing Township. This preservation will likely decrease or stabilize these communities' hazard vulnerability.

Making use of the analysis of Carbon County's current and future population and development trends, it is important to explore how these projected changes may influence the County's future vulnerability to the profiled hazards. Hazard vulnerability and loss potential will be higher in the places of higher density throughout the County. For example, population growth and its associated development is likely to create increases in loss potential, as more people may be living in areas prone to hazards. For example, while development occurs most often along transportation networks, because of their access and the increased demand for travel and access to services, this additional development increases the vulnerability to transportation incidents. Key hazards that are specific to Carbon County's growth and development trends include flooding, wildfire, and transportation accidents.

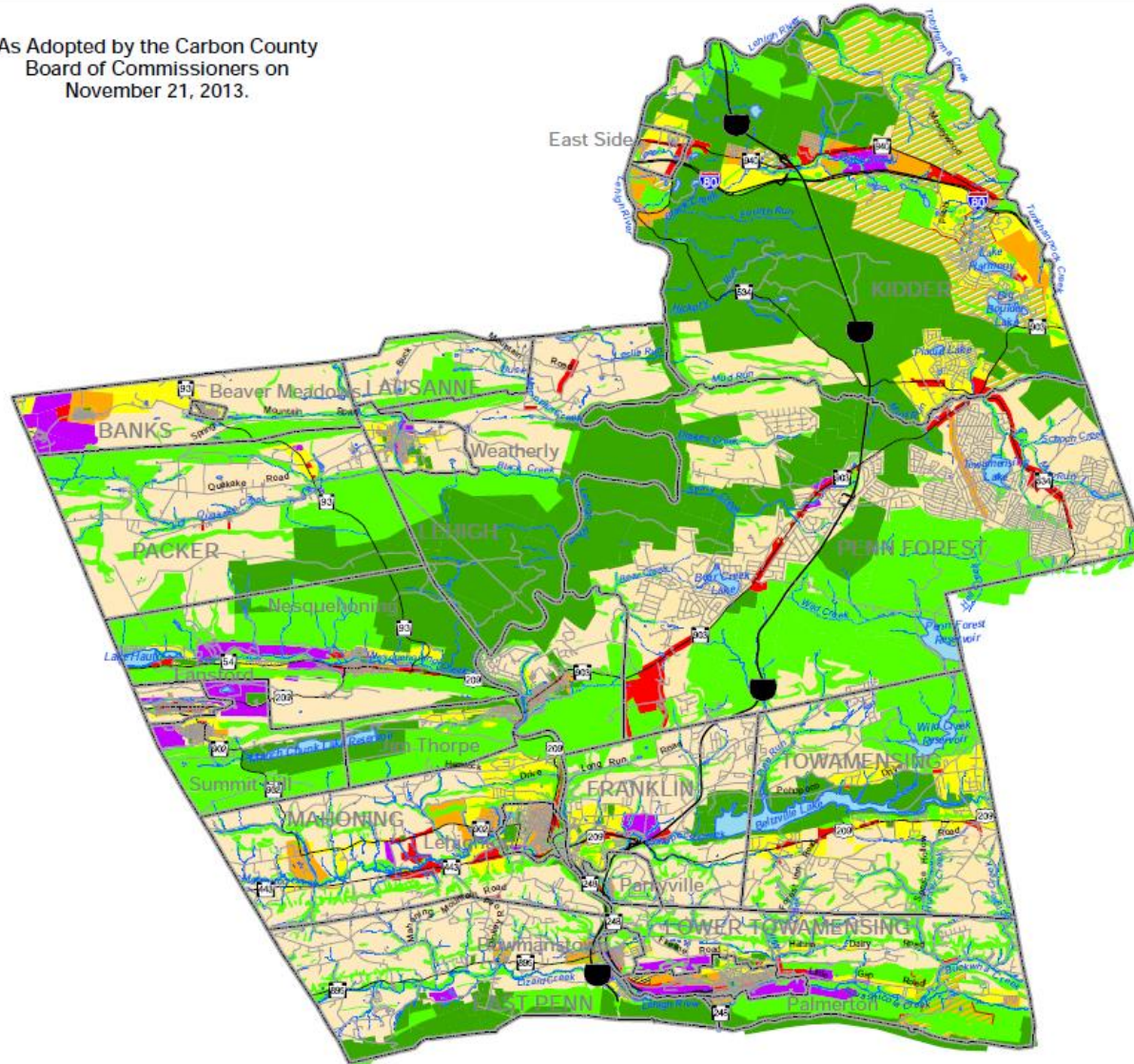
As discussed previously, Carbon County's comprehensive plan incorporates growth management strategies and appropriate recommendations to protect environmentally sensitive areas and preserve open space, which may help to funnel growth away from hazard-prone areas. In addition, while there may be growth areas that include SFHA or other hazard areas, to comply with state requirements, municipalities have floodplain regulations that limit construction within flood-prone areas and other

hazard or environmentally sensitive areas. These provisions are included within each municipality's and the county's subdivision and land development ordinance.

This updated hazard mitigation plan can be used in tandem with the County's Comprehensive Plan and Greenway Plan to guide future development because it identifies areas that may be more prone to hazards. Utilizing both the maps associated with the hazard mitigation plan and the County's future land use plan can assist Carbon County in accomplishing their goals of development and make them less prone to the negative impacts of hazards.

Figure 4.4-4 Carbon County Future Land Use Plan (Carbon County, 2013)

As Adopted by the Carbon County Board of Commissioners on November 21, 2013.



Carbon County Comprehensive & Greenway Plan

Future Land Use Plan

- Conservation
- Rural
- Low Density Residential
- Medium-High Density Residential
- Commercial
- Hospital & Related
- Industrial and Industrial/Commercial
- Resort & Commercial Recreation
- Existing Public Recreation Land

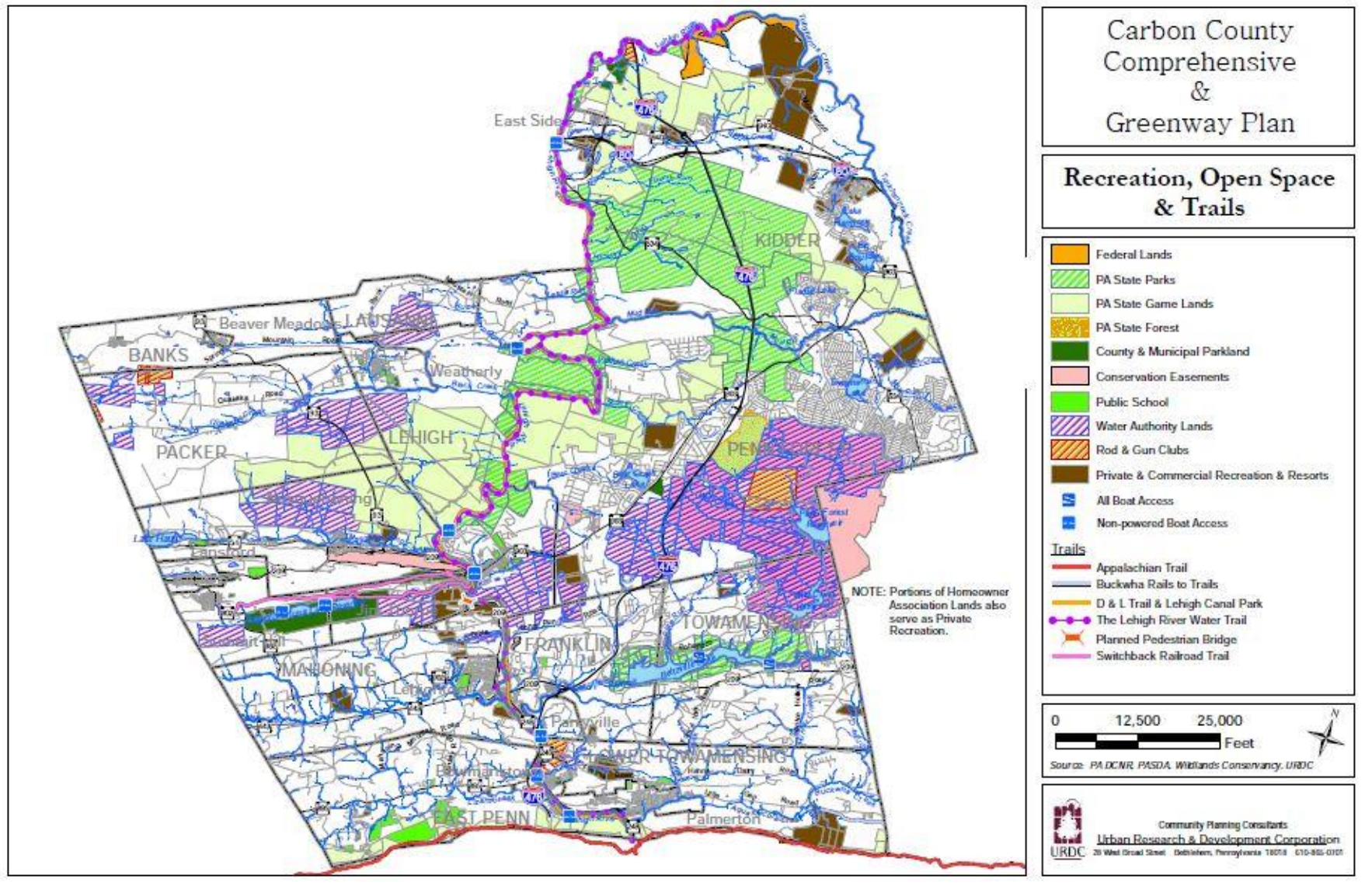
0 12,500 25,000
Feet

Source: PA DCNR, PASDA, Wildlands Conservancy, URDC



Community Planning Consultants
Urban Research & Development Corporation
28 West Broad Street Bethlehem, Pennsylvania 18018 610-865-0701

Figure 4.4-5 Carbon County Recreation, Open Space & Trails (Carbon County, 2013)



5. CAPABILITY ASSESSMENT

5.2.Update Process Summary

Carbon County has a number of resources it can access to implement hazard mitigation initiatives including local planning and regulatory tools, administrative assistance and technical expertise, fiscal resources; use of local, regional, state, and federal funding sources; and educational outreach methods. The presence of these resources enables community resiliency through actions taken before, during, and after a hazard event.

During the 2010 HMP process, local plans, ordinances, and codes were identified for each municipality. Through responses to the *Capability Assessment Survey* distributed to all of the County's municipalities and input from the HMSC and the HMPT, the 2010 HMP provided an inventory of the most critical local planning tools available within each municipality and a summary of the fiscal and technical capabilities available through programs and organizations outside of the County. It also identified emergency management capabilities and the processes used for implementation of the NFIP.

For the 2015 HMP update, a revised Capability Assessment Survey was developed based on the most recent FEMA and PEMA guidance. The survey contained 3 main sections including: planning and regulatory capability, administrative and technical capability, and self-assessment of capability. To assist municipalities in reducing the amount of time needed to complete the survey, survey responses received from each municipality as part of the 2010 HMP Update were pre-populated in a survey for each municipality. If a municipality did not complete a survey from the 2010 HMP Update, they were provided with a survey including the municipal name but no pre-populated information. Communities were then invited to update and/or confirm the information for 2015. The Capability Assessment survey was provided in both hard copy (meeting handout) and electronic format (via e-mail and/or via the project website) to each municipality. In addition, Carbon County Office of Planning and Development (CCOPD) completed a Capability Assessment Survey to identify county-level capabilities.

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.

5.3.Capability Assessment Findings

Within Pennsylvania, no county-level capability assessment would be complete without considering the constituent municipalities. Local municipalities have their own governing body, enforce their own rules and regulations, purchase their own equipment, maintain their own infrastructure, and manage their own resources. In many ways, the County is only as good as the capabilities of its constituent municipalities. As such, this capability assessment does not consider Carbon County as a lone entity, but evaluates it in light of the various characteristics and differences of and between its municipalities.

5.3.1. Planning and Regulatory Capability

Pennsylvania municipalities have the authority to govern more restrictively than the state and federal minimum requirements, as long as they are in compliance with all criteria established in the Pennsylvania Municipalities Planning Code (MPC). Municipalities can develop their own policies and programs and implement their own rules and regulations to protect and serve their local residents. Carbon County and municipalities have used, and could continue to use, planning and regulatory tools to support the goals of this hazard mitigation plan and to provide opportunities for further mitigating the potentially negative effects of hazards.

Some of the most important planning and regulatory capabilities that can be utilized for hazard mitigation include comprehensive plans, building codes, floodplain ordinances, subdivision and land development ordinances, and zoning ordinances. These tools provide mechanisms for the implementation of adopted mitigation strategies. Below are descriptions of these planning tools, which were included in the Capability Assessment survey.

Hazard Mitigation Plan

Hazard mitigation plans (HMPs) such as this 2015 HMP Update, describe in detail the hazards that may affect the community, the community's vulnerability to those hazards, and an action plan for how the community plans to minimize or eliminate that vulnerability. HMPs are governed by the Disaster Mitigation Act of 2000 (DMA 2000), and having a FEMA-approved HMP makes the jurisdiction eligible for federal mitigation funding.

