2018 Lebanon County Hazard Mitigation Plan

Lebanon County Emergency Management Agency

Certification of Annual Review Meetings

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

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

Record of Changes

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

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

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1. Introduction

1.1. Background

The Lebanon County Board of Commissioners, in response to the Disaster Mitigation Act of 2000 (DMA 2000), organized a countywide hazard mitigation planning effort to prepare, adopt and implement a multi-jurisdictional Hazard Mitigation Plan (HMP) for Lebanon County and all of its 26 municipalities. The Lebanon County Emergency Management Agency was charged by the County Board of Commissioners to prepare the 2018 plan. The 2013 HMP has been utilized and maintained during the 5-year life cycle.

The Lebanon County Commissioners were successful in securing hazard mitigation grant funding to update the county hazard mitigation plan. The pre-disaster mitigation grant funding was administered by the Pennsylvania Emergency Management Agency and provided to Lebanon County as a sub-grantee. The Lebanon County Commissioners assigned the Lebanon County Emergency Management Agency with the primary responsibility to update the hazard mitigation plan. MCM Consulting Group, Inc. was selected to complete the update of the HMP. A local hazard mitigation planning team was developed comprised of government leaders and citizens from Lebanon County. This updated HMP will provide another solid foundation for the Lebanon County Hazard Mitigation Program.

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

Hazard mitigation planning has the potential to produce long-term and recurring benefits. A core assumption of mitigation is that current dollars invested in mitigation practices will significantly reduce the demand for future dollars by lessening the amount needed for recovery, repair and reconstruction. These mitigation practices will also enable local residents, businesses and industries to reestablish themselves in the wake of a disaster, getting the economy back on track sooner and with less interruption.

1.2. Purpose

The purpose of this All-Hazard Mitigation Plan (HMP) is:

- To protect life, safety and property by reducing the potential for future damages and economic losses that result from natural hazards;
- To qualify for additional grant funding, in both the pre-disaster and the post-disaster environment;
- To speed recovery and redevelopment following future disaster events;
- To demonstrate a firm local commitment to hazard mitigation principles; and
- To comply with both state and federal legislative requirements for local hazard mitigation plans.

1.3. Scope

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

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

1.4. Authority and Reference

Authority for this plan originates from the following federal sources:

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

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

- Pennsylvania Emergency Management Services Code. Title 35, Pa C.S. Section 101

- Pennsylvania Municipalities Planning Code of 1968, Act 247 as reenacted and amended by Act 170 of 1988
- Pennsylvania Storm Water Management Act of October 4, 1978. P.L. 864, No. 167

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

- FEMA 386-1: *Getting Started*. September 2002
- FEMA 386-2: Understanding Your Risks: Identifying Hazards and Estimating Losses. August 2001
- FEMA 386-3: Developing the Mitigation Plan. April 2003
- FEMA 386-4: *Bringing the Plan to Life*. August 2003
- FEMA 386-5: Using Benefit-Cost Review in Mitigation Planning. May 2007
- FEMA 386-6: Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning. May 2005
- FEMA 386-7: Integrating Manmade Hazards into Mitigation Planning. September 2003
- FEMA 386-8: Multijurisdictional Mitigation Planning. August 2006
- FEMA 386-9: Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects. August 2008
- FEMA Local Multi-Hazard Mitigation Planning Guidance. July 1, 2008
- FEMA National Fire Incident Reporting System 5.0: Complete Reference Guide. January 2008
- FEMA Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards. January 2013

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

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

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

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

2. Community Profile

2.1. Geography and Environment

Lebanon County covers approximately 363 square miles and is situated in south central Pennsylvania. The county is bordered by Lancaster County in the south, Berks and Schuylkill Counties to the north and east, and Dauphin County to the west. Lebanon County straddles three physiographic provinces. Almost all of Lebanon County lies in sections of the Ridge and Valley Physiographic Province. The southernmost part of the county is in the Gettysburg-Newark Lowland Section of the Piedmont Province. The southeastern portion of the county is in the Reading Prong Section of the New England Province. The county is the 26th ranked county in terms of population within the Commonwealth of Pennsylvania.

Lebanon County contains a fertile valley bordered by east-west trending mountain ridges to the north and hills and ridges to the south. Over 9,299 acres of the county's slopes are steep slopes (greater than 25%). These are mostly located along the ridges in the northernmost section of the county. Another 23,300 acres of slopes are considered precautionary steep slopes (15% – 25%). The lowest elevation in Lebanon County is 46 feet. Lebanon County's highest elevation is 1,148 feet which ranks it 60th in terms of highest elevation when compared to the 67 other counties in Pennsylvania.

The climate of Lebanon County is best described as humid continental. Most of the weather systems that affect the county develop in the Central United States and are modified considerably after traversing the Northern Plains and the Midwest and crossing the Appalachian Mountains. The climate is also influenced by the Atlantic Ocean. The proximity to the ocean, combined with modifying influences on frontal systems approaching from the west results in a climate where extremes only occur under the influence of unusually powerful weather systems. During the summer, highs typically reach into the mid-80s and lows dip into the 60s at night. Extended periods of hot and humid conditions do occur, and 90 degrees plus readings are recorded on an average of 25 days a year. The warmest month is usually July. During the winter, colder temperatures seep in through the Canadian air masses. Daytime highs average in the upper 30s, and nighttime lows drop into the lower 20s. On average, the coldest month is January. Precipitation is distributed throughout the year though slightly less precipitation falls in the winter months. Total average annual rainfall is roughly 44 inches. The average amount of snowfall each winter is 26 inches.

Stream valleys dominate the landscape of Lebanon County. The Swatara Creek is one of the larger creeks in the area and is a tributary to the Susquehanna River. It stretches 71 miles in length over 570 square miles of south-central Pennsylvania, including portions of Schuylkill, Berks, Lebanon, and Dauphin Counties and 46 municipalities.

Lebanon County is comprised of 12 stormwater watersheds:

- Beaver/Bow/Manada Creeks Chickies Creek Watershed
- Clark Creek
- Cocalico Creek
- Conewago Creek (East)
- Donegal/Little Chickies Creeks
- Quittapahilla Creek
- Spring Creek (East)
- Stony Creek
- Swatara Creek
- Tulpehocken Creek
- Wiconisco Creek

2.2. Community Facts

In 1813, Lebanon County was formed from an Act of Assembly from parts of Dauphin and Lancaster Counties. The City of Lebanon is the county seat and has historically been the center of major business and banking activity.

The following cities, boroughs and townships are located in Lebanon County:

- Cities: City of Lebanon
- Boroughs: Cleona, Cornwall, Jonestown, Mt. Gretna, Myerstown, Palmyra, Richland.
- Townships: Annville, Bethel, Cold Spring, East Hanover, Heidelberg, Jackson, Millcreek, North Annville, North Cornwall, North Lebanon, North Londonderry, South Annville, South Lebanon, South Londonderry, Swatara, Union, West Cornwall, West Lebanon.

Lebanon County's leading industries are education, healthcare, social services, manufacturing, and retail trade. According to the Penn State University Center for Economic and Community Development, Lebanon County is one of fifteen counties in Pennsylvania that experienced less than 5.0% unemployment in 2008 and 2016. It is anticipated that in the future counties in southeastern Pennsylvania will experience lower unemployment rates than in other areas of the state. The primary employment providers within Lebanon County are displayed below in *Table 1 - Top Employers*.

Table 1 - Top Employers

Lebanon County Top Employers	
Company	**Industry**
Department of Military and Veteran Affairs	Government
Farmers Pride Inc./Bell & Evans	Poultry Processing
Philhaven	Healthcare
Cornwall Lebanon School District	Education
VA Medical Center	Healthcare

Lebanon County Top Employers	
Company	**Industry**
Bayer Consumer Care	Pharmaceuticals
Supreme Mid-Atlantic Corporation	Manufacturing-Truck Bodies
Murry's, Inc.	Meat Packing
The Good Samaritan Hospital	Healthcare
County Government	Government
Butler Manufacturing Company	Manufacturing
ASK Foods, Inc.	Food Processing
Elk Corporation	Manufacturing
Source: Lebanon Valley Chamber of Commerce	

The wealth of natural resources found in the county has been instrumental in shaping the diversity of communities within its borders. The Lebanon Valley was fueled in its early growth by natural resources of iron ore, timber and limestone. Later in the early 20th century, anthracite coal was found and mined in the northern part of the county. However, the main industry that has shaped the county's land use patterns has been agriculture. Most of Lebanon County sits in a very fertile limestone valley between Blue Mountain and South Mountain. This area has served as a major agricultural center, and to this day, has close to 900 working farms. To this day agriculture is the predominant land use in Lebanon County, occupying 99,996 acres and 42.7% of the total county land area. Transportation infrastructure in Lebanon County has allowed industries to take advantage of the region's location. Because of these major transportation routes, industrial development has resulted in the growth and expansion of warehouse and trucking facilities. Lebanon County's major transportation routes are: Interstate 81 (I-81), Interstate 78 (I-78), Interstate 76 (I-76), and U.S. Routes 22, 322, and 422, and State Routes 72, 117, 241, 343, 419, 443, 501, 897, and 934.

2.3. Population and Demographics

Lebanon County recorded a population of 133,568 during the 2010 U.S. Census, ranking the county in the 26th position among Pennsylvania's sixty-seven counties. The population in this county is increasing according to the U.S. Census Bureau whom estimated the population to be 138,863 in July of 2016, or a 3.8% increase from the April 1, 2010 population census. The median income of households in Lebanon County is $54,259. This is approximately $602 more than the national median household income (U.S. Census, 2014).

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

Table 2 - Municipal Population

Lebanon County Municipality Populations			
Municipality	**Population**	**Municipality**	**Population**
Annville Township	4,767	North Annville Township	2,381
Bethel Township	5,007	North Cornwall Township	7,553
Cleona Borough	2,080	North Lebanon Township	11,429
Cold Spring Township	52	North Londonderry Township	8,068
Cornwall Borough	4,112	Palmyra Borough	7,320
East Hanover Township	2,801	Richland Borough	1,519
Heidelberg Township	4,069	South Annville Township	2,850
Jackson Township	8,163	South Lebanon Township	9,463
Jonestown Borough	1,905	South Londonderry Township	6,991
City of Lebanon	25,477	Swatara Township	4,555
Millcreek Township	3,892	Union Township	3,099
Mt. Gretna Borough	196	West Cornwall Township	1,976
Myerstown Borough	3,062	West Lebanon Township	781
Source: US Decennial Census			

The median age in Lebanon County is 41.1 years old (according to the 2010 United States Census Bureau). The largest population in Lebanon County is eighteen years or younger (23%), according to the 2010 census data. A total of 55,258 housing units were identified during the 2010 census.

Lebanon County is one of the most rapidly developing counties in Pennsylvania since 2010. *Figure 1 - Lebanon County Population Growth,* shows that while other counties have experienced slightly higher growth between 2010 and 2017, Lebanon County is tied with two other counties in terms of having the highest growth in a one-year period between 2016-2017 (0.9% increase). Growth is expected to continue for the foreseeable future in this county as well as throughout the Commonwealth of Pennsylvania. The population of Pennsylvania is projected to reach 14.1 million in 2040, up from 12.7 million in 2010 according to a 2014 report given by The Center for Rural Pennsylvania. By 2040, the population in Lebanon County is expected to reach 149,347 or increase by 11.7% since 2010.

Population growth as well as housing and employment trends brings opportunities for positive change. Increased revenues from new business and industry as well as increased tourism grants cities and towns more funds for municipal improvements and a higher standard of living along with better infrastructure. Unfortunately, growth also presents the need for additional consideration of potential impacts on public safety. Emergency plans must consider how new road and highway construction will affect an isolated or communitywide evacuation order. New developments also require additional emergency response agencies which must be considered by planners. Additionally,

growing populations will bring a rapidly increasing demand for natural resources which may be more challenging to restore during a disaster.

Figure 1 - Lebanon County Population Growth

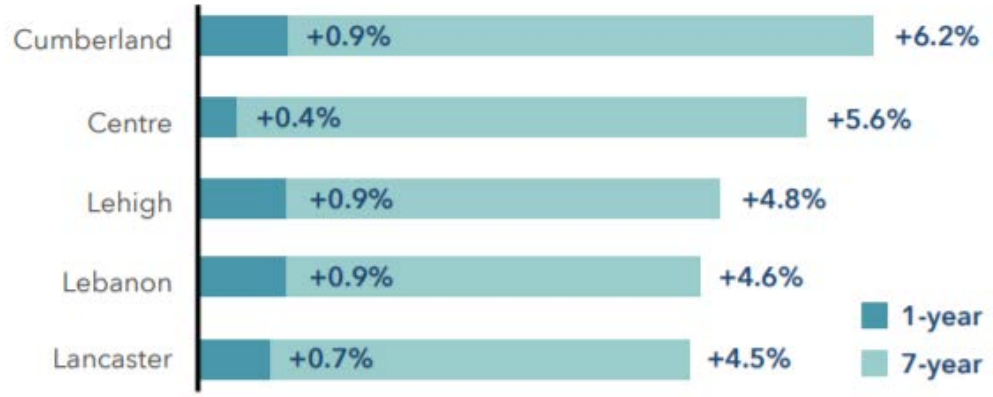
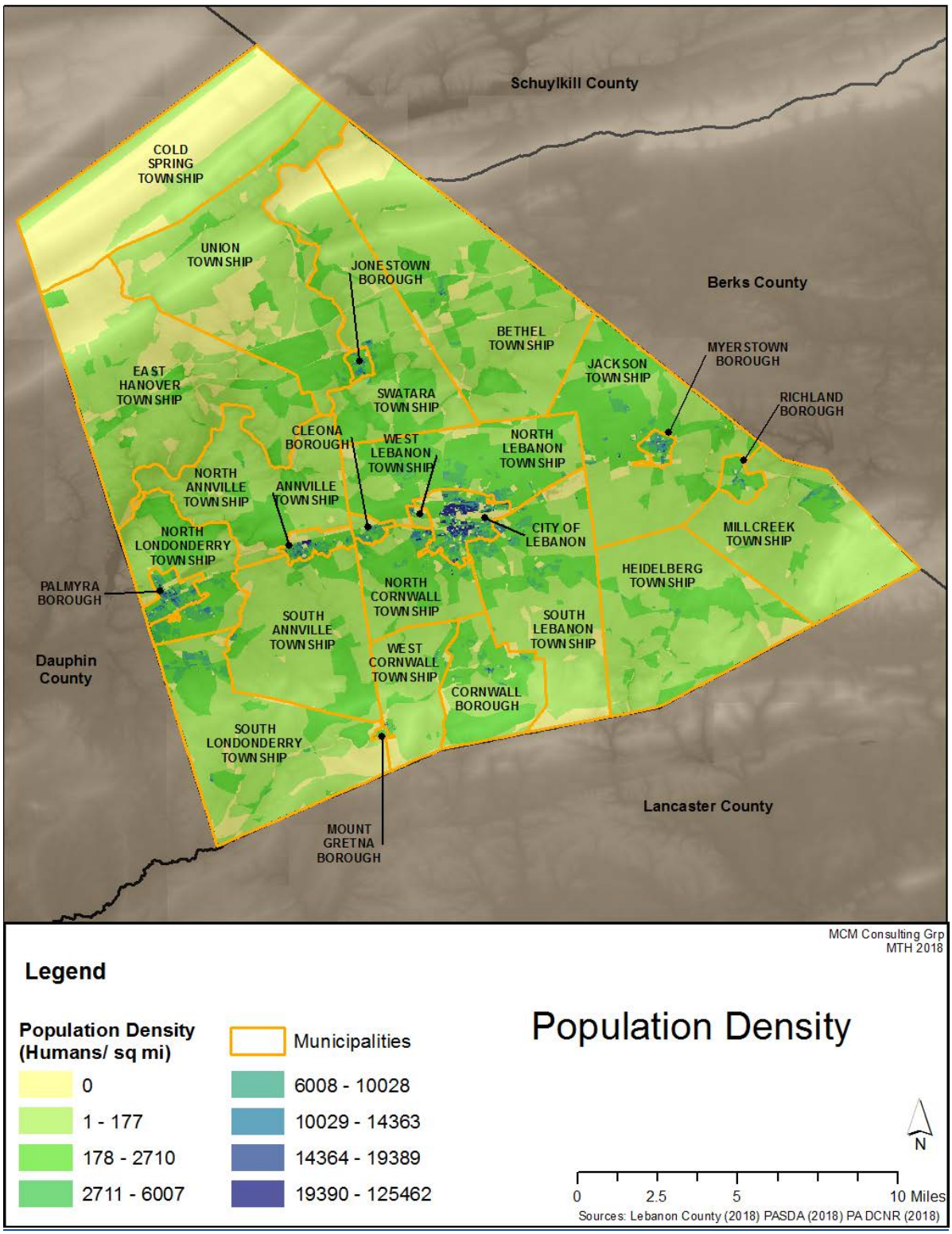


Figure 2 - Population Density Map



2.4. Land Use and Development

Lebanon County is composed of twenty six municipalities, which includes:

- Eighteen (18) townships
- Seven (7) boroughs
- One (1) city

The Lebanon Valley is predominantly an agricultural landscape and the northern and southern mountains are predominantly forested; agricultural and forest lands together account for 169,537 acres or approximately 72.4% of the county's total land area. Of the residential land total, approximately 5,935 acres or 20.2% are high density residential, 22,720 acres or 77.4% are low-density residential, 264 acres or 0.9% are a residential/commercial mix, and 434 acres or 1.5% are seasonal residential lands. Commercial land uses are distributed throughout the county, generally adjacent to residential areas and in downtown centers and occupy 7,738 acres (3.3%) of the county's land area. There is approximately 1,321 acres of industrial land, of which 84% are located along or near Route 422 and the Norfolk Southern rail corridor.

2.5. Data Sources

- Lebanon County Comprehensive Plan
- Lebanon County Regional Planning Commission
- United States Census Bureau (2010, 2014)
- United States Department of Agriculture
- Natural Resources Conservation Service
- Pennsylvania State Data Center
- Lebanon County Conservation District
- Pennsylvania Department of Environmental Protection
- Lebanon County Geographic Information Systems (GIS)
- Pennsylvania Spatial Data Access (PASDA)
- National Oceanic and Atmospheric Administration
- Pennsylvania Department of Conservation and Natural Resources
- Lebanon County Today - Summary of Indicators
- Lebanon Valley Chamber of Commerce
- Lebanon County Greenways and Open Spaces Plan
- Lebanon County Conservation District Strategic Plan
- Soil Survey of Lebanon County

Figure 3 - Lebanon County Base Map

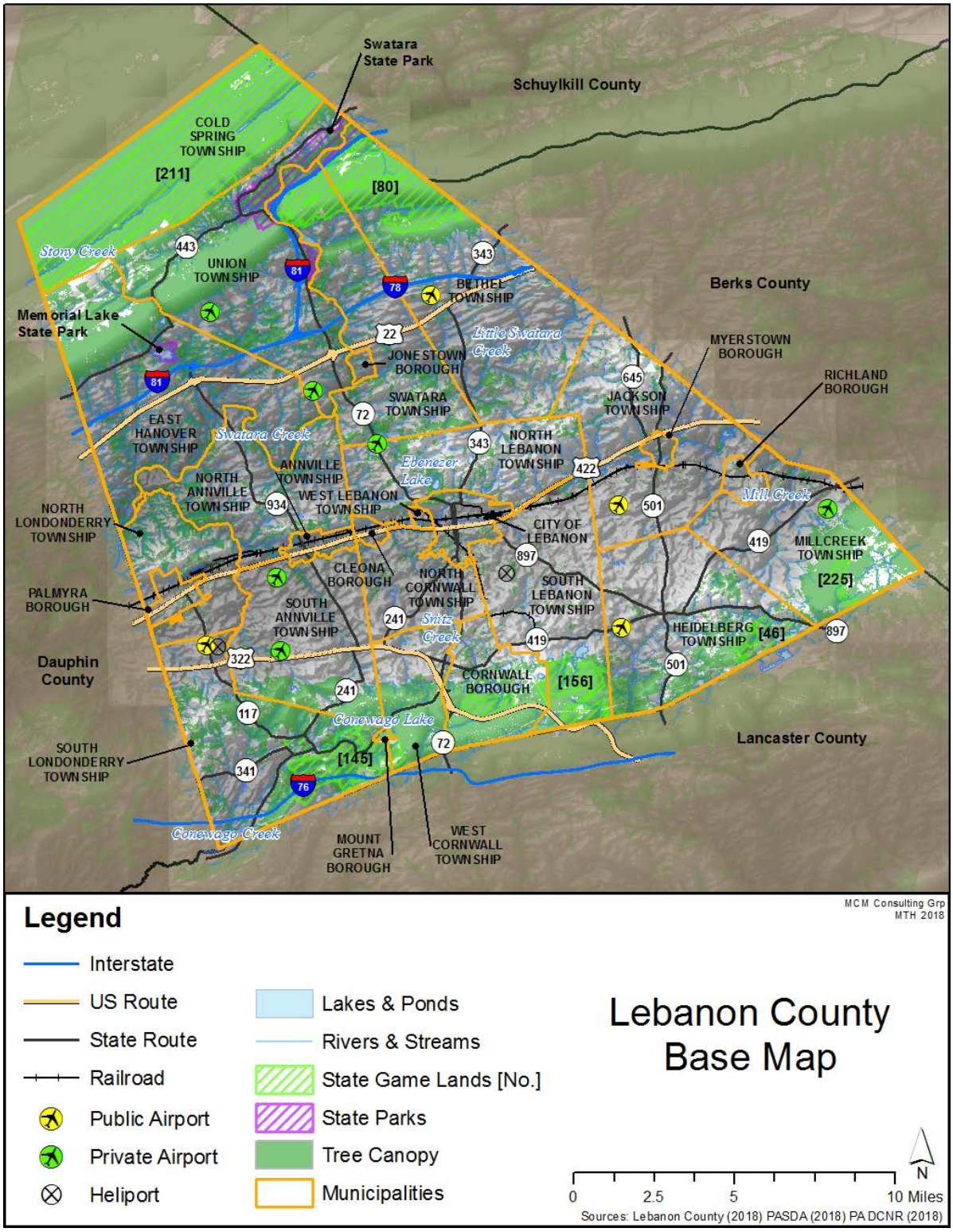


Figure 4 - Land Use/Land Cover Map

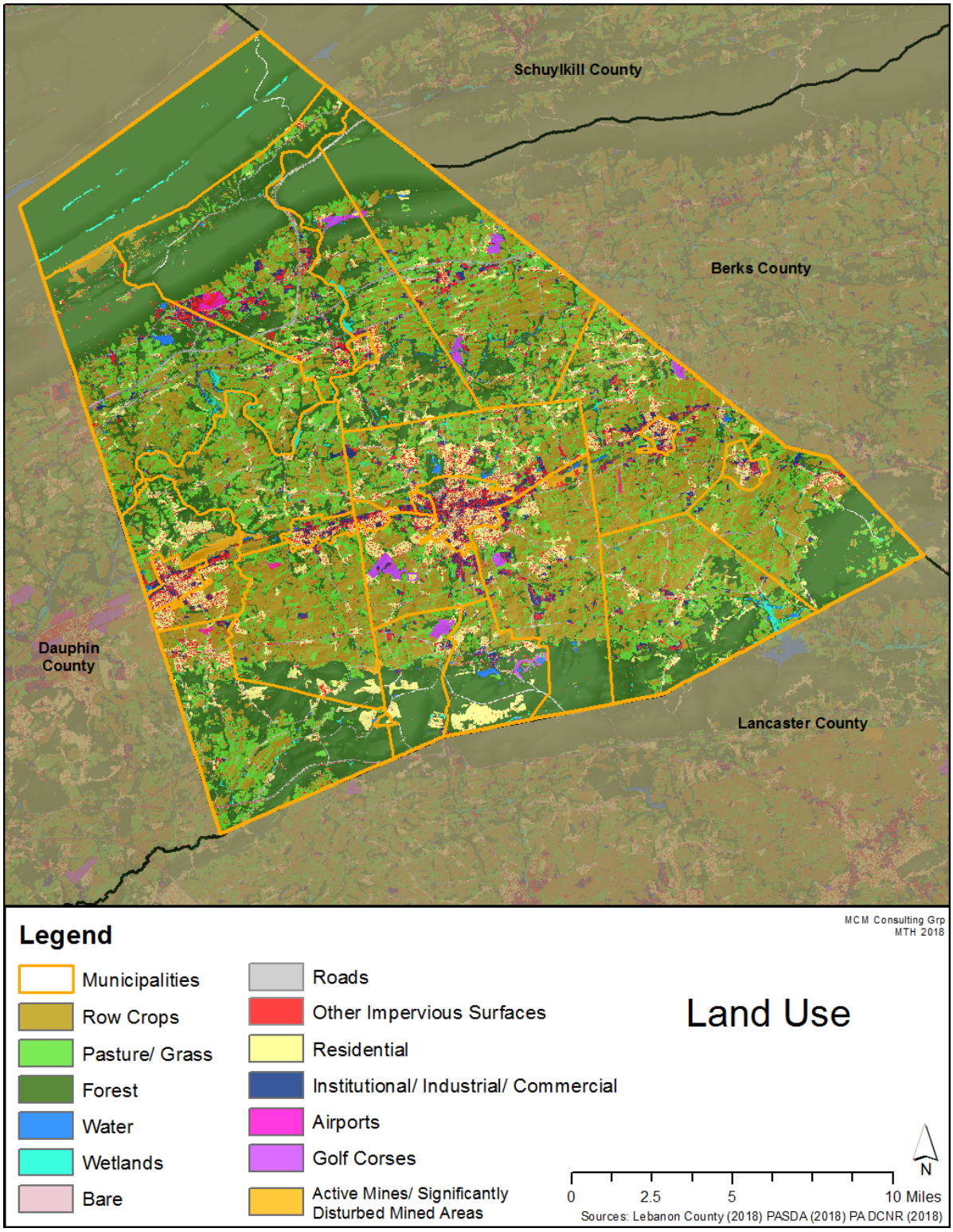


Figure 5 - Recreation Features

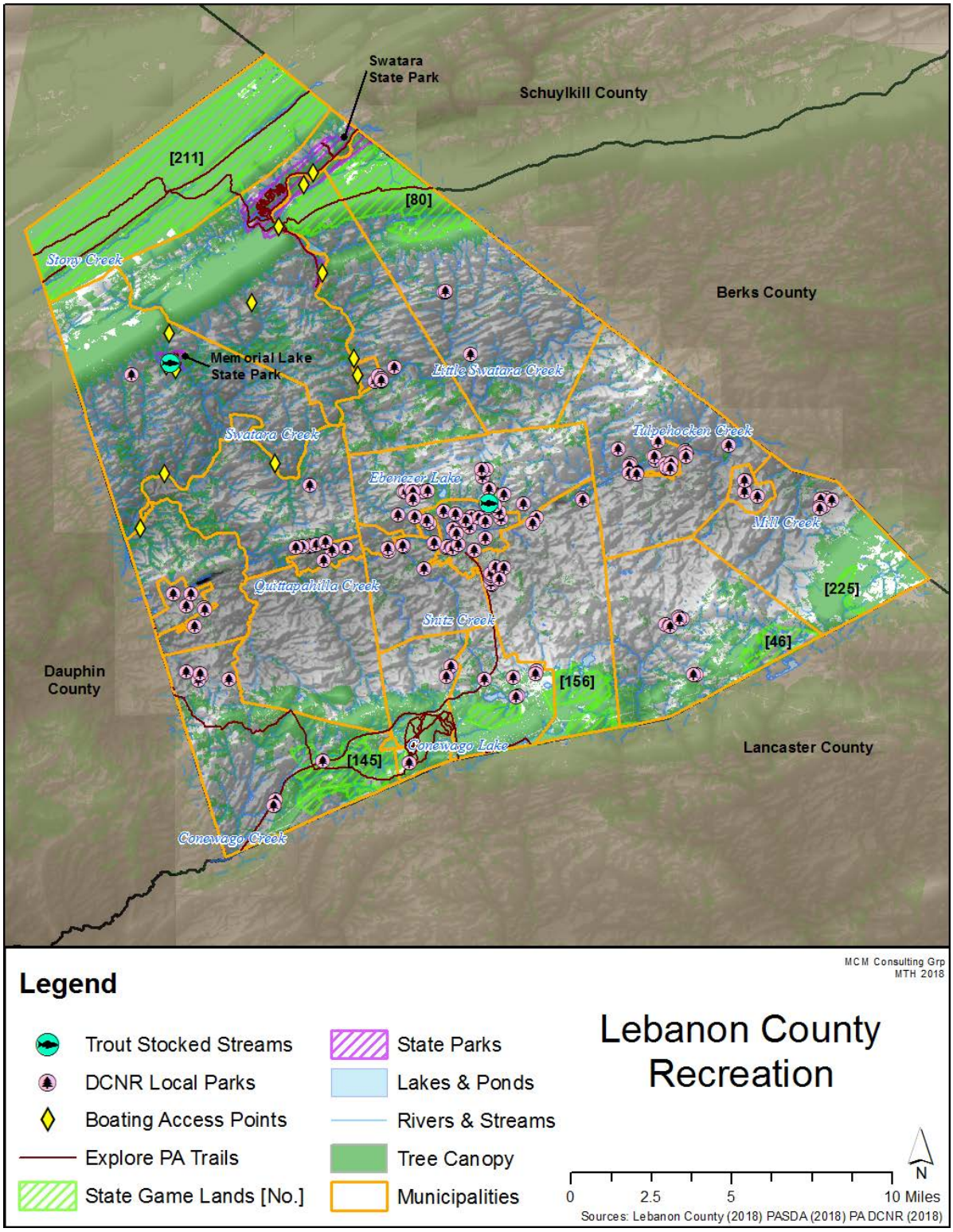
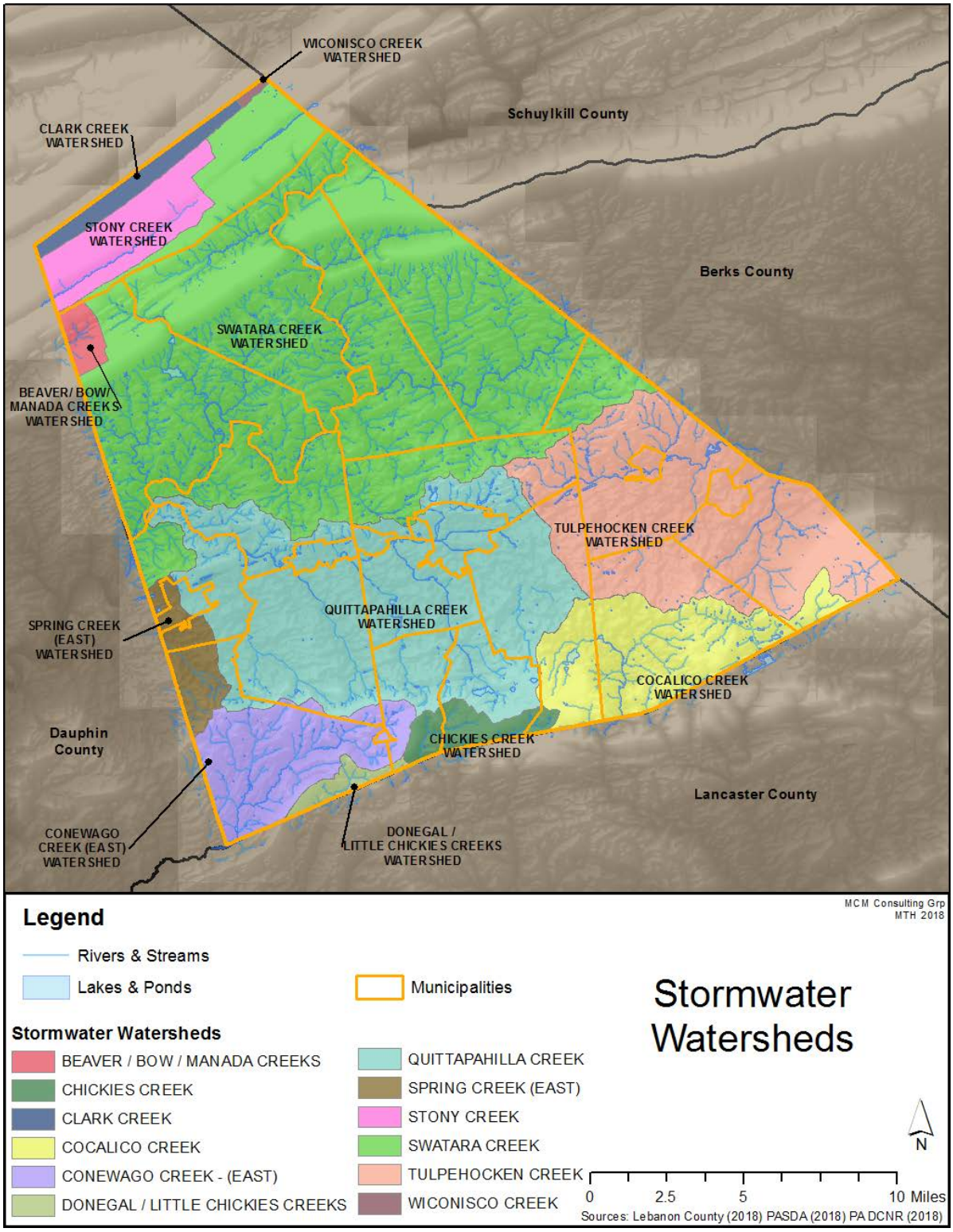


Figure 6 - Hydrologic Features



3. Planning Process

3.1. Update Process and Participation Summary

The Lebanon County Hazard Mitigation Plan update began July 11, 2017. The Lebanon County Commissioners were able to secure a hazard mitigation grant to start the process. The Lebanon County Emergency Management Agency was identified as the lead agency for the Lebanon County Hazard Mitigation Plan update. The planning process involved a variety of key decision makers and stakeholders within Lebanon County. Lebanon County immediately determined that the utilization of a contracted consulting agency would be necessary to assist with the plan update process. MCM Consulting Group, Inc. was selected as the contracted consulting agency to complete the update of the hazard mitigation plan. The core hazard mitigation team, which was referred to as the steering committee, included officials from the Lebanon County GIS and Planning Departments, Emergency Management Agency and MCM Consulting Group, Inc. (MCM).

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

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

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

The HMP planning process consisted of:

- Applying for and receiving a hazard mitigation planning grant (HMPG) to fund the planning project.

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

The draft version of the 2018 Lebanon County HMP was completed June 5, 2018. The 2018 plan follows an outline developed by PEMA which provides a standardized format for all local HMPs in the Commonwealth of Pennsylvania. The 2018 HMP format is consistent with the PEMA recommended format. The 2018 Lebanon County HMP has additional hazard profiles that were added to the HMP and these additional profiles increased the subsections in section 4.3 of the HMP.

3.2. The Planning Team

The 2018 Lebanon County Hazard Mitigation Plan update was led by the Lebanon County Steering Committee. The Lebanon County Steering Committee provided guidance and leadership for the overall project. The steering committee assisted MCM Consulting Group, Inc. with dissemination of information and administrative tasks. *Table 3 - Steering Committee* outlines the individuals that comprised this team.

Table 3 - Steering Committee

Lebanon County Hazard Mitigation Plan Update Steering Committee		
Name	**Organization**	**Position**
Bob Dowd	Lebanon County DES	Director
John Wilson	Lebanon County DES	Planning Officer
Joe Morales	Lebanon County DES	Deputy Director
Carl Wenzler	Lebanon County DES	Planning Officer
Cherie Brown	Lebanon County GIS	GIS Manager
Jamie George,	Lebanon County GIS	GIS Specialist
Drew Purzycki	Lebanon County GIS	GIS Specialist

Lebanon County Hazard Mitigation Plan Update Steering Committee		
Name	**Organization**	**Position**
Julie Cheyney,	Lebanon County Planning	Director
Corbin Snyder	MCM Consulting Group, Inc.	Project Coordinator
Michael Rearick	MCM Consulting Group, Inc.	Project Manager

In order to represent the county, the Lebanon County Steering Committee developed a diversified list of potential local planning team (LPT) members. Members that participated in the 2013 hazard mitigation plan were highly encouraged to join the 2018 team. The steering committee then provided invitations to the prospective members and provided a description of duties to serve on the LPT. The following agencies, departments and organizations were invited to participate in the LPT: Lebanon County Commissioners, Lebanon County Planning Department, Pennsylvania Department of Conservation and Natural Resources (DCNR Bureau of Parks, DCNR Bureau of Forestry), Pennsylvania Department of Environmental Protection, PennDOT, Pennsylvania State Police, Lebanon County Conservation District, Lebanon County Intermediate Unit - 13, Lebanon County Agriculture Office, Lebanon County Chamber of Commerce, Lebanon County Coroner, Fort Indiantown Gap, Wellspan Good Samaritan Hospital and all twenty six municipalities. The invitations for membership of the LPT were disseminated by the Lebanon County Emergency Management Agency utilizing letters, email and telephone calls. The LPT worked throughout the process to plan and hold meetings, collect information and conduct public outreach.

The stakeholders listed in *Table 4 - Local Planning Team* served on the 2018 Lebanon County Hazard Mitigation Local Planning Team, actively participated in the planning process by attending meetings, completing assessments, surveys and worksheets and/or submitting comments.

Table 4 - Local Planning Team

Lebanon County Hazard Mitigation Plan Update Local Planning Team		
Name	**Organization**	**Position**
Bob Dowd	Lebanon County DES	Director
John Wilson	Lebanon County DES	Planning Officer
Joe Morales	Lebanon County DES	Deputy Director
Carl Wenzler	Lebanon County DES	Planning Officer
Cherie Brown	Lebanon County GIS	GIS Manager
Jamie George	Lebanon County GIS	GIS Specialist
Drew Purzycki	Lebanon County GIS	GIS Specialist
Julie Cheyney	Lebanon County Planning	Director
Nicholas T. Yingst	Annville Township	Elected or Appointed Official
Bruce D. Harris	Cornwall Borough	Elected or Appointed Official
Robin L. Getz	Lebanon City	Elected or Appointed Official
Duane A. Trautman	Lebanon City Fire Department	Elected or Appointed Official

Lebanon County Hazard Mitigation Plan Update Local Planning Team		
Name	**Organization**	**Position**
Todd H. Breiner	Lebanon City Police Department	Elected or Appointed Official
Brian Hartman	Lebanon VA Med. Center	Elected or Appointed Official
John Baker	LLIV13 Schools Police Department	Elected or Appointed Official
Ethan Holmes	Millcreek Township EMA	Elected or Appointed Official
Thomas Long	North Cornwall Township	Elected or Appointed Official
David D. Lauver Jr.	North Lebanon Township	Elected or Appointed Official
Cheri Grumbine	North Lebanon Township	Elected or Appointed Official
Kris Troupe	North Londonderry Township	Elected or Appointed Official
Michael Belleman	Richland Borough	Elected or Appointed Official
Jeanette Henning	South Annville Township	Elected or Appointed Official
James Loser Sr.	South Lebanon Township	Elected or Appointed Official
Jennifer Harding	Swatara Township	Elected or Appointed Official
Renee Lehman	Union Township	Elected or Appointed Official
John Brenner	West Lebanon Township	Elected or Appointed Official
Del. Olson	Wellspan Good Samaritan Hospital	Elected or Appointed Official
Robert Anderson	MCM Consulting Group, Inc.	Senior Consultant
Corbin Snyder	MCM Consulting Group, Inc.	Project Coordinator
Michael Rearick	MCM Consulting Group, Inc.	Project Manager

3.3. Meetings and Documentation

Public meetings with local elected officials and the local planning team were held. At each of the public meetings, municipal officials were strongly encouraged to submit hazard mitigation project opportunity forms, complete their respective portions of the capability assessment and review and eventually adopt the multi-jurisdictional HMP. *No public comments were received during the public comment period.*

Table 5 - HMP Process Timeline lists the meetings held during the HMP planning process, which organizations and municipalities attended and the topic that was discussed at each meeting. All meeting agendas, sign-in sheets, presentation slides, any other documentation is located in Appendix C.

A final public meeting was held on June 5, 2018 to present the draft plan and invite public comments. The meeting was advertised in the local newspaper and made available digitally on the Lebanon County web site at: www.lebanonema.org The Lebanon County website was used to make a digital copy of the draft hazard mitigation plan available.