Comprehensive Plans

Comprehensive Plans promote sound land use and regional cooperation among local governments to address planning issues. These plans serve as the official policy guide for influencing the location, type and extent of future development by establishing the basis for decision-making and review processes on zoning matters, subdivision and land development, land uses, public facilities and housing needs over time. Pennsylvania's MPC (Act 247 of 1968), as reauthorized and amended, requires counties to prepare and maintain a county comprehensive plan and to update it every 10 years.

The existing countywide Comprehensive Plan and Greenway Plan for Carbon County was developed in 2013. Two multi-municipal regional plans were developed to address specific issues and characteristics of the Central Region (Franklin, East Penn and Mahoning Townships, and Weissport and Lehighton Boroughs) and the Middle Region (Penn Forest Township, and Jim Thorpe, Summit Hill and Lansford Boroughs). Also, several jurisdictions in the County have local municipal comprehensive plans and include: Beaver Meadows, East Side, Nesquehoning, and Weatherly Boroughs and Kidder, Lausanne, and Lehigh Townships. County governments are required by law to adopt a comprehensive plan, while local municipalities may do so at their option. All municipalities in Carbon County are covered, in some capacity, under the county or a regional or local comprehensive plan.

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

consideration to storm drainage and floodplain management. The 2013 Comprehensive Plan and Greenway Plan considers findings from the 2010 HMP and future updates and improvements will continue to incorporate HMP findings.

Building Codes

Building codes regulate construction standards for new construction and substantially renovated buildings. Standards can be adopted that require resistant or resilient building design practices to address hazard impacts common to a given community. In 2003, the Commonwealth of Pennsylvania implemented Act 45 of 1999, the Uniform Construction Code (UCC), a comprehensive building code that establishes minimum regulations for most new construction, including additions and renovations to existing structures.

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

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 Department of Labor and Industry is responsible for all commercial code enforcement in that municipality. The Department of Labor and Industry also has sole jurisdiction for all state-owned buildings no matter where they are located. All municipalities in Carbon County are required to adhere to the UCC. Twenty out of the twenty-three municipalities in the County “opt-in” to the UCC (PA L&I, 2015). The HMSC indicated that some municipalities that “opt-out” in Carbon County might do so because of the ICC Wildland-Urban Interface Code, as many municipalities rely on well water and implementation of the code could halt development in these municipalities.

Floodplain Management Ordinances

Through administration of floodplain ordinances, municipalities can ensure that all new construction or substantial improvements to existing structures located in the floodplain are flood-proofed, dry-proofed, or built above anticipated flood elevations. Floodplain ordinances may also prohibit development in certain areas altogether. The NFIP establishes minimum ordinance requirements which must be met in order for that community to participate in the program. However, a community is permitted, and in fact, encouraged to adopt standards which exceed NFIP requirements. Through participation in the NFIP, all municipalities within the County have floodplain regulations in place including Beaver Meadows Borough which has no identified SFHAs.

Subdivision Regulations and Zoning Ordinances

Subdivision and land development ordinances (SALDO) are intended to regulate the development of housing, commercial, industrial or other uses, including associated public infrastructure, as land is subdivided into buildable lots for sale or future development. Within these ordinances, guidelines on how land will be divided, the placement and size of roads and the location of infrastructure can reduce exposure of development to hazard events.

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

Firewise

Firewise is a national program that brings together the response community, community planners, and homeowners to minimize the risk of wildfires. The program focuses on development that is compatible with the natural environment. Participation in the program is begun and maintained by groups of homeowners. Six entities in Carbon County participate in the Firewise program and are as follows: Bear Creek Lakes, Hickory Run Forest, Penn Forest Streams and Pleasant Valley Westin Jim Thorpe Borough; Indian Mountain Lakes in Penn Forest Township; and Towamensing Trails in Albrightsville (DCNR-BOF, 2015b).

Carbon County assists communities in the establishment of a Firewise community rating for the local municipality and provides trainings and exercises in cooperation with the Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry.

Farmland Preservation

Farmland preservation measures are important to hazard mitigation. Preserved farms protect soil from erosion and prevent the contamination of local surface water. In addition, farms and forest land are important for recharging the community's aquifer and providing habitat for local wildlife. Carbon County has a very active agricultural land preservation program overseen by the Carbon County Agricultural Land Preservation Board, which works closely with the Conservation District.

As discussed in Section 4.4.4, Carbon County has taken steps to preserve land through the PA Act 319, otherwise known as the Clean and Green Act (1074). Additional planning mechanisms employed by the County include the use of agricultural conservation easements and Agricultural Security Areas (ASAs). Agricultural conservation easements restrict the conversion of agricultural land for development by placing a permanent conservation easement on the land. Landowners voluntarily sell the easement to government agencies or a private conservation organization, who compensates the landowner and strictly prohibits the use of the land for nonagricultural purposes (Carbon County, 2013; APA, 2012). Unlike easements, ASAs are not legally binding, but are a means to express the intent of the landowner to use the land for agriculture.

Emergency Management and Emergency Operations Plans

The Pennsylvania Emergency Management Services Code, Title 35, requires all political jurisdictions in the Commonwealth to have an emergency operations plan (EOP), an emergency management coordinator (EMC), and an emergency operations center (EOC).

The Carbon County Emergency Management Agency (CCEMA) coordinates countywide emergency management efforts. The HMSC indicated that the CCEMA also participates in regional planning efforts

through a Regional Long Term Recovery Committee (LTRC). The LTRC consists of private sector representatives, local volunteers and government representatives from Carbon, Lehigh, Monroe, and Northampton Counties and works to coordinate community recovery and reconstruction. Each municipality in Carbon County has a designated local emergency management coordinator who possesses a unique knowledge of the impact hazard events have on their community. A significant amount of information used to develop this plan was obtained from the emergency management coordinators. All 23 municipalities in Carbon County have a local EOP and a countywide EOP also exists. Municipalities are not required to sign on to the County EOP, because County staff prefers to keep municipal emergency management coordinators actively engaged at a more local level.

Carbon County also has community-led resources dedicated to emergency response, such as a Community Emergency Response Team (CERT) with over 600 active members in 2010, Carbon County Citizen Corps volunteer response, education, and training team, and a County Animal Response Team (CART) to assist in animal related emergencies in the County (Carbon County, 2013).

In addition, the County has a community alert system that emergency management personnel can use to notify residents of important information during a major crisis or emergency impacting the County. Carbon County residents can register for the text notifications at the ReadyNotifyCarbon website at <https://carbon.alertpa.org/index.php?CCheck=1>.

Participation in the NFIP

All 23 municipalities in Carbon County are participants in the NFIP (see Table 5.3-1). The program is managed by local municipalities participating in the program through ordinance adoption and floodplain regulation while the Carbon County Office of Planning and Development provides an oversight and coordination role. Similarly, permitting processes needed for building construction and development in the floodplain are implemented at the municipal level through various ordinances (e.g. zoning, subdivision/land development and floodplain ordinances).

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

The Pennsylvania Department of Community and Economic Development (DCED) provides communities, based on their 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.

Act 166 mandates municipal participation in and compliance with the NFIP. It also establishes higher regulatory standards for hazardous materials and high risk land uses. As new Digital Flood Insurance Rate Maps (DFIRMs) are published, the Pennsylvania State NFIP Coordinator housed at DCED, works with communities to ensure the timely and successful adoption of an updated floodplain management ordinance by reviewing and providing feedback on existing and draft ordinances. In addition, DCED

provides guidance and technical support through Community Assistance Contacts (CAC) and Community Assistance Visits (CAV).

Carbon County municipalities are currently utilizing 2002 Digital Flood Insurance Rate Maps (DFIRMS). The digital maps greatly enhanced mitigation capabilities as they relate to identifying flood hazards and is a significant improvement to the previously effective paper Flood Insurance Rate Maps. Residents and municipal officials are provided with mapping assistance from the Carbon County GIS Department and the Carbon County Office of Planning and Development upon request.

There are no communities in Carbon County currently participating in the NFIP Community Rating System (FEMA CIS, 2015).

Table 5.3-1 Carbon County NFIP Information by Municipality (CIS, 2015).				
MUNICIPALITY	PARTICIPATION STATUS	COMMUNITY IN GOOD STANDING	POLICIES IN FORCE	TOTAL PREMIUM AND COVERAGE
Banks Township	P	Yes	0	\$0
Beaver Meadows Borough	P	Yes	0	\$0
Bowmanstown Borough	P	Yes	12	\$1,428,341.00
East Penn Township	P	Yes	10	\$1,666,477.00
East Side Borough	P	Yes	0	\$0
Franklin Township	P	Yes	12	\$1,783,758.00
Jim Thorpe Borough	P	Yes	12	\$1,361,580.00
Kidder Township	P	Yes	11	\$2,625,507.00
Lansford Borough	P	Yes	2	\$207,476.00
Lausanne Township	P	Yes	0	\$0
*Lehigh Township	P	Yes	1	\$242,185.00
Lehighon Borough	P	Yes	6	\$944,956.00
Lower Towamensing Township	P	Yes	25	\$5,145,871.00
Mahoning Township	P	Yes	20	\$5,076,538.00
Nesquehoning Borough	P	Yes	20	\$4,401,879.00
Packer Township	P	Yes	3	\$201,569.00
Palmerton Borough	P	Yes	80	\$12,047,457.00
Parryville Borough	P	Yes	1	\$350,414.00
Penn Forest Township	P	Yes	23	\$5,584,907.00
Summit Hill Borough	P	Yes	2	\$378,636.00
Towamensing Township	P	Yes	4	\$543,266.00
Weatherly Borough	P	Yes	7	\$1,444,242.00
Weissport Borough	P	Yes	57	\$6,406,657.00
*Erroneously listed as Thornhurst Township in FEMA's CIS.				

Carbon County Capabilities

Table 5.3-2 summarizes the major planning tools that were identified by the municipalities during the planning process, as well as through Carbon County records.

Table 5.3-2 Major Planning Tools in Carbon County				
MUNICIPALITY	COMPREHENSIVE LAND USE PLAN	BUILDING CODE	NFIP/FP REGULATIONS	SUBDIVISION REGULATIONS OR ZONING ORDINANCES
Banks Township	County	X - Opt-Out	X	X
Beaver Meadows Borough	County, X (1996)	X - Opt-Out	X	X
Bowmanstown Borough	County, X (2009)	X	X	X
East Penn Township	County, X (2011)	X	X	X
East Side Borough	County, X (1996)	X - Opt-Out	X	X
Franklin Township	County, X (2011)	X	X	X
Jim Thorpe Borough	County, X (2013)	X	X	X
Kidder Township	County, X (2012)	X	X	X
Lansford Borough	County, X (1999)	X	X	X
Lausanne Township	County, X (1995)	X	X	X
Lehigh Township	County, X (1992)	X - Opt-Out	X	X
Lehighton Borough	County, X (2011)	X	X	X
Lower Towamensing Township	County, X (2009)	X	X	X
Mahoning Township	County, X (2011)	X	X	X
Nesquehoning Borough	County, X (1991)	X	X	X
Packer Township	County	X	X	X
Palmerton Borough	County, X (2009)	X	X	X
Parryville Borough	County, X (1981)	X	X	X
Penn Forest Township	County, X (2013)	X	X	X
Summit Hill Borough	County, X (2013)	X	X	X
Towamensing Township	County, X (2009)	X	X	X
Weatherly Borough	County, X (2012)	X	X	X
Weissport Borough	County, X (2011)	X	X	X
X = in place locally				
County = Under County Ordinance or Countywide Plan				

5.3.2. Administrative and Technical Capability

Administrative capability is described by an adequacy of departmental and personnel resources for the implementation of mitigation-related activities. Technical capability relates to an adequacy of knowledge and technical expertise of local government employees or the ability to contract outside resources for this expertise in order to effectively execute mitigation activities. Common examples of skill sets and technical personnel needed for hazard mitigation include: planners with knowledge of land development/management practices, engineers or professionals trained in construction practices related

to buildings and/or infrastructure (e.g. building inspectors), planners or engineers with an understanding of natural and/or human caused hazards, emergency managers, floodplain managers, land surveyors, scientists familiar with hazards in the community, staff with the education or expertise to assess community vulnerability to hazards, personnel skilled in geographic information systems, resource development staff or grant writers, fiscal staff to handle complex grant application processes.

Based on assessment results, municipalities in Carbon County have moderate administrative and technical staff needed to conduct hazard mitigation activities. There seems to be sufficient emergency management staff across the County and several municipalities have grant writing capabilities. However, there seems to be a common lack of personnel for land surveying and scientific work related to community hazards. This result is not necessarily surprising since these tasks are typically contracted to outside providers. Many communities do not have their own personnel skilled in geographic information systems but have identified that the County GIS Department is able to provide these services. All municipalities in the County have an emergency management coordinator.