The public comment period remained open until July 3, 2018. All public comments were to be submitted in writing to Joe Morales at the Lebanon County Emergency Management Agency. No public comments were received during the public comment period.

Table 5 - HMP Process Timeline

Lebanon County HMP Process - Timeline		
Date	**Meeting**	**Description**
07/11/17	Lebanon County Hazard Mitigation Plan (HMP) Kick-Off Meeting	Identified challenges and opportunities as they relate to fulfilling the DMA 2000 requirements. Identified existing studies and information sources relevant to the hazard mitigation plan. Identified stakeholders, including the need to involve local officials.
09/12/17	Local Planning Team Initial Meeting	Defined hazard mitigation planning and identified roles and responsibilities. Discussed the 2013 hazard mitigation plan and defined a timeline to complete the update.
01/18/18	Public Meeting	Conducted a public meeting to review the draft risk assessment section of the Lebanon County Hazard Mitigation Plan update.
02/20/18 02/21/18 02/22/18	Meeting with Municipal Officials	Educated county and local elected officials on the hazard mitigation planning process. Presented the findings of the hazard vulnerability analysis and risk assessment. Sought input for mitigation projects throughout the county. Distributed Hazard Mitigation Project Opportunity Forms.
06/05/18	Lebanon County Hazard Mitigation Plan – Draft Plan Review Public Meeting	An update of the hazard mitigation planning process was delivered. The Draft HMP was reviewed with the municipal representatives and public. Attendees were informed about the timeline and their opportunity to review the entire draft plan and provide written comments for inclusion into the plan.

3.4. Public and Stakeholder Participation

Lebanon County engaged numerous stakeholders and encouraged public participation during the HMP update process. Advertisements for public meetings were completed utilizing the local newspaper and the Lebanon County website. Copies of those advertisements are located in Appendix C. Municipalities and other county entities were invited to participate in various meetings and encouraged to review and update various worksheets and surveys. Copies of all meeting agendas, meeting minutes and sign-in sheets are located in Appendix C. Worksheets and surveys completed by the municipalities and other stakeholders are summarized in this plan update as well. Municipalities were also encouraged to review hazard mitigation related items with other constituents located in the municipality like businesses, academia, private and nonprofit interests.

The tools listed below were distributed with meeting invitations, provided directly to municipalities to complete and return to the Lebanon County Emergency Management Agency or at meetings to solicit information, data and comments from both local municipalities and other key stakeholders. Responses to these worksheets and surveys are available for review at the Emergency Management Agency.

1. **Risk Assessment Hazard Identification and Risk Evaluation Worksheet:** Capitalizes on local knowledge to evaluate the change in the frequency of occurrence, magnitude of impact and/or geographic extent of existing hazards and allows communities to evaluate hazards not previously profiled using the Pennsylvania Standard List of Hazards.

2. **Capability Assessment Survey:** Collects information on local planning, regulatory, administrative, technical, fiscal and political capabilities that can be included in the countywide mitigation strategy.
3. **Municipal Project Opportunity Forms and Mitigation Actions:** Copies of the 2013 mitigation opportunity forms that were included in the current HMP were provided to the municipalities for review and amendment. The previous mitigation actions were provided and reviewed at update meetings. Previous still valid 2013 project opportunities and new 2018 municipal project opportunity forms are located in Appendix G**.**

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

Lebanon County invited all contiguous counties to review the 2018 draft hazard mitigation plan. A letter was sent to the emergency management coordinator in Berks, Dauphin, Lancaster and Schuylkill Counties on June 5, 2018. Copies of these letters are included in Appendix C.

3.5. Multi-Jurisdictional Planning

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

Table 6 - Worksheets, Surveys and Forms Participation

Municipality Participation in Worksheets, Surveys and Forms			
Municipality	**Capability Assessment Survey**	**Risk Assessment Hazard Identification and Risk Evaluation Worksheet**	**Hazard Mitigation Opportunity Form Review and Updates**
Lebanon County	X	X	X
Annville Township	X	X	X
Bethel Township	X	X	
Cleona Borough	X	X	X
Cornwall Borough	X	X	
East Hanover Township	X	X	X
Heidelberg Township	X	X	X
Jackson Township	X	X	
Jonestown Borough	X	X	X
Lebanon City	X	X	X
Millcreek Township	X	X	X
Mount Gretna Borough	X	X	X
Myerstown Borough	X	X	X
North Annville Township	X	X	X
North Cornwall Township	X	X	X
North Lebanon Township	X	X	X
North Londonderry Township	X	X	X
Palmyra Borough	X	X	X
Richland Borough	X	X	
South Annville Township	X	X	X
South Lebanon Township	X	X	X
South Londonderry Township	X	X	X
Swatara Township	X	X	X
Union Township	X	X	
West Cornwall Township	X	X	X
West Lebanon Township	X	X	X

All municipalities within Lebanon County have adopted the 2013 Lebanon County Hazard Mitigation Plan as the municipal hazard mitigation plan. The Lebanon County Local Planning Team goal is 100% participation by municipalities in adopting the 2018 Lebanon County Hazard Mitigation Plan.

4. Risk Assessment

4.1. Update Process Summary

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

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

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

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

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

The Lebanon County Local Planning Team reviewed and assessed the change in risk for all natural and human caused hazards identified in the 2013 hazard mitigation plan. The mitigation planning team then identified hazards that were outlined within the Pennsylvania Hazard Mitigation Plan but not included in the 2013 Lebanon County Hazard Mitigation Plan that could impact Lebanon County. The team utilized the Hazard

Identification and Risk Evaluation worksheet that was provided by the Pennsylvania Emergency Management Agency.

The Lebanon County Steering committee met with municipalities and provided guidance on how to complete the municipal hazard identification and risk evaluation worksheet. Twenty-five municipalities returned a completed worksheet. Cold Spring Township does not have an organized government. This information was combined with the county information to develop an overall list of hazards that would need to be profiled.

Once the natural and human caused hazards were identified and profiled, the local planning team then completed a vulnerability assessment for each hazard. An inventory of vulnerable assets was completed utilizing GIS data and local planning team knowledge. The team used the most recent Lebanon County assessment data to estimate loss to particular hazards. Risk factor was then assessed to each profiled hazard utilizing the hazard prioritization matrix. This assessment allows the county and its municipalities to focus on and prioritize local mitigation efforts on areas that are most likely to be damaged or require early response to a hazard event.

4.2. Hazard Identification

4.2.1. Presidential and Gubernatorial Disaster Declarations

Table 7 - Presidential & Gubernatorial Disaster Declarations presents a list of all Presidential and Governor's Disaster Declarations that have affected Lebanon County from 1972 through 2018, according to the Pennsylvania Emergency Management Agency.

Table 7 - Presidential & Gubernatorial Disaster Declarations

Presidential Disaster Declarations and Gubernatorial Declarations and Proclamations		
Date	**Hazard Event**	**Action**
February, 1958	Heavy snow	Gubernatorial Declaration
January, 1966	Heavy snow	Gubernatorial Declaration
February, 1972	Heavy snow	Gubernatorial Declaration
June, 1972	Flood (Agnes)	Presidential Disaster Declaration
February, 1974	Truckers strike	Gubernatorial Declaration
September, 1975	Flood (Eloise)	Presidential Disaster Declaration
October, 1976	Flood	Presidential Disaster Declaration
January, 1978	Heavy snow	Gubernatorial Declaration
February, 1978	Blizzard	Gubernatorial Declaration
November, 1980	Drought Emergency	Gubernatorial Declaration
July, 1991	Drought	Gubernatorial Proclamation of Emergency
March, 1993	Blizzard	Presidential Emergency Declaration
January, 1994	Severe winter storms	Presidential Disaster Declaration
January, 1996	Severe winter storms	Presidential Disaster Declaration
January, 1996	Flooding	Presidential Disaster Declaration

Presidential Disaster Declarations and Gubernatorial Declarations and Proclamations		
Date	**Hazard Event**	**Action**
July, 1999	Drought	Gubernatorial Declaration
September, 1999	Hurricane Floyd	Presidential Disaster Declaration
February, 2002	Drought & water shortage	Gubernatorial Declaration
February, 2003	Severe winter storm	Presidential Emergency Declaration
September, 2003	Hurricane Isabel/Henri	Presidential Disaster Declaration
September, 2004	Tropical Depression Ivan	Presidential Disaster Declaration
September, 2005	Hurricane Katrina – to render mutual aid and to receive and house evacuees	Presidential Emergency Declaration
September, 2005	Hurricane Katrina	Gubernatorial Proclamation of Emergency
June, 2006	Flooding	Presidential Proclamation of Emergency
September, 2006	Tropical depression Ernesto	Gubernatorial Proclamation of Emergency
February, 2007	Severe winter storm	Gubernatorial Proclamation of Emergency
February, 2007	Waive the regulations regarding hours of service limitations for drivers of commercial vehicles	Gubernatorial Proclamation of Emergency - Regulations
April, 2007	Severe storm	Gubernatorial Declaration
April, 2007	Severe winter storm	Gubernatorial Proclamation of Emergency
February, 2010	Severe winter storm	Gubernatorial Proclamation of Emergency
April, 2010	Severe winter storm	Presidential Emergency Declaration
January, 2011	Severe winter storm	Gubernatorial Proclamation of Emergency
September, 2011	Severe storms and flooding (Lee/Irene)	Gubernatorial Proclamation of Emergency
September, 2011	Remnants of Tropical Storm Lee	Presidential Proclamation of Emergency
September, 2011	Remnants of Tropical Storm Lee	Presidential Emergency Declaration
April, 2012	Spring winter storms	Gubernatorial Proclamation of Emergency
October, 2012	Hurricane Sandy	Gubernatorial Proclamation of Emergency
October, 2012	Hurricane Sandy	Presidential Proclamation of Emergency Declaration
May, 2013	Dauphin Bridge fire	Gubernatorial Proclamation of Emergency to utilize all available resources and personnel as is deemed necessary to cope with the situation.
June, 2013	High winds, thunderstorms, heavy rain, tornado, flooding	Gubernatorial Proclamation of Emergency
January, 2014	Extended prolonged cold	Gubernatorial Proclamation of Emergency
January, 2014	Driver hours waived due to prolonged and continued severe winter weather	Gubernatorial Proclamation of Emergency
February, 2014	Severe winter weather	Gubernatorial Proclamation of Emergency
February, 2014	Severe winter storm	Presidential Proclamation of Emergency
January, 2016	Severe winter storm and snowstorm	Presidential Proclamation of Emergency

4.2.2. Summary of Hazards

The Lebanon County Local Planning Team (LPT) was provided the Pennsylvania Standard List of Hazards to be considered for evaluation in the 2018 HMP Update. Following a review of the hazards considered in the 2013 HMP and the standard list of hazards, the local planning team decided that the 2018 plan should identify, profile and analyze twenty-one hazards. These hazards include all of the hazards profiled in the 2013 plan. The list below contains the hazards that have the potential to impact Lebanon County as identified through previous risk assessments, the Lebanon County Hazards Vulnerability Analysis and input from those that participated in the 2018 HMP update. Hazard profiles are included in Section 4.3 for each of these hazards.

Identified Natural Hazards

Drought

Drought is a natural climatic condition which occurs in virtually all climates, the consequence of a natural reduction in the amount of precipitation experienced over a long period of time, usually a season or more in length. High temperatures, prolonged winds and low relative humidity can exacerbate the severity of drought. This hazard is of particular concern in Pennsylvania due to the presence of farms as well as water-dependent industries and recreation areas across the Commonwealth. A prolonged drought could severely impact these sectors of the local economy, as well as residents who depend on wells for drinking water and other personal uses. (National Drought Mitigation Center, 2006).

Earthquake

An earthquake is the motion or trembling of the ground produced by sudden displacement of rock usually within the upper 10-20 miles of the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of underground caverns. Earthquakes can affect hundreds of thousands of square miles, cause damage to property measured in the tens of billions of dollars, result in loss of life and injury to hundreds of thousands of persons and disrupt the social and economic functioning of the affected area. Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking which is dependent upon amplitude and duration of the earthquake. (FEMA, 1997).

Extreme Temperatures

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

the summer months. Extreme heat is responsible for more deaths in Pennsylvania than all other natural disasters combined.

Flood, Flash Flood, Ice Jam

Flooding is the temporary condition of partial or complete inundation on normally dry land and it is the most frequent and costly of all hazards in Pennsylvania. Flooding events are generally the result of excessive precipitation. General flooding is typically experienced when precipitation occurs over a given river basin for an extended period of time. Flash flooding is usually a result of heavy localized precipitation falling in a short time period over a given location, often along mountain streams and in urban areas where much of the ground is covered by impervious surfaces. The severity of a flood event is dependent upon a combination of stream and river basin topography and physiography, hydrology, precipitation and weather patterns, present soil moisture conditions, the degree of vegetative clearing as well as the presence of impervious surfaces in and around flood-prone areas. Winter flooding can include ice jams which occur when warm temperatures and heavy rain cause snow to melt rapidly. Snow melt combined with heavy rains can cause frozen rivers to swell, which breaks the ice layer on top of a river. The ice layer often breaks into large chunks, which float downstream, piling up in narrow passages and near other obstructions such as bridges and dams. All forms of flooding can damage infrastructure.

Hurricanes, Tropical Storms, 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 counterclockwise (in the Northern Hemisphere) and whose diameter averages 10-30 miles across. While most of Pennsylvania is not directly affected by the devastating impacts cyclonic systems can have on coastal regions, many areas in the state are subject to the primary damaging forces associated with these storms including high-level sustained winds, heavy precipitation and tornados. Areas in southeastern Pennsylvania could be susceptible to storm surge and tidal flooding. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea and Gulf of Mexico during the official Atlantic hurricane season (June through November). (FEMA, 1997).

Landslide

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

hillsides and areas recently burned by forest and brush fires. (Delano & Wilshusen, 2001).

Pandemic and Infectious Diseases

A pandemic occurs when infection from of a new strain of a certain disease, to which most humans have no immunity, substantially exceeds the number of expected cases over a given period of time. Such a disease may or may not be transferable between humans and animals. (Martin & Martin-Granel, 2006).

Radon Exposure

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

Subsidence, Sinkhole

Subsidence is a natural geologic process that commonly occurs in areas with underlying limestone bedrock and other rock types that are soluble in water. Water passing through naturally occurring fractures dissolves these materials leaving underground voids. Eventually, overburden on top of the voids causes a collapse which can damage structures with low strain tolerances. This collapse can take place slowly over time or quickly in a single event, but in either case. Karst topography describes a landscape that contains characteristic structures such as sinkholes, linear depressions, and caves. In addition to natural processes, human activity such as water, natural gas, and oil extraction can cause subsidence and sinkhole formations. (FEMA, 1997).

Tornado, Wind Storm

A wind storm can occur during severe thunderstorms, winter storms, coastal storms, or tornados. Straight-line winds such as a downburst have the potential to cause wind gusts that exceed 100 miles per hour. Based on 40 years of tornado history and over 100 years of hurricane history, FEMA identifies western and central Pennsylvania as being more susceptible to higher winds than eastern Pennsylvania. (FEMA, 1997). A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornados are most often generated by thunderstorm activity (but sometimes result from hurricanes or tropical storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of high wind velocities and wind-blown debris. According

to the National Weather Service, tornado wind speeds can range between 30 to more than 300 miles per hour. They are more likely to occur during the spring and early summer months of March through June and are most likely to form in the late afternoon and early evening. Most tornados are a few dozen yards wide and touch down briefly, but even small, short-lived tornados can inflict tremendous damage. Destruction ranges from minor to catastrophic depending on the intensity, size and duration of the storm. Structures made of light materials such as mobile homes are most susceptible to damage. Waterspouts are weak tornados that form over warm water and are relatively uncommon in Pennsylvania. Each year, an average of over 800 tornados is reported nationwide, resulting in an average of 80 deaths and 1,500 injuries (NOAA, 2002). Based on NOAA Storm Prediction Center Statistics, the number of recorded F3, F4, & F5 tornados between 1950-1998 ranges from <1 to 15 per 3,700 square mile area across Pennsylvania (FEMA, 2009). A water spout is a tornado over a body of water (American Meteorological Society, 2009).

Wildfire

A wildfire is a raging, uncontrolled fire that spreads rapidly through vegetative fuels, exposing and possibly consuming structures. Wildfires often begin unnoticed and can spread quickly, creating dense smoke that can be seen for miles. Wildfires can occur at any time of the year, but mostly occur during long, dry hot spells. Any small fire in a wooded area, if not quickly detected and suppressed, can get out of control. Most wildfires are caused by human carelessness, negligence and ignorance. However, some are precipitated by lightning strikes and in rare instances, spontaneous combustion. Wildfires in Pennsylvania can occur in fields, grass, brush and forests. 98% of wildfires in Pennsylvania are a direct result of people, often caused by debris burns (PA DCNR, 1999).

Winter Storm

Winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. A winter storm can range from a moderate snowfall or ice event over a period of a few hours to blizzard conditions with wind-driven snow that lasts for several days. Many winter storms are accompanied by low temperatures and heavy and/or blowing snow, which can severely impair visibility and disrupt transportation. The Commonwealth of Pennsylvania has a long history of severe winter weather. (NOAA, 2009).

Identified Human Caused Hazards

Civil Disturbance

Civil disturbance hazards encompass a set of hazards emanating from a wide range of possible events that cause civil disorder, confusion, strife and economic hardship. Civil disturbance hazards include the following:

- Famine; involving a widespread scarcity of food leading to malnutrition and increased mortality (Robson, 1981).
- Economic Collapse, Recession; Very slow or negative growth, for example (Economist, 2009).
- Misinformation; erroneous information spread unintentionally (Makkai, 1970).
- Civil Disturbance, Public Unrest, Mass Hysteria, Riot; group acts of violence against property and individuals, for example (18 U.S.C. § 232, 2008).
- Strike, Labor Dispute; controversies related to the terms and conditions of employment, for example (29 U.S.C. § 113, 2008).

Dam Failure

A dam is a barrier across flowing water that obstructs, directs, or slows down water flow. Dams provide benefits such as flood protection, power generation, drinking water, irrigation and recreation. Failure of these structures results in an uncontrolled release of impounded water. Failures are relatively rare, but immense damage and loss of life is possible in downstream communities when such events occur. Aging infrastructure, hydrologic, hydraulic and geologic characteristics, population growth and design and maintenance practices should be considered when assessing dam failure hazards. The failure of the South Fork Dam, located in Johnstown, Pennsylvania, was the deadliest dam failure ever experienced in the United States. It took place in 1889 and resulted in the Johnstown Flood which claimed 2,209 lives (FEMA, 1997). Today there are approximately 3,200 dams and reservoirs throughout Pennsylvania (Pennsylvania Department of Environmental Protection, 2009).

Environmental Hazards

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

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

- Product Defect or Contamination; highly flammable or otherwise unsafe consumer products and dangerous foods (Consumer Product Safety Commission, 2003).

Nuclear Incidents

Nuclear accidents generally refer to events involving the release of significant levels of radioactivity or exposure of workers or the general public to radiation (FEMA, 1997). Nuclear accidents/incidents can be placed into three categories: 1) Criticality accidents which involve loss of control of nuclear assemblies or power reactors, 2) Loss-of-coolant accidents which result whenever a reactor coolant system experiences a break or opening large enough so that the coolant inventory in the system cannot be maintained by 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).

Opioid Epidemic

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

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

Terrorism

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

Transportation Accidents

Transportation accidents can result from any form of air, rail, water, or road travel. It is unlikely that small accidents would significantly impact the larger community. However, certain accidents could have secondary regional impacts such as a hazardous materials release or disruption in critical supply/access routes, especially if vital transportation corridors or junctions are present. (Research and Innovative Technology Administration, 2009). Traffic congestion in certain circumstances can also be hazardous. Traffic congestion is a condition that occurs when traffic demand approaches or exceeds the available capacity of the road network. This hazard should be carefully evaluated during emergency planning since it is a key factor in timely disaster or hazard response, especially in areas with high population density. (Federal Highway Administration, 2009).

Urban Fire and Explosion

An urban fire involves a structure or property within an urban or developed area. For hazard mitigation purposes, major urban fires involving large buildings and/or multiple properties are of primary concern. The effects of a major urban fire include minor to significant property damage, loss of life, and residential or business displacement. Explosions are extremely rapid releases of energy that usually generate high temperatures and often lead to fires. The risk of severe explosions can be reduced through careful management of flammable and explosive hazardous materials. (FEMA, 1997).

Utility Interruption

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

- Geomagnetic Storms; including temporary disturbances of the Earth's magnetic field resulting in disruptions of communication, navigation and satellite systems (National Research Council et al., 1986).
- Fuel or Resource Shortage; resulting from supply chain breaks or secondary to other hazard events, for example (Lebanon County, PA, 2005).
- Electromagnetic Pulse; originating from an explosion or fluctuating magnetic field and causing damaging current surges in electrical and electronic systems (Institute for Telecommunications Sciences, 1996).
- Information Technology Failure; due to software bugs, viruses, or improper use (Rainer Jr., et al, 1991).
- Ancillary Support Equipment; electrical generating, transmission, system-control and distribution-system equipment for the energy industry (Hirst & Kirby, 1996).
- Public Works Failure; damage to or failure of highways, flood control systems, deep-water ports and harbors, public buildings, bridges, dams, for example (United States Senate Committee on Environment and Public Works, 2009).

- Telecommunications System Failure; Damage to data transfer, communications and processing equipment, for example (FEMA, 1997)
- Transmission Facility or Linear Utility Accident; liquefied natural gas leakages, explosions, facility problems, for example (United States Department of Energy, 2005)
- Major Energy, Power, Utility Failure; interruptions of generation and distribution, power outages, for example (United States Department of Energy, 2000).

4.2.3. Climate Change

Impacts of Climate Change on Identified Hazards

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

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

Climate change is likely to increase the risk of droughts (Section 4.3.1). Higher average temperatures mean that more precipitation will fall as rain rather than snow, snow will melt earlier in the spring, and evaporation and transpiration will increase. Along with the prospect of decreased annual precipitation, the risk of hydrological and agricultural drought is expected to increase (Sheffield & Wood, 2008). Correspondingly this will impact wildfires (Section 4.3.11). Drought is accompanied by drier soils and forests, resulting in an elongated wildfire season and more intense and long-burning wildfires (Pechony & Shindell, 2010). However, the Southwest United States is at a greater risk

of this increased drought and wildfire activity than Lebanon County in the Eastern United States.

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

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

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

4.3. Hazard Profiles

4.3.1. Drought

4.3.1.1 Location and Extent

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

There are three types of drought:

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

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

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

4.3.1.2 Range of Magnitude

The Commonwealth uses five parameters to assess drought conditions:

- Stream flows (compared to benchmark records).
- Precipitation (measured as the departure from normal, thirty-year average precipitation).
- Reservoir storage levels in a variety of locations such as three New York City reservoirs in the upper Delaware River Basin.
- Groundwater elevations in a number of counties (comparing to past month, past year and historic record).
- Soil moisture via the Palmer Drought Index (See *Table 8 - Palmer Drought Severity Index*) - a soil moisture algorithm calibrated for relatively homogeneous regions which measures dryness based on recent precipitation and temperature.

Table 8 - Palmer Drought Severity Index

Palmer Drought Severity Index	
Severity Category	**PDSI**
Extremely wet	4.0 or more
Very wet	3.0 to 3.99
Moderately wet	2.0 to 2.99
Slightly wet	1.0 to 1.99
Incipient wet spell	0.5 to 0.99
Near normal	0.49 to -0.49
Incipient dry spell	-0.5 to -0.99
Mild drought	-1.0 to -1.99
Moderate drought	-2.0 to -2.99
Severe drought	-3.0 to -3.99
Extreme drought	-4.0 or less

Table 9 - Drought Preparation Phases

Drought Preparation Phases *(PA DEP, 2017)*				
Phase	**General Activity**	**Actions**	**Request**	**Goal**
Drought Watch	Early stages of planning and alert for drought possibility	Increased water monitoring, awareness and preparation for response among government agencies, public water suppliers, water users and the public	Voluntary water conservation	Reduce water use by 5%
Drought Warning	Coordinate a response to imminent drought conditions and potential water shortages	Reduce shortages - relieve stressed sources, develop new sources if needed	Continue voluntary water conservation, impose mandatory water use restrictions if needed	Reduce water use by 10-15%
Drought Emergency	Management of operations to regulate all available resources and respond to emergency	Support essential and high priority water uses and avoid unnecessary uses	Possible restrictions on all nonessential water uses	Reduce water use by 15%

Local Water Rationing: With the approval of the PA Emergency Management Council, local municipalities may implement local water rationing to share a rapidly dwindling or severely depleted water supply in designated water supply service areas. These individual water rationing plans, authorized through provisions of 4 PA Code Chapter 120, will require specific limits on individual water consumption to achieve significant reductions in use. Under both mandatory restrictions imposed by the Commonwealth and local water rationing, procedures are provided for granting of variances to consider individual hardships and economic dislocations. [PEMA, 409 Plan]

4.3.1.3 Past Occurrence

Table 10 - Drought Event History shows declared drought status for Lebanon County from 1980 to March 2018 as reported by the Pennsylvania Department of Environmental Protection (PA DEP) and the table also includes past disaster declarations impacting Lebanon County due to drought events. Figure 6 shows that Lebanon County has experienced severe drought (PDSI ≤ -3) between five and ten percent of the time from 1895-1995, which gives a good idea of how often the county has been affected by drought events.

The worst drought event on record for Lebanon County occurred in 1963 when precipitation statewide averaged below normal for ten of twelve months. Drought emergency status led to widespread water use restrictions, and reservoirs dipped to record low levels. Corn, hay, and other agricultural products desiccated in parched fields, causing economic losses. Governor William Scranton sought drought aid for Pennsylvania in the

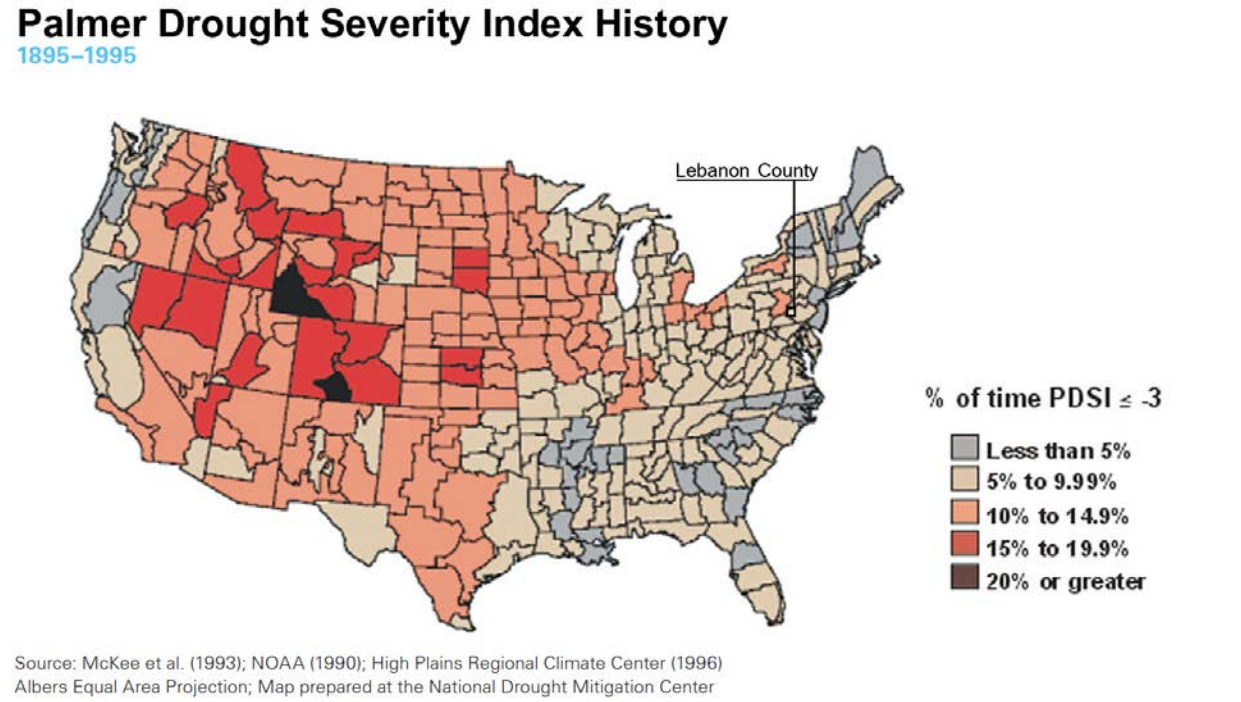
face of mounting agricultural losses, and the event became a presidentially declared disaster in September 1963.

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

Table 10 - Drought Event History

Drought Event History ***(PA DEP, 2018)***			
Start Date	**End Date**	**Type**	**Duration**
11/18/1980	4/20/1982	Emergency	1 year, 5 months, 2 days
4/26/1985	10/22/1985	Watch	7 months, 23 days
10/22/1985	12/19/1985	Emergency	
7/7/1988	12/19/1988	Watch	5 months, 12 days
6/28/1991	7/24/1991	Warning	11 months, 26 days
7/24/1991	10/21/1991	Emergency	
10/21/1991	6/23/1992	Warning	
9/1/1995	11/8/1995	Warning	3 months, 17 days
11/8/1995	12/18/1995	Watch	
7/17/1997	10/27/1997	Watch	7 months, 2 days
10/27/1997	1/16/1998	Warning	
1/16/1998	2/19/1998	Watch	
12/8/1998	12/14/1998	Watch	1 year, 4 months, 27 days
12/14/1998	3/15/1999	Warning	
3/15/1999	6/10/1999	Watch	
6/10/1999	7/20/1999	Warning	
7/20/1999	9/30/1999	Emergency	
9/30/1999	5/5/2000	Watch	
8/8/2001	11/6/2001	Watch	1 year, 4 months, 11 days
11/6/2001	2/12/2002	Warning	
2/12/2002	11/7/2002	Emergency	
11/7/2002	12/19/2002	Watch	
4/11/2006	6/30/2006	Watch	2 months, 19 days
8/6/2007	9/5/2007	Watch	30 days
10/5/2007	1/11/2008	Watch	3 months, 6 days
9/16/2010	11/10/2010	Watch	1 months, 25 days
8/5/2011	9/2/2011	Watch	0 months, 28 days
8/2/2016	5/16/2017	Watch	9 months, 14 days
12/5/2017	2/20/2018	Watch	2 months, 15 days

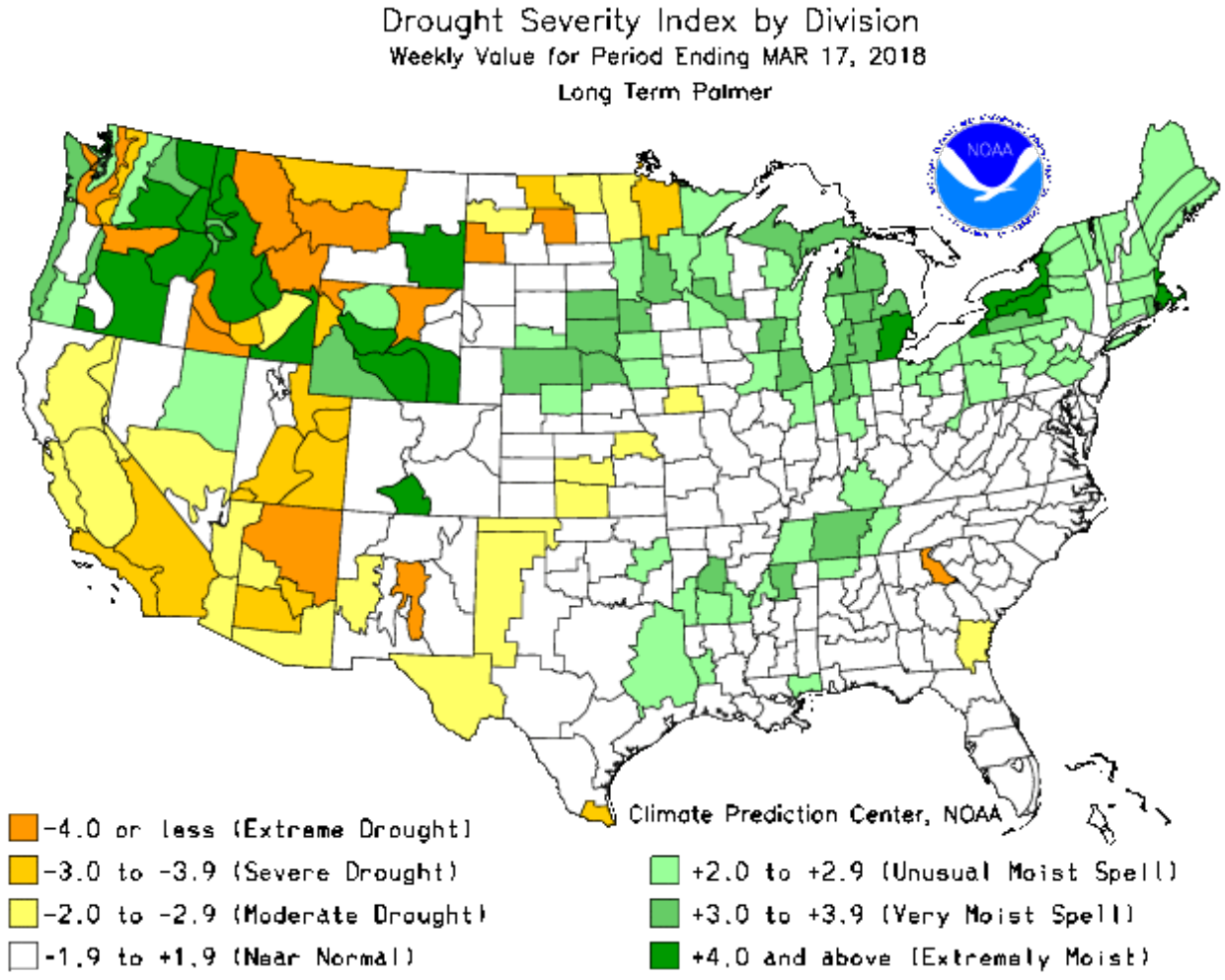
Figure 7 - Palmer Drought Severity Index History



4.3.1.4 Future Occurrence

It is difficult to forecast the exact severity and frequency of future drought events, and the future of climate change will lead to increased uncertainty and extremity of climate events, suggesting that it is best to be prepared for potentially adverse conditions. Lebanon County has experienced severe drought between five and ten percent of the time between 1895 and 1995 (*Figure 7 - Palmer Drought Severity Index History)*, which can be used to make a rough estimate of the future probability of drought in Lebanon County, although it does not account for uncertainty introduced by climate change. *Figure 8 - Recent Drought Severity Index* shows a recent Palmer Drought Severity Index reading for the continental United States and as of March 17th, Lebanon County and the surrounding region are experiencing an unusually moist spell, with a PDSI between -2.0 and 2.9.

Figure 8 - Recent Drought Severity Index



4.3.1.5 Vulnerability Assessment

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

While these were statewide impacts, they illustrate the potential for droughts to severely impair the local economy in more agricultural communities. As of the 2012 Census of Agriculture, there were an estimated 1,219 farms in Lebanon County, at an average size of 100 acres. Lebanon County ranks fifth of the sixty-seven counties in the Commonwealth for agricultural production, totaling approximately $349 million dollars (USDA, 2012). The majority of this production comes from livestock, poultry and their products

(~$303 million). The remaining agricultural production comes from crops, including nursery and greenhouse crops (~$46 million).

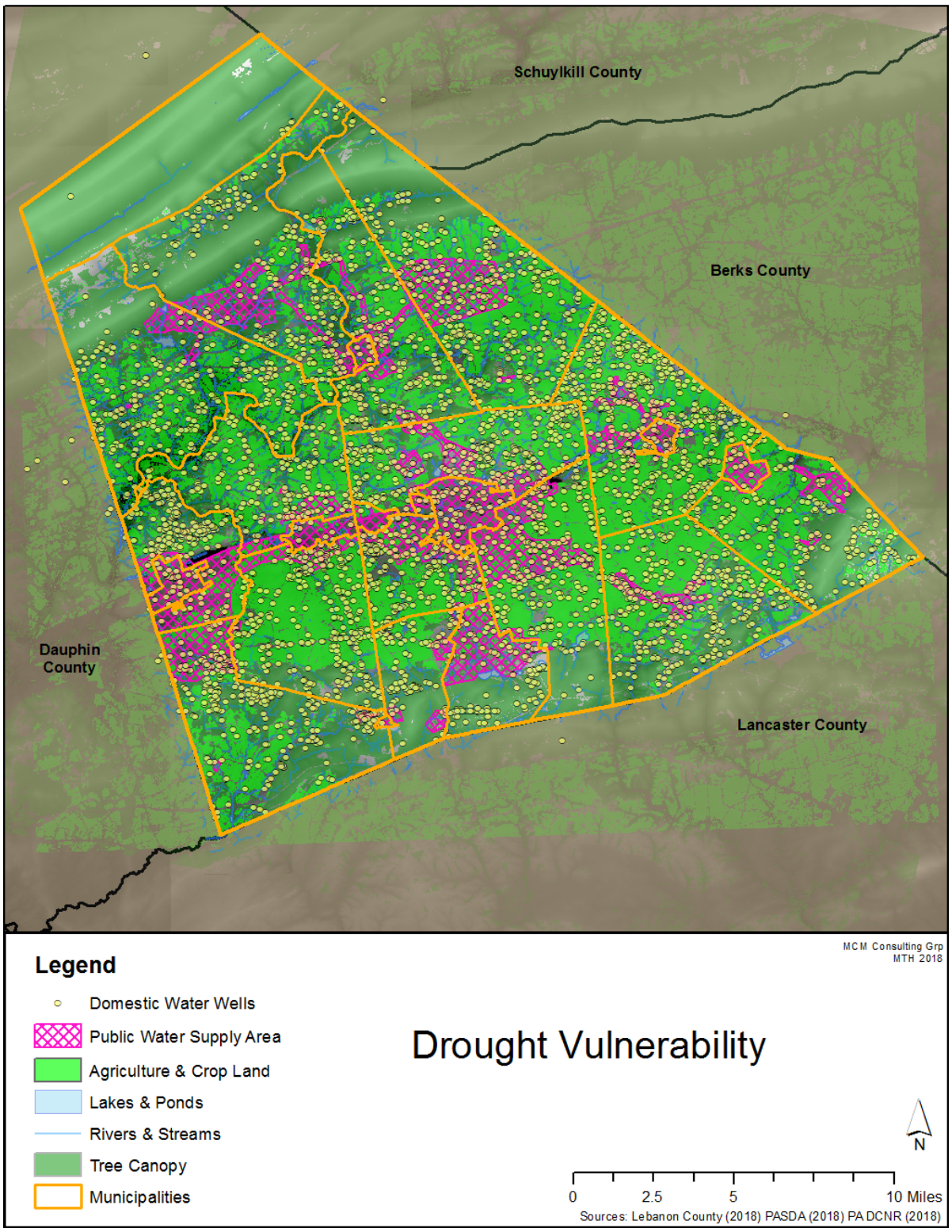
Water supplies are also vulnerable to the effects of drought. Public water service areas cover 15.6% of the county, including all of the City of Lebanon, Richland Borough, Myerstown Borough, Annville Township, Palmyra Borough, Jonestown Borough and Mount Gretna Borough *(*See *Figure 9 - Drought Vulnerability).* The majority of the county however relies on wells for their fresh drinking water. Droughts will quickly affect systems that rely on surface supplies, whereas systems with wells are more capable of handling short-term droughts without issue. Longer-term droughts inhibit the recharging of groundwater aquifers which has an impact on well owners. Depending on the severity of the drought, this could cause the well to dry up, rendering the well owner at a loss for useable water, meaning Lebanon County residents who use private domestic wells are vulnerable to drought events. *Table 11 - Domestic Water Wells* shows the number of wells in each municipality in Lebanon County. Well data was gathered from the Pennsylvania Groundwater Information System (PaGWIS), which relies on voluntary submissions by well drillers. While this is the best dataset of domestic wells available for Lebanon County, it is not comprehensive due to the voluntary nature of the data submission. Not all wells were reported including a location designation.

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

Table 11 - Domestic Water Wells

Domestic Water Wells *(PA DEP, 2018)*			
Municipality	**Domestic Water Wells**	**Municipality**	**Domestic Water Wells**
Annville Township	50	North Cornwall Township	468
Bethel Township	797	North Lebanon Township	749
Cleona Borough	5	North Londonderry Township	492
Cold Spring Township	6	Palmyra Borough	54
Cornwall Borough	446	Richland Borough	20
East Hanover Township	581	South Annville Township	645
Heidelberg Township	560	South Lebanon Township	475
Jackson Township	1173	South Londonderry Township	742
Jonestown Borough	5	Swatara Township	469
Lebanon City	247	Union Township	429
Millcreek Township	351	West Cornwall Township	213
Mt Gretna Borough	7	West Lebanon Township	43
Myerstown Borough	44	Undesignated	41
North Annville Township	418	**Total**	**9530**

Figure 9 - Drought Vulnerability



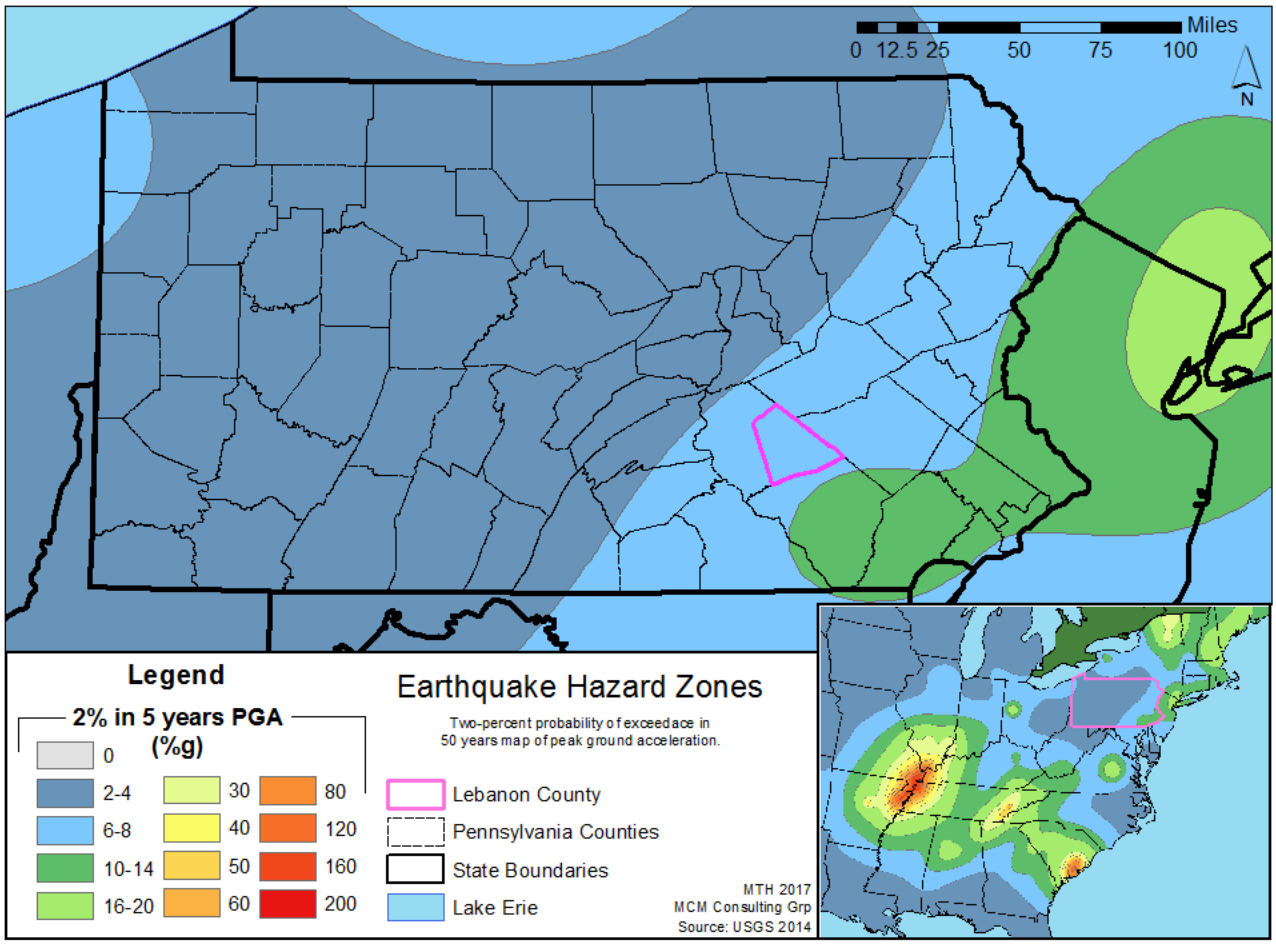
4.3.2. Earthquake

4.3.2.1 Location and Extent

An earthquake is sudden movement of the earth's surface caused by the release of stress accumulated within or along the edge of the earth's tectonic plates, a volcanic eruption, or by a human induced explosion (DCNR, 2007). Earthquake events in Pennsylvania, including Lebanon County are usually mild events; impacting areas no greater than 62 miles in diameter from the epicenter. A majority of earthquakes occur along boundaries between tectonic plates, and some earthquakes occur at faults on the interior of plates. Today, Eastern North America, including Lebanon County, Pennsylvania, is far from the nearest plate boundary. That plate boundary is the Mid-Atlantic Ridge and is approximately 2,000 miles to the east.

When the supercontinent of Pangaea broke up about 200 million years ago, the Atlantic Ocean began to form. Since then, many faults have developed. Locating all of the faults would be an idealistic approach to identifying the region's earthquake hazard; however, many of the fault lines in this region have no seismicity associated with them. The best way to determine earthquake history for Lebanon County is to conduct a probabilistic earthquake-hazard analysis with the earthquakes that have already happened in and around the county (See *Figure 10 - Earthquake Hazard Zones*).

Figure 10 - Earthquake Hazard Zones



4.3.6.2 Range of Magnitude

Earthquakes result in the propagation of seismic waves, which are detected using seismographs. These seismograph results are measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake. *Table 12 - Richter Scale* summarizes Richter Scale Magnitudes as they relate to the spatial extent of impacted areas.

Table 12 - Richter Scale

Richter Scale	
Richter Magnitude	**Earthquake Effects**
Less than 3.5	Generally, not felt, but recorded.
3.5-5.4	Often felt, but rarely causes damage.

Richter Scale	
Richter Magnitude	**Earthquake Effects**
Under 6.0	At most, slight damage to well-designed buildings; can cause major damage to poorly constructed buildings over small regions.
6.1-6.9	Can be destructive in areas where people live up to about 100 kilometers across.
7.0-7.9	Major earthquake; can cause serious damage over large areas.
8.0 or greater	Great earthquake; can cause serious damage in areas several hundred kilometers across.

The Richter Scale does not give any indication of the impact or damage of an earthquake, although it can be inferred that higher magnitude events cause more damage. Instead, the impact of an earthquake event is measured in terms of earthquake intensity, usually measured using the Modified Mercalli Intensity Scale.

The Modified Mercalli Intensity Scale (*Table 13 - Modified Mercalli Intensity Scale*) is an alternative measure of earthquake intensity that is broken down by the impacts of the earthquake event. Earthquakes have many secondary impacts, including disrupting critical facilities, transportation routes, public water supplies and other utilities. Based on historical data of earthquakes with a recorded intensity, little damage is expected from earthquake events.

However, since the worst earthquake recorded in Pennsylvania was a magnitude 5.2, a worse-case scenario for this hazard would be if an earthquake of similar magnitude occurred in Lebanon County or near the border in an adjacent county, causing mild damage in populated areas.

Table 13 - Modified Mercalli Intensity Scale

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

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

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

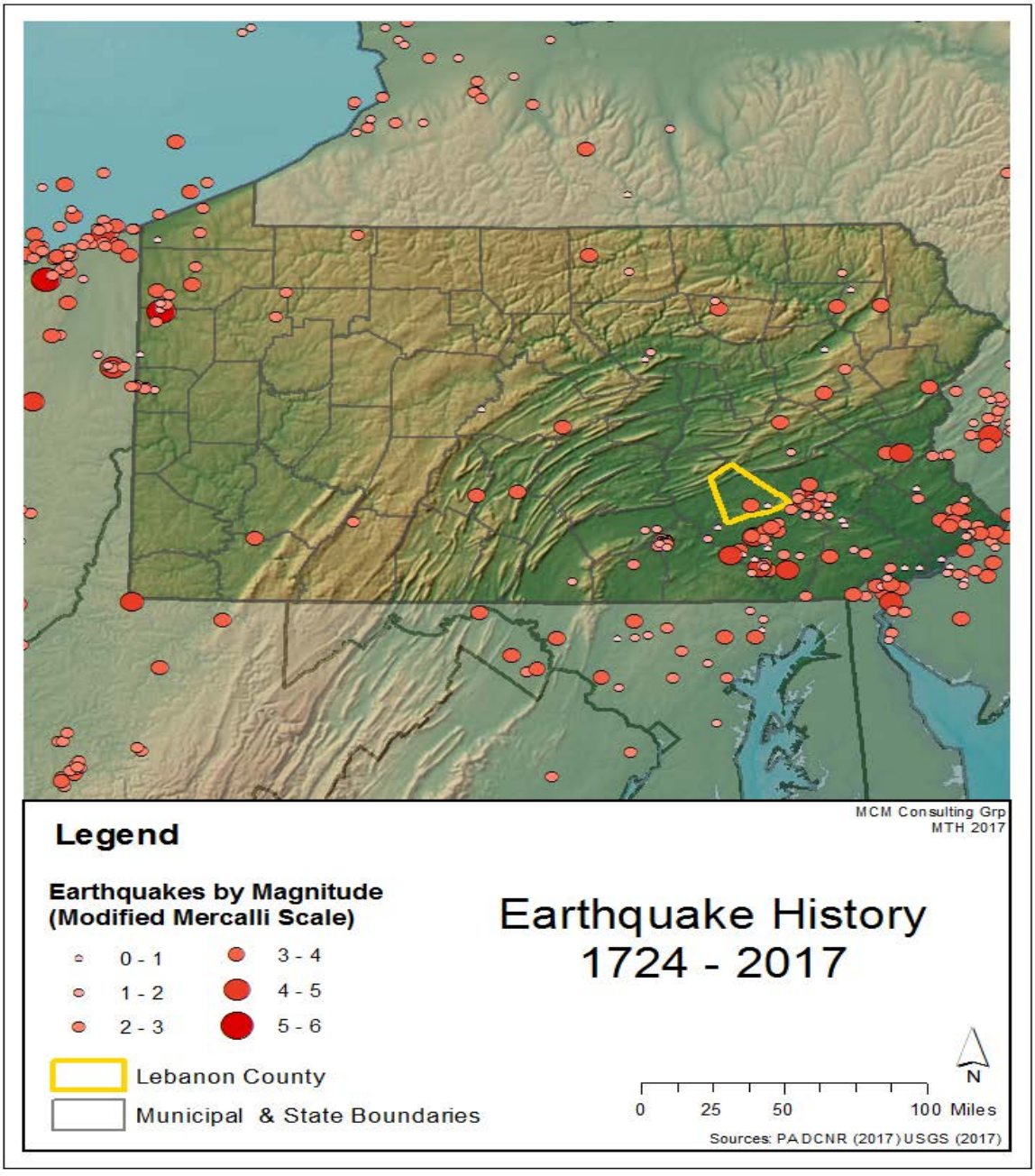
4.3.2.3 Past Occurrence

Lebanon County has experienced only minor earthquakes that resulted in minimal damage. According to the Pennsylvania Department of Conservation of Natural Resources' (DCNR) Epicenter Map of Pennsylvania, Lebanon County has experienced two epicenters in the last 300 years. Both recorded events occurred prior to 1966. The first of the two recorded events occurred on January 15, 1885. The magnitude of this event is unknown. The second of the two events occurred on May 12, 1964 and had a magnitude of 3.2 on the Richter Scale. More recent events have occurred near the Lebanon County border. Neighboring Berks County experienced an event that measured a 4.6 in magnitude in 1994. Lancaster County witnessed a series of small events in (1.8-3.2 in magnitude) in 1997.

On August 23, 2011 a 5.8 magnitude earthquake struck the central Virginia area. Tremors were felt as far north as Canada. Although it was felt in the Lebanon County area there were no reports of significant damage.

All earthquake events that occurred in the area surrounding Lebanon County since 1724 can be seen in *Figure 11 - Earthquake History*.

Figure 11 - Earthquake History



4.3.2.4 Future Occurrence

Earthquake activity and intensities are difficult to predict, but a probabilistic analysis of prior earthquakes can assist in gauging the likelihood of future occurrences. *Figure 10 - Earthquake Hazard Zones* shows Lebanon County in the three lowest non-zero hazard zones for earthquake activity according to the USGS (2014), suggesting a moderately low probability of earthquake occurrence. However, according to the USGS, there has been a recent trend increasing the frequency of magnitude 3 and larger earthquakes in the central and eastern US (*Table 14 - Recent Earthquake Trends*). This uptick in seismicity is considered to be due to fracking activities, and specifically occurs as a result of waste water from the hydraulic fracturing process being injected into the earth (Meyer, 2016). Recent studies have moved towards being able to predict such induced seismicity by looking at uplift after injections, but more work needs to be done to confirm uplift as a reliable indicator of induced seismicity (Shirzaei et al., 2016). As of January 2018, Lebanon County had no active or abandoned wells (PA DEP, 2018), though there are two methane recovery wells proposed, but not yet constructed. It is important to note that seismicity can occur even after wells become inactive and injections rates decline (Shirzaei et al., 2016).

Table 14 - Recent Earthquake Trends

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

4.3.2.5 Vulnerability Assessment

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

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

4.3.3. Extreme Temperatures

4.3.3.1 Location and Extent

Extreme temperatures can be devastating: extreme heat can cause sunburn, heat cramps, heat exhaustion, heat stroke, and dehydration while extreme cold can cause hypothermia and frostbite. Both can potentially cause long-lasting disabilities. *Figure 12 - Average Maximum Temperature* and *Figure 13 - Average Minimum Temperature* show annual mean maximum and minimum temperatures for Pennsylvania. July is typically the warmest month for Lebanon County, with normal temperatures ranging from mid-70s to low 80s. January or February is typically the coldest month for Lebanon, with normal temperatures ranging from teens to mid-30s. Temperatures can vary across Lebanon County due to elevation changes in topography.

Figure 12 - Average Maximum Temperature

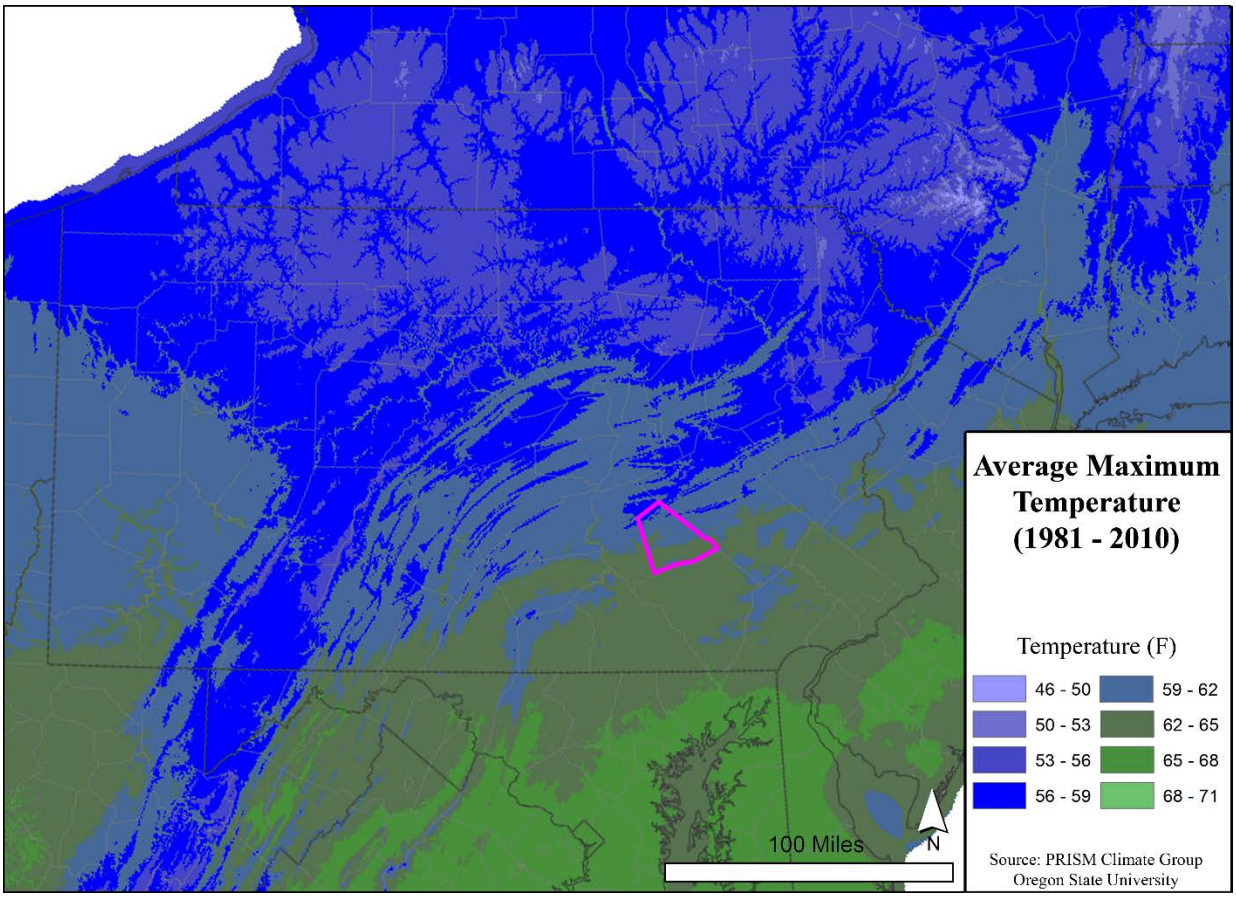
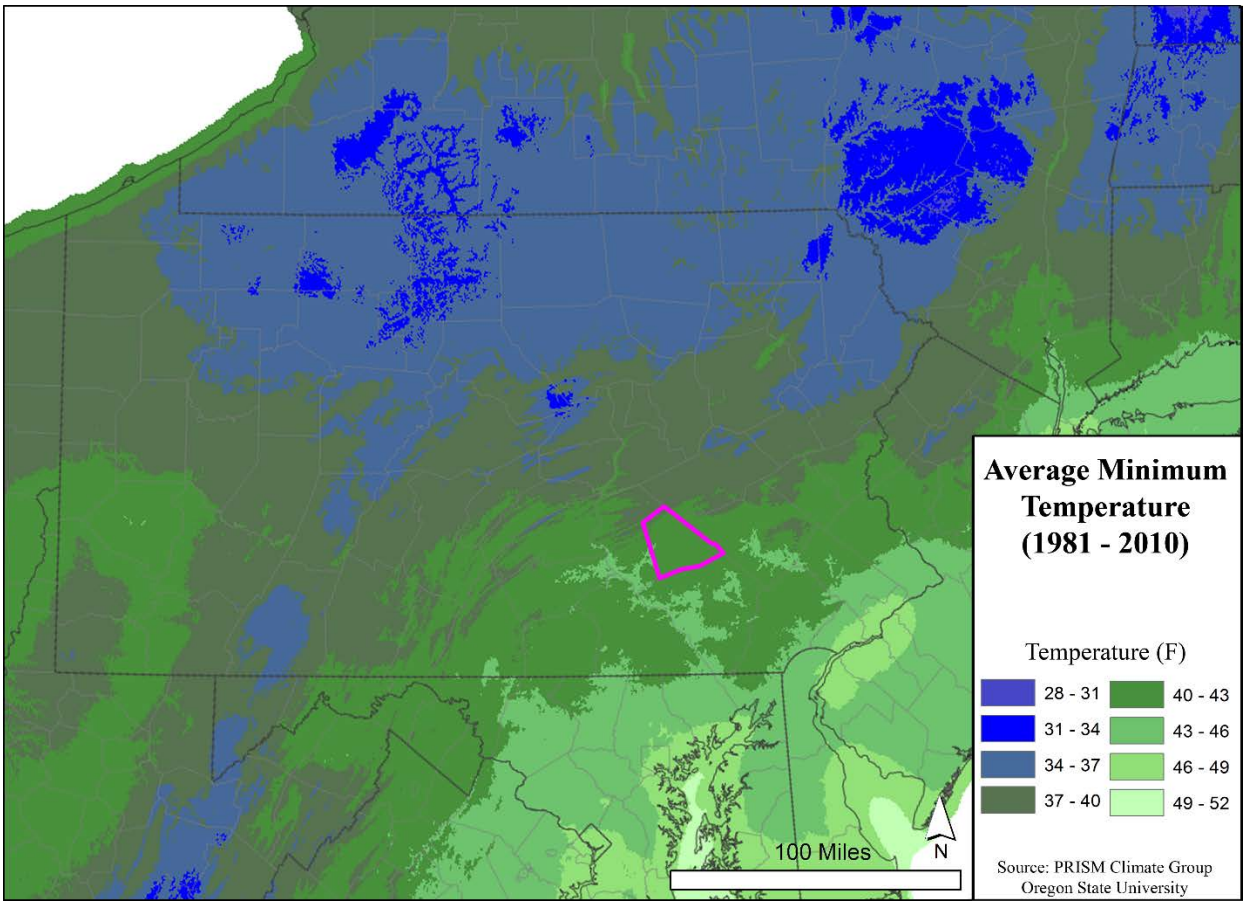


Figure 13 - Average Minimum Temperature



4.3.3.2 Range of Magnitude

When extreme temperature events occur, they typically impact the entirety of Lebanon County, including the surrounding region. Extreme heat is described as temperatures that hover at least 10ºF above the average high temperature for a region during the summer months. Extreme heat is responsible for more deaths in Pennsylvania than all other natural disasters combined. The apparent temperature of the air increases as relative humidity increases, and the National Weather Service created a Heat Index chart (*Figure 14 - National Weather Service Heat Index (NOAA, 2018)*) which shows the likelihood of heat disorders relative to the temperature and relative humidity. *Heat Advisories* are issued when the heat index will be equal to or greater than 100°F, but less than 105°F, *Excessive Heat Warning*s are issued when heat indices will attain or exceed 105°F, and *Excessive Heat Watches*, are issued when there is a possibility that excessive heat warning criteria may be experienced within twelve to forty-eight hours (NOAA NWS, 2010). A potential worst-case extreme temperature scenario would be if widespread areas of the Commonwealth experienced 90°F or higher temperatures for an extended

number of days. The heat could overwhelm the power grid and cause widespread black-outs, cutting off vital HVAC services for residents.

Extreme cold temperatures drop well below typical temperatures and are often associated with winter storm events. Wind can make the apparent temperature drop further, and exposure to such extreme cold temperatures can cause hypothermia, frost bite and death. The National Weather Service created a Wind Chill chart (*Figure 15 - National Weather Service Wind Chill (NOAA, 2018)*) which shows the time frostbite takes to set in depending on temperature and wind speed. Wind Chill Warnings are issued when wind chills drop to -25°F or lower. Wind Chill Advisories are issued in the southeast and western sections of Pennsylvania when wind chill values drop to -10°F to -24°F. South-central to northern sections of the Commonwealth when wind chills drop to -15°F to -24°F (NOAA NWS, 2010).

Figure 14 - National Weather Service Heat Index (NOAA, 2018)

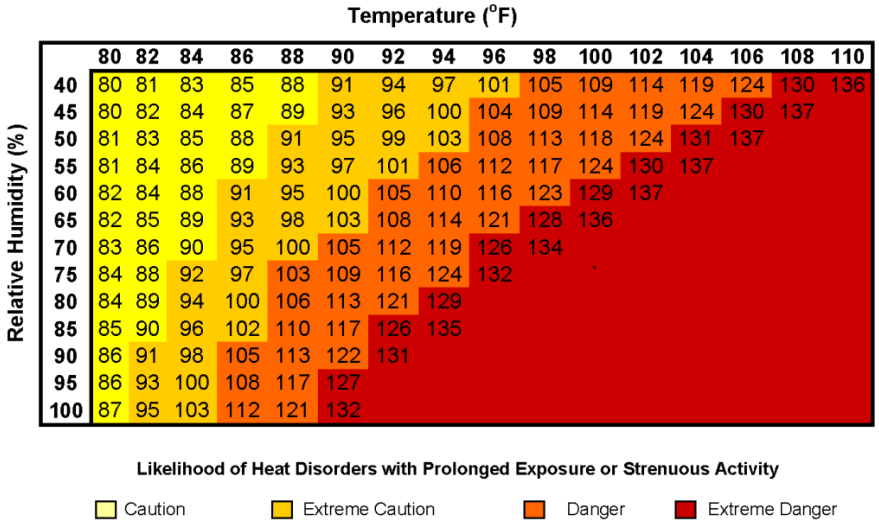
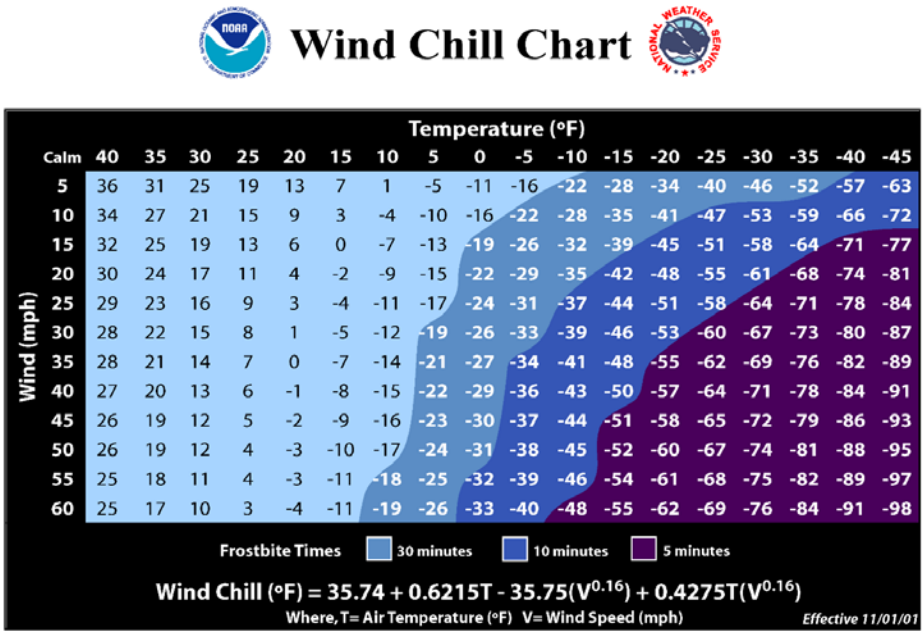


Figure 15 - National Weather Service Wind Chill (NOAA, 2018)



4.3.3.3 Past Occurrence

In the state of Pennsylvania, there have been 315 extreme temperature events between 1950 and 2013, resulting in 587 deaths and 530 injuries (NCDC, 2013). Of those events, 71 were extreme cold (27 deaths, 129 injuries), and 205 were extreme heat (560 deaths, 401 injuries) (NCDC, 2013). From 1994 to 1999 in Lebanon County, 108 people fell victim to excessive heat or cold conditions. Exact occurrence data for Lebanon County is somewhat limited below (*Table 15 - Extreme Temperature History*), it should be assumed that the county experienced the effects of extreme temperatures more than it has been documented – these instances serve as a sample of all events.

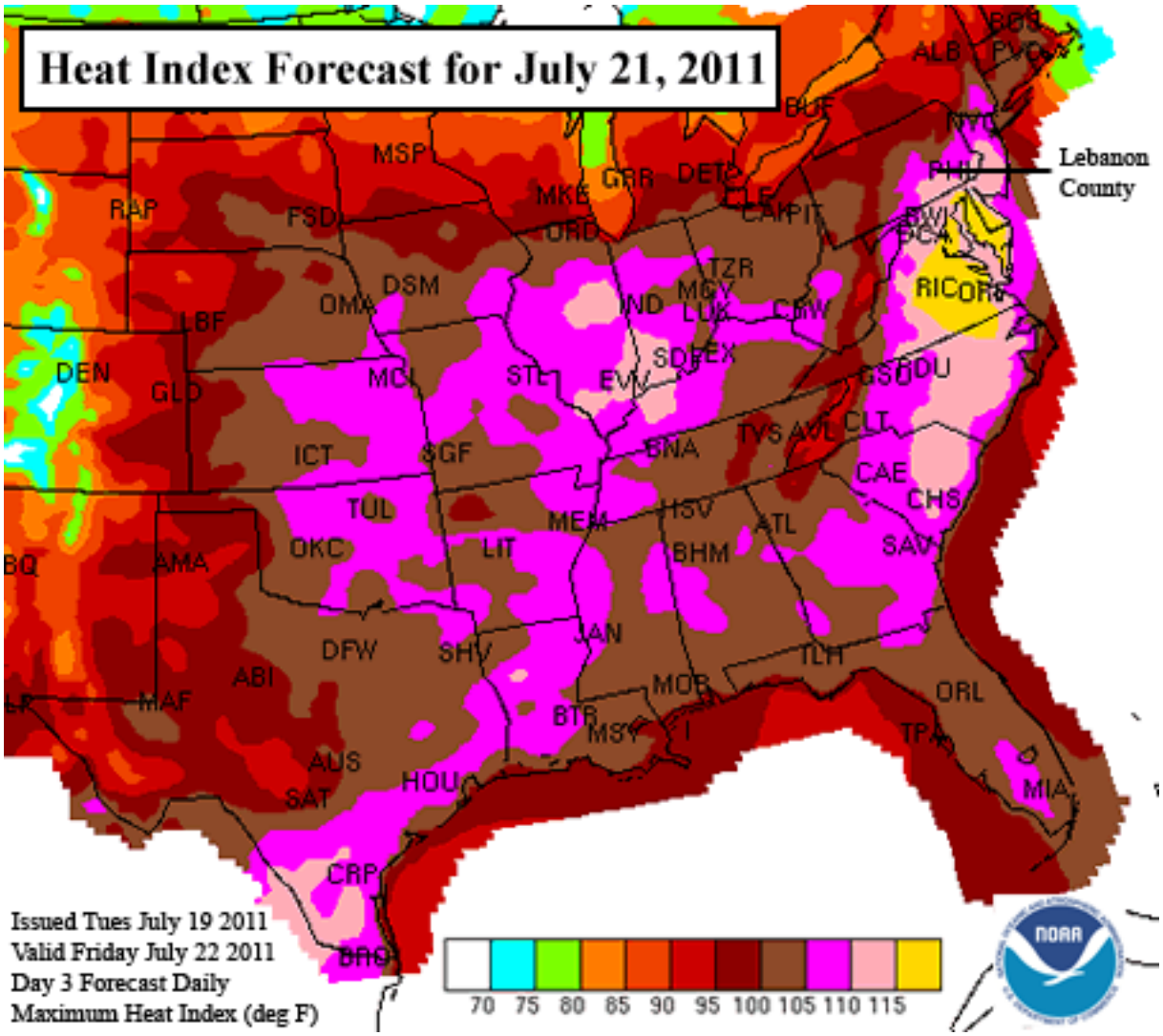
In 2011, Pennsylvania experienced record-breaking heat in 19 counties and a total of 45 broken heat records. *Figure 16 - Heat Index Forecast for July 22, 2011* shows the temperatures for July 21, 2011. Pennsylvania was again hit with record breaking temperatures on July 9, 2012 when daily record highs were broken in several cities in eastern Pennsylvania, including Harrisburg, Lancaster, and Chambersburg, which each reached 101 °F (38.3 °C).

Table 15 - Extreme Temperature History

Extreme Temperature History 1994-2018 *(NOAA NCEI, 2018; 2013 HMP)*				
Date	**Type**	**Deaths**	**Injuries**	**Description**
6/13/1994	Heat Waves	5	0	
7/6/1994	Heat Wave	0	0	
11/1/1994	Unseasonably Warm	0	0	
1/14/1995	Record Warmth	0	0	
2/6/1995	Extreme Cold	1	0	
7/1/1995	Excessive Heat	67	0	
7/13/1995	Heat Wave	4	0	
7/29/1995	Heat Wave	0	0	
8/1/1995	Unseasonably Warm	29	0	
8/12/1995	Heat Wave	0	0	
8/29/1995	Heat Wave	0	0	
7/5/1999	Heat	2	0	
7/17/2006	Heat	0	0	Unseasonably hot and humid weather settled over Pennsylvania during the middle of July. On July 18th, air temperatures reached the middle 90s and combined with dewpoints in the lower 70s, produced heat index values of 96 to 101. There were no reported injuries or deaths associated with the heat. The unseasonably hot and humid weather continued through the first week of August.
8/1/2006	Heat	0	0	Strong high pressure both at the surface and aloft allowed unseasonably hot and humid weather to develop over Pennsylvania during the end of July into the first week of August. Between August 1st and 3rd, air temperatures reached the middle 90s, combined with dewpoints in the middle 70s, and produced heat index values of 103 to 108. There were no reported injuries or deaths associated with the heat.
2/5/2007	Extreme Cold/Wind Chill	0	0	Temperatures in the single digits, combined with west winds of 10 to 20 mph, produced wind chills of 10 to 15 degrees below zero.

Extreme Temperature History 1994-2018 ***(NOAA NCEI, 2018; 2013 HMP)***				
Date	**Type**	**Deaths**	**Injuries**	**Description**
7/21/2011	Excessive Heat	0	0	A dangerous heat wave spread eastward from the Central U.S. and impacted much of the Mid-Atlantic and Northeast states from July 21-22. Very hot afternoon temperatures near and above record levels in the upper 90s and low 100s combined with dewpoints in the upper 60s to mid-70s to create heat index values between 105 and 115 degrees. Several record high minimum temperatures were also recorded with overnight readings around 80 degrees in some areas. The most intense heat and humidity were felt across the Middle and Lower Susquehanna Valley, where poor air quality further contributed to extremely oppressive conditions. The heat wave lasted several days but peaked on July 21-22. Numerous cooling and senior centers were opened to provide relief from the dangerous heat. The heat also put significant stress on power stations and HVAC systems with localized rolling blackouts and loss of AC reported in some locations. Heat index values exceeded 110 degrees in Lebanon County.
2/15/2015	Extreme Cold/Wind Chill	0	0	Extreme cold combined with gusty winds resulted in wind chill or apparent temperature values in the -25 degrees to -35 degrees range.
7/25/2016	Excessive Heat	0	0	A stretch of hot weather that began Friday, July 22 peaked on Monday, July 25, prompting Heat Advisories across much of central Pennsylvania and an Excessive Heat Warning across the Lower Susquehanna Valley. Heat index values reached between 105 and 110 degrees in Lebanon County.
8/13/2016	Excessive Heat	0	0	A prolonged heat wave impacted southeastern Pennsylvania from 10-16 August with afternoon temperatures in the low-mid 90s and overnight lows in the mid to upper 70s. When factoring in oppressive humidity with dewpoints in the upper 70s, maximum heat indices exceeded 100 degrees most afternoons. The peak of the high heat/humidity occurred on 14 August with maximum heat index values ranging from 105 to 110 degrees in Lebanon County

Figure 16 - Heat Index Forecast for July 22, 2011



4.3.3.4 Future Occurrence

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

4.3.3.5 Vulnerability Assessment

Extreme temperatures are usually a regional hazard when they occur. The elderly (18% of the County's population as of 2010) and young people (24.5% as of 2010) are most vulnerable to extreme temperatures due to mobility challenges and disabilities. Extreme

temperatures can increase the demand for utility services, often resulting in an increased cost to consumers. The increased expense can make it difficult for the consumer to afford the service. The increased demand for services may cause a decrease in availability of these services or failure of the system. A decrease or failure of the utility system during extreme temperature events puts a large population at great risk. Extreme temperature events can also drastically increase the volume of emergency calls, potentially overwhelming the Public Safety Answering Point. Extreme heat events may also contribute to drought conditions, which in turn increases the risk of wildfires.

4.3.4. Flood, Flash Flood and Ice Jams

4.3.4.1 Location and Extent

Flooding is the temporary condition of partial or complete inundation on normally dry land and it is the most frequent and costly of all hazards in Pennsylvania. Flooding events are generally the result of excessive precipitation. General flooding is typically experienced when precipitation occurs over a given river basin for an extended period of time. Flash flooding is usually a result of heavy localized precipitation falling in a short time period over a given location, often along mountain streams and in urban areas where much of the ground is covered by impervious surfaces. Flash floods are the most common type of flooding in Lebanon County. The severity of a flood event is dependent upon a combination of stream and river basin topography and physiography, hydrology, precipitation and weather patterns, present soil moisture conditions, the degree of vegetative clearing as well as the presence of impervious surfaces in and around flood-prone areas.

Winter flooding can include ice jams which occur when warm temperatures and heavy rain cause snow to melt rapidly. Snow melt combined with heavy rains can cause frozen rivers to swell, which breaks the ice layer on top of a river. The ice layer often then breaks into large chunks, which float downstream, piling up in narrow passages and near other obstructions such as bridges and dams. All forms of flooding can damage infrastructure.

Floodplains are lowlands adjacent to rivers, streams and creeks that are subject to recurring floods. The size of the floodplain is described by the recurrence interval of a given flood. Flood recurrence intervals are explained in more detail in Section 4.3.4.4. However, in assessing the potential spatial extent of flooding, it is important to know that a floodplain associated with a flood that has a 10% chance of occurring in a given year is smaller than the floodplain associated with a flood that has a 0.2% annual chance of occurring. The National Flood Insurance Program (NFIP) publishes digital flood insurance rate maps (DFIRMs). These maps identify the 1% annual chance of flood area. Special flood hazard area (SFHA) and base flood elevations (BFE) are developed from the 1% annual chance flood event, as seen in *Figure 17 - Flooding and Floodplain Diagram*. Structures located in the SFHA have a 26% chance of flooding in a thirty-year

period. The SFHA serves as the primary regulatory boundary used by FEMA, the Commonwealth of Pennsylvania and Lebanon County local governments. Federal floodplain management regulations and mandatory flood insurance purchase requirements apply to the following high-risk special flood hazard areas in *Table 16 - Flood Hazard High Risk Zones*. Appendix D of this hazard mitigation plan includes a flooding vulnerability map for each municipality in Lebanon County with vulnerable structures and critical facilities identified using the most current DFIRM data for Lebanon County dated 2016.

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

Figure 17 - Flooding and Floodplain Diagram

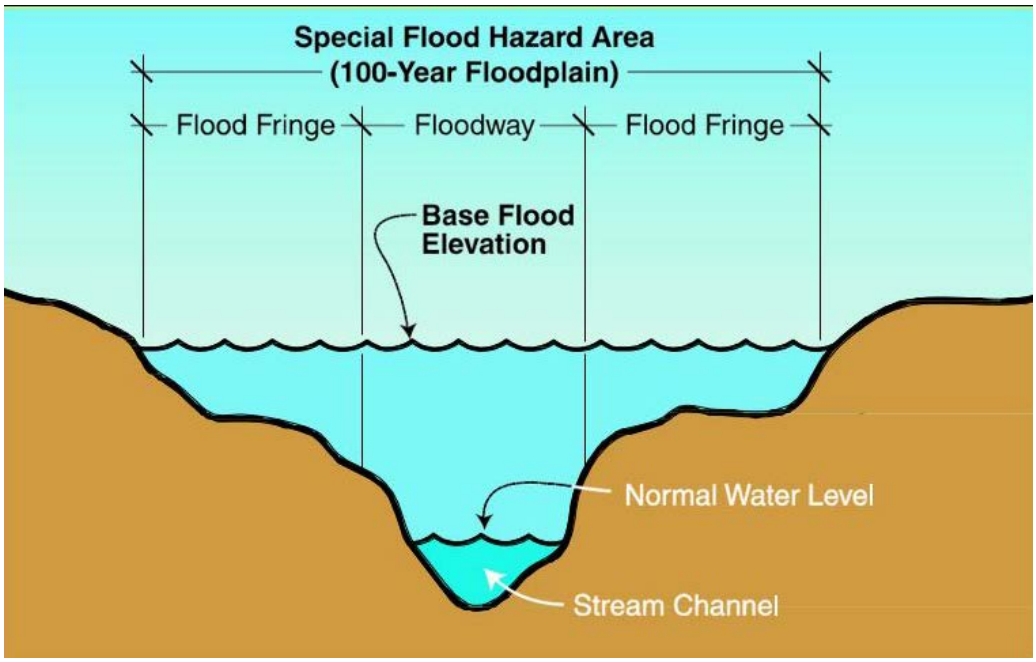


Table 16 - Flood Hazard High Risk Zones

Flood Hazard High Risk Zones *(FEMA, 2017)*	
Zone	**Description**
A	Areas subject to inundation by the 1% annual chance flood event. Because detailed hydraulic analysis have not been performed, no base flood elevations or flood depths are shown
AE	Areas subject to inundation by the 1% annual chance flood event determined by detailed methods. BFEs are shown within these zones.
AH	Areas subject to inundation by the 1% annual chance shallow flooding (usually areas of ponding) where average depths are 1-3 feet. BFEs derived from detailed hydraulic analysis are shown in this zone.
AO	Areas subject to inundation by the 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are 1-3 feet. Average flood depths derived from detailed hydraulic analysis are shown within this zone.
AR	Areas that result from the decertification of a previously accredited flood protection system that is determined to be in the process of being restored to provide base flood protection.