Other local organizations that could act as partners include the Carbon County Conservation District, the Penn State Cooperative Extension, the Carbon County Fire Chiefs, the Carbon County Groundwater Guardians, the Carbon County Citizen Corps Council, business development organizations such as the Carbon County Chamber of Commerce, and historical or cultural agencies such as the Mauch Chunk Historical Society of Carbon County. In addition, The Carbon County Agricultural Land Preservation Board is appointed to oversee the selection and purchase of agricultural conservation easements in the County. The board, which works closely with the Conservation District, can help farmers apply for an easement and see how individual farms will rate against other applicants. As the facilitator of farmland preservation, the board has an important role in preserving contiguous belts of farmland throughout the County.

Regional or statewide organizations that could act as partners or provide technical assistance include but are not limited to:

- The Pennsylvania Land Trust Association: The Pennsylvania Land Trust Association (PALTA), which consists of nonprofit and land conservation groups. PALTA has developed model easements that are available on the association website (<http://www.conserveland.org>). The model easements include:
 - Pennsylvania Conservation Easement
 - Riparian Forest Buffer Protection Agreement
 - Water Quality Improvement Easement
- Natural Lands Trust
- Wildlands Conservancy
- Chesapeake Conservancy
- Appalachian Mountain Club – Delaware Valley Chapter

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

- Pennsylvania Department of Community and Economic Development;

- Pennsylvania Department of Conservation and Natural Resources; and
- Pennsylvania Department of Environmental Protection.

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

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

5.3.3. Financial Capability

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

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

- Community Conservation Partnerships Program;
- Community Revitalization Program;
- Growing Greener Program;
- Keystone Communities Grant Program;
- Local Government Capital Projects Loan Program;
- Land and Water Conservation Fund;
- Land Use, Transportation, and Economic Development Initiative (LUTED);
- Municipal Assistance Program (MAP),
 - Floodplain Land Use Assistance Program;
 - Shared Services Planning
- Pennsylvania Heritage Areas Program;
- Pennsylvania Recreational Trails Program;
- Shared Municipal Services; and
- Technical Assistance Program.

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

- Community Development Block Grants (CDBG);
- Disaster Housing Program;
- Emergency Conservation Program;
- Emergency Management Performance Grants (EMPG);
- Emergency Watershed Protection Program;
- Hazard Mitigation Grant Program (HMGP);
- Flood Mitigation Assistance Program;
- Non-insured Crop Disaster Assistance Program;
- Pre-Disaster Mitigation Program;
- Section 108 Loan Guarantee Programs;
- USDA Rural Development Programs; and
- Weatherization Assistance Program.

Existing Limitations

As mentioned, there are no communities in Carbon County participating in the NFIP Community Rating System. However, 22 of the 23 municipalities in the County have been designated as floodprone. Community participation in this program can provide premium reductions for properties located outside of Special Flood Hazard Areas of up to 10 percent and reductions for properties located in Special Flood Hazard Areas of up to 45 percent. These discounts can be obtained by undertaking public information, mapping and regulations, flood damage reduction and flood preparedness activities (FEMA, 2009c).

Based on the capability assessment results, very few municipalities in the County have an adopted stormwater management plan or ordinance. A stormwater management plan is designed to address flooding associated with stormwater runoff. These plans typically focus on design and construction measures that are intended to reduce the impact of more frequently occurring minor urban flooding. Carbon County has an Act 167 Stormwater Management Plan which is a joint plan for Carbon and Schuylkill Counties covering the Nequehoning, Mauch Chunk, Mahoning, and Lizard Creek Watersheds. However, the plan was adopted in 1995 and has not been updated since. The presence of an updated stormwater management plan would greatly enhance mitigation capabilities needed to address flood and transportation hazards.

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

As mentioned previously, several communities in Carbon County participate in the Firewise program. However, other communities in the County are identified as vulnerable to wildfire hazards. The Pennsylvania Firewise Community Program assists planned and existing communities in implementing management practices which reduce the risk of wildfire events. Firewise communities are those that avoid potential fire emergencies by addressing and correcting fire hazards and preparing for the threat of a wildfire event (DCNR-BOF, 2015a). Improved participation in this program will reduce the loss of lives, property and resources to wildfires by building and maintaining communities using practices that are compatible with their natural surroundings.

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

5.3.4. Education and Outreach

Education and outreach programs and methods are used to implement mitigation activities and communicate hazard-related information. Examples include fire safety programs that fire departments deliver to students at local schools; participation in community programs, such as Firewise Communities Certification or StormReady Certification and activities conducted as part of hazard awareness campaigns, such as Tornado or Flood Awareness Month. Some communities have their own public information or communications office to handle outreach initiatives. A number of trainings, meetings and seminars relevant to hazard mitigation are coordinated annually by the Carbon County Emergency Management Agency. Courses provided in 2015 include:

- Hazmat Awareness
- Hazmat Operations Refresher
- FEMA Advanced Professional Series (APS)
 - Emergency Management Operations (G-110)
 - CERT Basic Skills Course (G-317)
 - Multi-Hazard Emergency Planning for Schools (G-364)
 - Mass Fatality Incident Response (G-386)
- FEMA Emergency Management Institute Courses
 - Introduction to Incident Command System (ICS-100)
 - ICS for Single Resources and Initial Action Incidents (IS-200)
 - National Incident Management System (NIMS) An Introduction (IS-700)
 - National Response Framework: An Introduction (IS-800)
 - Rapid Needs Assessment (G-250.7)
 - Mass Facility Incident Response (G-386)
- Department of Health Points of Distribution (POD) Training

5.3.5. Plan Integration

Plan integration recognizes that hazard mitigation is most effective when it works in concert with other plans, regulations, and programs. Per FEMA, plan integration is described as the regular consideration and management of hazard risks in a community's existing planning framework. The planning framework is the collection of plans, policies, codes, and programs that guide land use and development, how those

are maintained and implemented, and the roles of a range of stakeholders to evaluate and update them. Effective integration of hazard mitigation occurs when the planning framework fosters development that does not increase risks from known hazards or leads to redevelopment that reduces risk from known hazards (FEMA, 2013).

In Pennsylvania, integrating hazard mitigation into planning tools is afforded through the Municipalities Planning Code in that protecting and promoting safety and health is a purpose of the code. Further, a purpose of the Municipalities Planning Code is “to minimize such problems as may presently exist or which may be foreseen”, which is the focus of hazard mitigation planning.

When developing the HMP, certain sections of the County Comprehensive Plan, EOP, and various land use ordinances and regulations provided key information. Moving forward, each of these documents should not be treated as unrelated and updated separately. The County and each participating municipality are responsible for incorporating the specific mitigation actions recommended in this Plan into the necessary planning documents, including the appropriate comprehensive plan, the County EOP, and any land use ordinances and regulations.

For example, zoning and other land use regulations can be amended to reflect the newly identified hazard areas, to ensure that development in those areas is minimized or at least conducted in a way that otherwise mitigates against the effects of hazards (e.g., requiring structures built in the floodplain to be elevated). As proposed changes to building codes are presented, their potential for mitigating damage due to hazards will be examined, and the changes will only be adopted if they are shown to lower risk. Changes to stormwater management plans will incorporate identified mitigation actions and will encourage increased participation in the NFIP.

Plan integration is not only accomplished through the MPC and planning tools such as comprehensive plans and zoning ordinances, but through capital improvement planning, area plans such as highway corridors and downtown plans, functional plans like stormwater and open space plans, and public and stakeholder outreach and education. This section highlights key opportunities for plan integration in Carbon County.

2013 Carbon County Comprehensive Plan & Greenway Plan

Carbon County’s current Comprehensive Plan & Greenway Plan was adopted on November 21, 2013 by the Carbon County Board of Commissioners. The Plan provides a general direction and blueprint for the future of Carbon County and constituent communities, particularly as it pertains to resource preservation and land conservation. For example, the Plan recommends specific land use and development regulations and provides model ordinance provisions that could be used to preserve open space and greenways in the County. In regards to floodplain management, these recommendations go above and beyond minimum federal requirements and suggest that in some areas of the County, municipalities consider prohibiting new development within the 100-yr floodplain. The Plan also identifies key areas for conservation and greenway enhancements, such as wayfinding signage that could reduce the County’s vulnerability to disorientation.

Recommendations from the HMP can be incorporated into the document and as reflected in Section 4.4.4 and described above, several hazard mitigation techniques are already reflected in the Comprehensive Plan.

Table 5.2.5-1 outlines specific planning, zoning, and land use goals, recommendations and key actions identified in the Comprehensive Plan that are relevant to hazard mitigation planning and the Hazard Mitigation Plan Update. Actions in the table have been categorized by the various sections of the Comprehensive Plan & Greenway Plan, but many actions are crosscutting and address the goals outlined in multiple areas of the Plan.

Table 5.3-3 Planning, Zoning and Land Use Actions Relevant to Hazard Mitigation Planning

	GOALS	LOCATION IN PLAN	ACTIONS	LOCATION IN PLAN
GREENWAYS	- Goal 1: Develop a greenway system that includes both recreation and conservation greenways. - Goal 2: Expand the County's existing trail and open space system. - Goal 3: Protect environmentally sensitive, cultural, scenic, and historic areas of Carbon County.	8.1	- Adopt official maps as a tool to help preserve needed parkland and trail links. - Establish/stabilize riparian buffers with support from grants and volunteer efforts by local landowners and conservation groups. - Provide technical assistance and expand educational programs for municipalities and landowners regarding land conservation - Protect environmentally sensitive areas through education/information programs, local ordinances, and a focus on priority natural areas. - Prepare a river conservation plan for every water-based greenway in the Carbon County Greenway Plan to identify the unique characteristics and threats posed to each waterway as well as appropriate protection measures and key parcels for preservation. - Provide clear signage along trails to assist users in locating existing and future trails and amenities along the trails - Protect environmentally sensitive areas through education/information programs, local ordinances, and a focus on priority natural areas - Promote the formation of Environmental Advisory Councils at the municipal level.	17.11-17.12
NATURAL FEATURES AND AGRICULTURAL CONSERVATION	- Use a range of methods to fund land conservation - Use a State Law to promote a greater use of easements - Work to protect creek corridors, with thick vegetation along creeks. - Promote proper management of forested areas.	10.1	- Encourage landowners to join Agricultural Security Areas to make more land eligible for easement purchase and to protect farmers against nuisance challenges - Encourage additional landowners to apply for the County for purchase of the right to develop their farmland - Seek additional sources of funding to supplement	17.1-17.4

Table 5.3-3 Planning, Zoning and Land Use Actions Relevant to Hazard Mitigation Planning				
	GOALS	LOCATION IN PLAN	ACTIONS	LOCATION IN PLAN
	• Preserve wetlands. • Limit development on steeply sloped lands. • Maintain open space corridors for wildlife. • Seek to preserve concentrations of prime agricultural soils. • Encourage landowners to join agricultural security areas. • Promote additional agricultural easements to preserve farmland.		the existing State-County agricultural preservation program (e.g. tax increase) • To promote voluntary land preservation, utilize State Act 4 of 2006 to have the townships, school district and the County freeze the real estate taxes of land that has been permanently preserved. • Encourage municipalities to adopt zoning provisions that provide strong incentives to preserve farmland and natural areas • Promote the strengthening of zoning regulations on important natural features particularly related to steeply sloped lands, setbacks for wetlands and streams; studies for wetlands when expected onsite, and BMPS for stormwater management • Consider prohibiting new structures in the 100 year floodplain (townships) • Seek Federal mitigation funds to acquire the most flood-prone structures and convert land to open space • Require dedicated open space or for major new residential development	
LAND USE AND HOUSING	• Moderate the rate of housing construction to avoid overloading the public school systems, roads, utilities and groundwater supplies, • Coordinate development across municipal borders, • Avoid serious traffic congestion and safety problems, particularly by avoiding new commercial strip development along major roads, • Promote new business development in appropriate locations, particularly by	11.1	• Emphasize redevelopment of older industrial areas for new business development • Discourage the conversion of agricultural land for residential growth using zoning regulations; focus density development on areas already served by existing water and sewage infrastructure. • Avoid the creation of new strip development; concentrate most commercial uses within existing commercial areas. • Limit new mining activities to areas where they currently exist, with reasonable room for expansion. Emphasize setbacks from residential areas.	17.4-17.5

Table 5.3-3 Planning, Zoning and Land Use Actions Relevant to Hazard Mitigation Planning				
	GOALS	LOCATION IN PLAN	ACTIONS	LOCATION IN PLAN
	strengthening older business areas, with careful attention towards controlling very intense new businesses allowed in areas near homes, and • Make sure development properly relates to the natural features of the land, particularly to protect steeply sloped areas and creek/river valleys.			
TRANSPORTATION	• Provide a safe and efficient network that is very closely coordinated with the plans for land uses.	14.1	• Work with PennDOT to resolve traffic congestion bottlenecks and traffic safety problems (as described in plan text). Seek funding through the 12 Year Plan to resolve traffic problems in the region.	17.9
COMMUNITY FACILITIES AND SERVICES PLAN	• Provide high-quality community facilities and services in the most cost-efficient manner, including addressing needs for future growth.	15.1	• Emphasize high-quality police, emergency medical and fire protection services, with joint training and cooperation between providers, including those in adjacent municipalities. Provide incentives and recognition to recruit and retain volunteers. • Protect water supplies from contamination and make sure that alternative supplies are available in case a source is no longer suitable.	17.10

Goals and objectives from the Comprehensive Plan have been incorporated into the Hazard Mitigation Plan Update in the following sections:

- Section 2.4 Land Use and Development
- Section 4.4.4 Future Development and Vulnerability
- Section 5.3 Capability Assessment Findings

Options for incorporating additional hazard mitigation planning principles into the Comprehensive Plan include:

- Consider using the Hazard Mitigation Plan Update to further refine and exclude high hazard areas from future development through the use of land use controls, zoning ordinances, and designated future growth areas.
- Consider developing a safety goal and objectives to address high-hazard risks identified in the Hazard Mitigation Plan Update.
- Consider developing a mechanism for monitoring, evaluating and reporting out progress made towards achieving plan goals.
- Consider further educational outreach and partnership with the Bureau of Forestry to encourage local communities to achieve Firewise certification.

6. MITIGATION STRATEGY

6.1. Update Process Summary

A Mitigation Solutions Workshop was held on May 13, 2015. The five goals from the existing HMP were reviewed and a *Mitigation Action Progress* form was handed out to allow each municipality and stakeholder organization the opportunity to provide information about mitigation progress over the last five years. The final list of goals and objectives is available in Table 6.2-1. During the workshop, attendees were provided with a standard list of Mitigation Techniques and asked to complete at least one *Mitigation Action Form* taking into consideration previously selected goals and objectives. The Mitigation Action Plan, provided in Table 6.4-1, contains at least one action and/or project for each jurisdiction in the planning area. The completed mitigation strategy forms are available in **Appendix C** along with meeting minutes from the Mitigation Solutions Workshop.

Mitigation actions and projects were then evaluated and ranked using the methodology developed by the Pennsylvania Hazard Mitigation Team contained in the Standard Operating Guide. Table 6.4-2 contains this evaluation. The final list of actions and projects is contained in the Mitigation Action Plan in Table 6.4-1.

A total of 66 mitigation action were included as part of the 2010 HMP mitigation strategy. Responsibility for addressing each action was assigned to the County, municipalities, and other stakeholders, or a combination thereof. Mitigation Action Evaluation forms were prepared to review the status of each action including whether the action was completed, is in-progress or ongoing, or should be discontinued. Each municipality was provided with a Mitigation Action Evaluation form customized to include each of the actions assigned to the municipality as part of the 2010 HMP. Forms were handed to municipal representatives in attendance at the Risk Assessment and Mitigation Solutions Workshop. Forms were e-mailed to municipalities not able to attend the workshop.

Table 6.1-1. lists the 2010 mitigation actions and corresponding status or progress. *Appendix C - Meeting and Other Participation Documentation* includes completed *Mitigation Action Progress* forms.

Table 6.1-1 Review of 2010 Mitigation Action Plan	
ACTION	REVIEW
Complete Lime Street in order to provide emergency access to Meadowcrest Subdivision.	This action has been carried over into the 2015 Carbon County HMP.
Provide emergency generators at multiple facilities which can afford shelter during an emergency.	This action has been carried over into the 2015 Carbon County HMP.
Build another bridge across Hazle Creek in the Borough in order to provide an emergency access route in the event the current bridge over Hazle Creek becomes damaged or unusable.	Weatherly Borough is in discussions with PennDOT and seeking grant funding. Borough has obtained land at proposed site.
Complete and implement Western Carbon County Comprehensive Plan.	This action has been carried over into the 2015 Carbon County HMP.

Table 6.1-1 Review of 2010 Mitigation Action Plan	
ACTION	REVIEW
Conduct youth outreach campaign aimed at existing hazard and hazard mitigation education.	This action has been carried over into the 2015 Carbon County HMP.
Extend coverage of community warning system to entire township.	Carbon County established the Carbon Alert Program and Towamensing Township can alert its own residents in an emergency.
Hold public forum to educate public about types of hazard mitigation that can be done on an individual basis.	This action has been carried over into the 2015 Carbon County HMP.
Identify critical transportation arteries and evaluate means to open roads for emergency access.	This action has been carried over into the 2015 Carbon County HMP.
After a flood event or windstorm provide information on alternatives to reconstruction of structures that sustain damages more than or equal to 50% of value to property owners.	This action has been carried over into the 2015 Carbon County HMP.
Work with County Tax Assessor and GIS Department to determine the feasibility of collecting GIS building points for the County.	County GIS Director is working with communities on detailed mapping program to incorporate parcel and zoning information.
Install flood gates at Tippetts Dam.	This action has been carried over into the 2015 Carbon County HMP.
Foster increased cooperation and communication between Carbon County and the four significant out-of-county high-hazard dams that could impact Carbon through education, outreach, and dam failure scenarios or exercises, as appropriate.	This action has been carried over into the 2015 Carbon County HMP.
Increase awareness of and participation in FEMA's Community Rating System (CRS) Program.	This action has been carried over into the 2015 Carbon County HMP.
Conduct low level benefit-cost analysis to determine most appropriate project solution to flooding of homes on those streets previously identified as having high vulnerability to flooding.	This action has been carried over into the 2015 Carbon County HMP.
Replace pipes and re-grade Rhume Run from the mouth at Nesquehoning Creek to the headwaters.	This action has been carried over into the 2015 Carbon County HMP.
Extend pipe at Franklin and Fireline Road culvert to the stream in order to prevent flooding.	This action has been carried over into the 2015 Carbon County HMP.
Increase the culvert/pipe sizes at identified problem sites.	This action has been carried over into the 2015 Carbon County HMP.
Continue to provide property owners information on how to obtain flood insurance from the NFIP.	This action has been carried over into the 2015 Carbon County HMP.
Raise SR 895 at known vulnerable sections.	This action has been carried over into the 2015 Carbon County HMP.

Table 6.1-1 Review of 2010 Mitigation Action Plan	
ACTION	REVIEW
Evaluate the inclusion of more restrictive floodplain management requirements in floodplain management ordinance in those communities showing increased population and development trends.	Kidder Township attended a FEMA FP seminar, drafting and reviewing a new floodplain plan.
Install storm drains on Germans Road at identified location to prevent flooding.	This action has been carried over into the 2015 Carbon County HMP.
Install/replace/repair culverts previously identified as problem areas Borough-wide.	This action has been carried over into the 2015 Carbon County HMP.
Undertake stormwater management in the Borough.	This action has been carried over into the 2015 Carbon County HMP.
Develop and implement a comprehensive watershed study and plan for Mud Run Creek Watershed.	This action has been cancelled. The Township was unable to coordinate this effort with the county. Currently Kidder Township is working on a stream monitoring project through the EAC and Trout Unlimited.
Dredge Panther Creek near Edgemont Road and Oak Streets and along Dock Street area.	This action has been carried over into the 2015 Carbon County HMP.
Install new storm water collection drains to stormwater system at previously identified locations.	This action has been carried over into the 2015 Carbon County HMP.
Re-grade and repair 23 additional stormwater inlet culverts.	This action has been carried over into the 2015 Carbon County HMP.
Perform flood control along South and North Stagecoach Roads.	This action has been carried over into the 2015 Carbon County HMP.
Clean streets and protect piers and abutments of various bridges and culverts within the Borough to prevent flooding and/or structure failure.	The Thomas J. McCall bridge on SR 209 has undergone major and extensive repairs.
Construct adequate culvert in Gypsy Hill Road.	This action has been carried over into the 2015 Carbon County HMP.
Clean and repair catch basins and stormwater controls throughout community to eliminate local flooding.	This action has been carried over into the 2015 Carbon County HMP.
Redirect water from Hunter's Creek to the Buckwha Creek in order to alleviate flooding problems.	This action has been carried over into the 2015 Carbon County HMP.
Dredge the 1,000 feet of the Aquashicola Creek that currently remain undredged from the 1998 Army Corps dredging project.	This action has been carried over into the 2015 Carbon County HMP.
Widen obsolete narrow bridges on township and state roads which cross various small streams and restrict water passage during high water conditions.	This action has been carried over into the 2015 Carbon County HMP.

Table 6.1-1 Review of 2010 Mitigation Action Plan	
ACTION	REVIEW
Remove gravel bars, vegetation and silt deposits from Nesquehoning Creek from the Jim Thorpe-Nesquehoning Borough Line to Tippetts Dam.	This action has been carried over into the 2015 Carbon County HMP.
Replace pipes and construct a stormwater collection system along SR 54 to prevent flooding.	This action has been carried over into the 2015 Carbon County HMP.
Repair storm drains that collapse due to flooding or washing out of roads during storms.	This action has been carried over into the 2015 Carbon County HMP.
Increase the height of the banks of Hazle Creek that runs through the Borough's downtown.	This action has been carried over into the 2015 Carbon County HMP.
Divert stormwater from SR 4006 at identified problem area to storm sewer system to Hazle Creek.	This action has been carried over into the 2015 Carbon County HMP.
Install a storm sewer system to control stormwater from High Street, Jefferson Street, Franklin Street, and Dunningan Street.	This action has been carried over into the 2015 Carbon County HMP.
Elevate Blue Mountain Road (road to fire department).	This action has been carried over into the 2015 Carbon County HMP.
Map location of pipes, culverts and channels and perform routine maintenance.	This action has been carried over into the 2015 Carbon County HMP.
Mitigate flood damage to 3 critical facilities located within the 1% annual-chance floodplain.	This action has been carried over into the 2015 Carbon County HMP.
Install retaining walls or overflow systems to divert stormwater flowing from the old water reserve dam located on the mountain north of the Borough, under the railroad tracks to the Hazle Creek. This will prevent flooding of the electric substation.	Connecting pipes to fill dam have been disconnected and diversion ditch is in place.
Correct water run-off problems on various Township roads to prevent washouts during heavy rains.	This action has been carried over into the 2015 Carbon County HMP.
Re-build road shoulder and install retaining walls at stream crossings where shoulders and guardrails have been routinely washed out.	This action has been carried over into the 2015 Carbon County HMP.
Correct water run-off problems within other areas of the Borough to prevent washouts of roads during storms.	This action has been carried over into the 2015 Carbon County HMP.
Re-grading and repair of hillside, adjacent to pool pump house at rear of Lansford Pool.	This action has been carried over into the 2015 Carbon County HMP.
Install a ¼ mile section of guardrail along the west side of White Street (heading toward Palmerton) in order to provide driver and pedestrian safety.	This action has been carried over into the 2015 Carbon County HMP.
Install traffic lights and other necessary traffic control devices at high accident intersections.	This action has been carried over into the 2015 Carbon County HMP.

Table 6.1-1 Review of 2010 Mitigation Action Plan	
ACTION	REVIEW
Trim trees along roads electrical distribution system to prevent power outages during storms.	This action is ongoing. Numerous trees have been trimmed or removed.
Clear large trees adjacent to PPL power lines on Summer Mountain Road.	This is ongoing and requires coordination with PPL.
Improve access to electric transmission line along the Lehigh River.	This action has been carried over into the 2015 Carbon County HMP.
Purchase of an emergency generator to operate raw water pump station.	This action has been carried over into the 2015 Carbon County HMP.
Configure the internal wiring of the three wells that supply the Borough's water to accept a portable trailer type generator power in the event of an outage.	Weatherly Borough has obtained portable generators and is getting bids to complete wiring.
Install dry hydrants at water's edge encompassing Lake Harmony.	A plan has been created to install hydrants; some have been installed and others are pending.
Run newspaper ad pertaining to tree and brush clearing near road to prevent fire from crossing. Include area map.	Focus was shifted away from general public outreach to targeting at a more local level such as at risk housing developments. Currently eight subdivisions have Firewise Plans.
Adopt Firewise program.	DCNR Firewise program is ongoing with subdivision developments. Currently eight entities have Firewise Plans.
Designate fire lane in identified critical areas.	
Hold meeting between county and DCNR to evaluate the feasibility of a Wildfire Response Plan.	Subdivisions and housing developments have been targeted and contacted about joining the Firewise Program which has been successful.
Utilize Fire House as storm shelter during winter storms.	This action has been carried over into the 2015 Carbon County HMP.
Repair and widen Packerton Dam Drive to correct a hazardous narrow road that accumulates water and ice.	This action has been carried over into the 2015 Carbon County HMP.
Develop plan for locating and sheltering stranded travelers during winter storms.	This action has been carried over into the 2015 Carbon County HMP.
Review wildfire section of ICC code and evaluate current level of enforcement.	This is canceled. The wildfire section of ICC is not realistic for most of the communities in the County so there has not been interest at the township level.
Resurface portions of various streets and intersections.	This action has been carried over into the 2015 Carbon County HMP.
Remove large trees over power lines on Golf Road, south to the Palmerton Borough line.	This is ongoing and under review.