4.3.4.2 Range of Magnitude

The Swatara Creek is a major waterway that passes through Lebanon County – it is a tributary to the Susquehanna River, which connects at Middletown PA. The Swatara Creek stretches 71 miles over 570 square miles of south-central PA, including portions of Schuylkill, Berks, Lebanon, and Dauphin Counties, including 46 municipalities. At its headwaters, the Swatara Creek's elevation is approximately 1,510 feet, and drops to 279 feet above sea level at the connecting point with the Susquehanna River.

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

In winter months, local flooding could be exacerbated by ice jams in rivers. Ice jam floods occur on rivers that are totally or partially frozen. A rise in stream level will break up a totally frozen river and create ice flows that can pile up on channel obstructions such as shallow riffles, log jams, or bridge piers. The jammed ice creates a dam across the channel over which the water and ice mixture continues to flow, allowing for more jamming to occur.

Severe flooding can cause injuries and deaths and can have long-term impacts on the health and safety of the citizens. Severe flooding can also result in significant property damage, potentially disrupting the regular function of critical facilities and have long-term negative impacts on local economies. Industrial, commercial and public infrastructure facilities can become inundated with flood waters, threatening the continuity of government and business. The special needs population must be identified and located in flooding situations, as they are often home-bound. Mobile homes are especially vulnerable to high water levels. Flooding can have significant environmental impacts when flood waters release and/or transport hazardous materials and can also result in spreading diseases.

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

Severe flooding also comes with many secondary effects that could have long lasting impacts on the population, economy and infrastructure of Lebanon County. Power failures are the most common secondary effect associated with flooding. Coupled with a shortage of critical services and supplies, power failures could cause a public health emergency. Critical infrastructure, such as sewage and water treatment facilities, can be severely damaged, having a significant effect on public health. High flood waters can cause sewage systems to fail and overflow, contaminating groundwater and drinking water. Flooding also has the potential to trigger other hazards, such as landslides, hazardous material spills and dam failures.

The maximum threat of flooding in Lebanon County is estimated by looking at potential loss data and repetitive loss data, both analyzed in the risk assessment portion of the hazard mitigation plan. In these cases, the severity and frequency of damage can result in permanent population displacement, and businesses may close if they are unable to recover from the disaster.

Although floods can cause deaths, injuries and damage to property, they are naturally occurring events that benefit riparian systems which have not been disrupted by human actions. Such benefits include groundwater recharge and the introduction of nutrient rich sediment which improves soil fertility. However, human development often disrupts natural riparian buffers by changing land use and land cover, and the introduction of chemical or biological contaminants that often accompany human presence can contaminate habitats after flood events.

4.3.4.3 Past Occurrence

Lebanon County has experienced numerous flooding, flash flooding and ice jam flooding events in the past. The flooding and flash flooding was caused by a variety of heavy storms, tropical storms and other issues. A summary of flood event history for Lebanon

County is found in *Table 18 - Flood Event History* – property damage that appears as "-" was not reported. Details of each event can be found in NOAA's NCEI Storm Events Database (www.ncdc.noaa.gov/stormevents).

A significant flooding event occurred when Lebanon County was hit by the remnants of Tropical Storm Lee in September of 2011. Major flooding was reported county-wide, and the Swatara Creek river gauge at Harper Tavern crested at 24.6 feet (flood stage is 9 feet), the second highest gauge recorded there (more can be seen in *Table 17 - Swatara Creek Historical Flood Crests at Harper Tavern*.) A 55-year old man was swept away in floodwaters from Route 72 just north of Frog Hollow Drive in Swatara Township and died trapped in rising waters on Swatara Creek. The Lebanon County Emergency Management Agency fielded 4,500 calls. A man attempting to warn motorists of the high water was struck and killed by a vehicle on West Cumberland Street in North Lebanon Township. The Quittapahilla Creek was out of its banks and flooding roadways around Annville and Cleona Borough, submerging all bridges over the creek. Lebanon City and Myerstown had many flooded roads with stranded cars, all major routes in and out of Jonestown were closed, and Interstate 81 was closed near Swatara Creek. Across Lebanon County, 148 structures were destroyed, 1,601 suffered major damage, and 701 had minor damage, with a total of 3,398 structures impacted. Damage was estimated at approximately $2 million for public facilities.

Pennsylvania Governor Corbett requested a presidential declaration from President Obama on September 12, 2011, and a presidential declaration was received for individual assistance and public assistance on September 13, 2011. Eventually, 43 homes in Annville Township, Swatara Township, South Lebanon Township, East Hannover Township and Jonestown Borough would enter the federal buyout program. Five million dollars was allocated for the buyout of these homes.

Another major flood event occurred on June 30, 2006. A presidential declaration of a major disaster within the Commonwealth was issued on June 30, 2006. Lebanon County was added to the list of affected counties by amendment on July 7, 2006. Heavy rains which began on June 23rd caused flash flooding throughout central Pennsylvania. The Damage in Lebanon County included 10 destroyed homes, 19 homes with major damage, 65 homes with minor damage, 92 homes minimally impacted, and 2 homes that were inaccessible due to flood waters. Parks, roads, sewer treatment facilities, bridges and culverts were also damaged. The damage covered a broad portion of Lebanon County, affecting 16 of the 26 municipalities. On July 6, 2006, Governor Edward Rendell assigned Lebanon County a federal disaster designation for the Individual Assistance Program. According to a FEMA press release dated July 20, 2006, 154 individuals in Lebanon County registered for assistance. The Individual and Households program total expenditure within the county was $274,159.

Lebanon County experienced flooding due to Hurricane Agnes on June 23, 1972, with the Swatara Creek reaching its third highest crest at 23.72 feet.

Table 17 - Swatara Creek Historical Flood Crests at Harper Tavern

Swatara Creek Historical Flood Crests at Harper Tavern	
Date	**Stage Height (feet)**
6/1/1889	25.60
8/24/1933	17.53
6/23/1972	23.72
6/26/2006	18.28
9/8/2011	24.60

Table 18 - Flood Event History

Flood Event History Lebanon County *(NOAA NCEI, 2018; 2013 HMP)*					
Location	**Date**	**Type**	**Deaths**	**Injuries**	**Property Damage**
Eastern PA	11/28/1993	Flood	0	-	-
Eastern PA	6/6/1994	Flood	0	-	-
Lebanon County	7/6/1995	Flood	0	-	-
Lebanon County	10/21/1995	Flood	0	-	-
Lebanon (Zone)	1/19/1996	Flood	0	0	0
Countywide	1/19/1996	Flash Flood	0	0	0
Lickdale	6/17/1996	Flash Flood	0	0	0
Fredericksburg	6/24/1996	Flash Flood	0	0	0
Cleona	11/8/1996	Flash Flood	0	0	0
Countywide	12/13/1996	Flash Flood	0	0	0
Countywide	1/8/1998	Flash Flood	0	0	0
Lebanon	6/23/1998	Flash Flood	0	0	0
Countywide	1/18/1999	Flash Flood	0	0	0
Countywide	9/16/1999	Flash Flood	0	0	$20,000
Countywide	6/25/2000	Flash Flood	0	0	$250,000
Countywide	12/17/2000	Flash Flood	0	0	0
Lebanon	8/10/2001	Flash Flood	0	0	0
Countywide	9/24/2001	Flash Flood	0	0	0
Lebanon (Zone)	3/21/2003	Flood	0	0	0
Lebanon (Zone)	6/21/2003	Flood	0	0	0
Lickdale	8/11/2003	Flash Flood	0	0	0
Lebanon (Zone)	8/11/2003	Flood	0	0	0
Lebanon (Zone)	12/11/2003	Flood	0	0	0
Lebanon (Zone)	12/11/2003	Flood	0	0	0
Richland	8/12/2004	Flash Flood	0	0	0
Lebanon (Zone)	8/12/2004	Flood	0	0	0
Lebanon (Zone)	9/17/2004	Flood	2	0	0
Lebanon (Zone)	9/18/2004	Flood	0	0	0
Lebanon (Zone)	9/28/2004	Flood	0	0	0
Lebanon (Zone)	9/28/2004	Flood	0	0	0
Lebanon (Zone)	11/28/2004	Flood	0	0	0
Lebanon (Zone)	1/14/2005	Flood	0	0	0
Lebanon (Zone)	1/14/2005	Flood	0	0	0
Lebanon (Zone)	1/15/2005	Flood	0	0	0
Lebanon (Zone)	3/28/2005	Flood	0	0	0
Lebanon (Zone)	3/28/2005	Flood	0	0	0

Flood Event History Lebanon County *(NOAA NCEI, 2018; 2013 HMP)*					
Location	**Date**	**Type**	**Deaths**	**Injuries**	**Property Damage**
Lebanon (Zone)	4/2/2005	Flood	0	0	0
Lebanon (Zone)	4/2/2005	Flood	0	0	0
Lebanon	7/7/2005	Flash Flood	0	0	0
Lebanon	6/25/2006	Flash Flood	0	0	0
Lebanon	6/25/2006	Flood	0	0	0
Newmanstown	6/26/2006	Flash Flood	0	0	0
Countywide	6/27/2006	Flash Flood	0	0	0
Countywide	6/28/2006	Flood	0	0	0
Lebanon	11/16/2006	Flash Flood	0	0	0
Lebanon	3/3/2007	Flood	0	0	0
Richland	3/5/2008	Flood	0	0	0
Cornwall	8/2/2009	Flash Flood	0	0	0
Lawn, Kleinfeltersville	3/10/2011	Flood	0	0	0
Annville Millard Arp, Annville	4/16/2011	Flash Flood	0	0	0
Jonestown, Bunker Hill	6/11/2011	Flash Flood	0	0	0
Mt Pleasant	6/11/2011	Flash Flood	0	0	0
West Lebanon	6/11/2011	Flash Flood	0	0	0
Weavertown	6/11/2011	Flash Flood	0	0	0
Lebanon	6/11/2011	Flash Flood	0	0	0
Avon	6/11/2011	Flash Flood	0	0	0
West Jonestown	6/11/2011	Flash Flood	0	0	0
East Hanover, Lawn	8/7/2011	Flash Flood	0	0	0
East Hanover, Bordnersville	9/7/2011	Flash Flood	0	0	0
Lawn, Newmanstown	9/7/2011	Flood	1	0	$2,000,000
Newmanstown, Greble	7/22/2013	Flash Flood	0	0	0
Newmanstown, Greble	7/22/2013	Flood	0	0	0
Indiantown Gap, Newmanstown	10/10/2013	Flood	0	0	0
East Hanover, Syner	5/1/2014	Flood	0	0	0
Annville Millard Arp, Cleona	5/18/2015	Flash Flood	0	0	0
		Total	**3**	**0**	**$2,270,000**

The National Flood Insurance Program identifies properties that frequently experience flooding. *Repetitive loss properties* are structures insured under the NFIP which have had at least two paid flood losses of more than $1,000 over any ten-year period since 1978. The hazard mitigation assistance (HMA) definition of a repetitive loss property is a structure covered by a contract for flood insurance made available under the NFIP that has incurred flood-related damage on two occasions, in which the cost of the repair, on the average, equaled or exceeded twenty five percent of the market value of the structure at the time of each such flood event; and at the time of the second incidence of flood-related damage, the contract for flood insurance contains in-creased cost of compliance coverage.

A property is considered a *severe repetitive loss property* either when there are at least four losses each exceeding $5,000 or when there are two or more losses where the building payments exceed the property value. As of December 31, 2017, there are eighty

repetitive loss properties and two severe repetitive loss properties in Lebanon County. This is a slight increase from 2013 when there was seventy-six repetitive loss property, but still two severe repetitive loss properties.

Most municipalities in Lebanon County participate in the NFIP except for Cold Spring Township. Information on each participating municipality is in *Table 21 - Municipal NFIP Policies & Vulnerability*, where NFIP data for Cold Spring Township appears as "-".

Table 19 - Repetitive Loss Properties

Repetitive Loss Properties ***(PEMA, 2018)***						
Comm. Name	**Comm. Nbr**	**Total Building Payment**	**Total Contents Payment**	**Losses**	**Total Paid**	**Properties**
Annville Township	420570	$68,936	$316,105	6	$385,042	2 Residential 1 Non-Res
Cleona Borough	420571	$4,484	$ -	2	$4,484	1 Residential
Cornwall Borough	420968	$156,738	$29,955	2	$186,693	1 Residential
East Hanover Township	421012	$491,912	$34,259	21	$626,171	7 Residential
Jackson Township	421805	$15,447	$10,783	6	$26,230	3 Residential
Jonestown Borough	420572	$253,819	$ -	2	$253,819	1 Non-Res
Lebanon City	420573	$896,705	$173,642	72	$1,070,347	26 Residential 1 Non-Res
Myerstown Borough	420575	$11,648	$3,420	3	$15,068	1 Residential
North Annville Township	420970	$1,465,284	$152,199	37	$1,617,483	13 Residential
North Cornwall Township	420576	$247,833	$16,816	7	$264,649	2 Residential
North London-derry Township	420577	$190,617	$22,599	5	$213,216	2 Residential
South Lebanon Township	420581	$16,504	$8,626	2	$25,130	1 Residential
South London-derry Township	421043	$42,636	$ -	3	$42,636	1 Non-Res
Swatara Township	420582	$381,768	$108,392	13	$490,160	6 Residential
Union Township	421806	$748,535	$122,403	36	$870,938	9 Residential 2 Non-Res
Totals	**-**	**$4,992,866**	**$1,099,200**	**217**	**$6,092,065**	**74 Residential 6 Non-Res**

Table 20 - Severe Repetitive Loss Properties

Severe Repetitive Loss Properties *(PEMA, 2018)*						
Comm. Name	**Comm. Nbr.**	**Building Payments**	**Contents Payments**	**Total Payments**	**Losses**	**Property Type**
City of Lebanon	420573	$49,247	$11,397	$60,644	8	1 Residential
Union Township	421806	$40,730	$9,827	$50,557	4	1 Residential
Totals	**-**	**$89,977**	**$21,224**	**$ 111,201**	**12**	**2 Residential**

Table 21 - Municipal NFIP Policies & Vulnerability

Municipal NFIP Policies & Vulnerability *(PEMA, 2018; Lebanon Co. GIS, 2018)*			
Municipality	**Losses**	**Active Contracts**	**Buildings in SFHA**
Annville Township	68	44	117
Bethel Township	13	11	68
Cleona Borough	10	5	1
Cold Spring Township	-	-	0
Cornwall Borough	11	5	20
East Hanover Township	36	10	69
Heidelberg Township	1	7	99
Jackson Township	19	15	116
Jonestown Borough	13	11	12
Lebanon City	435	101	245
Millcreek Township	11	4	72
Mount Gretna Borough	0	1	0
Myerstown Borough	37	22	60
North Annville Township	92	8	85
North Cornwall Township	40	56	83
North Lebanon Township	5	31	27
North Londonderry Township	10	10	2
Palmyra Borough	8	3	0
Richland Borough	0	0	0
South Annville Township	12	10	42
South Lebanon Township	37	36	103
South Londonderry Township	16	28	118
Swatara Township	39	9	63
Union Township	54	19	62
West Cornwall Township	1	0	6

Municipal NFIP Policies & Vulnerability *(PEMA, 2018; Lebanon Co. GIS, 2018)*			
Municipality	**Losses**	**Active Contracts**	**Buildings in SFHA**
West Lebanon Township	3	2	0
Total	**971**	**448**	**1470**

4.3.4.4 Future Occurrence

Table 22 - Flood Probability Summary (FEMA)

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

Flooding is a frequent problem throughout Pennsylvania. Lebanon County will certainly be impacted by flooding events in the future – Lebanon County experiences some degree of flooding annually. The threat of flooding is compounded in the late winter and early spring months, as melting snow can overflow streams, creeks and tributaries, increasing the amount of groundwater, clogging stormwater culverts and bridge openings. The NFIP recognizes the 1%-annual-chance flood, also known as the base flood or one-hundred-year flood, as the standard for identifying properties subject to federal flood insurance purchase requirements. A 1%-annual-chance flood is a flood which has a 1% chance of occurring over a given year or is likely once every one hundred years. The digital flood insurance rate maps (DFIRMs) are used to identify areas subject to the 1% annual-chance flooding. A property's vulnerability to a flood is dependent upon its location in the floodplain. Properties along the banks of a waterway are the most vulnerable. The property within the floodplain is broken into sections depending on its distance from the waterway. The ten-year flood zone is the area that has a ten percent chance of being flooded every year. However, this label does not mean that this area can-not flood more than once every ten years. It just designates the probability of a flood of this magnitude every year. Further away from this area is the fifty-year flood-plain. This area includes all of the ten-year floodplain plus additional property. The probability of a flood of this magnitude occurring during a one-year period is two percent. A summary of flood probability is shown in *Table 22 - Flood Probability Summary (FEMA)*.

4.3.4.5 Vulnerability Assessment

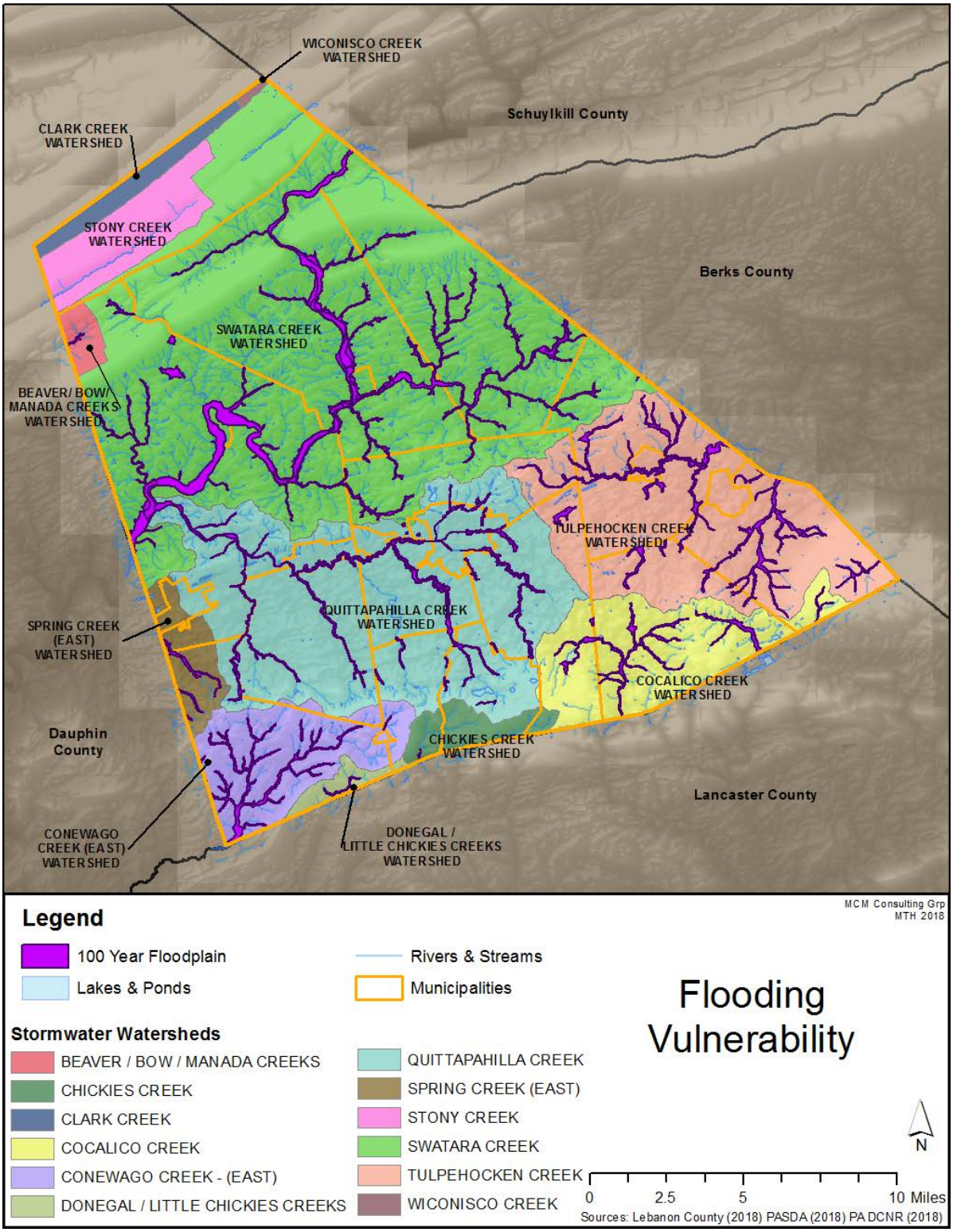
Lebanon County is vulnerable to flooding events. Flooding puts the entire population at some level of risk, whether through the flooding of homes, businesses, places of employment, or the road, sewer and water infrastructure. *Table 21 - Municipal NFIP Policies & Vulnerability* identifies how many structures located in the special flood hazard area by municipality using county GIS data. It's important to note that the building dataset used

for this analysis is a dataset of digitized building footprints, so it includes non-addressable structures such as barns, garages, and other out-buildings. Critical facilities are facilities that if damaged would present an immediate threat to life, public health and safety. Appendix D of this hazard mitigation plan includes a flooding vulnerability map for each municipality in Lebanon County with vulnerable structures and critical facilities identified. There are nine critical facilities that are located within the special flood hazard area (see *Table 23 - Critical Facilities Vulnerable to Flooding*)

Table 23 - Critical Facilities Vulnerable to Flooding

Critical Facilities Vulnerable to Flooding ***(Lebanon Co. GIS, 2018)***			
Type	**Name**	**Municipality**	**Address**
Health / Medical Facility	Rothermel Caplan Transitional Care Unit	City Of Lebanon	300 Willow St, Lebanon, PA 17046
Health / Medical Facility	The Gardens at Campbelltown (formally Twin Oaks)	South Londonderry Township	2880 Horseshoe Pike, Campbelltown, PA 17010
Government / Military Facility	Campbelltown Post Office	South Londonderry Township	20 Palmyra Rd, Campbelltown, PA 17010
Water Supply and Treatment	Northern Lebanon County Authority	Union Township	400 Jonestown Rd, Jonestown, PA 17038
Water Supply and Treatment	Millcreek-Richland Authority Lift Station	Millcreek Township	Ns Richland Rd, Richland, PA 17073
SARA Tier II Facility	Borough of Myerstown Water Treatment Facility	Jackson Township	331 E Mill Ave, Myerstown, PA 17067
SARA Tier II Facility	Flintwood Metals, Inc.	City Of Lebanon	244 N Lincoln Ave, Lebanon, PA 17046
SARA Tier II Facility	L&I	Jackson Township	960 Tulpehocken Rd, Richland, PA 17087
SARA Tier II Facility	WellSpan Health	City Of Lebanon	30 N 4Th St, Lebanon, PA 17046

Figure 18 - Flooding Vulnerability



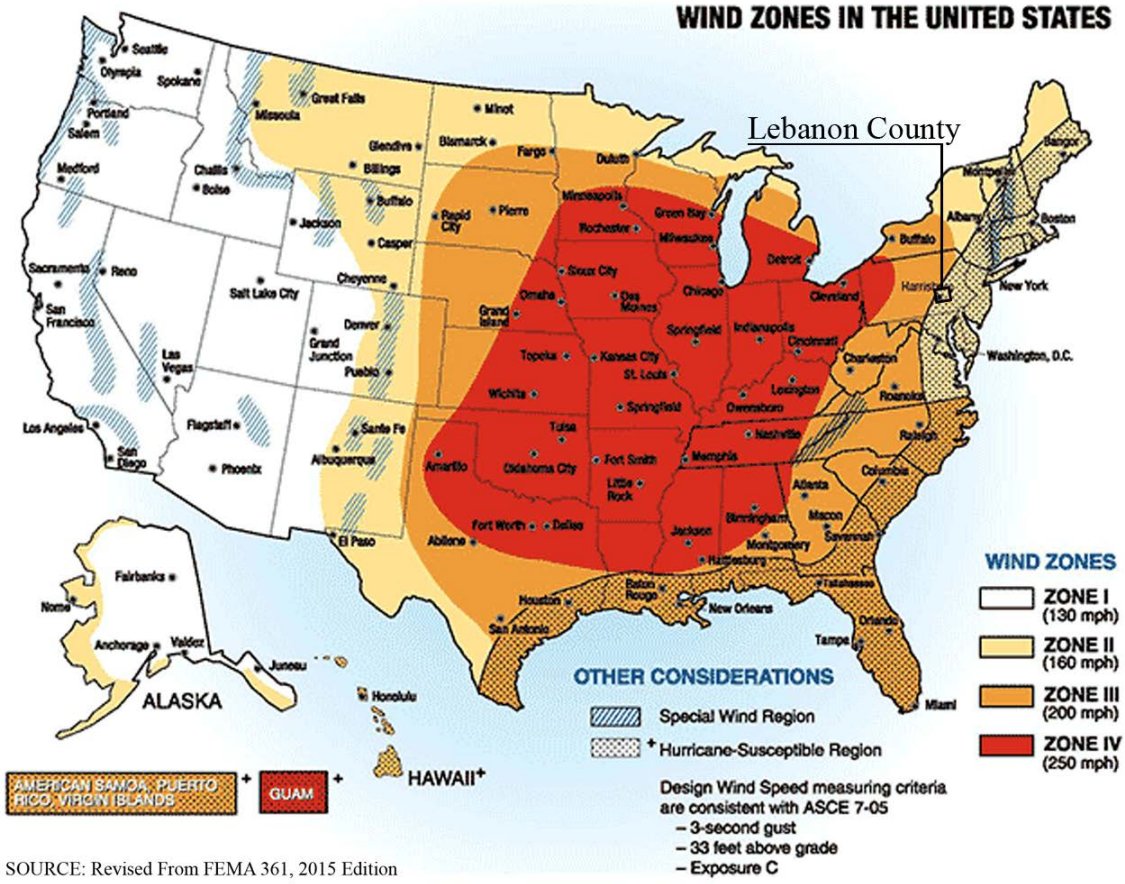
4.3.5. Hurricane, Tropical Storms, Nor'easter

4.3.5.1 Location and Extent

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

While Lebanon County is located over one hundred miles inland of the East Coast of the United States, tropical storms can track inland and cause heavy rainfall and strong winds. Lebanon County is in the East Coast region designated by FEMA as being Hurricane-Susceptible (see *Figure 19 - Wind Zones*). Lebanon County falls within the wind Zone II, which suggests that shelters and critical facilities should be able to withstand a 3-second gust of wind up to 160 miles per hour (*Figure 19 - Wind Zones*). All communities within Lebanon County are equally subject to the impacts of hurricanes and tropical storms that track near the county. Areas in Lebanon County which are subject to flooding, wind and winter storm damage are particularly vulnerable.

Figure 19 - Wind Zones



4.3.5.2 Range of Magnitude

The impact tropical storm or hurricane events have on an area is typically measured in terms of wind speed. Expected damage from hurricane force winds is measured using the Saffir-Simpson Scale (*Table 24 - Saffir-Simpson Scale*). The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential (characteristic of tropical storms and hurricanes, but not a threat to inland locations like Lebanon County). Categories 3, 4, and 5 are classified as "major" hurricanes. While major hurricanes comprise only twenty of all tropical cyclones making landfall, they account for over seventy percent of the damage

Table 24 - Saffir-Simpson Scale

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

in the United States. While hurricanes can cause high winds and associated impacts, it is also important to recognize the potential for flooding events during hurricanes, tropical storms and nor'easters; the risk assessment and associated impact for flooding events is included Section 4.3.4.5.

4.3.5.3 Past Occurrence

Table 25 - History of Coastal Storms Impacting Lebanon County lists all coastal storms that have impacted Lebanon County from 1970 to March 2018. Although impacts of tropical storms are commonly felt in the Commonwealth, it is rare that a hurricane would track through Lebanon County.

Hurricane Agnes was a severe coastal storm event in 1972 that impacted Lebanon County. After making first landfall as a hurricane near Panama City, Florida, Agnes weakened and exited back into the Atlantic off the North Carolina coast. The storm skirted along the coast and made a second landfall near New York City as a tropical storm and merged with an extra-tropical low-pressure system over northern Pennsylvania. This brought extremely heavy rains to Pennsylvania, with a concentration of rain in the Susquehanna River Basin. Pennsylvania incurred $2.1 billion in damages and 48 deaths statewide. Fire and flood destroyed 68,000 homes and 3,000 businesses and left 220,000 Pennsylvanians homeless. The event triggered a Presidential Disaster Declaration for the region.

In 2004 Tropical Storm Ivan caused extensive flooding as well, also resulting in a Presidential Disaster Declaration for regions in Pennsylvania. The Ivan event produced flooding somewhat less than 100-year event crests in some locations.

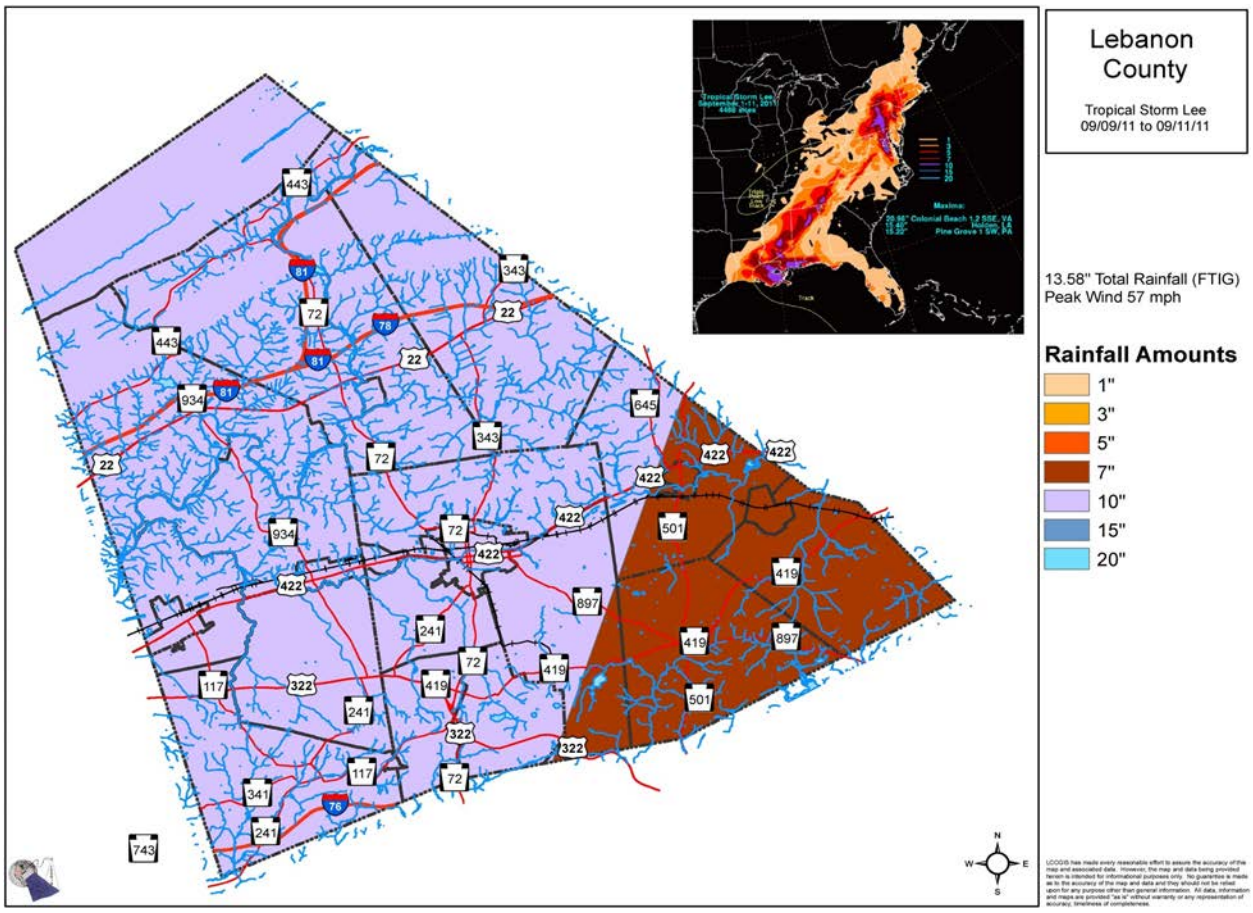
Tropical Storm Lee in September of 2011 was the most severe tropical storm to impact Lebanon County, causing significant flooding and damage throughout Lebanon County (see *Figure 20 - Tropical Storm Lee*). The Swatara Creek gauge at Harper Tavern crested at a record high of 24.6 feet, and 2,212 homes were damaged or destroyed in this flooding event. One death occurred when someone was swept away by flood waters along State Route 72. President Obama declared the event a disaster in Pennsylvania, opening federal funding for individual and public assistance. Forty-three homes in Annville Township, North Annville Township, Swatara Township, South Lebanon Township, East

Hannover Township and Jonestown Borough entered the federal buyout program. Five million dollars was allocated to the buyout of these homes.

Table 25 - History of Coastal Storms Impacting Lebanon County

History of Coastal Storms Impacting Lebanon County (NCEI, 2018)	
Year	**Name**
1972	Tropical Storm Agnes
1999	Hurricane Floyd
2003	Tropical Storm Henri
2003	Tropical Storm Isabel
2004	Tropical Depression Frances
2004	Tropical Depression Ivan
2005	Hurricane Katrina
2006	Tropical Depression Ernesto
2008	Hurricane Ike
2011	Hurricane Irene
2011	Tropical Storm Lee
2012	Hurricane Sandy
2017	Tropical Storm Cindy

Figure 20 - Tropical Storm Lee



4.3.5.4 Future Occurrence

Although hurricanes and tropical storms can cause flood events consistent with 100 and 500-year flood levels, the probability of occurrence of hurricanes and tropical storms is measured relative to wind speed. *Table 26 - Annual Probability of Wind Speeds (FEMA, 2000*) shows the annual probability of winds that reach the strength of tropical storms and hurricanes in Lebanon County and the surrounding areas based on a sample period of forty-six years. NOAA's Hurricane Research Division estimates that Lebanon County will experience impacts from a named tropical storm or hurricane up to once every five years, with a probability between 10% and 20% annually (*Figure 21 - Mean Occurrence of Named Storms)*. However according to FEMA, there is a high probability each year that Lebanon County will experience winds from coastal storms that could cause minimal to moderate damages (*Table 26 - Annual Probability of Wind Speeds (FEMA, 2000)*). The probability of winds exceeding 118 mph is less than .1% annually.

Figure 21 - Mean Occurrence of Named Storms

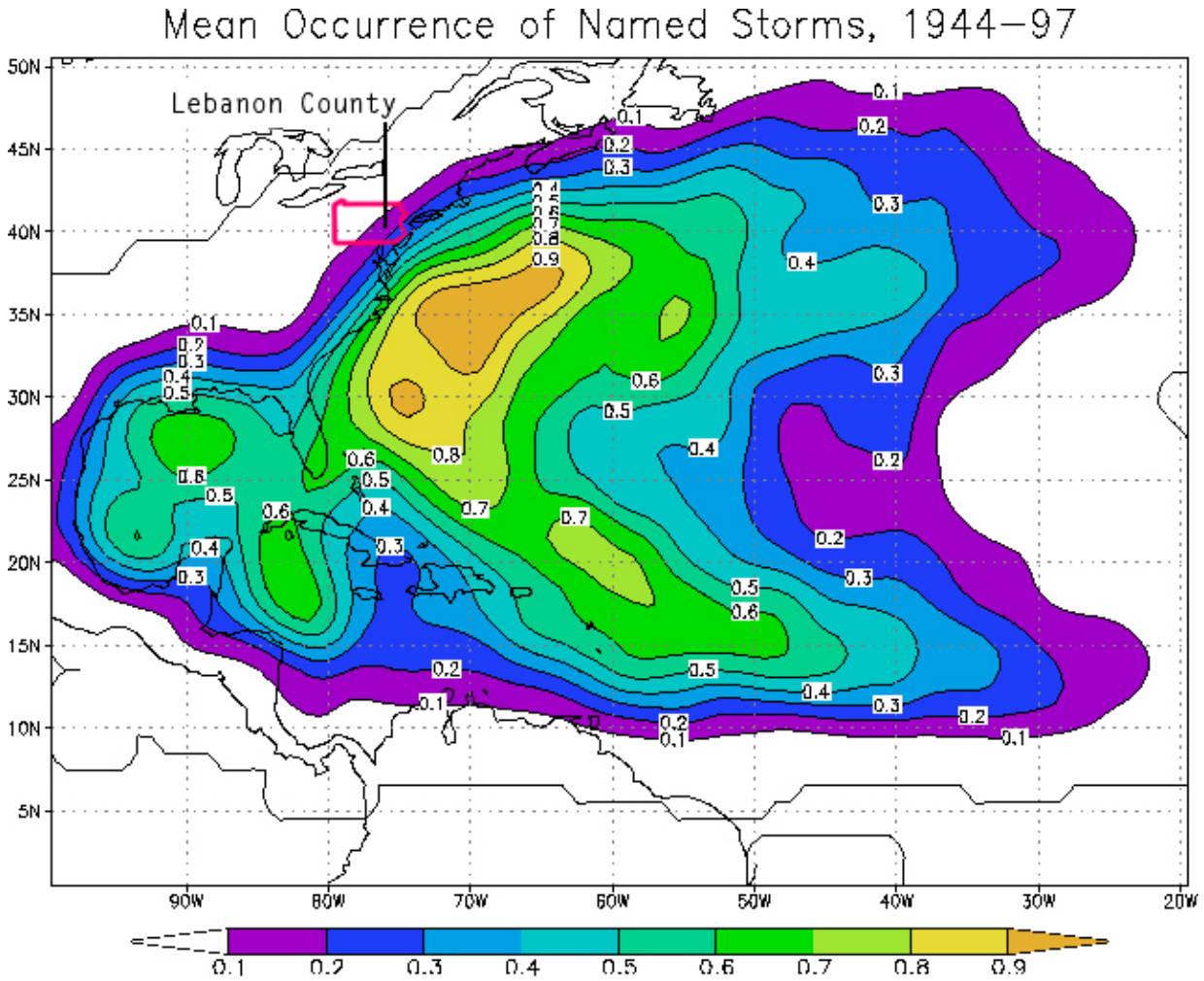


Table 26 - Annual Probability of Wind Speeds (FEMA, 2000)

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

Climate change is causing atmospheric temperatures to rise, which corresponds to a rise in ocean surface temperatures, resulting in warmer and moister conditions where tropical storms develop (Stott et al., 2010). Warmer oceans store more energy and are capable of fueling stronger storms and it is projected that Atlantic hurricanes will become more intense and produce more precipitation as ocean surface temperatures rise (Trenberth, 2010). There are expected to be more category 4 and 5 hurricanes in the Atlantic, and the hurricane season may be elongating. Lebanon County can be affected by Atlantic coastal storms, so the county should be prepared to deal with impacts of coastal storms more frequently in the future.

4.3.5.5 Vulnerability Assessment

Tropical storms tracking nearby Lebanon County can still cause high winds and heavy rains. A vulnerability assessment for hurricanes and tropical storms focuses on the impacts of flooding and severe wind. The assessment for flood-related vulnerability is addressed in Section 4.3.4.5 and discussion of wind related vulnerability is addressed in Section 4.3.10.5.