6.2.Mitigation Goals and Objectives

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 while mitigation actions and mitigation projects are very specific and measurable. Five goals and fifteen objectives were identified during the 2010 HMP development process and carried over into the 2015 HMP. Table 6.2-1 details the mitigation goals and objectives that support the 2015 mitigation strategy.

Table 6.2-1 List of Mitigation Strategy Goals and Objectives.	
GOAL 1	Reduce vulnerability including loss of life and damage to assets from natural hazards.
Objective 1A	Identify and evaluate potential protection measures for existing critical facilities with the highest relative vulnerability in the 1 percent annual chance floodplain.
Objective 1B	Ensure that existing drainage systems such as pipes, culverts and channels are adequate and functioning properly.
Objective 1C	Evaluate the means of managing stranded travelers during the winter storms.
Objective 1D	Reduce wildfire potential through planning and outreach.
Objective 1E	Implement structural projects to reduce the impacts from flooding.
GOAL 2	Increase Public Awareness regarding natural and manmade hazard risks, preparedness and mitigation.
Objective 2A	Promote partnerships between the municipalities and the County to continue to develop a County-wide approach to identifying and implementing mitigation actions.
Objective 2B	Provide public education to increase awareness of hazards and opportunities for mitigation.
GOAL 3	Improve emergency warning and response procedures and capabilities.
Objective 3A	Provide residents with adequate warning of potential floods and other weather related events.
Objective 3B	Ensure that emergency response services and critical facilities functions are not interrupted or are minimally interrupted by natural hazards.
Objective 3C	Improve coordination and communication disaster response organizations, emergency management entities, and local and county governments.
Objective 3D	Increase awareness by residents (i.e. through public outreach/education) of actions to take during an emergency.
GOAL 4	Protect existing natural resources.
Objective 4A	Ensure the adequacy of erosion and sedimentation control practices throughout the County.

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

Objective 4B	Work to preserve steeply sloping areas, sinkhole areas, floodplains, wetlands, etc.
GOAL 5	Promote disaster-resistant future development and increase participation in the NFIP.
Objective 5A	Encourage and facilitate the development or revision of comprehensive plans and zoning, land-use and floodplain management ordinances to consider limiting development in high-hazard areas.
Objective 5B	Provide adequate and consistent enforcement of ordinances and codes within and between jurisdictions.

6.3. Identification and Analysis of Mitigation Techniques

The mitigation strategy in the updated HMP should include analysis of a comprehensive range of specific techniques or actions. FEMA, through the March 2013 Local Mitigation Handbook, and PEMA, through the October 2013 Standard Operating Guide (SOG), identify four categories of hazard mitigation techniques.

Local plans and regulations: Government authorities, policies, or codes that influence the way land and buildings are developed and built. Examples include, but are not limited to: comprehensive plans, subdivision regulations, building codes and enforcement, and NFIP and CRS.

Structure and infrastructure: Modifying existing structures and infrastructure or constructing new structures to reduce hazard vulnerability. Examples include, but are not limited to: acquisition and elevation of structures in flood prone areas, utility undergrounding, structural retrofits, floodwalls and retaining walls, detention and retention structures, and culverts.

Natural systems protection: Actions that minimize damage and losses and also preserve or restore the functions of natural systems. Examples include, but are not limited to: sediment and erosion control, stream corridor restoration, forest management, conservation easements, and wetland restoration and preservation.

Education and awareness: Actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate the hazards, and may also include participation in national programs. Examples include, but are not limited to: radio or television spots, websites with maps and information, provide information and training, NFIP outreach, StormReady, and Firewise Communities.

Table 6.3-1 provides a matrix identifying the mitigation techniques used for the moderate and high risk hazards in the County. The specific actions associated with these techniques are included in Table 6.4-1.

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

HAZARD	MITIGATION TECHNIQUE			
	LOCAL PLANS AND REGULATIONS	STRUCTURE AND INFRASTRUCTURE	NATURAL SYSTEMS PROTECTION	EDUCATION AND AWARENESS
Flood, Flash Flood, Ice Jam	✓	✓	✓	✓
Winter Storm	✓	✓		✓
Wildfire		✓	✓	✓
Utility Interruption		✓		✓
Dam Failure		✓		✓
Nuclear Incident		✓		✓
Transportation Accidents	✓	✓		✓
Drought	✓			✓
Disorientation		✓		✓
Hurricane, Tropical Storm, Nor'easter		✓	✓	✓
Levee Failure		✓		✓

6.4.Mitigation Action Plan

A Mitigation Strategy Workshop was held on May 13, 2015 to develop a framework for the County Mitigation Action Plan (see meeting minutes in **Appendix C**). As part of the mitigation strategy review and evaluation during the Mitigation Workshop, the group went over the four new Mitigation Techniques identified by FEMA. Mitigation Action Plan worksheets were given to all participants. Potential mitigation actions developed by the HMSC were reviewed and participants were asked to provide at least one hazard related mitigation action for each municipality. Participants were given the option of taking part in the existing list of potential actions developed by the HMSC or providing new actions of their choosing specific to their community.

The final list of 64 mitigation actions in Table 6.4-1 is made up of actions developed by the HMSC along with actions developed by municipalities and other stakeholders at the Mitigation Strategy Workshop. In addition, the list includes 2010 actions and projects that were identified as still viable or not yet complete. At least one mitigation action was established for each moderate and high risk hazard in Carbon County. More than one action is identified for several hazards. Every participating jurisdiction has at least one mitigation action. Each mitigation action is intended to address one or more of the goals and objectives identified in Section 6.2.

Table 6.4-1 Carbon County Mitigation Action Plan.	
COMMUNITY: Bowmanstown Borough	ACTION: Complete Lime Street in order to provide emergency access to Meadowcrest Subdivision.
ACTION NO: 1	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Drought; Flood, Flash Flood, & Ice Jam; Hurricane, Tropical Storm, & Nor'easter; Landslide; Wildfire; Winter Storm; Dam Failure; Disorientation; Nuclear Incidents; Transportation Accident; Utility Interruption
Lead Agency/Department:	Bowmanstown Borough; County
Implementation Schedule:	2 years
Funding Source:	DCED/Community Development Block Grant; County, Borough
COMMUNITY: Lehighon Borough	ACTION: Provide emergency generators at multiple facilities which can afford shelter during an emergency.
ACTION NO: 2	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam; Hurricane, Tropical Storm, & Nor'easter; Landslide; Wildfire; Winter Storm; Dam Failure; Disorientation; Nuclear Incidents; Transportation Accident; Utility Interruption
Lead Agency/Department:	Lehighon Borough
Implementation Schedule:	As funds becomes available
Funding Source:	FEMA/HMGP; PEMA
COMMUNITY: Weatherly Borough	ACTION: Build another bridge across Hazle Creek in the Borough in order to provide an emergency access route in the event the current bridge over Hazle Creek becomes damaged or unusable.
ACTION NO: 3	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Drought; Flood, Flash Flood, & Ice Jam; Hurricane, Tropical Storm, & Nor'easter; Landslide; Wildfire; Winter Storm; Dam Failure; Disorientation; Nuclear Incidents; Transportation Accident; Utility Interruption
Lead Agency/Department:	Weatherly Borough
Implementation Schedule:	5 years
Funding Source:	FEMA/HMGP; PennDOT, County
COMMUNITY: Mahoning Township	ACTION: Conduct youth outreach campaign aimed at existing hazard and hazard mitigation education.
ACTION NO: 4	
Category:	Education and Awareness
Hazard(s) Addressed:	Drought; Flood, Flash Flood, & Ice Jam; Hurricane, Tropical Storm, & Nor'easter; Landslide; Wildfire; Winter Storm; Dam Failure; Disorientation; Nuclear Incidents; Transportation Accident; Utility Interruption

Table 6.4-1 Carbon County Mitigation Action Plan.	
Lead Agency/Department:	Mahoning Township
Implementation Schedule:	Annually, ongoing
Funding Source:	HMGP, PEMA, County, Township
COMMUNITY: Carbon County; Banks Township; Beaver Meadows Borough; Bowmanstown Borough; East Penn Township; East Side Borough; Franklin Township; Jim Thorpe Borough; Kidder Township; Lansford Borough; Lausanne Township; Lehigh Township; Lehighon Borough; Lower Towamensing Township; Mahoning Township; Nesquehoning Borough; Packer Township; Palmerton Borough; Parryville Borough; Penn Forest Township; Summit Hill Borough; Towamensing Township; Weatherly Borough; Weissport Borough	ACTION: Hold public forum to educate public about types of hazard mitigation that can be done on an individual basis.
ACTION NO: 5	
Category:	Education and Awareness
Hazard(s) Addressed:	Drought; Flood, Flash Flood, & Ice Jam; Hurricane, Tropical Storm, & Nor'easter; Landslide; Wildfire; Winter Storm; Dam Failure; Disorientation; Nuclear Incidents; Transportation Accident; Utility Interruption
Lead Agency/Department:	Carbon County EMA
Implementation Schedule:	1 year
Funding Source:	FEMA/HMGP; PEMA, County

Table 6.4-1 Carbon County Mitigation Action Plan.	
COMMUNITY: Carbon County; Banks Township; Beaver Meadows Borough; Bowmanstown Borough; East Penn Township; East Side Borough; Franklin Township; Jim Thorpe Borough; Kidder Township; Lansford Borough; Lausanne Township; Lehigh Township; Lehighon Borough; Lower Towamensing Township; Mahoning Township; Nesquehoning Borough; Packer Township; Palmerton Borough; Parryville Borough; Penn Forest Township; Summit Hill Borough; Towamensing Township; Weatherly Borough; Weissport Borough	ACTION: Identify critical transportation arteries and evaluate means to open roads for emergency access.
ACTION NO: 6	
Category:	Local Plans and Regulations
Hazard(s) Addressed:	Drought; Flood, Flash Flood, & Ice Jam; Hurricane, Tropical Storm, & Nor'easter; Landslide; Wildfire; Winter Storm; Dam Failure; Disorientation; Nuclear Incidents; Transportation Accident; Utility Interruption
Lead Agency/Department:	Carbon County EMA; Carbon County Office of Planning and Development
Implementation Schedule:	2 years.
Funding Source:	PennDOT, County
COMMUNITY: Carbon County; Banks Township; Beaver Meadows Borough; Bowmanstown Borough; East Penn Township; East Side Borough; Franklin Township; Jim Thorpe Borough; Kidder Township; Lansford Borough; Lausanne Township; Lehigh Township; Lehighon Borough; Lower Towamensing Township; Mahoning Township; Nesquehoning Borough; Packer Township; Palmerton Borough; Parryville Borough; Penn Forest Township; Summit Hill Borough; Towamensing Township; Weatherly Borough; Weissport Borough	ACTION: After a flood event or windstorm provide information on alternatives to reconstruction of structures that sustain damages more than or equal to 50% of value to property owners.
ACTION NO: 7	
Category:	Local Plans and Regulations
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam; Hurricane, Tropical Storm, & Nor'easter; Landslide; Wildfire; Winter Storm; Dam Failure

Table 6.4-1 Carbon County Mitigation Action Plan.	
Lead Agency/Department:	Carbon County EMA, Carbon County Office of Planning and Development
Implementation Schedule:	3 years.
Funding Source:	County; FEMA/HMGP
COMMUNITY: Carbon County; Banks Township; Beaver Meadows Borough; Bowmanstown Borough; East Penn Township; East Side Borough; Franklin Township; Jim Thorpe Borough; Kidder Township; Lansford Borough; Lausanne Township; Lehigh Township; Lehighon Borough; Lower Towamensing Township; Mahoning Township; Nesquehoning Borough; Packer Township; Palmerton Borough; Parryville Borough; Penn Forest Township; Summit Hill Borough; Towamensing Township; Weatherly Borough; Weissport Borough	ACTION: Work with County Tax Assessor and GIS Department to complete detailed mapping initiative to incorporate parcel and zoning information into countywide dataset.
ACTION NO: 8	
Category:	Local Plans and Regulations
Hazard(s) Addressed:	Drought; Flood, Flash Flood, & Ice Jam; Hurricane, Tropical Storm, & Nor'easter; Landslide; Wildfire; Winter Storm; Dam Failure; Disorientation; Nuclear Incidents; Transportation Accident; Utility Interruption
Lead Agency/Department:	Carbon County EMA, Carbon County Office of Planning and Development
Implementation Schedule:	5 years
Funding Source:	County
COMMUNITY: Jim Thorpe Borough; Nesquehoning Borough	ACTION: Install flood gates at Tippetts Dam.
ACTION NO: 9	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Dam Failure; Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	DEP
Implementation Schedule:	As funds become available.
Funding Source:	DEP, FEMA/HMGP, PEMA

Table 6.4-1 Carbon County Mitigation Action Plan.	
COMMUNITY: Carbon County; Banks Township; Beaver Meadows Borough; Bowmanstown Borough; East Penn Township; East Side Borough; Franklin Township; Jim Thorpe Borough; Kidder Township; Lansford Borough; Lausanne Township; Lehigh Township; Lehighon Borough; Lower Towamensing Township; Mahoning Township; Nesquehoning Borough; Packer Township; Palmerton Borough; Parryville Borough; Penn Forest Township; Summit Hill Borough; Towamensing Township; Weatherly Borough; Weissport Borough	ACTION: Foster increased cooperation and communication between Carbon County and the four significant out-of-county high-hazard dams that could impact Carbon through education, outreach, and dam failure scenarios or exercises, as appropriate.
ACTION NO: 10	
Category:	Education and Awareness
Hazard(s) Addressed:	Dam Failure; Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Carbon County EMA
Implementation Schedule:	3 years
Funding Source:	FEMA/HMGP; PEMA; DEP
COMMUNITY: Banks Township; Beaver Meadows Borough; Bowmanstown Borough; East Penn Township; East Side Borough; Franklin Township; Jim Thorpe Borough; Kidder Township; Lansford Borough; Lausanne Township; Lehigh Township; Lehighon Borough; Lower Towamensing Township; Mahoning Township; Nesquehoning Borough; Packer Township; Palmerton Borough; Parryville Borough; Penn Forest Township; Summit Hill Borough; Towamensing Township; Weatherly Borough; Weissport Borough	ACTION: Increase awareness of and participation in FEMA's Community Rating System (CRS) Program.
ACTION NO: 11	
Category:	Local Plans and Regulations; Education and Awareness
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam; Hurricane, Tropical Storm, & Nor'easter
Lead Agency/Department:	Individual Municipalities
Implementation Schedule:	Begin review of CRS requirements in 2010. Adopt measures when appropriate to attain CRS credit through 2015.