4.3.6. Landslides

4.3.4.1 Location and Extent

Landslides are described as downward and outward movement of slope-forming soil, rock and vegetation reactive to the force of gravity. Rockfalls, rockslides, rock topples, block glides, debris flows, mudflows and mudslides are all forms of landslides. Natural causes of landslides include heavy rain, rapid snow melt, erosion, earthquakes and changes in groundwater levels. Landslides occur most frequently in areas with moderate to steep slopes and high precipitation, and most often slope failures happen during or after periods of sustained above average precipitation or snowmelt events. Human activity can increase the likelihood of landslides by reducing vegetation cover, altering the natural slope gradient or increasing the soil water content. One location where this type of human activity is common are areas that were excavated along highways and other roadways.

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

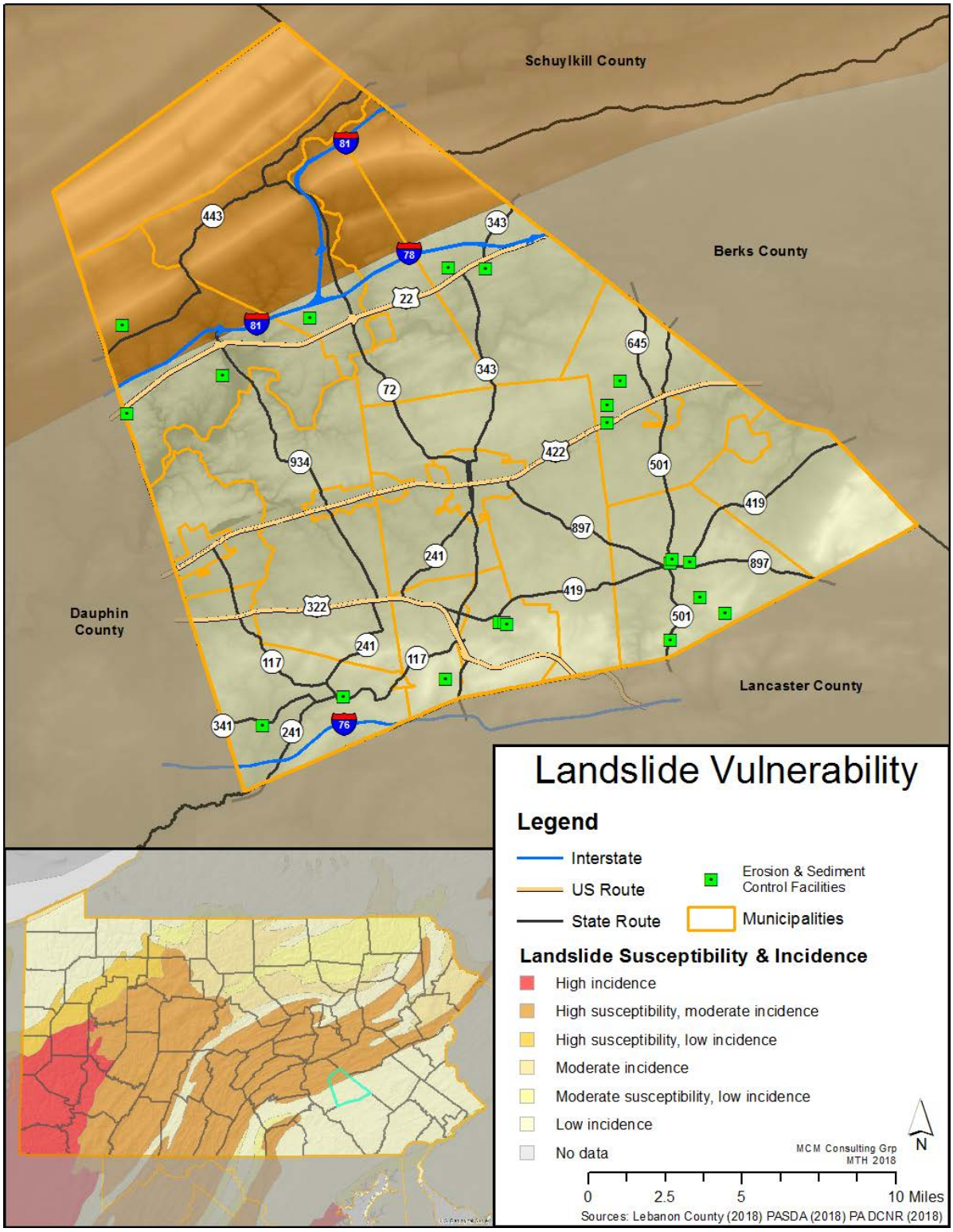
4.3.4.2 Range and Magnitude

Landslides can cause damage to utilities as well as transportation routes, resulting in road closure or travel delays. Fortunately, deaths and injuries due to landslides are rare in Pennsylvania and Lebanon County. Most reported deaths due to landslides have occurred when rockfalls or other slides along highways have involved vehicles. Storm-induced debris flows can also sometimes cause death and injury. As residential and

recreational development increases on and near steep mountain slopes, the hazard from these rapid events will also increase. Most Pennsylvania landslides are moderate to slow moving and damage property rather than people.

The Pennsylvania Department of Transportation and large municipalities incur substantial costs due to landslide damage and to extra construction costs for new roads in known landslide-prone areas. A 1991 estimate showed an average of ten million per year is spent on landslide repair contracts across the Commonwealth and a similar amount is spent on mitigation costs for grading projects. A number of highway sites in Pennsylvania need permanent repair at estimated costs of $300,000 to $2 million each (DCNR, 2010). The USGS identifies the southern two thirds of Lebanon County as falling into a low incidence zone for landslides, with the northern third of the County considered to be a high susceptibility and moderate incidence zone (see *Figure 22 - Landslide Susceptibility*). Areas that are susceptible to landslides are geologically prone to giving way after significant precipitation events

Figure 22 - Landslide Susceptibility



4.3.4.3 Past Occurrence

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

4.3.4.4 Future Occurrence

The majority of Lebanon County is not at high risk for landslides, however mismanaged development in steeply sloped areas would increase the frequency of occurrence of landslides. Road cuts are the most common development that puts an area at a heightened probability of a slide. The PA Department of Environmental Protection has an Erosion and Sediment (E&S) program that sets requirements for development projects of a certain scale that are intended to mitigate erosion, which are similar practices to prevent causing landslides.

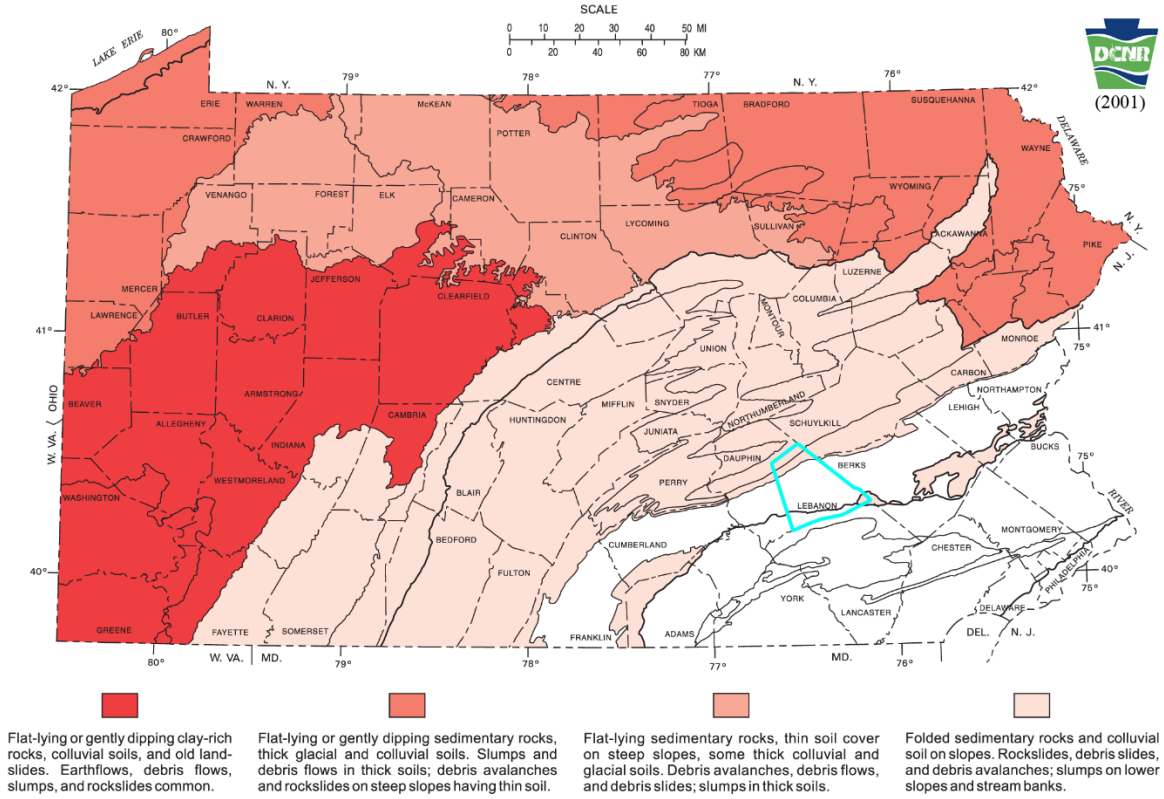
4.3.4.5 Vulnerability Assessment

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

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

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

Figure 23 - Landslide Rock Type (PA DCNR 2001)



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

4.3.7. Pandemic and Infectious Disease

4.3.7.1 Location and Extent

Pandemic & Epidemic

Pandemic is a widespread outbreak of infectious disease that impacts an extensive region, potentially spanning continents and having global impacts. An epidemic also refers to an outbreak of a rapidly spreading infectious disease but is more regional and less widespread than a pandemic. The spread of a disease depends on the mode of transmission of the disease, how contagious it is, and the amount of contact between infected and non-infected persons. In the event of a pandemic occurring in the eastern United States, the entirety of Lebanon County would likely be affected. Strains of influenza, or the flu have caused epidemics and pandemics, and they commonly attack the respiratory tract in humans. Influenza pandemic planning began in response to the H5N1 (avian) flu outbreak in Asia, Africa, Europe, the Pacific, and the Near East in the late

1990s and early 2000s. Avian flu did not reach pandemic proportions in the United States, but the county began planning for flu outbreaks. The PA Department of Health Influenza Pandemic Response Plan states that "an influenza pandemic is inevitable and will probably give little warning" (PA Department of Health, 2005). For this reason, influenza is a primary concern regarding pandemic and infectious disease in Lebanon County.

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

Infectious Disease

West Nile Virus has been detected in all sixty-seven counties in the Commonwealth at least once in the past ten years, making it a hazard to Lebanon County. The disease is commonly spread by ticks or insects such as the mosquito. West Nile causes headaches, high fever, neck stiffness, disorientation, tremors, convulsions, muscle weakness, paralysis, and death in its most serious form. Blacklegged ticks in Lebanon County can also spread Lyme disease, a bacterial disease with symptoms including fever, headaches and a characteristic skin rash (erythema migrans). Untreated, Lyme disease can spread to joints, the heart and the nervous system (CDC, 2016).

4.3.7.2 Range of Magnitude

Pandemic

Advancements in medical technologies have greatly reduced the number of deaths caused by influenza over time. In the early 1900s, flu pandemics could cause tens of millions of deaths, while the 2009 Swine Flu caused fewer than 20,000 deaths worldwide, and many people infected with Swine Flu in 2009 have recovered without needing medical treatment. However, the modern flu viruses are still quite dangerous. About seventy percent of those who were hospitalized with the 2009 H1N1 flu virus in the United States belonged to a high-risk group (CDC, 2009). High risk populations for influenza include children, the elderly, pregnant women, and patients with reduced immune system capability. Such high-risk populations are discussed in more detail in Section 4.3.7.5.

Infectious Disease

West Nile Virus originated in regions of East Africa around 1937 but spread globally. In 2012, West Nile Virus caused 286 deaths in the United States. Most West Nile infections

in humans are subclinical, causing no symptoms. Approximately twenty percent of infections cause symptoms and less than one percent of cases result in severe neurological disease or death. Symptoms typically appear between two and fifteen days after infection and there is currently no vaccine for West Nile Virus. Person to person transmission of West Nile is less prevalent than person to person transmission of influenza.

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

4.3.7.3 Past Occurrence

Pandemic & Epidemic

Table 27 - Past Influenza Outbreaks and Pandemics

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

Influenza outbreaks of Spanish Flu, Asian flu, Hong Kong Flu and Swine Flu caused deaths in the United States and are considered pandemics. The 1918-1920 Spanish Flu claimed fifty million lives worldwide and 500,000 in the United States with 350,000 cases in Pennsylvania. The Asian flu caused about 1.5-2 million deaths worldwide with 70,000 deaths in the United States, peaking between September 1957 and March 1958. Approximately fifteen percent of the population of Pennsylvania was affected by Asian flu. The first cases of the Hong Kong Flu in the U.S. were detected in September of 1968 with deaths peaking between December 1968 and January 1969 (Global Security, 2009). The most recent global flu outbreak to impact Lebanon County was the 2009 outbreak of Swine flu (H1N1). There were 10,940 cases reported in Pennsylvania resulting in seventy-eight deaths (PA DOH, 2010).

Infectious Disease

West Nile Virus was first detected in Pennsylvania in the year 2000. The most annual reported cases of West Nile occurred in 2003, with 237 infected Pennsylvanians result-

ing in nine deaths. Since then, a comprehensive network has been developed in Pennsylvania to detect West Nile Virus, including trapping mosquitoes, collecting dead birds and monitoring horses, people, and in past years, sentinel chickens. West Nile Virus was detected in forty nine of sixty-seven counties in the Commonwealth in 2017, with sixteen human cases (PA West Nile Virus Control Program, 2017). West Nile Virus has been detected in Lebanon County in sixteen of the last seventeen years with one human case (See *Table 28 - West Nile Disease Reported* Cases). Cases of Lyme disease are consistently reported in Lebanon County with a recent spike in cases throughout the Commonwealth – reported cases are summarized in *Table 29 - Lyme Disease Reported Cases*.

Table 28 - West Nile Disease Reported Cases

West Nile Occurrences *(PAWNVCP, 2018)*			
Year	**Positive Detection**	**Human Cases**	**Deaths**
2001			
2002	✓	2	
2003	✓	5	
2004	✓	1	
2005	✓	1	
2006	✓		
2007	✓	1	
2008	✓		
2009	✓		
2010	✓		
2011	✓	2	
2012	✓	2	
2013	✓		
2014	✓		
2015	✓	1	
2016	✓	1	
2017	✓		
Totals	**16 of 17**	**16**	**0**

Table 29 - Lyme Disease Reported Cases

Lyme Disease Reported Cases *(CDC, 2018)*			
Year	**Number of Cases**	**Year**	**Number of Cases**
1980	0	1999	12
1981	0	2000	14
1982	0	2001	19
1983	0	2002	36
1984	0	2003	42
1985	0	2004	80
1986	0	2005	54
1987	0	2006	46
1988	0	2007	72
1989	5	2008	66
1990	<4	2009	120
1991	<4	2010	56
1992	<4	2011	88
1993	<4	2012	61
1994	<4	2013	96
1995	<4	2014	81
1996	<4	2015	90
1997	7	2016	102
1998	5	**Total**	**~1166**

4.3.7.4 Future Occurrence

Pandemic & Epidemic

The precise timing of pandemic influenza is uncertain, but occurrences are most likely when the Influenza Type A virus makes a dramatic change, or antigenic shift, that results in a new or "novel" virus to which the population has no immunity. The emergence

of a novel virus is the first step towards pandemic, and based on historical events, is expected to occur every eleven to forty-one years. In the event of an influenza pandemic, colleges and universities can plan an integral role in protecting the health and safety of university members as well as the greater community.

In response to the 2009 H1N1 pandemic, the American College Health Association (ACHA) initiated a pandemic influenza surveillance project entitled the College Health Surveillance Network (CHSN) to gain an understanding of the influenza activity on college campuses. Epidemiologic data on novel H1N1 flu suggested significant risk among those in the college setting. Interested institutions of higher education voluntarily submitted data on a weekly basis regarding the number of new cases of influenza-like illnesses, and ACHA began reporting on the availability of the vaccine, along with the success uptake rate. This information was provided to the CDC, public health officials, and other college health professionals in an effort to continue assisting with tracking national vaccine trends. The H1N1 surveillance project was an important milestone for college health. Through the efforts of ACHA's national office and participating schools, the project resulted in an accurate representation of the epidemiology of the H1N1 outbreak on college campuses nationally. The data holds valuable lessons learned from the 2009 H1N1 outbreak.

Infectious Disease

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

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

4.3.7.5 Vulnerability Assessment

Pandemic & Epidemic

Certain groups are at higher risk of infectious disease infection, including people sixty-five years and older, children younger than five years, pregnant women, and people with

certain chronic medical conditions. Such conditions include but are not limited to diabetes, heart disease, asthma, and kidney disease. Schools, convalescent centers, and other institutions serving those younger than five years old and older than sixty-five are locations that are conducive to faster transmission of influenza. More generally, areas with higher population densities and places where people gather can be hotspots where influenza can spread more rapidly. *Figure 24 - Pandemic & Infectious Disease Vulnerability* shows the population density according to 2010 census data and locations of schools, daycares and health care facilities, shedding light on areas where the disease may more readily spread. The highest concentration of elevated-transmission risk locations in Lebanon County such as schools and medical facilities are found in the City of Lebanon, West Lebanon Township, Myerstown Borough, Annville Township, Palmyra Borough & Cleona Borough areas.

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

During a public health emergency, the Pennsylvania Department of Health (PA DOH) opens emergency medicine centers called "Points of Dispensing (PODs)" to ensure that medicine, supplies, vaccines, and information reach Pennsylvania residents during a public health emergency. An Open POD is where the general public goes to receive free emergency medicine and supplies from public health officials, while a closed POD provides free emergency medicine and supplies to University faculty, staff and students. Dispensing of medications/vaccines is a core function of the Strategic National Stockpile plan, and preparedness of an Open POD.

The U.S. Department of Health and Humans Services and the Centers for Disease Control and Prevention have developed the following checklist as a framework to assist colleges and universities to develop and/or improve plants to prepare for and respond to an influenza pandemic:

1. Coordination

- Identify a pandemic coordinator and response team (including campus health services and mental health staff, student housing personnel, security, communications staff, physical plant staff, food services director, academic staff, and student representatives)
- Define roles and responsibilities for preparedness, response, and recovery planning.

2. Accountability

- Delineate accountability and responsibility as well as resources for key stakeholders engaged in planning and executing specific components of the operational plan.
- Assure that the plan includes timelines, deliverables, and performance measures.

3. Scenario-Driven

- Incorporate scenarios that address college/university functioning based upon having various levels of illness in students and employees and different types of community containment interventions.
- Plan for different outbreak scenarios including variations of severity of illness, mode of transmission, and rates of infection in the community. Consider social distancing options such as cancellation of classes, sporting events and/or other public events, closure of campus, student housing, and/or public transportation, self-isolation and/or assessment of the suitability of student housing for quarantine of exposed and/or ill students.
- Contingency plans for students who depend on student housing and food services (g.g., international students and other students who live too far away to travel home).
- Contingency plans for maintaining research laboratories, particularly those using animals.
- Stockpiling non-perishable food and equipment that may be needed in the case of an influenza pandemic.

4. Legal Implications

- Work with state and local public health and other local authorities to identify legal authority, decision-makers, trigger points, and thresholds to institute community containment measures such as closing (and re-opening) the college/ university.
- Identify and review the college/university's legal responsibilities and authorities for executing infection control measures, including case identification, reporting information about ill students and employees, isolation, movement restriction, and provision of healthcare on campus.

5. Consistency

- Ensure that pandemic influenza planning is consistent with any existing college/university emergency operations plan, and is coordinated with the pandemic plan of the community and of the state higher education agency.

6. Cooperation

- Work with the local health department to discuss an operational plan for surge capacity for healthcare and other mental health and social services to meet the needs of the college/university and community during and after a pandemic.

7. Communications

- Establish an emergency communication plan and revise regularly.
- This plan should identify key contacts with local and state public health officials as well as the state's higher education officials (including back-ups) and the chain of communications, including alternate mechanisms.

8. Incident Command

- Test the linkages between the college/university's Incident Command System and the Incident Command Systems of the local and/or state health department and the state's higher education agency.

9. Practice

- Implement an exercise/drill to test your plan and revise it regularly.
- Participate in exercises of the community's pandemic plan.

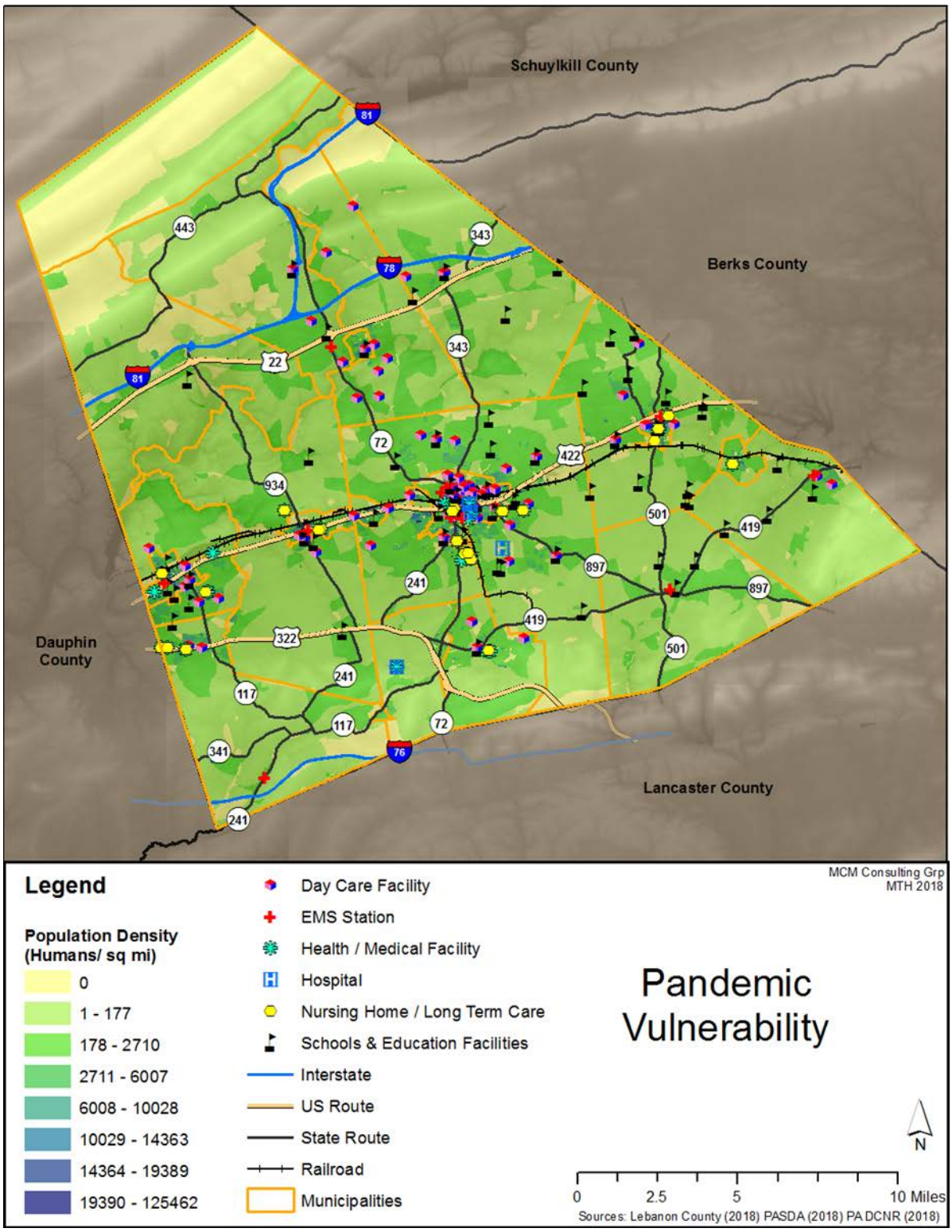
10. Recovery

- Develop a recovery plan to deal with consequences of the pandemic (e.g., loss of students, loss of staff, financial, and operational disruption).

11. Share

- Share what you have learned from developing your preparedness and response plan with other colleges/universities to improve community response efforts.

Figure 24 - Pandemic & Infectious Disease Vulnerability



4.3.8. Radon Exposure

4.3.8.1 Location and Extent

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

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

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

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

- Proximity to elevated uranium rich deposits (>50ppm). Areas within a few hundred feet of such deposits are most at risk. Such deposits are rare in Pennsylvania.

- Some more common rocks have higher than average uranium content (5 to 50 ppm), and proximity to such rocks also increases the risk of radon exposure. These rock types include black shales as well as granitic and felsic alkali igneous rocks. This is the most common source of high radon levels in Pennsylvania. The Reading Prong elevated radon levels come from Precambrian granitic gneisses.
- Other soil and bedrock properties that facilitate radon mobility. The amount of pore space in the soil and its permeability – more porous soils will allow radon to travel more easily. Limestone-dolomite soils can also be predisposed to collect radon from radium resultant from weathering of iron oxide or clay surfaces. In some cases (like in State College in Centre County PA) even with underlying bedrock having normal uranium concentrations (.5 to 5 ppm), the vast majority of locations built on limestone-dolomite soils exceed radon concentrations of 4pCi/L, and many exceeded 20 pCi/L.

4.3.8.2 Range of Magnitude

According to the EPA, about 21,000 lung cancer deaths each year in the U.S. are related to radon - it is the second leading cause of lung cancer after smoking and the number one cause of lung cancer among nonsmokers. There is no evidence that children are at a greater risk than adults. Radon causes lung cancer by continuing to radioactively decay after being inhaled, and turning into a daughter product (218Po, 214Pb, 214Bi) which may become attached to lung tissue and induce lung cancer due to their continued radioactive decay. *Table 30 - Radon Risk* (EPA, 2017) describes the relative risk to lung cancer that people experience depending on the radon level and their experience with smoking.

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

Table 30 - Radon Risk

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

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

4.3.8.3 Past Occurrence

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

The Pennsylvania Department of Environmental Protection (PA DEP) provides information for homeowners about how to test for radon in their homes, and when they receive a test result over 4 pCi/L, the PA DEP Bureau of Radiation Protection works to help homeowners repair the home and mitigate the hazard. The PA DEP records all the tests they receive and categorize them in a searchable database by zip code. *Table 31 - Radon Level Test Results* shows there are seventeen zip codes in Lebanon County where

sufficient tests were reported for the PA DEP to report their findings. All reporting zip codes in Lebanon County have average basement Radon levels above the suggested EPA action level of 4 pCi/L - The average basement reading for reporting zip codes in the County is 14.9 pCi/L, and the average first floor reading is 7.4 pCi/L.

Table 31 - Radon Level Test Results

Radon Level Test Results *(PA DEP, 2018)*					
Zip Code	**Municipalities**	**Location**	**Number of Tests**	**Max Result pCi/L**	**Avg Result pCi/L**
17003	Annville Township, North Anville Township, parts of South Annville Township, North Londonderry Township & East Hanover Township	BASEMENT	1888	333.5	16.3
		FIRST FLOOR	440	115.7	6.1
17016	Part of Cornwall Township	BASEMENT	81	62.1	9.5
17026	Parts of Bethel Township & Swatara Township	BASEMENT	247	153.4	19.8
		FIRST FLOOR	32	52.3	7.9
17028	Part of East Hannover Township	BASEMENT	307	565.3	12.3
		FIRST FLOOR	55	34.1	5
17033	Part of South Londonderry Township	BASEMENT	3923	140.2	7.6
		FIRST FLOOR	1957	113.3	2.9
17038	Cold Spring Township, Union Township, Jonestown Township, parts of Swatara Township, East Hanover Township & North Annville Township	BASEMENT	710	320.3	18.4
		FIRST FLOOR	64	145.6	11.7
17042	South Lebanon Township, North Cornwall Township, Parts of Cornwall Township, West Cornwall Township, South Londonderry Township, South Annville Township, Cleona Township, West Lebanon Township & the City of Lebanon	BASEMENT	4765	402.6	14.6
		FIRST FLOOR	631	87	7.2
17046	North Lebanon Township, parts of the City of Lebanon, West Lebanon Township, Cleona Township, Bethel Township, Swatara Township & North Annville Township	BASEMENT	1644	216.8	16.5
		FIRST FLOOR	240	80.5	6.8
17064	Mount Gretna Township & Part of West Cornwall Township	BASEMENT	85	36.5	6
17067	Myerstown Township, Parts of Heidelberg Township, Millcreek Township, Jackson Township, Bethel Township & North Lebanon Township	BASEMENT	1019	171.3	13.1
		FIRST FLOOR	116	37	5.9
17073	Parts of Millcreek Township & Heidelberg Township	BASEMENT	395	99.9	11.3
		FIRST FLOOR	39	139.2	8.6
17078		BASEMENT	4208	327.9	11.7

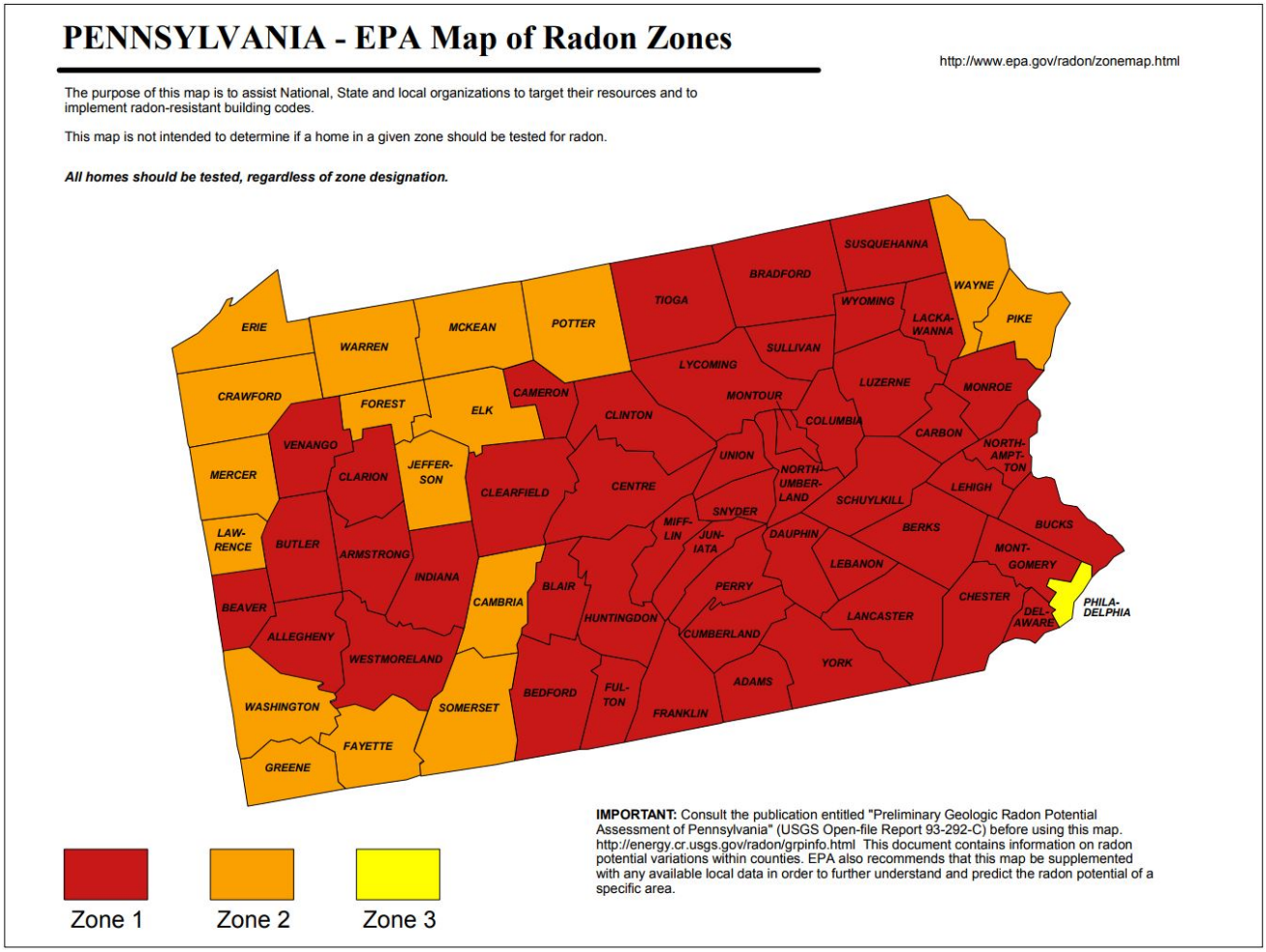
Radon Level Test Results *(PA DEP, 2018)*					
Zip Code	**Municipalities**	**Location**	**Number of Tests**	**Max Result pCi/L**	**Avg Result pCi/L**
	Palmyra Township, Parts of South Londonderry Township, North Londonderry Township & East Hanover Township	FIRST FLOOR	503	239	7.1
17087	Richland Township, parts of Jackson Township & Millcreek Township	BASEMENT	219	342.5	28.7
17088	Part of Heidelberg Township	BASEMENT	36	136.6	10.4
17545	Parts of West Cornwall Township & South Londonderry Township	BASEMENT	2844	630.6	19.3
		FIRST FLOOR	326	92.8	9.2
17963	Part of Bethel Township & Union Township	BASEMENT	580	173.8	18.9
		FIRST FLOOR	95	51	7.6
19551	Part of Millcreek Township	BASEMENT	804	395.4	18.5
		FIRST FLOOR	64	61.2	10.6
Averages		**Basement**			**14.9**
		First Floor			**7.4**

4.3.8.4 Future Occurrence

Radon exposure is inevitable given the geologic and geomorphic conditions in Lebanon County. The EPA and USGS have mapped radon potential in the US to help target resources and assist local governments in determining if radon-resistant features are applicable for new construction. The designations are broken down in three zones and are assigned by county, as shown in *Figure 25 - Radon Zones* (EPA, 2017). Each zone reflects the average short-term measurement of radon that can be expected in a building without radon controls. Lebanon County is located within Zone 1, with a high potential for radon.

1. Zone 1 has the highest potential and readings can be expected to exceed the 4 pCi/L recommended limit.
2. Zone 2 has a moderate potential for radon with levels expected to be between 2 and 4 pCi/L and
3. Zone 3 has a low potential with levels expected to be less than 2 pCi/L.

Figure 25 - Radon Zones (EPA, 2017)



4.3.8.5 Vulnerability Assessment

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

4.3.9. Subsidence, Sinkhole

4.3.9.1 Location and Extent

Subsidence refers to gradual caving in, sinking or collapse of an area of land. Many areas of Pennsylvania have bedrock conditions that lend themselves to subsidence events. Carbonate rock like limestone and dolomite is easily eroded and dissolved by water, so if an area has carbonate bedrock, that area is susceptible to subsidence because groundwater may erode and dissolve the carbonate rock, leading to the creation of caves, swales, sinkholes and other forms of subsidence. These types of features are generally referred to as karst topography. Lebanon County has a significant band of naturally occurring karst topography mostly located in a band that runs east – west through the southern portion of the County (see *Figure 26 - Karst Topography & AML*).

Human activity can also increase the risk of subsidence events. Leaking water pipes or structures that convey storm-water runoff in Lebanon County have contributed to areas of subsidence as the water dissolves rock over time.

Areas with coal or other mineral deposits which have been mined using deep mining techniques may become susceptible to subsidence. Poor engineering practices used at the time of withdrawal or progressive degradation in geological stability can increase the risk of subsidence. Lebanon County has a minimal history of such mining practices.

4.3.9.2 Range and Magnitude

No two subsidence areas or sinkholes are exactly alike. Variations in size and shape, time period under which they occur (i.e. gradually or abruptly), and their proximity to development ultimately determines the magnitude of damage incurred. Events could result in minor elevation changes or deep, gaping holes in the ground surface. Subsidence and sinkhole events can cause severe damage in urban environments, although gradual events can be addressed before significant damage occurs.

Problems related to subsidence include the disruption of utility services and damages to private and public property including buildings, roads, and underground infrastructure. Incidents of subsidence throughout the coal regions over the years have affected houses, garages, and trees that have been swallowed up by subsidence holes. Lengths of local streets and highways, and countless building foundations have been damaged.

The worst-case scenario in Lebanon County would result from long-term subsidence or sinkhole formation that were not recognized, and mitigation measures were not implemented. In this case fractures or complete collapse of building foundations and roadways may result.

4.3.9.3 Past Occurrence

The DCNR provides an online Sinkhole Inventory Database, which lists a total of 2,665 identified natural karst topographic features in Pennsylvania as of 2009 (DCNR, 2009).

Lebanon County GIS keeps a dataset of Karst features in the County, which contains 128 reported sinkholes and almost 11,300 surface depressions due to karst topography (see *Figure 26 - Karst Topography & AML*). There are four abandoned mine sites in the northern portion of Lebanon County in Cold Spring Township.

4.3.9.4 Future Occurrence

The annual occurrence of subsidence and sinkhole events in the county where karst topographic features have been observed in Lebanon County is considered likely. *Figure 26 - Karst Topography & AML* shows data as of March 2018 from the PA DEP and the Abandoned Mine Land Inventory System and shed light on the four abandoned mines in Cool Spring Township. As abandoned mines age, they are more likely to fail and result in subsidence due to the aging timber supports in the mine shafts, and increasing weight and pressure placed upon them from newly constructed buildings and traffic movement.

4.3.9.5 Vulnerability Assessment

Municipal officials in North Londonderry Township reported an increase in subsidence & sinkhole events since the last Hazard Mitigation Plan Update.

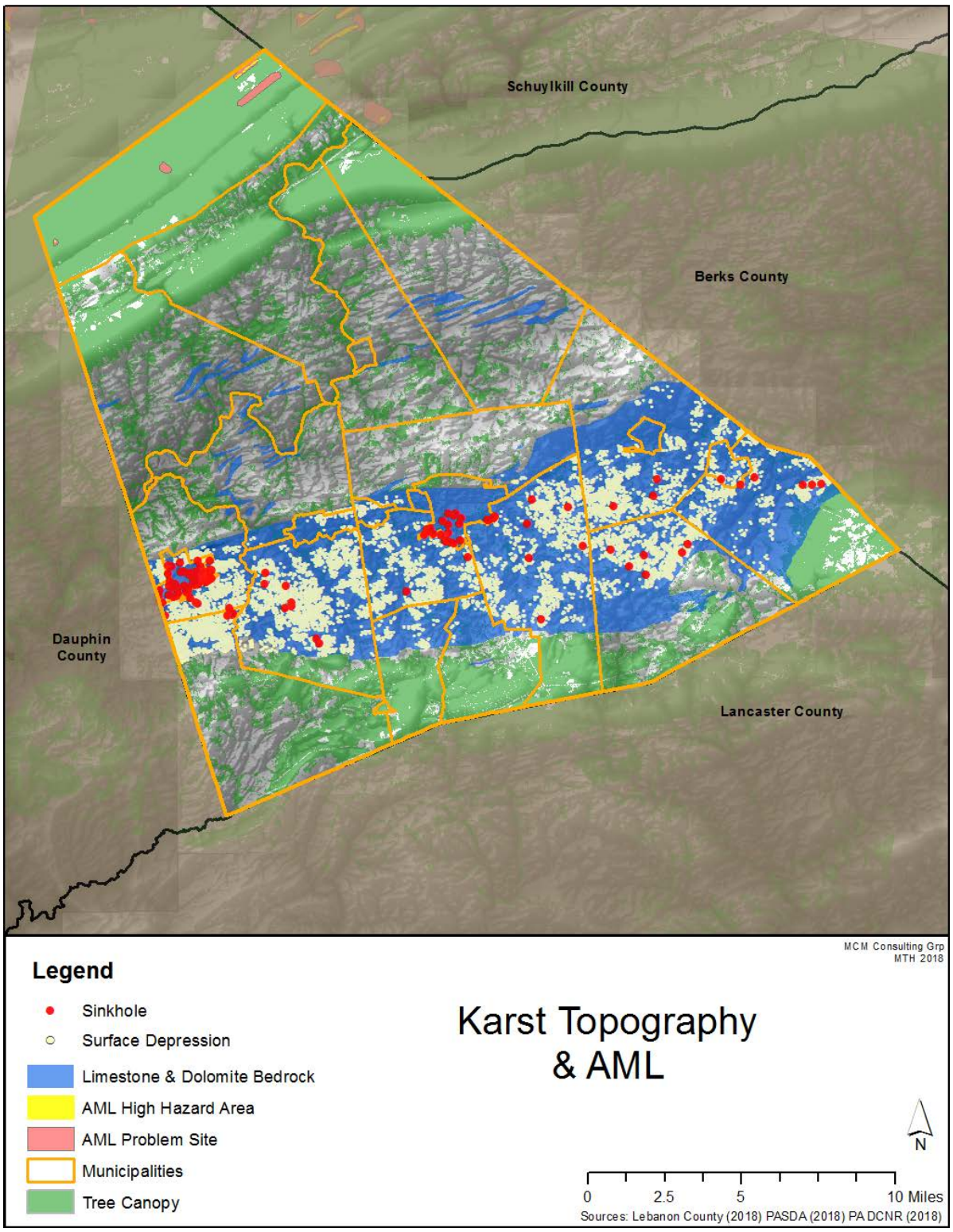
Abandoned mine sites are susceptible to subsidence events, and there has been some mining activity in Cool Spring Township. Mine Subsidence Insurance is available through the Pennsylvania Department of Environmental Protection (PA DEP). If citizens are aware they live in areas that have been mined, the PA DEP Mine Subsidence Insurance department can be contacted at 1-800-922-1678 to have a site-specific request conducted.

Vulnerable facilities are summarized in *Table 32 - AML Subsidence Vulnerable Structures* shows structures and critical facilities that exist in subsidence prone locations, defined by anywhere in Lebanon County with limestone or dolomite bedrock. There are no structures or critical facilities on top of the abandoned mine land locations in Cold Spring Township. It should be noted that the structures used for this analysis is a building footprint dataset, which includes any building such as barns and out buildings. *Figure 26 - Karst Topography & AML* shows the locations of karst features, AML sites as well as limestone and dolomite bedrock.

Table 32 - AML Subsidence Vulnerable Structures

Structures in Subsidence Prone Areas *(Lebanon Co. GIS, 2018)*		
Municipality	**Structures**	**Critical Facilities**
Annville Township	1881	25
Bethel Township	252	1
Cleona Borough	1235	10
Cold Spring Township	0	0
Cornwall Borough	860	7
East Hanover Township	199	1
Heidelberg Township	2082	13
Jackson Township	3852	26
Jonestown Borough	1	0
Lebanon City	6855	95
Millcreek Township	2682	16
Mount Gretna Borough	0	0
Myerstown Borough	1786	18
North Annville Township	205	2
North Cornwall Township	3289	16
North Lebanon Township	1396	10
North Londonderry Township	2892	11
Palmyra Borough	3627	28
Richland Borough	1053	9
South Annville Township	2013	9
South Lebanon Township	5510	44
South Londonderry Township	1806	16
Swatara Township	116	0
Union Township	0	0
West Cornwall Township	754	4
West Lebanon Township	458	6
Total	**44804**	**367**

Figure 26 - Karst Topography & AML



4.3.10. Tornado, Windstorm

4.3.10.1 Location and Extent

Tornados occur in the Commonwealth most frequently during the spring and summer months and are most likely at the warmest times of the day. In the past 67 years, records show that 826 tornados have been reported in all 67 counties in Pennsylvania during the period of 1950- January 2017 (NOAA NCEI, 2017). The National Weather Service estimates that the Commonwealth will experience ten tornados annually. According to the National Centers for Environmental Information (NCEI, formerly NCDC), wind speeds in tornados range from values below that of hurricane speeds to more than 300 miles per hour. The NCEI continues by reporting that, "the maximum winds in tornados are often confined to extremely small areas and vary tremendously over short distances." This is the reason that one house will be completely demolished by a tornado and the house next to it might be untouched. The width of tornados can vary greatly, from 100 feet wide to over a mile, and the forward motion of tornados can range from speeds between 0 and 50 miles per hour.

Windstorms may be caused by thunderstorms, hurricanes and tornadoes, but the most frequent cause of windstorms in Western Pennsylvania are thunderstorms. Straight-line winds and windstorms are experienced on a more regional scale. While such winds usually also accompany tornados, straight-line winds are caused by the movement of air from areas of high pressure to low pressure. Windstorms are generally defined with sustained wind speeds of 40 mph or greater, lasting for at least one hour, or simply winds of 58 mph or greater for any duration. A microburst is a very-localized column of sinking air, capable of producing damaging opposing and straight-line winds at the surface. A wind shear is usually found when a violent weather front is moving through; wind speeds have been recorded up to 100 mph. Wind shear is defined as a difference in wind speed and direction over a relatively short distance

Figure 27 - Microburst

The air moves downward until at ground level. It then spreads outward in all directions.

4.3.10.2 Range of Magnitude

Each year, tornados account for $1.1 billion in damages and cause over 80 deaths nationally. 2011 was the second worst year on record for deadly tornados, the worst being 1936. The number of tornado reports has increased by 14% since 1950. While the extent of tornado damage is usually localized, the vortex of extreme wind associated with a tornado can result in some of the most destructive forces on Earth.

Rotational wind speeds can range from 100 mph to more than 250 mph. In addition, a tornado's speed of forward motion can range from 0 to 50 mph. Therefore, some estimates place the maximum velocity (combination of ground speed, wind speed, and upper winds) of tornados at about 300 mph. The damage caused by a tornado is a result of the high wind velocity and wind-blown debris, also accompanied by lightning or large hail. The most violent tornados have rotating winds of 250 miles per hour or more and are capable of causing extreme destruction and turning normally harmless objects into deadly missiles.

Damages and deaths can be especially significant when tornados move through populated, developed areas. The destruction caused by tornados ranges from light to inconceivable depending on the intensity, size and duration of the storm. Typically, tornados cause the greatest damages to structures of light construction. The Enhanced Fujita Scale, also known as the "EF-Scale," measures tornado strength and associated damages. The EF-Scale is an update to the earlier Fujita Scale, also known as the "F-Scale," that was published in 1971. It classifies United States tornados into six intensity categories, as shown in, based upon the estimated maximum winds occurring within the wind vortex *(Table 33 - Enhanced Fujita Scale)*. Since its implementation by the National Weather Service in 2007, the EF-Scale has become the definitive metric for estimating wind speeds within tornados based upon damage to buildings and structures. Previously recorded tornadoes are reported with the older F-Scale values, but *Table 33 - Enhanced Fujita Scale* shows F-Scale categories with corresponding EF-Scale wind speeds.

Figure 19 - Wind Zones in Section 4.3.5 described the wind speed zones developed by the American Society of Civil Engineers based on tornado and hurricane historical events. These wind speed zones are intended to guide the design and evaluation of the structural integrity of shelters and critical facilities. Lebanon County falls within Zone II, meaning shelters and critical facilities should be designed to withstand a 3-second gust of up to 160 mph, regardless of whether the gust is the result of a tornado, coastal storm, or windstorm event. Therefore, these structures should be able to withstand the wind speeds experienced in an EF3 or EF4 tornado event. While it is difficult to pinpoint the exact locations at the greatest risk of a tornado, the southeast, southwest and northwest sectors of the Commonwealth are more prone to tornados.

Tornados can have varying secondary effects. The most common is power failure. The severe wind can dismantle power sources and cause significant structural damage. Hazardous material spills can occur if a tornado comes near a holding tank, or the spill stems from a traffic accident caused by high winds.

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

- Power failures lasting 4 hours or longer
- Loss of communications networks lasting 4 hours or more
- Residents requiring evacuation or provision of supplies or temporary shelter
- Severe crop loss and or damage

Table 33 - Enhanced Fujita Scale

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

4.3.10.3 Past Occurrence

Lebanon County has experienced eighteen tornados since 1954 (see *Figure 30 - Tornado History 1950-2018 (NCEI, 2018)*). One of the deadliest tornado events in Pennsylvania

occurred on May 31, 1985, with a total of 21 tornados in the Ohio and Northwest Pennsylvania region (none of which tracked through Lebanon County). These tornados resulted in 76 deaths, upwards of 1000 injuries, and hundreds of millions of dollars in property damage. One of the most significant tornados to track through Lebanon County was an F3 and occurred on July 14, 2004 around the Campbelltown area, causing an estimated $18 Million in property damage. Wind speeds were estimated at 175 to 200 mph, 24 people were injured, 32 houses were totally destroyed, 37 houses suffered major damage, and 50 additional houses suffered minor damages. The storm also downed hundreds of trees in the region around Campbelltown.

Aside from tornados, Lebanon County has 239 severe wind reports from 179 severe wind events from 1950 to 2018 causing a total of ~$701,000 dollars in property damage (NOAA NCEI, 2018). Most often these are the result of intense thunderstorms, which may fell trees, damaging power lines and cause power outages for upwards of four days in some areas. One strong wind event occurred on September 2, 2006 when remnants of tropical storm Ernesto caused heavy rainfall and high winds, felling multiple trees in the Eagle Peak Campground in Millcreek Township, one of which struck a camper and killed a person who was inside (NOAA NCEI, 2018).

Figure 28 - Campbelltown July 2004 Tornado Damage

Figure 29 - Campbelltown July 2004 Tornado Damage

Figure 30 - Tornado History 1950-2018 (NCEI, 2018)

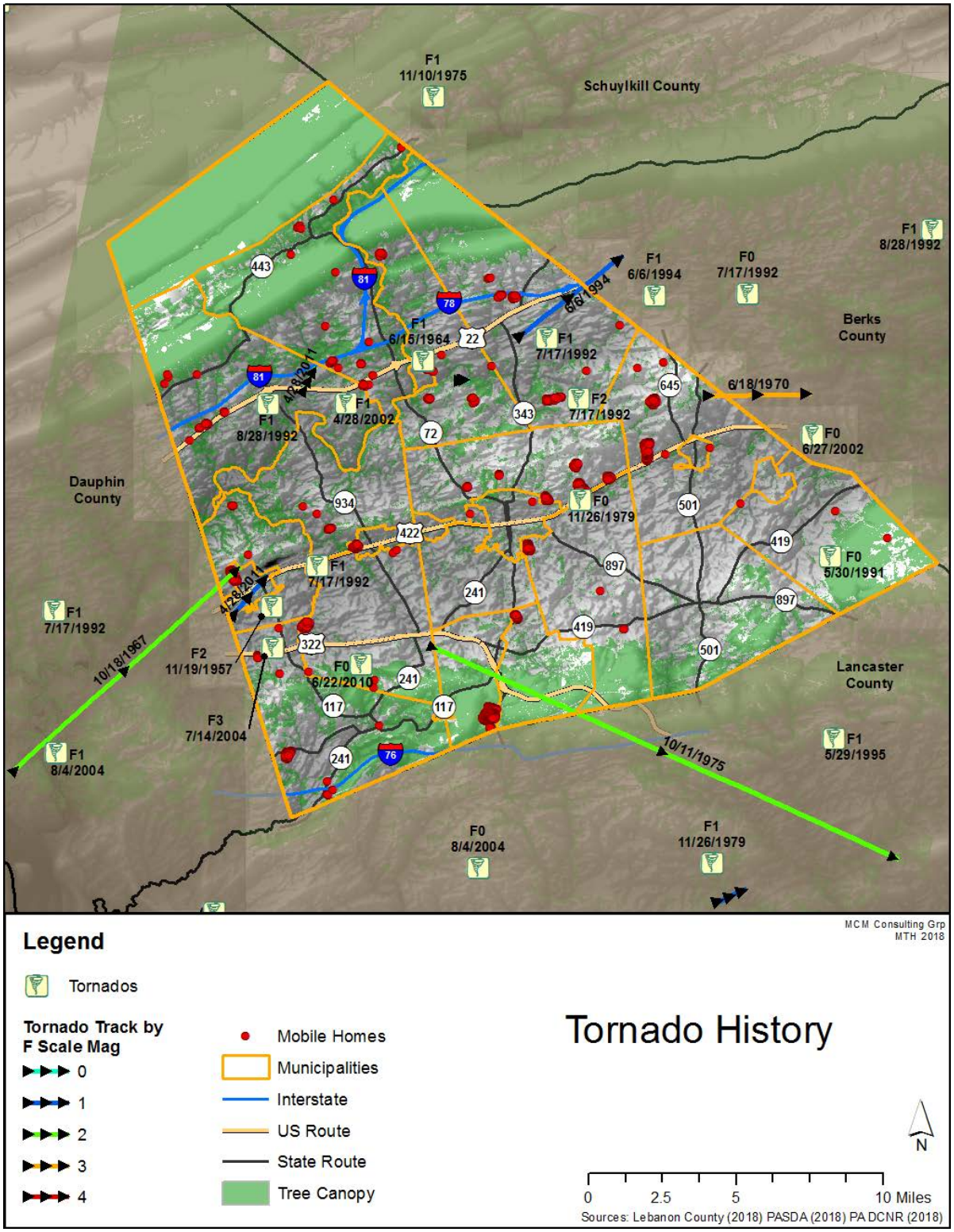


Table 34 - Tornado History

Tornado History *(NCEI, 2018)*						
Date	**F-Scale Mag**	**Fatalities**	**Injuries**	**Width (yards)**	**Length (miles)**	**Damage**
11/19/1957	F2	0	0	13	2	$5K-$50K
6/15/1964	F1	0	2	800	2	$50K-$500K
10/18/1967	F2	0	11	30	10.2	$50K-$500K
6/18/1970	F3	1	5	880	1.9	$500K-$5M
10/11/1975	F2	0	0	33	17.5	$500K-$5M
11/26/1979	F0	0	0	50	0.3	$500-$5000
5/30/1991	F0	0	0	20	0.3	$500-$5000
7/17/1992	F1	0	0	23	1	$5K-$50K
7/17/1992	F2	0	0	30	1	$50K-$500K
7/17/1992	F1	0	0	30	0.5	$50K-$500K
8/28/1992	F1	0	0	150	1	$50K-$500K
6/6/1994	F1	0	0	100	4	No Data
4/28/2002	F1	0	0	150	1.5	$775K
7/14/2004	F3	0	24	500	7.5	$18M
7/13/2008	F0	0	0	25	0.5	No Data
6/22/2010	F0	0	0	50	0.11	$10K
4/28/2011	F1	0	0	100	1.92	$10K
4/28/2011	F2	0	0	200	1.07	$15K

4.3.10.4 Future Occurrence

It is possible for a disastrous tornado to hit Lebanon County. While the chance of being hit by a tornado is somewhat small, the damage that results when the tornado arrives can be devastating. An EF5 tornado with a 0.019 percent annual probability of occurring can carry wind velocities of 200 mph, resulting in a force of more than 100 pounds per square foot of surface area. This is a "wind load" that exceeds the design limits of most buildings.

Based on tornado activity information for Pennsylvania between 1950 and 2002, Lebanon County lies within an area that has experienced twenty to forty tornado events per square mile, which is equivalent to about one to four tornados per square mile every five years (Pennsylvania State Climatology). Additionally, based on historic patterns, tornados are unlikely to remain on the ground for long distances, especially in areas of the county with hilly terrain. However, the high historical number of windstorms with winds over 50 knots indicates that annual chance of a windstorm is higher.

According to FEMA (*See Section 4.3.5 Table 26 - Annual Probability of Wind Speeds (FEMA, 2000)*), there is high probability (~92%) each year that Lebanon County will experience winds of 45-77 mph, however there is under a 10% chance of winds of 78-118 mph.

4.3.10.5 Vulnerability Assessment

Tornados can occur at any time of the year, though they're more likely during peak months, which are during the summer for the northern part of the United States. Tornados are most likely to occur between 3 P.M and 9 P.M. but have been known to occur at all hours of the day or night. Factors that impact the amount of damage caused by a tornado are the strength of the tornado, the time of day and the area of impact. Usually such distinct funnel clouds are localized phenomena impacting a small area, however, the high winds of tornados make them one of the most destructive natural hazards. There can be many secondary impacts of tornados and windstorms, including transportation accidents, hazardous material spills, flooding, and power outages. A proper warning system is vital for the public to be informed of what to do and where to go.

Dangers that accompany thunderstorms which can produce tornados:

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

Critical facilities are highly vulnerable to high wind storms. While many severe storms can cause exterior damage to structures, tornados can also completely destroy structures, along with their surrounding infrastructure, abruptly halting operations. Severe storms and their secondary effects often accompanying tornados and can be just as threatening to the critical facilities within the county. Many critical facilities are particularly vulnerable to power outages which can leave facilities functionless, potentially crippling infrastructure supporting the population of the county. With a storm's ability to destroy structures, citizens and their possessions are often left at the will of the storm. The elderly and disabled people are vitally at risk when faced with tornados. Without assistance to evacuate, they may be unable to prepare themselves or their homes and other possessions to safely weather the storm. Mobile homes are also particularly vulnerable to tornados and windstorms, and locations of mobile homes in Lebanon County can be found in *Figure 30 - Tornado History 1950-2018 (NCEI, 2018)*, and are summarized by municipality in *Table 35 - Mobile Homes*.

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

Table 35 - Mobile Homes

Mobile Homes *(Lebanon County GIS, 2018)*			
Municipality	**Mobile Homes**	**Municipality**	**Mobile Homes**
Annville Township	76	North Annville Township	34
Bethel Township	217	North Cornwall Township	0
City Of Lebanon	1	North Lebanon Township	493
Cleona Borough	0	North Londonderry Township	10
Cold Spring Township	0	Palmyra Borough	182
Cornwall Borough	72	Richland Borough	0
East Hanover Township	46	South Annville Township	222
Heidelberg Township	0	South Lebanon Township	118
Jackson Township	364	South Londonderry Township	178
Jonestown Borough	2	Swatara Township	107
Millcreek Township	3	Union Township	42
Mount Gretna Borough	0	West Cornwall Township	260
Myerstown Borough	1	West Lebanon Township	1
		Total	**2429**

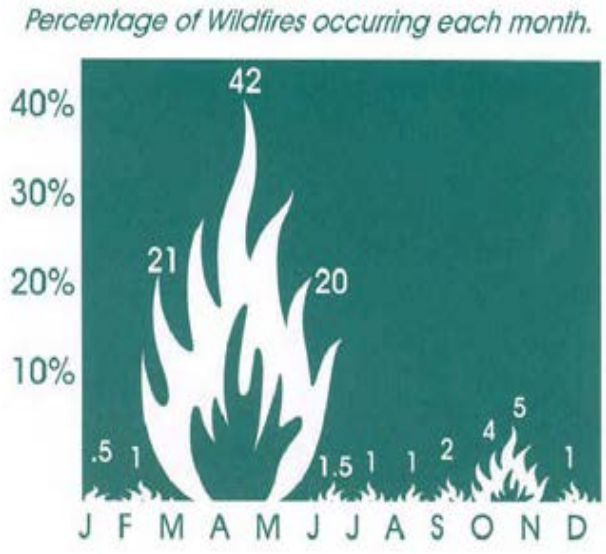
4.3.11. Wildfire

4.3.11.1 Location and Extent

The most prevalent causes of devastating wildfires are droughts, lightning strikes, arson, human carelessness, and in rare circumstances, spontaneous combustion. Most fires in Pennsylvania are caused by anthropogenic fires such as debris burns that get out of control. A fire, started in somebody's backyard, could travel through dead grasses and weeds into bordering woodlands starting a wildfire. Major urban fires can cause significant property damage, loss of life, and residential or business displacement. While wildfires are a natural and essential part of many native Pennsylvania ecosystems (e.g. pitch pine – scrub oak woodlands), wildfires can also cause devastating damage if they are undetected and allowed to propagate unfettered. Wildfires most often occur in less developed areas such as open fields, grass, dense brush or forests where they can spread rapidly by feeding off of vegetative fuels. Wildfires are most prevalent under prolonged dry and hot spells, or generally drought conditions. The greatest potential for wildfires (83% of all PA wildfires) occur in the spring months of March, April, and May, and the autumn months of October and November. In the spring, bare trees allow sunlight to reach the forest floor, drying fallen leaves and other ground debris and increasing wildfire vulnerability. In the fall, the surplus of dried leaves is fuel for fires. *Figure 31 - Seasonal Wildfire Percentage (PA DCNR, 2018)* shows the wildfire percentage occurrence during each month occurring in Pennsylvania.

Lebanon County is located in the Weiser Forest District of Pennsylvania (D-18) and includes Swatara State Park, Memorial Lake State Park, as well as State Game Lands 46, 80, 145, 156, 211 and 225.

Figure 31 - Seasonal Wildfire Percentage (PA DCNR, 2018)



4.3.9.2 Range of Magnitude

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

The United States Forest Service utilizes the Forest Fire Assessment System to classify the dangers of wildfire. *Table 36 - Wildland Fire Assessment System* identifies each threat classification and provides a description of the level.

Table 36 - Wildland Fire Assessment System

Wildland Fire Assessment System *(U.S. Forest Service)*	
Rank	**Description**
Low (L)	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.
Moderate (M)	Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
High (H)	All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High-intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.

Wildland Fire Assessment System *(U.S. Forest Service)*	
Rank	**Description**
Very High (VH)	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
Extreme (E)	Fires start quickly, spread furiously and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions the only effective and safe control action is on the flanks until the weather changes or the fuel supply lessens.

4.3.11.3 Past Occurrences

Between 2008 and February 2018, there were 1,217 calls for service that were categorized as Wildfire/ Brush fires that were recorded by the Lebanon County CAD system. Some of these calls were calls for mutual aid, and occurred in Dauphin, Berks or other neighboring counties. Fire department dispatch data from 2003-2006 was used, which reports how many times each station in Lebanon County was dispatched by month, including responses to both urban fires and wildfires. A summary of the fire department dispatch data appears in *Table 37 - Wildfires in the Weiser District*, which also includes a summary of wildfire events for the years 1999-2011. Unfortunately, more recent data was not available to include.

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

Table 37 - Wildfires in the Weiser District

Wildfires in the Weiser District 1999-2012 *(2013 HMP; Lebanon County, 2018)*					
Year	**Fires**	**% of Statewide**	**Acres**	**% of Statewide**	**Total Lebanon Co. Fire Dept. Dispatches**
1999	220	15.67%	1,008.50	11.97%	-
2000	102	13.86%	1,026	21.38%	-
2001	48	9.45%	292	4.09%	-
2002	139	32.40%	452.36	23.75%	-
2003	69	16.91%	190.48	9.40%	5993
2004	45	21.95%	43.82	1.58%	5614
2005	135	16.75%	447.16	10.48%	7055
2006	157	17.21%	1,554.83	19.63%	7795
2007	104	19.30%	220	19.30%	-
2008	143	16.80%	497.8	14.60%	-
2009	112	10.80%	172	2.80%	-
2010	94	16.50%	128.3	3.80%	-
2011	41	20.30%	40.7	7.00%	-
2012	150	20.90%	501.6	15.70%	-

Table 38 - PA Prescribed Burns

PA Prescribed Burns *(PA DCNR, 2018)*				
Year	**All Agencies and Organizations - Number of Pre-scribed Fires**	**All Agencies and Organizations - Number of Pre-scribed Fire Acres**	**DCNR - Number of Prescribed Fires**	**DCNR – Acreage of Prescribed Fires**
2010	56	2737	12	186
2011	70	6301	11	189
2012	96	4133	10	208
2013	142	8058	35	866
2014	161	7094	26	338
2015	244	14553	47	1317

4.3.11.4 Future Occurrence

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

or attention of fire-fighters, forestry personnel, or visitors to the forest, has the potential to become a wildfire.

4.3.11.5 Vulnerability Assessment

The size and impact of a wildfire depends on its location, climate conditions and the response of firefighters. If the right conditions exist, these factors may often mitigate the effects of wildfires, however during a drought, wildfires can be devastating. Wildfires are most common in the spring (March–May) and fall (October–November) months. During spring and fall months, the lack of leaves on the trees allows the sunlight to heat and dry the existing leaves on the ground, increasing the risk of forest fires. Firefighters and other first responders can encounter life threatening situations due to forest fires. Traffic accidents during a response and then the impacts of fighting the fire once on scene are examples of the first responder vulnerabilities.

The Wildland Urban Interface (WUI) was nationally mapped by a United States Department of Agriculture Forest Service effort in 2015 that used data from 1990-2010 to develop a robust dataset that relates housing density and vegetative density. The dataset provides a way to help identify locations where larger numbers of humans are living in or near natural areas that could be at risk in the event of a wildfire. The WUI defines two types of communities – interface and intermix: intermix WUI refers to areas where housing and wildland vegetation intermingle, and interface WUI refers to areas where housing is in the vicinity of a large area of dense wildland vegetation (Martinuzzi et al., 2015). Pennsylvania is among the states with the largest area of WUI and the most housing units in a WUI designated area.

Table 40 - Buildings in High Wildfire Hazard Areas shows the total addressable structures and critical facilities that are in state game lands, state parks and locations designated by the Wildland Urban Interface. Wildfire hazard is defined based on conditions that affect wildfire ignition and/or behavior such as fuel, topography and local weather.

There are forty-four fire departments that cover Lebanon County (see *Table 39 - Lebanon County Fire Departments*). Each fire department conducts its own schedule of in-house training sessions for their members.

Table 39 - Lebanon County Fire Departments

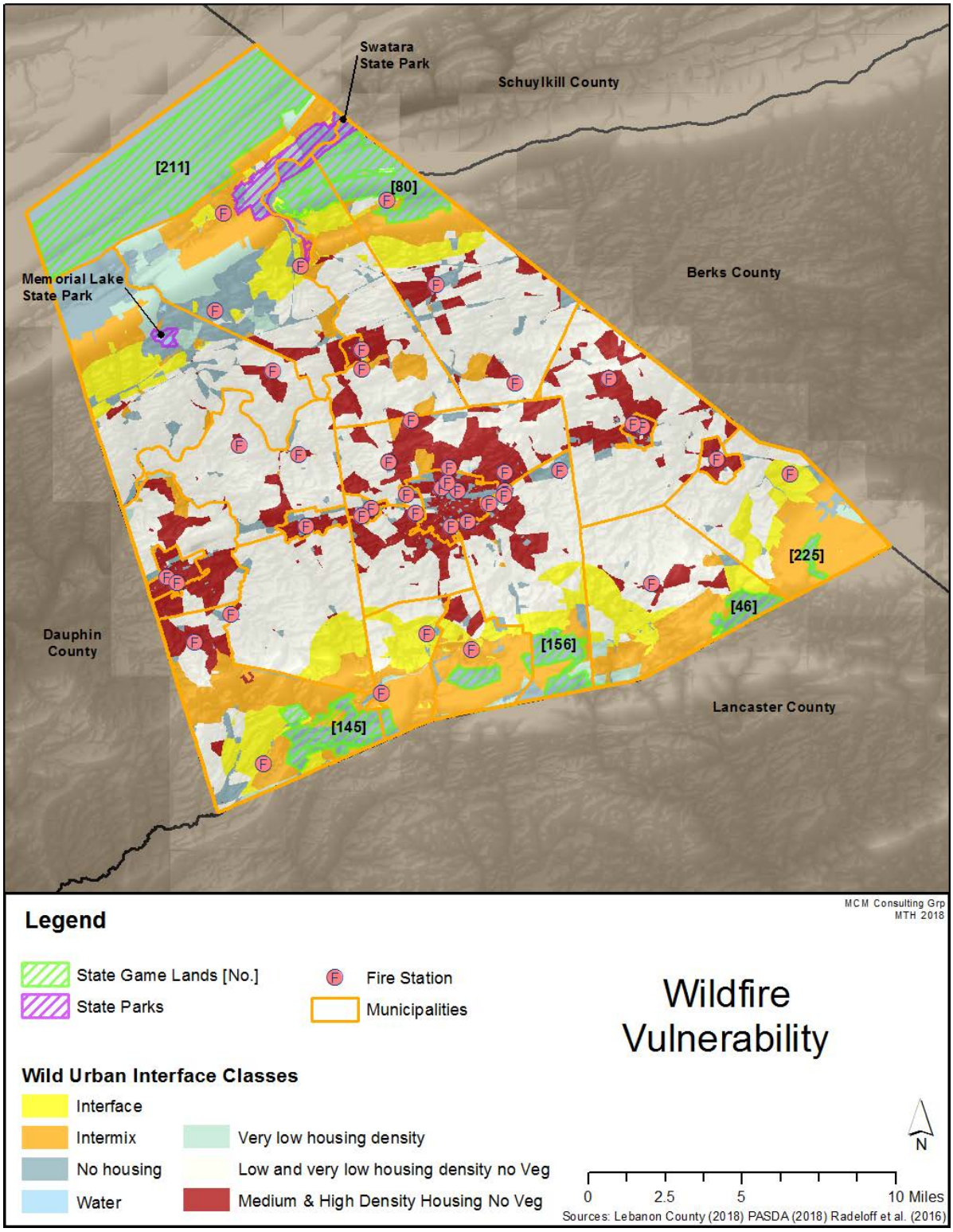
Fire Departments ***(Lebanon County GIS, 2018)***		
Name	**Address**	**Municipality**
Union Hose Company of Annville Inc.	215 E Main St	Annville Township
Mount Zion Community Fire Company	1520 Mount Zion Rd	Bethel Township
Camp Strause Fire Company	516 Camp Strause Rd	Bethel Township
Fredricksburg Fire Company #1	3052 S Pine Grove St	Bethel Township
City Fire Station #4 - Rescue Hose Company	400 Lehman St	City Of Lebanon
City Station #1	700 S 8Th St	City Of Lebanon
City Station #2	909 Mifflin St	City Of Lebanon

Fire Departments *(Lebanon County GIS, 2018)*		
Name	**Address**	**Municipality**
City Station #3	712 Maple St	City Of Lebanon
Central Medical EMS Station	201 E Penn Ave	Cleona Borough
Cleona Fire Company #1	136 W Walnut St	Cleona Borough
Community Fire Company of Cornwall Borough	50 Rexmont Rd	Cornwall Borough
Ono Fire Company	10805 Jonestown Rd	East Hanover Township
Volunteer Fire Company #1 of Schaefferstown	200 N Locust St	Heidelberg Township
Kutztown Community Fire Company	519 Kutztown Rd	Jackson Township
Perseverance Fire Company	107 S King St	Jonestown Borough
Newmanstown Fire Company	20 S Sheridan Rd	Millcreek Township
Keystone Hook and Ladder	25 S Railroad St	Myerstown Borough
Goodwill Fire Company #1	299 W Washington Ave	Myerstown Borough
Bellegrove Fire Company	1743 Blacks Bridge Rd	North Annville Township
Union Water Works Fire Company	2875 Water Works Way	North Annville Township
Neversink Fire Company	1912 Center St	North Cornwall Township
First Aid & Safety Patrol Station #2	442 Ebenezer Rd	North Lebanon Township
Ebenezer Fire House	442 Ebenezer Rd	North Lebanon Township
Glenn Lebanon Fire Company	42 Glenn Lebanon Dr	North Lebanon Township
Rural Security Fire Company	1301 N 7Th St	North Lebanon Township
Weavertown Fire Company #1	1538 Suzy St	North Lebanon Township
Life Lion EMS Palmyra Station	24 N Locust St	Palmyra Borough
Citizens Fire Company #1 of Palmyra	35 W Walnut St	Palmyra Borough
Neptune Fire Company	22 E Main St	Richland Borough
Lawn EMS Station 2	2379 Brandt Rd	South Annville Township
Citizens Fire Company of Avon	1220 King St	South Lebanon Township
Friendship Fire Company	610 S 2Nd St	South Lebanon Township
Hebron Hose Company #1	701 E Walnut St	South Lebanon Township
Prescott Community Fire Company	300 Prescott Rd	South Lebanon Township
Fire Marshall	730 E Walnut St	South Lebanon Township
Campbelltown Volunteer Fire Company	2818 Horseshoe Pike	South Londonderry Township
Lawn Fire Company	5596 Elizabethtown Rd	South Londonderry Township
Bunker Hill Fire Company	434 S Lancaster St	Swatara Township
Green Point Fire Company	75 Moonshine Rd	Union Township
Fort Indiantown Gap Fire Department	Indiantown Gap	Union Township
Lickdale Community Fire Company	3071 State Route 72	Union Township
Mt. Gretna Fire Company #1	41 Boulevard Ave	West Cornwall Township
Quentin Volunteer Fire Company	20 S Lebanon St	West Cornwall Township
Speedwell Engine and Hose Company	324 N 22Nd St	West Lebanon Township

Table 40 - Buildings in High Wildfire Hazard Areas

Buildings in High Wildfire Hazard Areas ***(Lebanon County GIS, 2018; Radeloff et al. 2016)***				
Municipality	**Wild Urban Interface & Intermix**		**State Parks & State Game Lands**	
	Buildings	**Critical Facilities**	**Buildings**	**Critical Facilities**
Annville Township				
Bethel Township	176	1		
Cleona Borough				
Cold Spring Township				
Cornwall Borough	1062	9		
East Hanover Township	45		11	
Heidelberg Township	426	2	11	
Jackson Township				
Jonestown Borough				
Lebanon City				
Millcreek Township	1430	9		
Mount Gretna Borough	195			
Myerstown Borough				
North Annville Township	23			
North Cornwall Township	8			
North Lebanon Township				
North Londonderry Township	142			
Palmyra Borough				
Richland Borough				
South Annville Township	100			
South Lebanon Township	24		1	
South Londonderry Township	449	3	5	
Swatara Township	287	1		
Union Township	156	1	9	
West Cornwall Township	843	7		
West Lebanon Township				
Total	**5366**	**33**	**37**	**0**

Figure 32 - Wildfire Vulnerability



4.3.12. Winter Storms

4.3.12.1 Location and Extent

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

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

4.3.12.2 Range of Magnitude

Winter storms consist of cold temperatures, heavy snow or ice and sometimes strong winds. Descriptions of types of winter storms can be found in *Table 41 - Winter Weather Events*. In severe cases, secondary effects of winter storms involve flooding, disruption to traffic, EMS response capabilities, communications, electric power and other utilities. Power outages can be caused by large amounts of snow or ice weighing on and breaking power lines. Especially in rural areas, loss of electric power can result in a loss of heat for residential customers, potentially posing a threat to human life.

Long cold spells can cause rivers and lakes to freeze over. A subsequent thaw and rise in the water level then break the ice into large chunks and can result in ice jams when the ice begins to flow. The ice jams can act as a dam and result in flooding. Environmental impacts often include damage to shrubbery and trees due to heavy snow loading, ice build-up and/or high winds which can break limbs or even bring down large trees. While gradual melting of snow and ice provides excellent groundwater recharge, high temperatures following a heavy snowfall can cause rapid surface water runoff and severe flooding. *Figure 33 - Pennsylvania Annual Snowfall 1981-2010* shows mean annual

snowfall in Lebanon County to be between twenty-one and thirty inches. *Table 42 - Recent Annual Snowfall by Snow Station* summarizes annual snowfall accumulation for recent years not covered in *Figure 33 - Pennsylvania Annual Snowfall 1981-2010* as recorded in the weather station in Lock Haven.

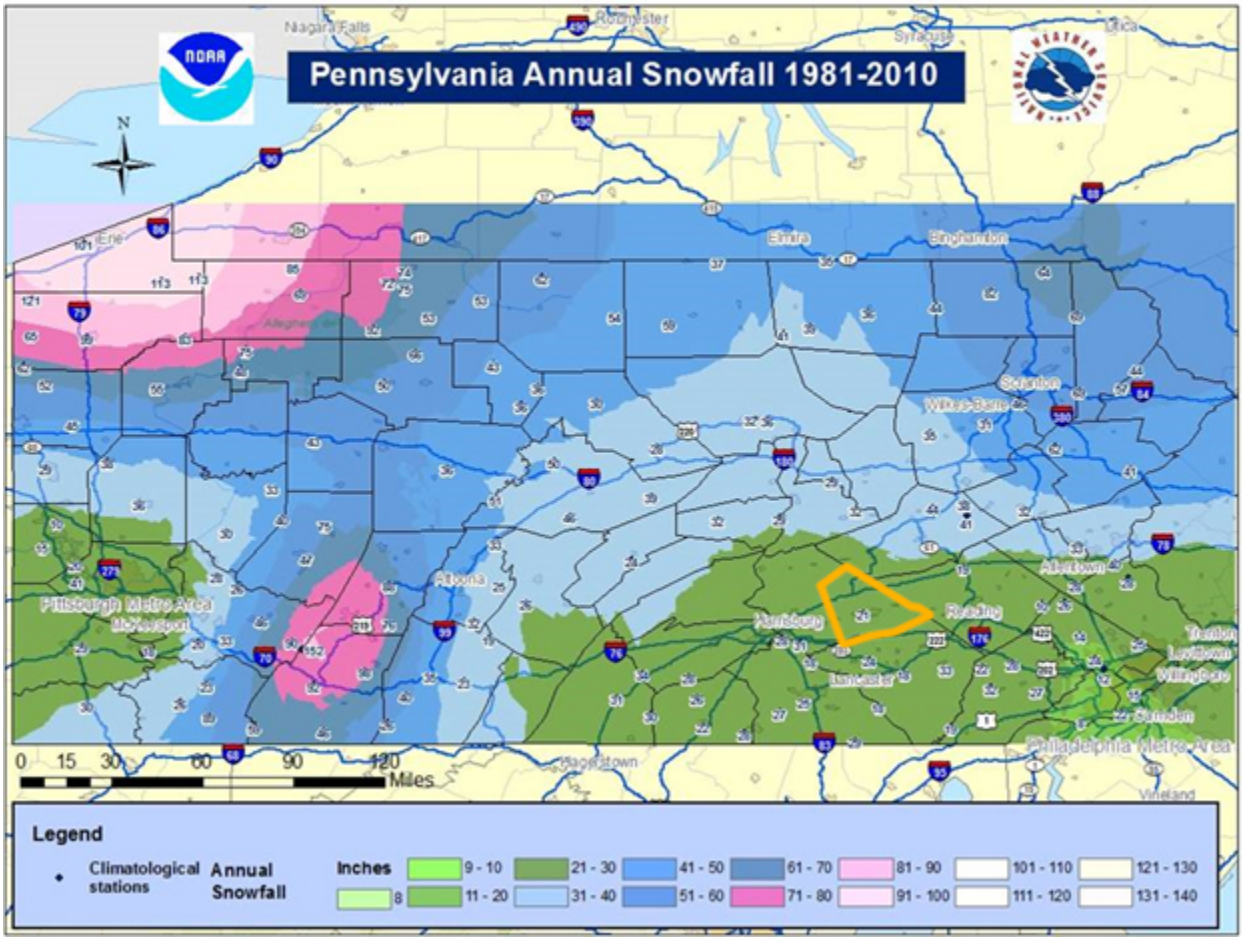
Table 41 - Winter Weather Events

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

Table 42 - Recent Annual Snowfall by Snow Station

Recent Annual Snowfall by Snow Station *(NOAA, 2018)*		
Winter Season	**Meyerstown**	**Lebanon 2 W**
2010-2011	25"	21.8"
2011-2012	9"	13.8"
2012-2013	23"	21.2"
2013-2014	47"	51.8"
2014-2015	40"	40.7"
2015-2016	34"	39.3"
2016-2017	24"	20.1"

Figure 33 - Pennsylvania Annual Snowfall 1981-2010



4.3.12.3 Past Occurrence

Historically, winter storms have occurred on the average of five times a year in Lebanon. One of the most severe winter events in the county's history was in the winter of 1993 – 1994 when the state was hit by a series of protracted winter storms. The severity and nature of these storms combined with accompanying record-breaking frigid temperatures posed a major threat to the lives, safety and well-being of Commonwealth residents and caused major disruptions to the activities of schools, businesses, hospitals, and nursing homes. One of these devastating winter storms occurred in early January 1994 with record snowfall depths in many areas of the Commonwealth, strong winds and sleet/freezing rains. Numerous storm-related power outages were reported and as many as 600,000 residents were without electricity, in some cases for several days at a time. A ravaging ice storm followed which closed major arterial roads and downed many trees and power lines. Utility crews from a five-state area were called to assist in power restoration repairs. Officials from PPL Corporation stated that this was the worst winter storm in the history of the company – related damage-repair costs exceeded $5,000,000.