Table 6.4-1 Carbon County Mitigation Action Plan.	
Funding Source:	Municipalities, County staff time,.
COMMUNITY: East Side Borough	ACTION: Conduct low level benefit-cost analysis to determine most appropriate project solution to flooding of homes on those streets previously identified as having high vulnerability to flooding.
ACTION NO: 12	
Category:	Local Plans and Regulations
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam; Hurricane, Tropical Storm, & Nor'easter
Lead Agency/Department:	East Side Borough
Implementation Schedule:	In progress; 3 years
Funding Source:	County staff time, Municipal staff time, FEMA/HMGP
COMMUNITY: Nesquehoning Borough	ACTION: Replace pipes and re-grade Rhume Run from the mouth at Nesquehoning Creek to the headwaters.
ACTION NO: 13	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	DEP; USACE
Implementation Schedule:	As funds become available.
Funding Source:	DEP; FEMA/HMGP; PEMA
COMMUNITY: Bowmanstown Borough	ACTION: Extend pipe at Franklin and Fireline Road culvert to the stream in order to prevent flooding.
ACTION NO: 14	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Bowmanstown Borough
Implementation Schedule:	Contingent upon obtaining final homeowner's approval for access
Funding Source:	DEP, PEMA, Municipality
COMMUNITY: East Penn Township	ACTION: Increase the culvert/pipe sizes at identified problem sites.
ACTION NO: 15	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	East Penn Township
Implementation Schedule:	5 years
Funding Source:	East Penn Township; DEP, PEMA

Table 6.4-1 Carbon County Mitigation Action Plan.	
COMMUNITY: Banks Township; Beaver Meadows Borough; Bowmanstown Borough; East Penn Township; East Side Borough; Franklin Township; Jim Thorpe Borough; Kidder Township; Lansford Borough; Lausanne Township; Lehigh Township; Lehighon Borough; Lower Towamensing Township; Mahoning Township; Nesquehoning Borough; Packer Township; Palmerton Borough; Parryville Borough; Penn Forest Township; Summit Hill Borough; Towamensing Township; Weatherly Borough; Weissport Borough	ACTION: Continue to provide property owners information on how to obtain flood insurance from the NFIP.
ACTION NO: 16	
Category:	Local Plans and Regulations; Education and Awareness
Hazard(s) Addressed:	Flood, Flash Flood, Ice Jam
Lead Agency/Department:	Individual Municipality
Implementation Schedule:	Ongoing
Funding Source:	Municipalities
COMMUNITY: East Penn Township	ACTION: Raise SR 895 at known vulnerable sections.
ACTION NO: 17	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	PENNDOT; East Penn Township
Implementation Schedule:	3 years
Funding Source:	PennDOT; East Penn Township
COMMUNITY: Franklin Township; Kidder Township; Lausanne Township; Penn Forest Township; Towamensing Township;	ACTION: Evaluate the inclusion of more restrictive floodplain management requirements in floodplain management ordinances in those communities showing increased population and development trends.
ACTION NO: 18	
Category:	Local Plans and Regulations
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Individual Municipalities
Implementation Schedule:	Ongoing

Table 6.4-1 Carbon County Mitigation Action Plan.	
Funding Source:	Municipal staff time
COMMUNITY: East Penn Township	ACTION: Install storm drains on Germans Road at identified location to prevent flooding.
ACTION NO: 19	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	East Penn Township
Implementation Schedule:	3 years
Funding Source:	East Penn Township; DEP; EPA
COMMUNITY: Jim Thorpe Borough	ACTION: Install/replace/repair culverts previously identified as problem areas Borough-wide.
ACTION NO: 20	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Jim Thorpe Borough
Implementation Schedule:	As funds become available.
Funding Source:	Jim Thorpe Borough; PEMA, DEP
COMMUNITY: Jim Thorpe Borough	ACTION: Undertake stormwater management in the Borough.
ACTION NO: 21	
Category:	Local Plans and Regulations
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Jim Thorpe Borough
Implementation Schedule:	1 year
Funding Source:	Jim Thorpe Borough
COMMUNITY: Lansford Borough	ACTION: Dredge Panther Creek near Edgemont Road and Oak Streets and along Dock Street area.
ACTION NO: 22	
Category:	Natural Systems Protection
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam; Hurricane, Tropical Storm & Nor'easter
Lead Agency/Department:	Lansford Borough; DEP, USACE
Implementation Schedule:	As funds become available.
Funding Source:	Lansford Borough; DEP, USACE

Table 6.4-1 Carbon County Mitigation Action Plan.	
COMMUNITY: Lansford Borough	ACTION: Install new storm water collection drains to stormwater system at previously identified locations.
ACTION NO: 23	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Lansford Borough
Implementation Schedule:	As funds become available.
Funding Source:	Lansford Borough; DEP; EPA
COMMUNITY: Lansford Borough	ACTION: Re-grade and repair 23 additional stormwater inlet culverts.
ACTION NO: 24	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Lansford Borough
Implementation Schedule:	As funds become available.
Funding Source:	Lansford Borough; DEP; EPA
COMMUNITY: Lausanne Township	ACTION: Perform flood control along South and North Stagecoach Roads.
ACTION NO: 25	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Lausanne Township
Implementation Schedule:	In progress, some repair work done; 2 years
Funding Source:	FEMA/HMGP; PEMA; Township
COMMUNITY: Lehighton Borough	ACTION: Clean streets and protect piers and abutments of various bridges and culverts within the Borough to prevent flooding and/or structure failure.
ACTION NO: 26	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Lehighton Borough
Implementation Schedule:	Repairs over Lehigh Drive Bridge and Bridge Street over Mahoning Creek in progress. Rip rap needs to be completed.
Funding Source:	Borough; County

Table 6.4-1 Carbon County Mitigation Action Plan.	
COMMUNITY: Leighton Borough	ACTION: Construct adequate culvert at Gypsy Hill Road.
ACTION NO: 27	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Leighton Borough
Implementation Schedule:	In progress, one of two culverts completed.
Funding Source:	Leighton Borough; PennDOT; DEP
COMMUNITY: Leighton Borough, Mahoning Township	ACTION: Clean and repair catch basins and stormwater controls throughout community to eliminate local flooding.
ACTION NO: 28	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Individual Municipality
Implementation Schedule:	Annually
Funding Source:	Municipalities
COMMUNITY: Lower Towamensing Township	ACTION: Redirect water from Hunter's Creek to the Buckwha Creek in order to alleviate flooding problems.
ACTION NO: 29	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	USACE; FEMA
Implementation Schedule:	5 years +
Funding Source:	FEMA; DEP; EPA; USACE
COMMUNITY: Lower Towamensing Township	ACTION: Dredge the 1,000 feet of the Aquashicola Creek that currently remain undredged from the 1998 Army Corps dredging project.
ACTION NO: 30	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	USACE
Implementation Schedule:	As funds become available.
Funding Source:	USACE; DEP

Table 6.4-1 Carbon County Mitigation Action Plan.	
COMMUNITY: Mahoning Township	ACTION: Widen obsolete narrow bridges on township and state roads which cross various small streams and restrict water passage during high water conditions.
ACTION NO: 31	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Mahoning Township
Implementation Schedule:	As funds become available.
Funding Source:	FEMA/HMGP; PEMA; PennDOT
COMMUNITY: Nesquehoning Borough	ACTION: Remove gravel bars, vegetation and silt deposits from Nesquehoning Creek from the Jim Thorpe-Nesquehoning Borough Line to Tippetts Dam.
ACTION NO: 32	
Category:	Natural Systems Protection
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	DEP; Carbon County Conservation District
Implementation Schedule:	As funds become available.
Funding Source:	DEP; FEMA/HMGP; PEMA; Conservation District
COMMUNITY: Nesquehoning Borough	ACTION: Replace pipes and construct a stormwater collection system along SR 54 to prevent flooding.
ACTION NO: 33	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Nesquehoning Borough
Implementation Schedule:	As funds become available.
Funding Source:	Nesquehoning Borough; FEMA/HMGP; PEMA
COMMUNITY: Summit Hill Borough	ACTION: Repair storm drains that collapse due to flooding or washing out of roads during storms.
ACTION NO: 34	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Summit Hill Borough
Implementation Schedule:	Annually
Funding Source:	Summit Hill Borough

Table 6.4-1 Carbon County Mitigation Action Plan.	
COMMUNITY: Weatherly Borough	ACTION: Increase the height of the banks of Hazle Creek that runs through the Borough's downtown.
ACTION NO: 35	
Category:	Natural Systems Protection
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	DEP; Weatherly Borough, Carbon County Conservation District
Implementation Schedule:	As funds become available
Funding Source:	FEMA/HMGP, DEP
COMMUNITY: Weatherly Borough	ACTION: Divert stormwater from SR 4006 at identified problem area to storm sewer system to Hazle Creek.
ACTION NO: 36	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Weatherly Borough, DEP
Implementation Schedule:	As funds become available.
Funding Source:	DEP
COMMUNITY: Weatherly Borough	ACTION: Install a storm sewer system to control stormwater from High Street, Jefferson Street, Franklin Street, and Dunningan Street.
ACTION NO: 37	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Weatherly Borough
Implementation Schedule:	As funds become available.
Funding Source:	Weatherly Borough
COMMUNITY: East Penn Township	ACTION: Elevate Blue Mountain Road (road to fire department).
ACTION NO: 38	
Category:	Local Plans and Regulations
Hazard(s) Addressed:	ALL
Lead Agency/Department:	East Penn Township; PennDOT
Implementation Schedule:	As funds become available.
Funding Source:	East Penn Township (staff time); FEMA/HMGP

Table 6.4-1 Carbon County Mitigation Action Plan.	
COMMUNITY: Franklin Township	ACTION: Map location of pipes, culverts and channels and perform routine maintenance.
ACTION NO: 39	
Category:	Local Plans and Regulations
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Franklin Township Public Works Department
Implementation Schedule:	2 years
Funding Source:	Township; DEP
COMMUNITY: Weissport Borough	ACTION: Mitigate flood damage to 3 critical facilities located within the 1% annual-chance floodplain.
ACTION NO: 40	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam
Lead Agency/Department:	Weissport Borough
Implementation Schedule:	Ongoing; 1 year
Funding Source:	Borough and County staff time
COMMUNITY: Weatherly Borough	ACTION: Install retaining walls or overflow systems to divert stormwater flowing from the old water reserve dam located on the mountain north of the Borough, under the railroad tracks to the Hazle Creek. This will prevent flooding of the electric substation.
ACTION NO: 41	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam; Dam Failure; Utility Interruption
Lead Agency/Department:	Weatherly Borough
Implementation Schedule:	1 year.
Funding Source:	FEMA/HMGP, PEMA; USACE; DEP
COMMUNITY: Franklin Township	ACTION: Correct water run-off problems on various Township roads to prevent washouts during heavy rains.
ACTION NO: 42	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam; Transportation Accident
Lead Agency/Department:	Franklin Township Public Works Department
Implementation Schedule:	Ongoing
Funding Source:	FEMA/HMGP; PEMA