Serious and sporadic power supply outages continued through mid-January in many locations due to record cold temperatures. The entire Pennsylvania-New Jersey-Maryland grid and its partners in the District of Columbia, New York and Virginia experienced 15-30 minute rolling blackouts, threatening the lives of people and the safety of the facilities in which they resided. Power and fuel shortages affecting Pennsylvania and the East Coast power grid system required the Governor to recommend power conservation measures be taken by all commercial, residential and industrial power consumers. The record cold conditions (with temperatures as low as -31˚F) resulted in numerous water-main breaks and interruptions of service to thousands of municipal and city water customers throughout the Commonwealth. The extreme cold in conjunction with accumulations of frozen precipitation resulted in acute shortages of road salt. Trucks were dispatched to haul salt from New York to expedite deliveries to Pennsylvania Department of Transportation storage sites.

On February 13, 2016, a strong snow squall resulted in whiteout conditions along Interstate 78, triggering a 64-car pileup at mile marker 7.5 in Bethel Township which killed three people and injured 70 others. Interstate 78 was closed for nearly 24 hours after the accident.

All other recorded winter weather events in Lebanon County from 1996-January 2018 are summarized in *Table 41 - Winter Weather Events*. No property damage or direct deaths or injuries were reported for any winter weather events in Lebanon County.

Table 43 - Winter Storm History

Winter Storm History ***(NOAA NCEI, 2018)***		
Date	**Event Type**	**Description**
01/07/96	Blizzard	On January 7th, more than 2 feet of snow fell across much of the lower Susquehanna Valley with 12 to 18 inches falling across the central mountains from Johnstown and State College east to Wilkes-Barre. Parts southern York County had in excess of 3 feet of new snow. The storm was appropriately termed the Blizzard of '96. Snow began falling during the morning of January 7th and continued into the early morning of the 8th. Transportation and commerce came to a halt as cities of south central Pennsylvania were buried under the heavy snow. New snow of 38 inches was reported in southern York County at Glenville. Two feet or more was reported near Harrisburg, Lancaster, Lebanon and York. The storm had a major impact on commerce across south central PA and was to set the stage for the Great Flood on the 19th. Details of the economic impact are included with the summary of the flood.
01/12/96	Heavy Snow	This second major snow storm of the new year for the Susquehanna Valley began less than 5 days after the blizzard of the 7th. Snow began falling across the lower Susquehanna Valley south of Harrisburg during the morning and spread north up the Susquehanna Valley during the afternoon. Nearly a foot of new snow fell in Harrisburg, and snow in excess of 1 1/2 feet fell across areas from Sunbury northward to Muncy and Laporte. Some areas reported snow falling at 2 to 3 inches an hour during the afternoon of the 12th.
02/02/96	Heavy Snow	Heavy snow fell across the lower Susquehanna Region of central Pennsylvania. Up to 8 inches of snow was reported at Elizabethtown in Lancaster County with 6 inches typical from York northeast to Lebanon. Arctic air spread south across the state dropping temperatures well below zero in many areas on the morning of the 3rd. In Kane and Meyersdale temperatures fell to 18 below.

Winter Storm History *(NOAA NCEI, 2018)*		
Date	**Event Type**	**Description**
11/28/96	Heavy Snow	Light snow fell Thanksgiving Day, one of the busiest travel days of the year. Although only 1 to 2 inches fell across the region, there were hundreds of traffic accidents and many injuries. Interstate 78 in Lebanon County was closed for hours.
02/13/97	Winter Storm	3 to 7 inches of snow fell across the area with an ice coating on top.
01/15/98	Ice Storm	
01/02/99	Winter Storm	
01/08/99	Winter Storm	
01/14/99	Winter Storm	
03/14/99	Heavy Snow	
01/25/00	Heavy Snow	
01/30/00	Heavy Snow	
02/13/00	Ice Storm	
02/18/00	Winter Storm	
12/13/00	Winter Storm	
01/20/01	Heavy Snow	
02/05/01	Heavy Snow	
01/06/02	Heavy Snow	
01/19/02	Heavy Snow	
12/05/02	Heavy Snow	
12/10/02	Ice Storm	
12/25/02	Heavy Snow	
02/06/03	Heavy Snow	A low pressure system developed along the central Gulf Coast Thursday afternoon, February 6th, and moved northeast to a position just east of the North Carolina coast by Friday morning, February 7th. A swath of light to moderate snow to the north of the low spread across central Pennsylvania during Thursday evening. The snow continued through Friday morning, and ended around midday. Total snowfall accumulations by midday Friday ranged from 5 to 8 inches across most of the lower Susquehanna Valley. A period of moderate to locally heavy snow occurred around daybreak Friday through the mid-morning hours, adversely impacting the morning commute throughout south central Pennsylvania.
02/16/03	Heavy Snow	A low-pressure system over the lower Mississippi Valley early Sunday morning moved slowly east northeast toward the central Appalachians by Sunday night, February 16th. This low then redeveloped along the North Carolina coast by early Monday morning, February 17th, and then moved slowly northeast as it intensified. This storm system spread light to moderate snow across south central Pennsylvania early Sunday morning, and into much of central and northern Pennsylvania by Sunday evening. The snowfall increased in intensity from late Sunday afternoon into midday Monday, and combined with gusty northeast winds of 15 to 25 mph to create near blizzard conditions at times across south central Pennsylvania. By the time the snow tapered off late Monday night, total snowfall accumulations ranged from 4 to 10 inches across portions of north central Pennsylvania, 12 to 22 inches across the central mountains, and 22 to locally 30 inches across south central Pennsylvania, including much of the lower Susquehanna Valley. This heavy snowfall paralyzed much of central and southern Pennsylvania, closing many schools, businesses, roadways, and airports for at least 1 to 2 days. There were 2 injuries attributed to the storm, both in the Pine Grove Furnace State Park in Cumberland County. Both were youths, and were part of a larger group that were rescued from the park while camping. One youth suffered minor frostbite, and the other suffered minor hypothermia. The other youths and counselors were unharmed.
12/05/03	Heavy Snow	
02/06/04	Ice Storm	
01/22/05	Winter Storm	
03/01/05	Heavy Snow	
12/09/05	Heavy Snow	

Winter Storm History *(NOAA NCEI, 2018)*		
Date	**Event Type**	**Description**
02/12/06	Heavy Snow	A low-pressure system developed along the Gulf Coast on Saturday morning, February 11th, and then tracked northeast to the mid-Atlantic Coast by late Saturday night, before passing off the southern New England Coast by midday on Sunday, February 12th. This storm system spread a swath of heavy snowfall across portions of south central and southeast Pennsylvania during Saturday evening, and continued into early Sunday morning. Storm total accumulations varied considerably across the area, with amounts of 6 to 10 inches falling to the north and west, closer to the Pennsylvania Turnpike, while amounts of 12 to 20 inches were common further south and east. The hardest hit areas were across southern York and Lancaster Counties, where hourly snowfall rates of up to 3 inches per hour, along with thunder and lightning occurred at the height of the storm just after midnight. This storm had a major impact on the hardest hit areas from Sunday into Monday, as numerous roads and businesses were closed. In addition, many schools in York and Lancaster Counties were closed on Monday due to snow removal and cleanup efforts. No major structural damage was reported, despite the heavy snowfall.
02/05/07	Extreme Cold/ Wind Chill	Temperatures in the single digits, combined with west winds of 10 to 20 mph, produced wind chills of 10 to 15 degrees below zero. Gusty west winds and low temperatures combined to produce very low wind chills across the region.
02/13/07	Winter Storm	A major winter storm, the first of the season, struck central Pennsylvania from the early morning hours of the 13th through the afternoon hours of the 14th. In Lebanon County, a mix of sleet and freezing rain fell in addition to 8 inches of snow.
03/16/07	Heavy Snow	A late season winter storm brought 8 to 12 inches of heavy snow to Lebanon County.
12/15/07	Winter Storm	A moderate to heavy coating of ice was common across the entire Lower Susquehanna Valley. Lebanon County emergency management along with trained spotters reported numerous trees and wires down. MetEd electric company reported approximately 64,000 customers without power across the Lower Susquehanna Valley. A brief period of sleet was observed at the onset of precipitation, but the heavy ice build-up was primarily due to freezing rain. The affected counties coordinated with local emergency units and the American Red Cross to establish shelters for residents who were without power.
02/01/08	Winter Storm	A storm system moved north from the Gulf Coast and into the Ohio Valley, then redeveloped over the Mid-Atlantic states. A wintry mix of sleet and freezing rain affected Central Pennsylvania with significant ice accumulations ranging from a quarter to one-half inch. Spotters in Lickdale measured over a quarter inch of ice accretion from freezing rain and sleet.
02/12/08	Ice Storm	Lebanon County emergency management reported a quarter inch of ice accumulation.
01/06/09	Ice Storm	A prolonged period of freezing rain resulted in a significant ice accumulation across much of Central Pennsylvania. Many locations received one quarter to one half inch of ice accumulation. The icing caused sporadic power outages and brought down several tree limbs. Ice accumulation of one quarter to one half inch was reported across Lebanon County.
01/27/09	Winter Storm	An area of low pressure originating along the Gulf Coast moved northeast over the Appalachians, producing a wintry mix of snow, sleet and freezing rain across central Pennsylvania. Heavy snow was observed over the Northwest Mountains with light to moderate snow and sleet accumulations common across the Central Mountains and Susquehanna Valley. Occasional freezing rain and drizzle resulted in a glaze of icing in most locations with significant ice accretion over the Lower Susquehanna Valley. Widespread hazardous winter weather resulted in numerous vehicle accidents and road closures. Sporadic power outages were also reported across the region. One to three inches of snow and sleet along with a significant ice accretion was reported across Lebanon County.
12/19/09	Winter Storm	A major winter storm brought heavy snow to the region from the early morning through the late evening hours. Storm total snow accumulations ranged from six to twelve inches across the Laurel Highlands and south-central mountains. The heaviest snow fell across portions of southeastern Pennsylvania where up to two feet of snow was observed. Storm total snow accumulations ranged from six to eight inches in Lebanon County.
02/05/10	Winter Storm	A major winter storm produced heavy snow across south-central Pennsylvania from the afternoon on the 5th through the late morning on the 6th. Snow accumulation ranged from 6 to 12 inches across the central mountains to 15 to 30 inches over the southern third of the state. A sharp gradient to the snow was observed north of Interstate 80 with little to no accumulation along the New York Border. Storm total snow accumulation ranged from 12 to 15 inches in Lebanon County.

Winter Storm History *(NOAA NCEI, 2018)*		
Date	**Event Type**	**Description**
02/09/10	Winter Storm	A major winter storm produced moderate to heavy snow across much of central Pennsylvania. Snowfall totals generally ranged from 6 to 12 inches over the central mountains and Laurel Highlands to 15 to 25 inches across the lower Susquehanna valley. Near-blizzard conditions were common across most of the area as gusty winds combined with blowing and falling snow to produce very low visibility. Storm total snow accumulation ranged from 10 to 20 inches in Lebanon County.
01/26/11	Heavy Snow	A fast-moving but intense winter storm moved through the region. This system brought moderate to heavy snow to the southern tier of central Pennsylvania, with accumulations ranging between 6 and 10 inches. The rapid strengthening of the surface low pressure system offshore the Mid-Atlantic coast produced thunder-snow and intense snowfall rates within narrow bands wrapping north-westward from the low center. An initial period of light snow occurred early in the morning, followed by a several hour lull in the precipitation. The bulk of the accumulations occurred between 1600 and 2200 EDT. The snow briefly mixed with sleet and freezing rain during the midafternoon in the Lower Susquehanna Valley. Snowfall totals up to 6 inches were observed in the southern half of the county. The bulk of the heavy snow fell during the evening hours, with snowfall rates between 1 and 2 inches per hour.
02/01/11	Winter Storm	A large winter storm brought periods of snow, sleet and freezing rain to central Pennsylvania. The initial round of mixed wintry precipitation (mainly snow and sleet) occurred during the early morning hours on the 1st, before tapering off to spotty freezing drizzle during the afternoon and evening. A steadier and much heavier round of freezing rain mixed with sleet overspread the region from the late evening on the 1st and continued until the early morning on the 2nd. A minor snow and sleet accumulation of 2 to 4 inches was common near and to the north of Interstate 80. Significant ice accumulations between one quarter to three quarters of an inch were observed over nearly the entire area. A large winter storm produced periods of snow, sleet and freezing rain over the area. In Lebanon County, snow and sleet accumulation was around 1 inch on the 1st, with 0.25 to 0.50 inches of ice on the 2nd.
10/29/11	Heavy Snow	An early season, high-impact, winter storm delivered heavy, wet snow to southern and eastern sections of the CWA on Saturday, October 29, 2011. The snow began just after midnight and ended during the evening, leaving a widespread 3 to 8 inches of accumulation with as much as 10 to 12 inches reported over many higher elevations and ridge tops. Despite snowfall rates between 1-2 per hour with convective enhancement in heavier bands, marginally-cold air temperatures in the low to mid 30s combined with warm road/ground temperatures and wetness of the snow reduced accumulations in some areas particularly in the central and southern valleys. Like most early-season snow events, elevation played a significant role in storm total accumulations. A 1010mb low pressure system centered near the Carolina coast during the predawn hours rapidly intensified to as it moved northward just offshore the Mid-Atlantic coast. The storm became a classic Nor'easter and deepened to 984mb as it passed east of Nantucket, Massachusetts. The strengthening low produced wind gusts between 20-30 mph over eastern Pennsylvania and gusts near hurricane force over the open ocean waters near the southern New England coast and Gulf of Maine. In most locations in central Pennsylvania, observed snowfall accumulations set all-time daily and monthly snowfall records for October. The heavy, wet snow produced widespread damage to trees and utility wires. This resulted in more than a half-million (520,000) power outages state-wide at the height of the storm. Warming shelters were opened to accommodate the power outages. Several secondary roads were closed due to the downed trees and wires. The weight of the snow (snow to liquid ratios generally less than 10:1) along with remaining leaf foliage contributed to the significant tree damage. There was one indirect storm-related death in Conewago Township, York County. Snow accumulations ranged from 4 to 8 inches in Lebanon County.
12/14/13	Winter Storm	Light snow started in the morning and became heavy at times through the afternoon and evening. Snow changed to sleet and then freezing rain/drizzle with a over a quarter inch of ice topping storm total snow accumulations between 2 and 4 inches. The mixed wintry precipitation adversely impacted travel especially along I-81.

Winter Storm History *(NOAA NCEI, 2018)*		
Date	**Event Type**	**Description**
02/03/14	Heavy Snow	A fast-moving low-pressure system streaked across the Central Appalachians and southern Mid-Atlantic states on 2-3 February 2014, producing a stripe of moderate to heavy snow on the northwest side of the low track over southern Pennsylvania. The heavy snowfall was aided by the placement of a coupled upper-level jet and strong low-mid level warm advection/isentropic lift. A general 4 to 8 inches of snow was common along and south of the US22/I-81 corridors, with 2-4 inches to the north from US22 to I-80. Heavy snow accumulations ranged from 4 to 8 inches in Lebanon County.
02/04/14	Winter Storm	Snow accumulations ranged from 1 to 2 inches. Ice accumulations from sleet and heavy freezing rain averaged between 0.25 and 0.50 inch.
02/13/14	Heavy Snow	The largest snow-producing storm of the 2013-2014 winter season affected much of central Pennsylvania on 13 February 2014. The heavy snow was produced by a strong coastal low-pressure system that moved northeastward from the Virginia Capes over the Delmarva peninsula. A heavy deformation snow band pivoted slowly to the northwest during the day and persisted over the central zones into the evening before dissipating. The snow ended across the region by midnight on 14 February 2014. Total snow accumulations generally ranged from 12 to 18 inches over the south-central and lower Susquehanna Valley zones with locally higher amounts (21.6 inches in Glencoe, Somerset County; 19.5 inches in Shrewsbury, York County). Snow amounts of 6 to 12 inches fell over the central ridge-valley region into the mid/upper Susquehanna valley, while 2 to 5 inches were common reports in the northwest mountains. Storm total snow accumulations ranged from 8 to 12 inches in Lebanon County.
11/25/14	Heavy Snow	A frontal wave of low pressure that originated in the Gulf of Mexico developed into a strong coastal storm as it moved northeast just off the East Coast. This high-impact system brought a wet, moderate-to-heavy snowfall to much of Central Pennsylvania which wreaked havoc on Thanksgiving holiday travelers. The snow expanded from south to north during the early to mid-morning hours and continued, heavy at times, through the afternoon before tapering off in the evening. Snowfall amounts generally ranged from 4 to 8 inches with locally higher amounts around a foot on the ridge tops near South Mountain. The precipitation began as rain for areas to the southeast of I-81 before changing to snow, which cut down on storm total amounts. Numerous state offices and schools were closed, and multiple flights were delayed or cancelled. The storm could not have come at a worse time on what is typically one of the busiest travel days of the year (day before Thanksgiving). Williamsport set a daily snowfall record of 4.8 inches, which broke the previous record of 1.8 inches set in 2013. The storm made the NESIS scale as a category 1. A high-impact snowfall of 2 to 4 inches affected the area basically from dawn to dusk. Lower amounts were observed southeast of I-81.
02/15/15	Extreme Cold/Wind Chill	An arctic airmass combined with gusty winds resulted in frigid temperatures and extremely dangerous wind chills across central Pennsylvania. Extreme cold combined with gusty winds resulted in wind chill or apparent temperature values in the -25 degrees to -35-degree range.
01/22/16	Winter Storm	A Nor'easter produced record-breaking snowfall across portions of southern Pennsylvania, with a large swath of 20+ inches of snow and localized areas of 30+ inches of accumulation. There was a sharp gradient in snowfall accumulation amounts from south to north across central Pennsylvania, with Harrisburg receiving two and a half feet of snow while Williamsport only had a trace. The storm was rated as a Category 4 (Crippling) on the Regional Snowfall Index for the northeastern United States. Four indirect fatalities resulted from the storm in the CTP CWA. PA Governor Wolf declared a Proclamation of Disaster Emergency for Winter Storm 1/22-24/16. There are ten counties with declarations: Adams, Bedford, Blair, Cumberland, Lancaster, Lebanon, Perry, Schuylkill, and York. Heavy snowfall amounts of 24 to 31 inches were observed across the county.
02/13/16	Winter Weather	A snow squall combined with blowing snow produced sudden whiteout conditions along Interstate 78 in Lebanon County at mile marker 7.5 in Bethel Township) on Saturday morning, February 13, 2016. The rapid change in conditions and visibility resulted in a 64-car pileup that killed three people, injured 70 and closed I-78 for nearly 24 hours.

Winter Storm History *(NOAA NCEI, 2018)*		
Date	**Event Type**	**Description**
02/15/16	Winter Storm	A winter storm developed over the Gulf Coast states and tracked northeastward up the spine of the Appalachians and across central Pennsylvania from Monday, February 15 to Tuesday, February 16, 2016. This storm spread a couple inches of snow across central Pennsylvania on Monday, which changed over to a wintry mix of sleet and freezing rain Monday night. Much of central PA changed over to plain rain on Tuesday, although Warren and McKean counties changed back to snow as colder air wrapped in behind the departing system. Northwestern PA received significant snowfall, while portions of central PA received significant icing. A quarter of an inch or more of ice accumulation was observed across the county.
03/13/17	Winter Storm	A Miller-B East Coast winter storm affected the mid-Atlantic and northeastern United States over this two-day period, producing heavy snow for the interior and snow to sleet to rain closer to the coast. Portions of central Pennsylvania received nearly two feet of snowfall, with much of the CTP CWA receiving warning-criteria snow. A winter storm produced 12-16 inches of snow across Lebanon County.

4.3.12.4 Future Occurrence

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

Winter storms are a regular, annual occurrence in Lebanon County and should be considered highly likely. Approximately thirty-five winter storm events occur across Pennsylvania annually and about five of which are estimated to significantly impact Lebanon County each year. *Table 44 - Probability of Measurable Snowfall by Snow Station* shows the normal monthly in Lebanon County and is based on data collected over a thirty-year period (NOAA, 2018).

Table 44 - Probability of Measurable Snowfall by Snow Station

Probability of Measurable Snowfall by Snow Station *(NOAA, 2017)*		
MONTH	**Normal Monthly Snowfall (inches)**	
	Renovo	**Myerstown**
January	12.7	4.6
February	11.4	8.3
March	8.8	2.9
April	1.7	0.2
May	0	0
June	0	0
July	0	0
August	0	0
September	0	0
October	0.5	0
November	3.1	0.6
December	8.1	4.6
Annual	46.3	21.2

4.3.12.5 Vulnerability Assessment

Winter storms are a frequent event in the county. Detrimental impacts of severe winter storms are mitigated by salting, plowing and snow removal by PennDOT and local municipalities. Icy and snow-covered roads often result in increases in traffic incidents. Swift response to utility outages during winter storms is another significant way to mitigate damages. Residents of the mountainous and more rural areas of the county may be more susceptible during severe storms, especially when emergency medical assistance is required due to the location's potential for isolation. There are rural areas which are susceptible to isolation due to winter storms. Residents in outlying areas often find it beneficial to keep an emergency food and fuel stock in the event of isolation or utility interruption during a winter storm.

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

4.3.13. Civil Disturbance

4.3.13.1 - Location and Extent

The scale and scope of civil disturbance events varies widely. However, government facilities, local landmarks, prisons, and universities are common sites where crowds and mobs may gather.

4.3.13.2 - Range of Magnitude

Civil disturbances can take the form of small gatherings or large groups blocking or impeding access to a building or disrupting normal activities by generating noise and intimidating people. They can range from a peaceful sit-in to a full-scale riot, in which a mob burns or otherwise destroys property and terrorizes individuals. Even in its more passive forms, a group that blocks roadways, sidewalks, or buildings interferes with public order. There are two types of large gatherings typically associated with civil disturbances: a crowd and a mob. A crowd may be defined as a casual, temporary collection of people without a strong, cohesive relationship. Crowds can be classified into four categories:

- **Casual Crowd**: A casual crowd is merely a group of people who happen to be in the same place at the same time. Violent conduct does not occur.
- **Cohesive Crowd**: A cohesive crowd consists of members who are involved in some type of unified behavior. Members of this group are involved in some type of common activity, such as worshipping, dancing, or watching a sporting event. Although they may have intense internal discipline, they require substantial provocation to arouse to action.
- **Expressive Crowd**: An expressive crowd is one held together by a common commitment or purpose. Although they may not be formally organized, they are assembled as an expression of common sentiment or frustration. Members wish to be seen as a formidable influence. One of the best examples of this type is a group assembled to protest.
- **Aggressive Crowd**: An aggressive crowd is comprised of individuals who have assembled for a specific purpose. This crowd often has leaders who attempt to arouse the members or motivate them to action. Members are noisy and threatening and will taunt authorities. They may be more impulsive and emotional and require only minimal stimulation to arouse violence. Examples of this type of crowd could include demonstrators and strikers, though not all demonstrators and strikers are aggressive.

A mob can be defined as a large disorderly crowd or throng. Mobs are usually emotional, loud, tumultuous, violent and lawless. Similar to crowds, mobs have different levels of commitment and can be classified into four categories:

- **Aggressive Mob**: An aggressive mob is one that attacks, riots and terrorizes. The object of violence may be a person, property, or both. An aggressive mob is distinguished from an aggressive crowd only by lawless activity. Examples of aggressive mobs are the inmate mobs in prisons and jails, mobs that act

out their frustrations after political defeat, or violent mobs at political protests or rallies.

- **Escape Mob**: An escape mob is attempting to flee from something such as a fire, bomb, flood, or other catastrophe. Members of escape mobs are generally difficult to control can be characterized by unreasonable terror.
- **Acquisitive Mob**: An acquisitive mob is one motivated by a desire to acquire something. Riots caused by other factors often turn into looting sprees. This mob exploits a lack of control by authorities in safeguarding property.
- **Expressive Mob**: An expressive mob is one that expresses fervor or revelry following some sporting event, religious activity, or celebration. Members experience a release of pent up emotions in highly charged situations.

A possible worst-case scenario would be an aggressive mob demonstration in Lebanon City, or North Lebanon Township, the two most populated municipalities in the county.

4.3.13.3 - Past Occurrence

Recorded events of civil disturbances for Lebanon County are minimal. Lebanon County has experienced two minor riots. The Cuban Riot of 1980 involved 200 Cuban refugees at Fort Indiantown Gap in Union Township. In 1983, a riot in the city of Lebanon began as an isolated fight but spread to encompass several city blocks. Two civil disturbances have occurred at the Lebanon County Correctional Facility in South Lebanon Township. The incidents were minor and occurred in 1991 and 1993. There are no other recorded events of civil disturbances in Lebanon County.

4.3.13.4 - Future Occurrence

Civil disturbances may occur in Lebanon County, but it is not possible to accurately predict the probability of future occurrence for civil disturbance events over the long-term. However, it may be possible to recognize the potential for an event to occur in the near-term. Although it is improbable, Lebanon County is most likely to experience civil disturbance in the form of protests, faculty union strikes, or sporting event rivalry based on the number of residents who either attend or are employed at both Lebanon Valley College (LVC) and Harrisburg Area Community College (HACC) – Lebanon Campus. Overall, the probability of future civil disturbances is considered as unlikely according to the Risk Factor Methodology. An overall risk factor of 1.3 has been determined by the local planning team using this methodology.

4.3.13.5 - Vulnerability Assessment

All municipalities in Lebanon County are vulnerable to civil disturbance.

Critical facilities located in Lebanon City, and North Lebanon Township (*Table 23 - Critical Facilities Vulnerable to Flooding* shows those facilities that are at risk) are most vulnerable to civil disturbances due to the relatively high population density. Civil disturbances can range from minor to significant events that can disrupt the functioning of a

community for weeks or months. Adequate law enforcement should be present to minimize the chances of a small assembly of people turning into a civil disturbance.

4.3.14 Dam Failure

See Appendix I for Dam Failure

4.3.15. Environmental Hazards

4.3.15.1 Location and Extent

With the constant production, storage, use and transportation of hazardous materials; a release from these chemicals poses a threat to Lebanon County. Hazardous materials include flammable liquids, solids, and gases, combustible liquids, explosives, blasting agents, radioactive materials, oxidizing materials, corrosive materials, poisons, refrigerated liquids, hazardous waste/substances, and other regulated materials.

One of the nation's leading industrial trade complexes, located in the City of Philadelphia and the Delaware Valley Region, is less than 100 miles southeast of Lebanon County. Hazardous materials are transported through numerous means into, out of, and through Lebanon County. The transportation of these hazardous materials poses a greater risk than a release from a fixed facility, due to the inherent dangers to residential areas. However, the carriers of hazardous materials must have response plans in place in the event of an accident.

In Pennsylvania, any facility that uses, manufactures, or stores hazardous materials must comply with the Title III of the Superfund Amendments and Reauthorization Act (SARA). This is also known as the Emergency Planning and Community Right-to-Know Act (EPCRA). These facilities must also comply with the reporting requirements, as amended, in Pennsylvania's hazardous materials Emergency Planning and Response Act (1990-165). The community right-to-know reporting requirements keep communities abreast of the presence and release of chemicals at individual facilities. EPCRA was designed to ensure that state and local communities are prepared to respond to potential chemical accidents through Local Emergency Planning Committees (LEPCs).

LEPCs are charged with developing emergency response plans for SARA Title III facilities; these plans cover the location and extent of hazardous materials, establish evacuation plans, response procedures, methods to reduce the magnitude of a materials release, and establish methods and schedules for training and exercises. Information about the chemicals that are being manufactured or processed in facilities can be found in the U.S. Environmental Protection Agency's (USEPA) Toxic Release Inventory (TRI) database (https://www.epa.gov/enviro/geospatial-data-download-service). There are additional resources at this site as listed below:

- Superfund National Priorities List sites,
- RCRA Info (EPA and state treatment, storage, disposal) facilities,

- Toxic Release Inventory System (TRI) sites,
- Integrated Compliance Information System and Permit Compliance System – National Pollutant Discharge Elimination System Majors,
- RCRA Info – Large Quantity Generators,
- Air Facility System – Major discharges of air pollutants,
- RCRA Info – Corrective Actions,
- Risk Management Plan,
- Section Seven Tracking System Sites (Pesticides),
- ACRES – Brownfields Properties.

Transportation hazards include:

- Highways – tanker trucks or trailers are responsible for the greatest number of hazard material release incidents.
- Railways – collisions and derailments result in large spills.

A list of each municipality and the number of SARA Tier II facilities is listed in *Table 45 - Lebanon County SARA Tier II Facilities*:

Table 45 - Lebanon County SARA Tier II Facilities

Lebanon County SARA Tier II Facilities	
Municipality	**SARA Tier II Facilities**
Annville Township	11
Bethel Township	1
City of Lebanon	30
Cleona Borough	1
Cold Spring Township	0
Cornwall Borough	3
East Hanover Township	2
Heidelberg Township	6
Jackson Township	12
Jonestown Borough	1
Millcreek Township	3
Mount Gretna Borough	0
Myerstown Borough	5
North Annville Township	1
North Cornwall Township	1
North Lebanon Township	9
North Londonderry Township	1
Palmyra Borough	12
Richland Borough	4
South Annville Township	3
South Lebanon Township	14
South Londonderry Township	3
Swatara Township	1
Union Township	5
West Cornwall Township	5
West Lebanon Township	2
Total	**136**

4.3.15.2 Range of Magnitude

A hazardous materials release can contaminate air, water and soils, with the possibility of causing injuries and/or deaths. Releases can occur as a result of human carelessness, intentional acts, or as a secondary event from a natural hazard. Hazardous materials can include toxic chemical, radioactive materials, infectious substances and hazardous wastes. Such releases can affect nearby populations and contaminate critical or sensitive environmental areas, such as wetlands or watersheds.

The greatest threat would be from a hazardous material spill in a populated area that may result in loss of life and will impact both the environment and the economy. Major transportation routes, connector roads and major railroad corridors maximize the threat of hazardous material spills. Roadways in Lebanon County include: I-81, I-78, and I-76, as well as U.S. Routes 22, 322, 422, and PA State Routes 72, 117, 241, 343, 419, 441, 443, 501, 897, and 934.

Lebanon County has a major railroad corridor that runs through the county, and also the highest populated area of the county. Due to the railway location and population density, a derailment or accident that produces a hazardous materials release could cause catastrophic injuries and/or deaths. Evacuation of the endangered population would be difficult and extensive. Lebanon County EMA is constantly reviewing and planning for these types of scenarios.

4.3.15.3 Past Occurrence

The National Response Center lists 150 hazardous materials instances occurring in Lebanon County between 1990 and February 2013. Most hazardous spills occur on highways.

Lebanon County 911 CAD reports for hazardous materials incidents from January 2014 to January 2018 are shown in *Table 46 - Hazardous Materials Incidents.*

Table 46 - Hazardous Materials Incidents

Hazardous Materials Incidents		
Date	**Location**	**Municipality**
10-16-14	132 Magnetite Ln.	Cornwall Borough
11-25-14	120 Interstate 78 E.	Union Township
12-27-14	117 S. Harris Street	Cleona Borough
01-20-15	8300 Interstate 81 S.	East Hanover Township
01-24-15	State Route 322 / Boyd Street	Cornwall Borough
01-27-15	29 Maple Street	City of Lebanon
02-16-15	154 W. Main Street	Bethel Township
05-06-15	200 Interstate 78 W.	Union Township
06-18-15	113 Lynmar Avenue	South Londonderry Township
07-27-15	302 E. Evergreen Road	South Lebanon Township
08-21-15	9270 Interstate 81 S.	Swatara Township
08-23-15	322 E. Pershing Avenue	City of Lebanon
09-09-15	1005 Cumberland Street	City of Lebanon

Hazardous Materials Incidents		
Date	**Location**	**Municipality**
11-07-15	840 N. 7th Street	City of Lebanon
11-20-15	690 Interstate 78 E.	Bethel Township
01-08-16	638 Union Street	City of Lebanon
02-01-16	7 Bachmanville Road	South Londonderry Township
02-16-16	730 E. Walnut Street	South Lebanon Township
04-04-16	3050 Hanford Drive	North Lebanon Township
04-07-16	9300 Interstate 81 N.	Swatara Township
04-23-16	210 N. Franklin Street	Palmyra Borough
05-24-16	3050 Hanford Drive	North Lebanon Township
06-03-16	9280 Interstate 81 S.	Swatara Township
06-12-16	221 N. 8th Street	City of Lebanon
07-09-16	8 Geesaman Park Lane	Bethel Township
07-25-16	8650 Interstate 81 S.	East Hanover Township
07-27-16	208 Maple Street	City of Lebanon
08-21-16	Oak Street/ Bollman Street	City of Lebanon
09-20-16	W. Main Street/ N. Sheridan Road	Millcreek Township
10-14-16	452 Ebenezer Road	North Lebanon Township
11-04-16	300 Interstate 78 E.	Swatara Township
11-15-16	S. College Street/ W. Richland Avenue	Myerstown Borough
12-01-16	804 E. Main Street	Annville Township
12-02-16	Bullfrog Road/ Allentown Blvd.	East Hanover Township
12-07-16	180 Lickdale Road	Swatara Township
12-17-16	9400 Interstate 81 S.	Swatara Township
12-18-16	100 W. Main Street	Palmyra Borough
04-13-17	400 S. 8th Street	City of Lebanon
05-01-17	2609 State Route 22	Bethel Township
06-02-17	2512 Cornwall Road	Cornwall Borough
06-26-17	343 King Street	Jackson Township
06-30-17	8700 Interstate 81	East Hanover Township
07-06-17	200 Rexmont Road	Cornwall Borough
07-11-17	8500 Interstate 81 N.	East Hanover Township
07-18-17	3875 Stiegel Pike	Heidelberg Township
08-20-17	1665 Meadow Lane	South Annville Township
08-30-17	509 Green Tree Vlg.	City of Lebanon
09-25-17	10362 Allentown Blvd	East Hanover Township
10-20-17	2401 W. Walnut Street	North Cornwall Township
10-27-17	Elizabethtown Road/Mount Wilson Road	South Londonderry Township
11-06-17	100 N. Harris Street	Cleona Borough
11-07-17	2373 Quarry Road	Swatara Township
11-09-17	2375 Quarry Road	Swatara Township
11-28-17	590 S. 5th Avenue	South Lebanon Township
12-20-17	Palmyra Bellegrove Road/Steelstown Rd.	North Annville Township
12-23-17	9275 Interstate 81 N.	Swatara Township
12-30-17	8790 Interstate 81 S.	Union Township
01-03-18	336 S. 9th Street	City of Lebanon
01-12-18	412 N. 5th Street	City of Lebanon
01-18-18	Horseshoe Pike/W. Main Street	West Cornwall Township

Over the span of the last four years, there has been at least one hazardous materials incident in twenty of the twenty-six municipalities in Lebanon County; the municipalities that did not have any hazardous materials incidents are:

- Cold Spring Township
- Jonestown Borough
- Mount Gretna Borough
- North Londonderry Township
- Richland Borough
- West Lebanon Township

Of these six municipalities, there are two: Cold Spring Township and Mount Gretna Borough; that do not have a SARA Tier II facility within their boundaries.

4.3.15.4 Future Occurrence

Lebanon County has the possibility of experiencing environmental hazards annually. With transportation hazardous material spills occurring more frequently than releases occurring from a fixed facility. It is extremely difficult to predict a transportation hazardous materials incident; weather conditions, roadway and/or railway conditions, and other human factors impact the occurrence of these incidents.

Environmental hazards from a release at a fixed facility does not occur as frequent as transportation incidents. The Local Emergency Planning commission (LEPC) for Lebanon County maintains and updates emergency plans for SARA Title III facilities throughout the county. Lebanon County LEPC also identified the facilities that must report the Tier II chemicals for their facility through the Hazardous Materials Emergency Planning and Response Act (1990-165) as amended.

Municipalities along the southwestern border of Lebanon County are in the “at-risk area” for Three Mile Island, in Dauphin County. Additionally, the county is located within the 50-mile ingestion pathway zone of Peach Bottom and Limerick nuclear power plants. Nuclear incidents are discussed in more detail in Section 4.3.16 of this report.

4.3.15.5 Vulnerability Assessment

Areas around major transportation routes are at a greater vulnerability to hazardous material spills and releases. Major transportation routes in Lebanon County are 1-81, I-78, I-76, U.S. Routes 22, 422, and 322, and State Routes 72, 501, and 934. There is also a railroad system that bisects the county. While transportation incidents alone do not pose a significant threat, hazardous material spills that happen as a result of accidents on these transportation routes endanger other drivers, local residents, and the environment.

A hazardous materials spill can be the result of human carelessness, an intentional act, or a natural hazard. Human carelessness occurs predominantly during the manufacturing, transporting, or storing of the material(s). An intentional act would be considered either a terrorist act, criminal act, or an act of vandalism.

4.3.16. Nuclear Incidents

4.3.16.1 Location and Extent

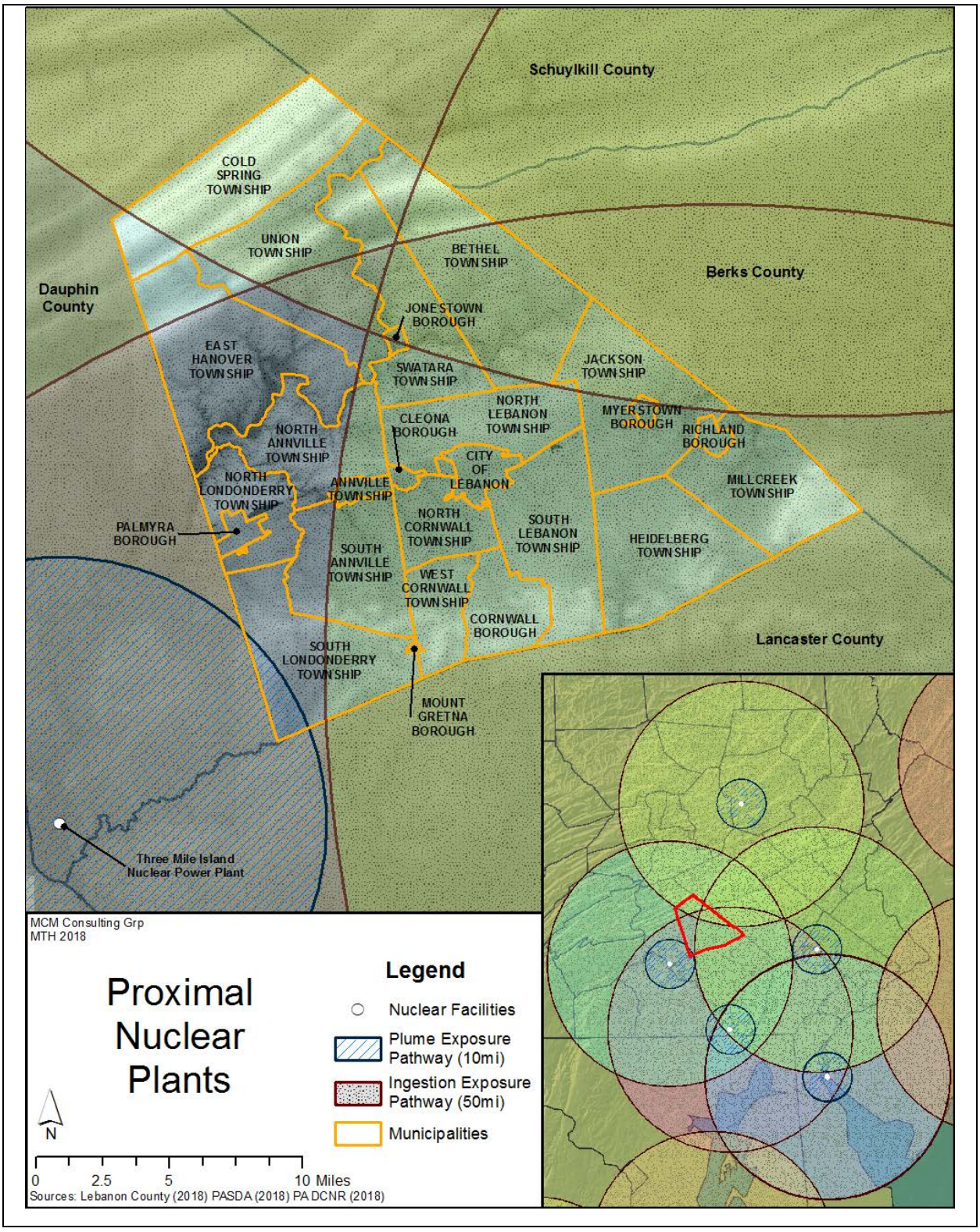
For planning purposes, FEMA and the Nuclear Regulatory Commission (NRC) have defined the plume exposure pathway for emergency planning zone (EPZ); also known as an "at risk area", consisting of an area about ten miles in radius and an ingestion pathway (EPZ) of about 50 miles in radius around each nuclear power plant. Emergency planning zones size and configuration may vary in relation to local emergency response needs and capabilities as affected by such conditions as demography, topography, land characteristics, access routes, evacuation routes, and jurisdictional boundaries. Counties within the ingestion exposure pathway are considered "support counties". FEMA and the NRC's requirements for emergency planning are contained in Title 10 of the Code of Federal Regulations, Part 50.47.