Table 6.4-1 Carbon County Mitigation Action Plan.	
COMMUNITY: Mahoning Township	ACTION: Re-build road shoulder and install retaining walls at stream crossings where shoulders and guardrails have been routinely washed out.
ACTION NO: 43	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam; Transportation Accident
Lead Agency/Department:	Mahoning Township
Implementation Schedule:	Ongoing; Re-built shoulders and paved shoulders on various roads within the Township.
Funding Source:	Mahoning Township
COMMUNITY: Summit Hill Borough	ACTION: Correct water run-off problems within other areas of the Borough to prevent washouts of roads during storms.
ACTION NO: 44	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam; Transportation Accident
Lead Agency/Department:	Summit Hill Borough
Implementation Schedule:	Annually
Funding Source:	Summit Hill Borough
COMMUNITY: Lansford Borough	ACTION: Re-grading and repair of hillside, adjacent to pool pump house at rear of Lansford Pool.
ACTION NO: 45	
Category:	Structure and Infrastructure; Natural Systems Protection
Hazard(s) Addressed:	Landslide
Lead Agency/Department:	Lansford Borough; Carbon County Conservation District
Implementation Schedule:	As funds become available.
Funding Source:	Lansford Borough; DCNR
COMMUNITY: Bowmanstown Borough	ACTION: Install a ¼ mile section of guardrail along the west side of White Street (heading toward Palmerton) in order to provide driver and pedestrian safety.
ACTION NO: 46	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Transportation Accident
Lead Agency/Department:	Bowmanstown Borough; PennDOT
Implementation Schedule:	As funds become available.
Funding Source:	Bowmanstown Borough

Table 6.4-1 Carbon County Mitigation Action Plan.	
COMMUNITY: Mahoning Township	ACTION: Install traffic lights and other necessary traffic control devices at high accident intersections.
ACTION NO: 47	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Transportation Accident
Lead Agency/Department:	Mahoning Township
Implementation Schedule:	Ongoing; New traffic light at Normal Square and four-way stop at New Mahoning Intersection.
Funding Source:	Mahoning Township
COMMUNITY: Jim Thorpe Borough, Lansford Borough, Lehigh Township, Mahoning Township, Packer Township, Penn Forest Township, Summit Hill Borough, Weatherly Borough	ACTION: Trim trees along roads electrical distribution system to prevent power outages during storms.
ACTION NO: 48	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Utility Interruption
Lead Agency/Department:	PPL
Implementation Schedule:	Ongoing
Funding Source:	PPL; Municipalities
COMMUNITY: Lower Towamensing Township	ACTION: Clear large trees adjacent to PPL power lines on Summer Mountain Road.
ACTION NO: 49	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Utility Interruption
Lead Agency/Department:	Lower Towamensing Township
Implementation Schedule:	As funds become available.
Funding Source:	Lower Towamensing Township
COMMUNITY: Lehigh Township	ACTION: Improve access to electric transmission line along the Lehigh River.
ACTION NO: 50	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Utility Interruption
Lead Agency/Department:	Lehigh Township
Implementation Schedule:	2 years

Table 6.4-1 Carbon County Mitigation Action Plan.	
Funding Source:	PPL; County
COMMUNITY: Leighton Borough	ACTION: Purchase an emergency generator to operate raw water pump station.
ACTION NO: 51	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Utility Interruption
Lead Agency/Department:	Leighton Borough Water Authority
Implementation Schedule:	As funds become available.
Funding Source:	FEMA/HMGP/EMPG; Borough Water Authority
COMMUNITY: Weatherly Borough	ACTION: Configure the internal wiring of the three wells that supply the Borough's water to accept a portable trailer type generator power in the event of an outage.
ACTION NO: 52	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Utility Interruption
Lead Agency/Department:	Weatherly Borough
Implementation Schedule:	In progress.
Funding Source:	Weatherly Borough
COMMUNITY: Kidder Township	ACTION: Install remaining dry hydrants at water's edge encompassing Lake Harmony.
ACTION NO: 53	
Category:	Structure and Infrastructure ; Natural Systems Protection
Hazard(s) Addressed:	Wildfire
Lead Agency/Department:	Kidder Township
Implementation Schedule:	As funding becomes available
Funding Source:	FEMA/HMGP; PEMA

Table 6.4-1 Carbon County Mitigation Action Plan.	
COMMUNITY: Banks Township; Beaver Meadows Borough; Bowmanstown Borough; East Penn Township; East Side Borough; Franklin Township; Jim Thorpe Borough; Kidder Township; Lansford Borough; Lausanne Township; Lehigh Township; Lehigh Township; Lower Towamensing Township; Mahoning Township; Nesquehoning Borough; Packer Township; Palmerton Borough; Parryville Borough; Penn Forest Township; Summit Hill Borough; Towamensing Township; Weatherly Borough; Weissport Borough	ACTION: Target subdivisions and housing developments for Firewise program participation.
ACTION NO: 54	
Category:	Local Plans and Regulations; Natural Systems Protection
Hazard(s) Addressed:	Wildfire
Lead Agency/Department:	DCNR; County
Implementation Schedule:	5 year rotation for hazard fuel mitigation projects; Annually for public education projects and training; Three years for updates on Emergency Action Plans
Funding Source:	U.S. Forest Service; DCNR
COMMUNITY: Banks Township; Beaver Meadows Borough; Bowmanstown Borough; East Penn Township; East Side Borough; Franklin Township; Jim Thorpe Borough; Kidder Township; Lansford Borough; Lausanne Township; Lehigh Township; Lehigh Township; Lower Towamensing Township; Mahoning Township; Nesquehoning Borough; Packer Township; Palmerton Borough; Parryville Borough; Penn Forest Township; Summit Hill Borough; Towamensing Township; Weatherly Borough; Weissport Borough	ACTION: Designate fire lane in identified critical areas.
ACTION NO: 55	
Category:	Local Plans and Regulations
Hazard(s) Addressed:	Wildfire
Lead Agency/Department:	Carbon County Office of Planning and Development; Municipal Planning Departments and Municipal Supervisors

Table 6.4-1 Carbon County Mitigation Action Plan.	
Implementation Schedule:	1 year
Funding Source:	PennDOT; County; Municipalities
COMMUNITY: Banks Township	ACTION: Utilize Fire House as storm shelter during winter storms. Make shelter ready.
ACTION NO: 56	
Category:	Local Plans and Regulations
Hazard(s) Addressed:	Winter Storm
Lead Agency/Department:	Banks Township
Implementation Schedule:	1 year
Funding Source:	FEMA/HMGP
COMMUNITY: Mahoning Township	ACTION: Repair and widen Packerton Dam Drive to correct a hazardous narrow road that accumulates water and ice.
ACTION NO: 57	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Winter Storm; Traffic Accident
Lead Agency/Department:	Mahoning Township
Implementation Schedule:	As funds become available.
Funding Source:	FEMA/HMGP; PEMA
COMMUNITY: Carbon County	ACTION: Develop plan for locating and sheltering stranded travelers during winter storms.
ACTION NO: 58	
Category:	Local Plans and Regulations
Hazard(s) Addressed:	Winter Storm
Lead Agency/Department:	Carbon County EMA
Implementation Schedule:	1 year
Funding Source:	County/Municipal Staff time; FEMA/HMGP
COMMUNITY: Lansford Borough	ACTION: Resurface portions of various streets and intersections.
ACTION NO: 59	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Transportation Accidents
Lead Agency/Department:	Lansford Borough; PennDOT
Implementation Schedule:	As funds become available.
Funding Source:	Lansford Borough

Table 6.4-1 Carbon County Mitigation Action Plan.	
COMMUNITY: Lower Towamensing Township	ACTION: Remove large trees over power lines on Golf Road, south to the Palmerton Borough line.
ACTION NO: 60	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Utility Interruption
Lead Agency/Department:	Lower Towamensing Township; PPL
Implementation Schedule:	As funds become available.
Funding Source:	PPL; Lower Towamensing Township
COMMUNITY: Kidder Township	ACTION: Township Engineer will work with local communities to develop stormwater management plan.
ACTION NO: 61	
Category:	Local Plans and Regulations
Hazard(s) Addressed:	Flooding
Lead Agency/Department:	Kidder Township
Implementation Schedule:	As funds become available.
Funding Source:	Township
COMMUNITY: Lower Towamensing Township	ACTION: Provide 2 nd access to be used during emergency at Little Gap Estates.
ACTION NO: 62	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam; Hurricane, Tropical Storm, & Nor'easter; Landslide; Wildfire; Winter Storm; Dam Failure; Nuclear Incidents; Transportation Accident
Lead Agency/Department:	Lower Towamensing Township
Implementation Schedule:	5 years.
Funding Source:	HMGP; DCNR-BOF
COMMUNITY: Palmerton Borough	ACTION: Replace/improve storm catches and lines in low lying and traffic areas.
ACTION NO: 63	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam; Hurricane, Tropical Storm, & Nor'easter; Transportation Accident, Utility Interruption
Lead Agency/Department:	Palmerton Borough
Implementation Schedule:	5 years.
Funding Source:	DEP

Table 6.4-1 Carbon County Mitigation Action Plan.	
COMMUNITY: Towamensing Township	ACTION: Control flow of water along roadways.
ACTION NO: 64	
Category:	Structure and Infrastructure
Hazard(s) Addressed:	Flood, Flash Flood, & Ice Jam; Hurricane, Tropical Storm, & Nor'easter; Landslide; Transportation Accident
Lead Agency/Department:	Towamensing Township
Implementation Schedule:	3 years.
Funding Source:	Township

Table 6.4-1 lists sixty-four mitigation actions, many of which will require substantial time commitments from staff at the County and local municipalities. While all of these activities will be pursued over the next five years, the reality of limited time and resources requires the evaluation and prioritization of mitigation actions. Evaluation allows the individuals and organizations involved to focus their energies and ensure progress on mitigation activities.

Mitigation actions were evaluated using the Multi-Objective Mitigation Action Prioritization criteria from the PEMA's SOG. The criteria are as follows:

- **Effectiveness (weight: 20% of score):** The extent to which an action reduces the vulnerability of people and property.
- **Efficiency (weight: 30% of score):** The extent to which time, effort, and cost is well used as a means of reducing vulnerability.
- **Multi-Hazard Mitigation (weight: 20% of score):** The action reduces vulnerability for more than one hazard.
- **Addresses High Risk Hazard (weight: 15% of score):** The action reduces vulnerability for people and property from a hazard(s) identified as high risk.
- **Addresses Critical Communications/Critical Infrastructure (weight: 15% of score):** The action pertains to the maintenance of critical functions and structures such as transportation, supply chain management, data circuits, etc.

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

- High Priority (highlighted red): 2.5 – 3.0
- Medium Priority (highlighted yellow): 1.9 – 2.49
- Low Priority (highlighted green): 1.0 – 1.89

Table 6.4-2 provides the results of this evaluation for all sixty-four mitigation actions.

Table 6.4-2 Prioritization of Mitigation Actions.

MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA					PRIORITY
ACTION NO.	NAME	EFFECTIVENESS	EFFICIENCY	MULTI-HAZARD MITIGATION	ADDRESSES HIGH RISK HAZARD	ADDRESSES CRITICAL COMMUNICATIONS /INFRASTRUCTURE	
1	Complete Lime Street in order to provide emergency access to Meadowcrest Subdivision.	3	2	3	3	1	2.40
2	Provide emergency generators at multiple facilities which can afford shelter during an emergency.	3	2	3	3	2	2.55
3	Build another bridge across Hazle Creek in the Borough in order to provide an emergency access route in the event the current bridge over Hazle Creek becomes damaged or unusable.	2	1	2	2	2	1.70
4	Conduct youth outreach campaign aimed at existing hazard and hazard mitigation education.	1.5	3	2	2	1	2.05
5	Hold public forum to educate public about types of hazard mitigation that can be done on an individual basis.	1.5	3	2	2	1	2.05
6	Identify critical transportation arteries and evaluate means to open roads for emergency access.	2	2	2.5	2	2	2.10
7	After a flood event or windstorm provide information on alternatives to reconstruction of structures that sustain damages more than or equal to 50% of value to property owners.	1.5	2	1	2.5	1	1.63
8	Work with County Tax Assessor and GIS Department to complete detailed mapping initiative to incorporate parcel and zoning information into countywide dataset.	2.5	3	2	2.5	1	2.33
9	Install flood gates at Tippetts Dam.	2.5	1.5	1	3	1.5	1.83

Table 6.4-2 Prioritization of Mitigation Actions.

MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA					PRIORITY
ACTION NO.	NAME	EFFECTIVENESS	EFFICIENCY	MULTI-HAZARD MITIGATION	ADDRESSES HIGH RISK HAZARD	ADDRESSES CRITICAL COMMUNICATIONS /INFRASTRUCTURE	
10	Foster increased cooperation and communication between Carbon County and the four significant out-of-county high-hazard dams that could impact Carbon through education, outreach, and dam failure scenarios or exercises, as appropriate.	1.5	2	1	1	1.5	1.48
11	Increase awareness of and participation in FEMA's Community Rating System (CRS) Program.	1	2	1	3	1	1.60
12	Conduct low level benefit-cost analysis to determine most appropriate project solution to flooding of homes on those streets previously identified as having high vulnerability to flooding.	2	1.5	1	3	1	1.65
13	Replace pipes and re-grade Rhume Run from the mouth at Nesquehoning Creek to the headwaters.	3	2	1	3	2	2.15
14	Extend pipe at Franklin and Fireline Road culvert to the stream in order to prevent flooding.	3	2	1	3	1	2.00
15	Increase the culvert/pipe sizes at identified problem sites.	3	2	1	3	1	2.00
16	Continue to provide property owners information on how to obtain flood insurance from the NFIP.	1	2	1	3	1	1.60
17	Raise SR 895 at known vulnerable sections.	3	2	1	3	1	2.00

Table 6.4-2 Prioritization of Mitigation Actions.

MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA					PRIORITY
ACTION NO.	NAME	EFFECTIVENESS	EFFICIENCY	MULTI-HAZARD MITIGATION	ADDRESSES HIGH RISK HAZARD	ADDRESSES CRITICAL COMMUNICATIONS /INFRASTRUCTURE	
18	Evaluate the inclusion of more restrictive floodplain management requirements in floodplain management ordinance in those communities showing increased population and development trends.	3	2.5	1	3	1.5	2.23
19	Install storm drains on Germans Road at identified location to prevent flooding.	3	1.5	1	3	1	1.85
20	Install/replace/repair culverts previously identified as problem areas Borough-wide.	3	1.5	1	3	1	1.85
21	Undertake stormwater management in the Borough.	3	2.5	2	3	2	2.50
22	Dredge Panther Creek near Edgemont Road and Oak Streets and along Dock Street area.	1	1.5	1	3	1	1.45
23	Install new storm water collection drains to stormwater system at previously identified locations.	3	2.5	2	3	2	2.50
24	Re-grade and repair 23 additional stormwater inlet culverts.	3	2	1	3	1	2.00
25	Perform flood control along South and North Stagecoach Roads.	3	2	1	3	1	2.00
26	Clean streets and protect piers and abutments of various bridges and culverts within the Borough to prevent flooding and/or structure failure.	3	2	1	3	1	2.00
27	Construct adequate culvert in Gypsy Hill Road.	3	2.5	2	3	2	2.50
28	Clean and repair catch basins and stormwater controls throughout community to eliminate local flooding.	3	2.5	2	3	2	2.50

Table 6.4-2 Prioritization of Mitigation Actions.

MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA					PRIORITY
ACTION NO.	NAME	EFFECTIVENESS	EFFICIENCY	MULTI-HAZARD MITIGATION	ADDRESSES HIGH RISK HAZARD	ADDRESSES CRITICAL COMMUNICATIONS /INFRASTRUCTURE	
29	Redirect water from Hunter's Creek to the Buckwha Creek in order to alleviate flooding problems.	3	2	2	3	2	2.35
30	Dredge the 1,000 feet of the Aquashicola Creek that currently remain undredged from the 1998 Army Corps dredging project.	1	1.5	1	3	1.5	1.53
31	Widen obsolete narrow bridges on township and state roads which cross various small streams and restrict water passage during high water conditions.	2	1	1	3	2	1.65
32	Remove gravel bars, vegetation and silt deposits from Nesquehoning Creek from the Jim Thorpe-Nesquehoning Borough Line to Tippetts Dam.	1.5	1.5	1	3	2	1.70
33	Replace pipes and construct a stormwater collection system along SR 54 to prevent flooding.	3	2	2	3	2	2.35
34	Repair storm drains that collapse due to flooding or washing out of roads during storms.	3	2.5	2	3	2	2.50
35	Increase the height of the banks of Hazle Creek that runs through the Borough's downtown.	2	1	1	3	1.5	1.58
36	Divert stormwater from SR 4006 at identified problem area to storm sewer system to Hazle Creek.	2	2	1	3	1.5	1.88
37	Install a storm sewer system to control stormwater from High Street, Jefferson Street, Franklin Street, and Dunningan Street.	3	2.5	2	3	2	2.50

Table 6.4-2 Prioritization of Mitigation Actions.

MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA					PRIORITY
ACTION NO.	NAME	EFFECTIVENESS	EFFICIENCY	MULTI-HAZARD MITIGATION	ADDRESSES HIGH RISK HAZARD	ADDRESSES CRITICAL COMMUNICATIONS /INFRASTRUCTURE	
38	Elevate Blue Mountain Road (road to fire department).	3	2	3	3	2	2.55
39	Map location of pipes, culverts and channels and perform routine maintenance.	2	3	2	3	1	2.30
40	Mitigate flood damage to 3 critical facilities located within the 1% annual-chance floodplain.	3	2.5	1.5	3	3	2.55
41	Install retaining walls or overflow systems to divert stormwater flowing from the old water reserve dam located on the mountain north of the Borough, under the railroad tracks to the Hazle Creek. This will prevent flooding of the electric substation.	2.5	2.5	1	3	3	2.35
42	Correct water run-off problems on various Township roads to prevent washouts during heavy rains.	2	2	1	3	2	1.95
43	Re-build road shoulder and install retaining walls at stream crossings where shoulders and guardrails have been routinely washed out.	2	2	3	3	2	2.35
44	Correct water run-off problems within other areas of the Borough to prevent washouts of roads during storms.	2	2	1	3	2	1.95
45	Re-grading and repair of hillside, adjacent to pool pump house at rear of Lansford Pool.	2.5	2.5	2	2	1	2.10
46	Install a ¼ mile section of guardrail along the west side of White Street (heading toward Palmerton) in order to provide driver and pedestrian safety.	3	2.5	1	1	1	1.85

Table 6.4-2 Prioritization of Mitigation Actions.

MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA					PRIORITY
ACTION NO.	NAME	EFFECTIVENESS	EFFICIENCY	MULTI-HAZARD MITIGATION	ADDRESSES HIGH RISK HAZARD	ADDRESSES CRITICAL COMMUNICATIONS /INFRASTRUCTURE	
47	Install traffic lights and other necessary traffic control devices at high accident intersections.	3	2.5	1	1	1	1.85
48	Trim trees along roads electrical distribution system to prevent power outages during storms.	3	3	2	1	2	2.35
49	Clear large trees adjacent to PPL power lines on Summer Mountain Road.	3	3	2	1	2	2.35
50	Improve access to electric transmission line along the Lehigh River.	2	2	3	1	3	2.20
51	Purchase of an emergency generator to operate raw water pump station.	3	2.5	2	1	3	2.35
52	Configure the internal wiring of the three wells that supply the Borough's water to accept a portable trailer type generator power in the event of an outage.	3	2.5	3	3	2	2.70
53	Install remaining dry hydrants at water's edge encompassing Lake Harmony.	3	3	1	3	2.5	2.53
54	Target subdivisions and housing developments for Firewise program participation.	3	3	1	3	2.5	2.53
55	Designate fire lane in identified critical areas.	2	3	1	3	2	2.25
56	Utilize Fire House as storm shelter during winter storms.	2.5	3	2	3	1	2.40
57	Repair and widen Packerton Dam Drive to correct a hazardous narrow road that accumulates water and ice.	3	2.5	3	3	1	2.55
58	Develop plan for locating and sheltering stranded travelers during winter storms.	2.5	2.5	3	3	1	2.45

Table 6.4-2 Prioritization of Mitigation Actions.

MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA					PRIORITY
ACTION NO.	NAME	EFFECTIVENESS	EFFICIENCY	MULTI-HAZARD MITIGATION	ADDRESSES HIGH RISK HAZARD	ADDRESSES CRITICAL COMMUNICATIONS /INFRASTRUCTURE	
59	Resurface portions of various streets and intersections.	2	1.5	3	2	1	1.90
60	Remove large trees over power lines on Golf Road, south to the Palmerton Borough line.	2	2	2	2	2	2.00
61	Township Engineer will work with local communities to develop stormwater management plan.	3	3	1	3	1	2.30
62	Provide 2nd access to be used during emergency at Little Gap Estates.	2.5	2	3	3	1.5	2.38
63	Replace/improve storm catches and lines in low lying and traffic areas.	2.5	2	1	3	1	1.90
64	Control flow of water along roadways.	2.5	2.5	1	3	1	2.05

7. PLAN MAINTENANCE

7.2.Process Summary

Monitoring, evaluating and updating this plan, is critical to maintaining its value and success in Carbon 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.

7.3.Monitoring, Evaluating and Updating the Plan

The HMSC established for the 2010 HMP is designated to administer the plan maintenance processes of monitoring, evaluation and updating with support and representation from all 23 participating municipalities. Mark Nalesnik, Director of the Carbon County Emergency Management Agency, in coordination with and cooperation of the Director of the Carbon County Office of Planning and Development Director, will lead the HMSC in all associated plan maintenance requirements including annual reviews. The HMSC will coordinate maintenance efforts, but the input needed for effective periodic evaluations will come from community representatives, local emergency management coordinators and planners, the general public and other important stakeholders. The HMSC will oversee the progress made on the implementation of action items identified in the 2015HMP and modify actions, as needed, to reflect changing conditions. The HMSC will meet annually each January to discuss specific coordination efforts that may be needed with other stakeholders. Should a significant disaster occur within the County, the HMSC may choose to reconvene within 30 days of the disaster to review and update the plan.

Each municipality will designate a community representative to monitor mitigation activities and hazard events within their respective communities. The local emergency management coordinator would be suitable for this role. This individual will be asked to work with the HMSC to provide updates on applicable mitigation actions and feedback on changing hazard vulnerabilities within their community.

Upon each HMP evaluation, the HMSC will consider whether applications should be submitted for existing mitigation grant programs. A decision to apply for funding will be based on appropriate eligibility and financial need requirements. The HMSC will also support local and County officials in applying for post-disaster mitigation funds when they are available. All state and federal mitigation funding provided to the County or local municipalities will be reported in subsequent plan updates. In addition, new plans and programs being developed within the County will be evaluated as to the ability and necessity to incorporate the 2015 HMP into them.

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

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

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

7.4.Continued Public Involvement

As was done during the development of the 2015 HMP, the HMSC will involve the public during the evaluation and update of the HMP through various workshops and meetings. The public will have access to the current HMP through their local municipal office, the Carbon County Emergency Management Agency or the Carbon County Office of Planning and Development. Information on upcoming events related to the HMP or solicitation for comments will be announced via newsletters, newspapers, mailings, and on the County website (<http://www.carboncounty.com>). The HMSC will incorporate all relevant comments during the next update of the HMP.

8. PLAN ADOPTION

The Plan was submitted to the Pennsylvania State Hazard Mitigation Officer on August 25, 2015.

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

The date each jurisdiction that has adopted the 2015 plan is listed in Table 8.2-1.

Table 8.2-1 Adoption date of the Hazard Mitigation Plan by Carbon County and local municipalities.	
JURISDICTION	2015 HMPU ADOPTION DATE
Banks Township	
Beaver Meadows Borough	
East Side Borough	
Franklin Township	
Kidder Township	
Lansford Borough	
Lehigh Township	
Lehighton Borough	
Lower Towamensing Township	
Mahoning Township	
Nesquehoning Borough	
Palmerton Borough	
Penn Forest Township	
Summit Hill Borough	
Towamensing Township	
Weatherly Borough	

**Carbon County 2015 Hazard Mitigation Plan
County Adoption Resolution**

Resolution No. _____
Carbon County, Pennsylvania

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

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

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

WHEREAS, the Carbon County 2015 Hazard Mitigation Plan has been developed by the Carbon County Emergency Management Agency and the Carbon County Office of Planning and Development in cooperation with other county departments, local municipal officials, and the citizens of Carbon County, and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the Carbon County 2015 Hazard Mitigation Plan, and

WHEREAS, the Carbon County 2015 Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural and human-made hazards that face the County and its municipal governments,

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

- The Carbon County 2015 Hazard Mitigation Plan is hereby adopted as the official Hazard Mitigation Plan of the County, and
- The respective officials and agencies identified in the implementation strategy of the Carbon County 2015 Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

ADOPTED, this _____ day of _____, 2015

ATTEST:

CARBON COUNTY COMMISSIONERS

By _____

By _____

By _____

**Carbon County 2015 Hazard Mitigation Plan
Municipal Adoption Resolution**

Resolution No. _____

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

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

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

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

WHEREAS, the Carbon County 2015 Hazard Mitigation Plan has been developed by the Carbon County Emergency Management Agency and the Carbon County Office of Planning and Development in cooperation with other county departments, local municipal officials, and the citizens of Carbon County, and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the Carbon County 2015 Hazard Mitigation Plan, and

WHEREAS, the Carbon County 2015 Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural and human-made hazards that face the County and its municipal governments,

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

- The Carbon County 2015 Hazard Mitigation Plan is hereby adopted as the official Hazard Mitigation Plan of the <Borough/Township>, and
- The respective officials and agencies identified in the implementation strategy of the Carbon County 2015 Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

ADOPTED, this _____ day of _____, 2015

ATTEST:

<BOROUGH/TOWNSHIP OF MUNICIPALITY NAME>

By _____

By _____

By _____

9. APPENDICES

Appendix A	Bibliography
Appendix B	Local Mitigation Plan Review Crosswalk
Appendix C	Meeting and Other Participation Documentation
Appendix D	Local Municipality Flood Vulnerability Maps
Appendix E	Critical Facilities
Appendix F	Hazus Methodology and Results Report
Appendix G	Winter Storm Past Occurrence Table
Appendix H	Dam Failure Hazard Profile (Section 4.3.5)