The Pennsylvania Emergency Management Agency (PEMA), in conjunction with the Commonwealth's at-risk counties, has identified the specific EPZ around each of the five nuclear power plants in Pennsylvania: Beaver Valley (Beaver County), Limerick (Montgomery County), Peach Bottom (York County), Susquehanna (Luzerne County), and Three Mile Island (Dauphin County).

Municipalities along the southwestern border of Lebanon County, closest to Three Mile Island, would be the area most severely affected by a nuclear accident; as they are located in the "at risk area". These municipalities could also experience a potentially catastrophic impact form radionuclide contamination to structures, facilities, and critical infrastructure. The disruption of essential services in these areas could also have a significant impact, with the greatest environmental impact in the western and southern municipalities of the county.

Additionally, Lebanon County is located within the 50-mile ingestion pathway zone of two other nuclear power plants: Peach Bottom and Limerick. The following map illustrates the location of Pennsylvania's five nuclear power plants and their respective 50-mile emergency planning zones, *Figure 34 - Nuclear Power Plants in Pennsylvania*.

Figure 34 - Nuclear Power Plants in Pennsylvania



4.3.16.2 Range of Magnitude

The effects and impacts of a nuclear threat depend on the type of radiation released, the duration of the release, the volume of the release, and the existing weather conditions, such as wind speed and direction. Since Lebanon County is located within the 10-mile "at-risk area" for the Three Mile Island facility, located in Dauphin County, the greatest threat and highest impact would be to the health and safety of the citizens. Additionally, the potential exists for catastrophic impacts on property, facilities, infrastructure, essential services the environment, and the county's economy.

Power failure is the most common secondary effect of a nuclear incident. More serious secondary effects would include public health emergencies resulting from widespread radionuclide ingestion and/or radiation fallout. Radionuclide ingestion by domesticated and farm animals could force agricultural product embargos, placing severe strain on the economy. Radiological particulate contamination of the environment may impact natural resources, disrupt service delivery, and cause work cessation and evacuations. Other response measurers could damage the county's economy as a result form the event.

The Nuclear Regulatory Commission (NRC) reexamined the role of emergency planning for protection of the public in the vicinity of nuclear power plants following the accident at Three Mile Island in 1979. The NRC issued regulations requiring that, before a plant could be licensed to operate, the NRC must have "reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency". Sixteen emergency planning standards were set forth with these regulations and define the responsibilities of licensees and state and local organizations involved in emergency response. The added feature of emergency planning to the NRC's "defense-in-depth" philosophy provides that, even in the unlikely event of a release of radioactive materials to the environment, there is reasonable assurance that actions can be taken to protect the population around nuclear power plants.

Pennsylvania is home to the worst nuclear facility accident in the history of the nation, with effects felt nationwide. Following the March 28, 1979 accident at Three Mile Island, state, county, and municipal entities designed plans for handling future accidents so that safety could be assured for all residents. However, many "unusual events" and "alerts" occur every year at the 100+ nuclear facilities across the nation. The NRC has four classification levels and are shown in *Table 47 - Emergency Classification Levels.*

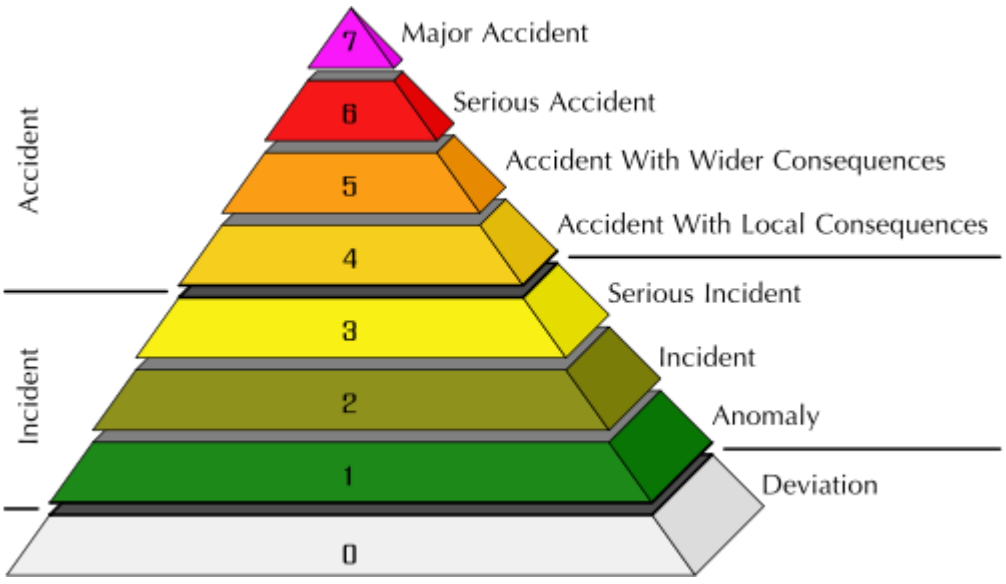
Table 47 - Emergency Classification Levels

Emergency Classification Levels	
Notification of Unusual Event	This is the lease serious of the four levels. The event poses no threat to you or plant employees, but emergency officials are notified. No action by the public is necessary.
Alert	An alert is declared when an event has occurred that could reduce the plant's level of safety, but backup systems still work. Emergency agencies are notified and kept informed, but no action by the public is necessary.
Site Area Emergency	A Site Area Emergency is declared when an event involving major problems with the plant's safety systems has progressed to the point that a release of some radioactivity into the air or water is possible but is not expected to exceed Environmental Protection Agency Protective Action Guidelines (PAGs) beyond the site boundary. Thus, no action by the public is necessary.
General Emergency	This is the most serious of the four classifications and is declared when an event at the plant has caused a loss of safety systems. If such an event occurs, radiation could be released that would travel beyond the site boundary. State and local authorities will take action to protect the residents living near the plant. The alert and notification system will be sounded.

4.3.16.3 Past Occurrence

Lebanon County is classified as a "support county" due to Three Mile Island being in Dauphin County. The March 28, 1979 accident at Three Mile Island was a partial nuclear meltdown in one of the two nuclear reactors, Unit 2. It has the classification of the worst accident in U.S. commercial nuclear power plant history. This accident was rated a five on the seven-point International Nuclear Event Scale: Accident with wider consequences, see *Figure 35 - International Nuclear and Radiological Event Scale*. As a result of the accident, Unit 2 was shut down in 1979.

Figure 35 - International Nuclear and Radiological Event Scale



4.3.16.4 Future Occurrence

Unit 1 at Three Mile Island is licensed to operate until April 19, 2034 and has had the following safety issues:

- Ground water leaks – radioactive water can be released and make its way onto public lands and into drinking water supplies.
- Flooding hazard – nuclear power plants are built next to rivers, lakes, and oceans because they require vast quantities of cooling water to carry away the large amounts of waste heat they produce. Reactors along rivers occasionally have one or more dams located upriver. If a dam fails, the ensuing flood waters could overwhelm the plant's protective barriers.
- Year plus outages – Nuclear reactors may be shut down for long periods of time. The majority of such occurrences resulted from numerous violations of federal regulations that require plant owners to find and fix safety problems in a timely, effective manner, coupled with the government's inability to detect those violations.

Since the 1979 accident at Three Mile Island, nuclear power has become one of the safest and most heavily regulated industries in the nation. The frequency of nuclear accidents in the United States, and more specifically Lebanon County, is extremely low and unlikely. Even though the probability of another incident is unlikely, the impact of an incident is catastrophic.

4.3.16.5 Vulnerability Assessment

The majority of Lebanon County is within the 50-mile ingestion pathway (EPZ) of the three nuclear power plants identified above, with many municipalities lying in the path of more than one nuclear power plant emergency planning zone.

Following an accident, the primary nuclear exposure for the immediate area around a nuclear power plant could last from hours to months. The health of the citizens in the surrounding area is the primary immediate concern. Next, is the long-term impact on the environment. Livestock, livestock by-products, and crops can be contaminated for many years after a nuclear incident. The health effects reported from the psychological stress of individuals living in the immediate area will strain stress management and disaster psychology resources to the limit.

4.3.17. Opioid Epidemic

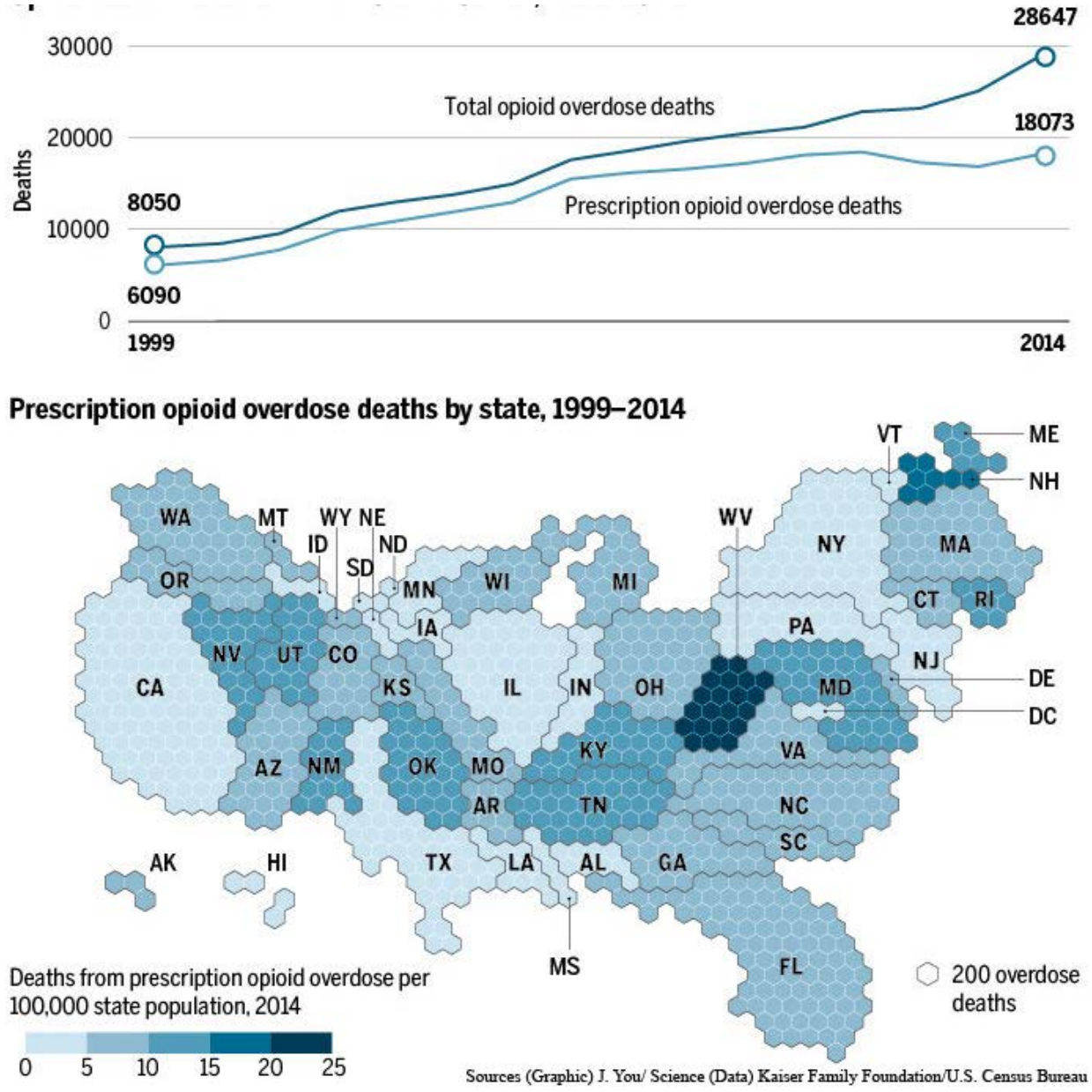
4.3.17.1 Location and Extent

Opioids are a class of drugs that interact with receptors on nerve cells in the body and brain, producing euphoria and pain relief. (NIH, 2017) Opioid drugs are highly addictive, and the Commonwealth and Country at large have been experiencing an epidemic of opioid addiction and abuse, resulting in increasing numbers of overdose deaths from both prescribed (e.g. fentanyl) and illicit (e.g. heroin) opioids (see *Figure 36 - US Opioid*

Deaths 1999-2014 (Science, 2016)). Overdose deaths from opioids occur when a large dose slows breathing, which can be especially likely when opioids are combined with alcohol or antianxiety drugs. While generally prescribed with good intentions, opioids can often be over-prescribed, resulting in addiction due to their highly addictive nature.

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

Figure 36 - US Opioid Deaths 1999-2014 (Science, 2016)



4.3.17.2 Range of Magnitude

According to the CDC, more than 140 Americans die every day from an opioid overdose. In 2014, 2,742 overdose deaths were reported across Pennsylvania. This number increased to 3,376 reported overdose deaths in 2015, an increase of 23.4 percent (DEA, 2015). Reported overdose deaths increased again in 2016 to 4,642, an increase of 37 percent from 2015 (DEA & PITT, 2017). Pennsylvania ranked 8th in the country for overdose deaths in 2014 at 21.9 deaths per 100,000 people (DEA, 2015).

4.3.17.3 Past Occurrence

For both years of 2014 and 2015, Lebanon County had 10.14 overdose deaths per 100,000 people per year, with fewer than ten recorded overdose deaths occurring in the county each year (DEA, 2015). *Table 48 - Overdose Death History* shows overdose deaths per 100,000 people in the year 2016 for Pennsylvania by County. *Figure 37 - Top 10 Drugs Present in 2016 Overdose Deaths (DEP & PITT, 2017)* shows the most prevalent drugs present in drug-related overdose deaths that occurred in Lebanon County in 2016, with Heroin and Fentanyl being the most frequently observed. *Table 48 - Overdose Death History* shows recorded overdose deaths in Lebanon County as reported by the Lebanon County Coroner.

Table 48 - Overdose Death History

Overdose Death History (Overdose Free PA, 2018; Lebanon County Coroner, 2018)			
Year	**Overdose Deaths**	**Overdose Deaths / 100,000 People**	**Overdose Deaths / 100,000 People PA Wide**
2014	15	Data Not Available	21.9
2015	20	14.4	26.7
2016	16	12	36.5
2017	27	Data Not Available	Data Not Available

Figure 37 - Top 10 Drugs Present in 2016 Overdose Deaths (DEP & PITT, 2017)

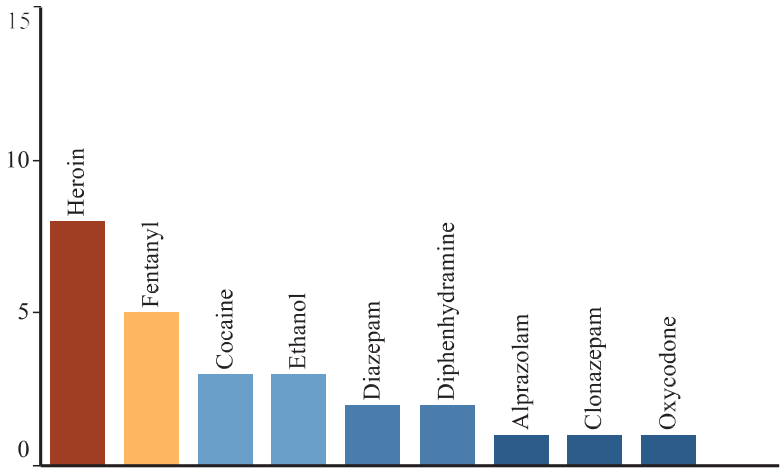
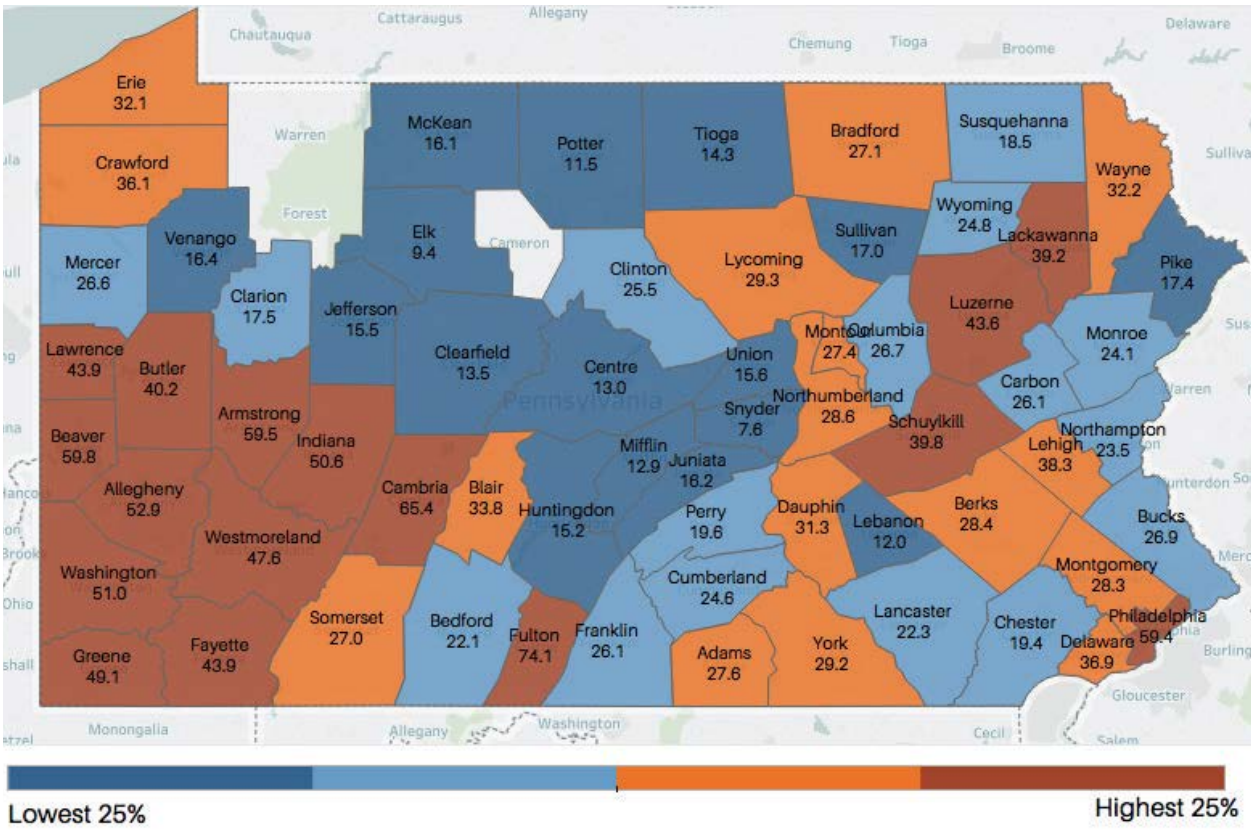


Figure 38 - PA Opioid Overdose Deaths 2016 (DEA, 2017)



4.3.17.4 Future Occurrence

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

Rather than reduce pain, in some cases high doses of opioid painkillers can actually increase pain due to a phenomenon known as opioid-induced hyperalgesia (OIH). It is however difficult to know how much of an influence OIH has on the opioid epidemic.

Some researchers think that OIH could be increasing patients' pain and in turn, increasing their dosages and dependence on opioid drugs, suggesting that patients should work with lower dosages of opioids (Servick, 2016). However, other researchers are unsure of the importance of OIH for opioid users (Servick, 2016).

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

4.3.17.5 Vulnerability Assessment

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

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

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

Enhancing Coordination and Data Collection to Bolster State and Local Response

- **Establishes and Opioid Command Center located at the Pennsylvania Emergency Management Agency (PEMA)**, which will house the Unified Opioid Coordination Group that will meet weekly during the disaster declaration to monitor implementation and progress of the initiatives in the declaration.

- **Expands Access to Prescription Drug Monitoring Program (PDMP) to Other Commonwealth Entities for Clinical Decision-Making Purposes** to improve treatment outcomes and better monitor compliance among prescribers. Since 2016, 90,000 physicians have conducted more than 1 million searches on the PDMP.

- **Adds Overdoses and Neonatal Abstinence Syndrome (NAS) as Reportable Conditions in Title 28, Chapter 27** to the DOH in order to increase data collection and improve outcomes in both areas.

- **Authorizes Emergency Purchase Under Procurement Code for Hotline Contract with Current Vendor,** giving DDAP further emergency purchase authorization to allow the department to enter into a contract with the current drug and alcohol hotline vendor to ensure uninterrupted services. To date, the 24/7 helpline, 1-800-662-HELP, has received more than 18,000 calls to connect those suffering from substance use disorder with treatment.

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

- **Enables Emergency Medical Services providers to leave behind naloxone** by amending the current Standing Order to include dispensing by first responders, including Emergency Medical Technicians (EMTs). The existing naloxone standing order and funding for naloxone to first responders has allowed for more than 5,000 lives to be saved so sufferers can be linked to treatment for substance use disorder.

- **Allows Pharmacists to Partner with Other Organizations to Increase Access to Naloxone** by waiving regulations to allow pharmacists to partner with other organizations, including prisons and treatment programs to make naloxone available to at-risk individuals upon discharge from these facilities.

- **Allows for the immediate temporary rescheduling of all fentanyl derivatives to align with the federal DEA schedule** while working toward permanent rescheduling.

- **Authorizes emergency purchasing under Section 516 of the Procurement Code** to allow for an emergency contract to expand the advanced body scanner pilot program currently in place at Wernersville that is used on re-entrants returning to the facility. This would prevent the program from lapsing.

Speeding Up and Expanding Access to Treatment

- **Waive the face-to-face physician requirement for Narcotic Treatment Program (NTP) admissions** to allow initial intake review by a Certified Registered Nurse Practitioner (CRNP) or Physician Assistant (PA) to expedite initial intakes and streamline coordination of care when an individual is most in need of immediate attention.

- **Expand access to medication-assisted treatment (MAT)** by waiving the regulatory provision to permit dosing at satellite facilities even though counseling remains at the base NTP. This allows more people to receive necessary treatments at the same location, increasing their access to all the care and chances for recovery.

- **Waive annual licensing requirements for high-performing drug and alcohol treatment facilities** to allow for bi-annual licensure process which streamlines licensing functions and better allocates staff time. DDAP will request that facilities seek a waiver by filing exception requests to the annual licensing requirement.

- **Waive the fee provided for in statute for birth certificates for individuals who request a good-cause waiver by attesting that they are affected by OUD**. This

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

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

4.3.18. Terrorism

4.3.18.1 Location and Extent

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

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

Critical facilities are either in the public or private sector that provide essential products and/or services to the general public. Critical facilities are often necessary to preserve the welfare and quality of life in the county, or fulfill important public safety, emergency response, and/or disaster recovery functions. Critical facilities identified in the county are shelters; gas, electric and communication utilities; hospitals and other health care facilities; water and wastewater treatment plants, hazardous waste sites; and schools.

In addition to critical facilities, the county contains at risk populations that should be factored into a vulnerability assessment. These populations include not only the residents and workforce in the county, but also the tourists that visit the area on a daily basis, those that are traveling through the county on any of the interstate or major highways and marginalized groups such as LGBTQ persons and racial minorities. Potential targets for attack include:

- Commercial facilities
- Abortion or family planning clinics and other organizations associated with controversial issues.
- Education facilities
- Events attracting large amounts of people
- Places of worship

- Industrial facilities, especially those utilizing large quantities of hazardous materials
- Transportation infrastructure
- Historical sites
- Government facilities

4.3.18.2 Range of Magnitude

Terrorism refers to the use of weapons of mass destruction (WMD) (including, biological, chemical, nuclear, and radiological weapons) arson, incendiary, explosive, armed attacks, industrial sabotage, intentional hazardous materials releases and cyber-terrorism. Within these general categories, however, there are many variations. Particularly in the area of biological and chemical weapons, there are a wide variety of agents and ways for them to be disseminated. Terrorist methods can take many forms, including:

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

Cyber terrorism is becoming increasingly prevalent. Cyber terrorism can be defined as activities intended to damage or disrupt vital computer systems. These acts can range from taking control of a host website to using networked resources to directly cause destruction and harm. Protection of databases and infrastructure are the main goals for a safe cyber environment. Cyber terrorists can be difficult to identify because the internet provides a meeting place for individuals from various parts of the world. Individuals or groups planning a cyber-attack are not organized in a traditional manner, as they are able to effectively communicate over long distances without delay. The largest threat to institutions from cyber terrorism comes from any processes that are networked and controlled via computer. Any vulnerability that could allow access to sensitive data or processes should be addressed and any possible measures taken to harden those resources to attack.

4.3.18.3 Past Occurrence

Active assailants, as defined by the US Department of Homeland Security, is an individual actively engaged in killing or attempting to kill people in a confined area; in most cases, active assailants use firearm[s] and there is no pattern or method to their selection of victims. One of the more recent high-profile shootings took place at a country

music festival in Las Vegas, Nevada, on October 1, 2017 where fifty-nine people were killed and over 500 injured, making it the deadliest mass shooting in modern US history. Another recent shooting occurred at the Pulse Nightclub in Orlando, Florida, on June 12, 2016 where the LGBTQ community was targeted – forty-nine people were killed and fifty-three were wounded. A few other significant active shooter events include those that occurred at Virginia Tech (April 2007), Sandy Hook Elementary School (December 2012), San Bernardino, California, (December 2015) an Aurora, Colorado movie theater (July 2012) and a church in Charleston, South Carolina (June 2015). A 2014 study by the Federal Bureau of Investigations (FBI) concluded that there has been a significant recent increase in frequency of active assailant incidents, and the vast majority (154 of 160 shooters between 2000 and 2013) were male (FBI, 2014). Of these 160 incidents, 45.6% took place in commercial environments, 24.4% took place in an educational environment, and the remaining 30% took place at other locations such as open spaces, military and other government properties, residential locations, houses of worship, and health care facilities (FBI, 2014) *Figure 39 - Active Assailant Incidents 2000-2013* summarizes the FBI's findings in the study. There are no active assailant related incidents on record in Lebanon County.

Significant international terrorism incidents in the USA include: the World Trade Center bombing in 1993, the bombing of the Murrow Building in Oklahoma City in 1995, and the September 11th 2001 attack on the World Trade Center. Lebanon County has not been directly impacted by any significant international terrorist incidents. However, terrorism cannot be predicted which necessitates Lebanon County to profile and address the hazard, possible locations, and vulnerabilities of the county.

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

According to CAD, the most common terrorist incident experienced by Lebanon County are bomb threats. CAD reports of terrorist activity in Lebanon County from January 2008 to March 2018 can be found in *Table 49 - CAD Incidents*.

Table 49 - CAD Incidents

CAD Incidents		
Description	**Location**	**Date**
Bomb Threat	Palmyra Borough	04/10/2008
Bomb Threat	South Lebanon Township	05/27/2008
Bomb Threat	Millcreek Township	06/16/2008
Bomb Threat	South Londonderry Township	02/26/2009
Bomb Threat	North Cornwall Township	04/17/2009
Bomb Threat	North Cornwall Township	01/29/2010
Bomb Threat	City of Lebanon	05/28/2010
Bomb Threat	South Lebanon Township	09/01/2010
Bomb Threat	City of Lebanon	11/11/2011
Bomb Threat	West Cornwall Township	01/19/2014
Bomb Threat	North Londonderry Township	03/04/2014
Bomb Threat	South Londonderry Township	04/01/2014
Bomb Threat	North Cornwall Township	07/09/2014
Bomb Threat	North Cornwall Township	07/09/2014
Bomb Threat	North Cornwall Township	07/09/2014
Bomb Threat	North Cornwall Township	07/09/2014
Bomb Threat	Palmyra Borough	09/07/2014
Bomb Threat	West Cornwall Township	09/17/2014
Bomb Threat	Cleona Borough	11/21/2014
Bomb Threat	North Londonderry Township	06/10/2015
Bomb Threat	City of Lebanon	03/22/2016
Bomb Threat	Myerstown Borough	07/14/2016
Bomb Threat	North Londonderry Township	02/03/2017

Figure 39 - Active Assailant Incidents 2000-2013

4.3.18.4 Future Occurrence

The likelihood of Lebanon County being a primary target for a major international terrorist attack is somewhat small. More likely, terrorist activity in Lebanon County are bomb threats or incidents at schools. The local planning team gave this hazard a risk factor of 1.3.

4.3.18.5 Vulnerability Assessment

The probability of terrorist activity is more difficult to quantify than some other hazards. Instead of considering likelihood of occurrence, vulnerability is assessed in terms of specific assets. By identifying potentially at-risk terrorist targets in a community, planning efforts can be put in place to reduce the risk of attack. Planning should work towards identifying potentially at-risk critical facilities and systems in the community, prioritizing those assets and locations, and identify their vulnerabilities relative to known potential threats.

All communities in Lebanon County are vulnerable on some level, directly or indirectly, to a terrorist attack. However, communities where critical facilities are located should be considered more vulnerable. Site-specific assessments should be based on the relative importance of a particular site to the surrounding community or population, threats that are known to exist, and vulnerabilities, including:

Inherent vulnerability:

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

Tactical vulnerability:

Site Perimeter:

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

Building Envelope:

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

Facility Interior:

- Architectural and Interior Space Planning – Does security screening cover all public and private areas?
- Mechanical Engineering – Are utilities and HVAC systems protected and/or backed up with redundant systems?
- Electrical Engineering – Are emergency power and telecommunications available? Are alarm systems operational? Is lighting sufficient?
- Fire Protection Engineering – Are the building's water supply and fire suppression systems adequate, code-compliant, and protected? Are on-site personnel trained appropriately? Are local first responders aware of the nature of the operations at the facility?
- Electronic and Organized Security – Are systems and personnel in place to monitor and protect the facility

4.3.19. Transportation Accidents

4.3.19.1 Location and Extent

Lebanon County is served by three U.S. Interstates (I-81, I-78, and I-76), three U.S. Highways (U.S. Routes 22, 322, and 422), over 400 miles of state-owned roads (PA State Routes 72, 117, 241, 343, 419, 441, 443, 501, 897, 934), and nearly 750 miles of locally owned roads. Lebanon County serves as a major transportation corridor and is heavily

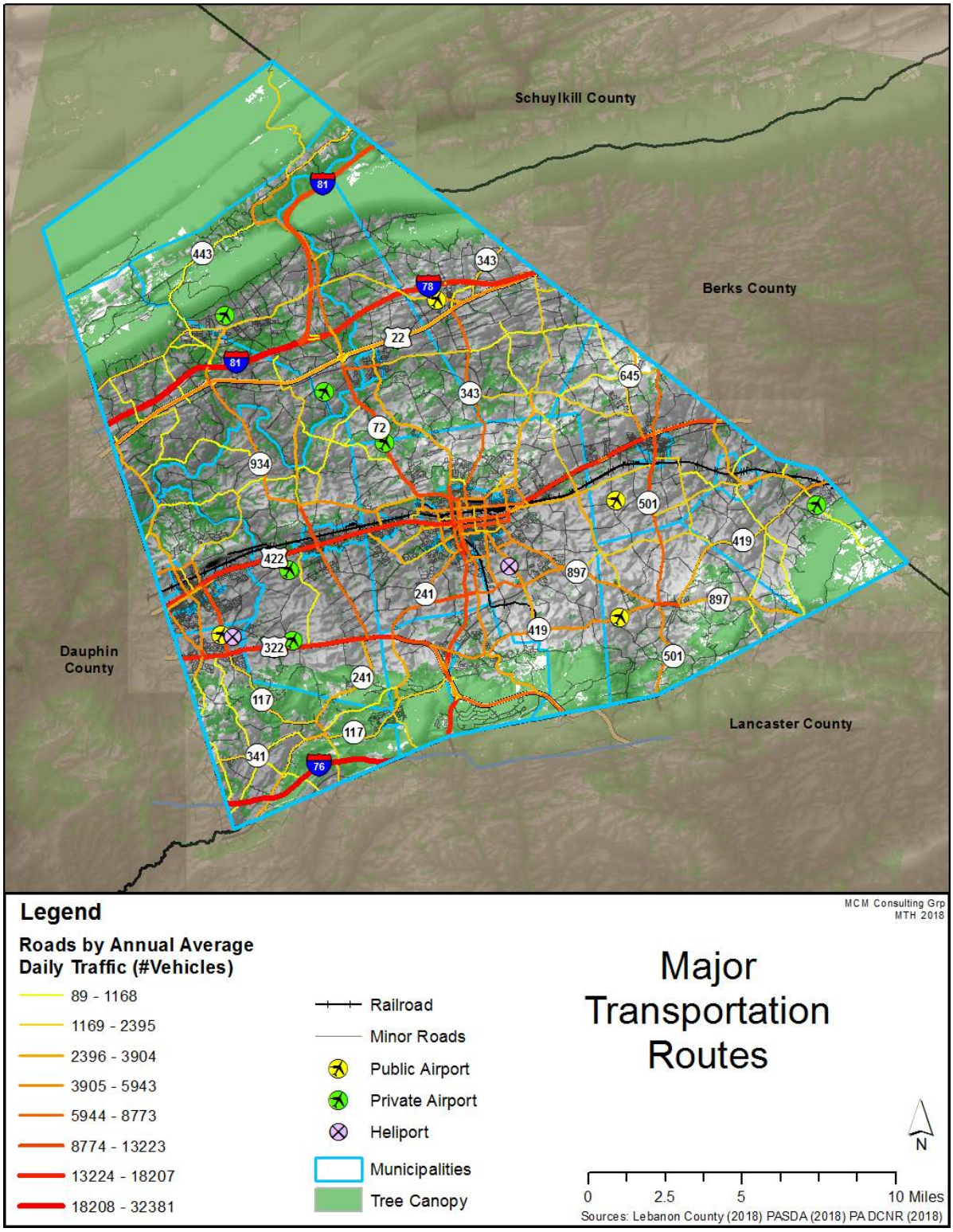
traveled by various motorists. *Figure 40 - Major Transportation Routes* shows the major transportation systems in Lebanon County.

Lebanon County has a major railroad corridor that cuts the county in half. This railway is located in the highest populated area of the county as well. Lebanon City and the surrounding municipalities are the most vulnerable due to location and population density. A derailment or accident that produces a hazardous materials release could cause catastrophic injuries and death. There are five privately-owned, one military-use airport, and two heliports in the county. For more details see *Table 50 - Airports*.

Table 50 - Airports

Airports			
Name	**Address**	**Owner-ship**	**Usage**
Deck Airport – 9D4	351 S Ramona Rd, Lebanon, PA 17042	Private	Airport
Farmers Pride Airport – 9N7	215 W Main St, Fredericksburg, PA 17026	Private	Airport
Reigle Field Airport – 58N	1805 S Forge Rd, Palmyra, PA 17078	Private	Airport
Rover Airport – PA31	1701 Horseshoe Pike, Annville, PA 17003	Private	Airport
Dee Jay Airport – 8PA1	5 Airport Way, Jonestown, PA 17038	Private	Airport
Muir Army Airfield - MUI	Annville, PA 17003	Govern-ment	Airport
Richard L Miller Heliport – 3PS3	701 Hilltop Road, Lebanon, PA 17067	Private	Heliport
VA Medical Center Heliport – PS92	1700 South Lincoln Ave, Lebanon PA 17042	Private	Heliport

Figure 40 - Major Transportation Routes



4.3.19.2 Range and Magnitude

Transportation accidents can result in death or serious injury and extensive property loss or damage. In the United States, over 37,000 people die in road crashes annually (ASIRT, 2017). Inclement weather and higher traffic volume and speed increase the risk for automobile accidents. Road and railway accidents in particular have a potential to result in hazardous material releases. Accidents involving hazardous materials can pose an environmental hazard and potentially contaminate the air, water and or soil. Hazardous material release is covered in more detail in *Section 4.3.15 Environmental Hazards*.

Aviation incidents most often occur near landing or take-off sites; a five-mile radius around each airport in Lebanon County is considered high-risk areas.

4.3.19.3 Past Occurrence

The most serious transportation concerns in Lebanon County involve I-81, I-78, and I-76, U.S. Routes 22, 322, and 422, and State Routes 72, 501, and 934. *Table 51 - Transportation Incidents* shows the accidents that were reported to the Lebanon County 9-1-1 as entered into the Lebanon County WebEOC™ database between May 2016 and December 2017. *Table 52 - PennDOT Lebanon County Crash Report* shows crash statistics recorded by the Pennsylvania Department of Transportation between 2007 and 2016.

There have been several transportation incidents in Lebanon County. One notable incident took place on February 13, 2016. A snow squall suddenly blew across an area of Interstate 78 in Bethel Township on the Berks County and Lebanon County lines. A total of 73 people had been taken to ten regional hospitals for treatment and three people had died as a result of the incident. Non-injured motorists were transported to a nearby firehall and were also cared for by the American Red Cross. Hazmat was called to the scene immediately and assisted with leaking fuel from disabled vehicles.

Table 51 - Transportation Incidents

Transportation Incidents		
Description	**Location**	**Date**
Vehicle Accident	North Lebanon Township	07/15/2016
Vehicle Accident – Chemical leak/spill	East Hanover Township	07/25/2016
School Bus Accident	Lebanon City	08/23/2016
Vehicle Accident	Millcreek Township	09/20/2016
Bus Accident	South Londonderry Township	10/31/2016
Vehicle Accident	North Annville Township	12/11/2016
Vehicle Accident	South Annville Township	12/11/2016
Vehicle Accident involving hazardous materials	Swatara Township	12/17/2016
Vehicle Accident	North Annville Township	12/17/2016
Bus Accident	North Cornwall Township	01/13/2017

Transportation Incidents		
Description	**Location**	**Date**
Bus Accident	Lebanon City	01/18/2017
Vehicle Accident	South Londonderry Township	05/18/2017
Vehicle Accident	Swatara Township	06/22/2017
Vehicle Accident	Union Township	06/22/2017
Accident involving aircraft	Bethel Township	07/08/2017
Vehicle Accident	South Annville Township	10/18/2017
Major roadway closure	South Annville Township	10/18/2017
Vehicle Accident	Cornwall Borough	11/14/2017
Vehicle Accident – Major roadway closure	Bethel Township	12/08/2017

Over a nine-year period from 2007-2016, alcohol-related accidents have slowly decreased. All other incidents, however, have remained relatively constant. *Table 52 - PennDOT Lebanon County Crash Report* summarizes the overall crash data within a nine-year period for Lebanon County. Information was gathered from PennDOT Crash Information Tool.

Table 52 - PennDOT Lebanon County Crash Report

PennDOT Lebanon County Crash Report											
Type	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**Total**
State Road	1006	883	866	810	930	889	881	859	915	875	8914
Local Road	870	804	767	733	782	752	819	740	847	838	7952
Hazardous Truck	2	3	2	4	1	2	4	4	4	2	28
School Bus	5	11	7	4	8	7	11	8	6	8	75
Alcohol Related	154	127	131	147	135	125	92	104	97	101	1213
Pedestrian	39	38	26	37	27	30	16	30	28	27	298
Fatal	17	19	14	15	20	14	18	6	17	17	157
Total Incidents	**2,093**	**1,885**	**1,813**	**1,750**	**1,903**	**1,819**	**1,841**	**1,751**	**1,914**	**1,868**	**18,637**

4.3.19.4 Future Occurrence

Automobile accidents occur frequently, and typically occur more frequently than a rail or aviation accident. The most traveled roadways in Lebanon County are I-81, I-78, and I-76, U.S. Routes 22, 322, and 422, and State Routes 72, 501, and 934 Additionally, these roadways are also the most traveled by heavy freight vehicles which can often carry hazardous materials.

The average rate of aviation accidents occurs at a rate of one per 1.2 million flights; with the chances of dying in a plane crash at 1 in 11 million. Therefore, the likelihood of an aviation incident in Lebanon County is considered low, however past events show that they are not impossible. While they are infrequent, railroad accidents have a greater likelihood of affecting larger areas of population and/or the environment.

The probability of transportation accidents is characterized as highly likely as defined by the risk factor methodology probability criteria. An overall risk factor of 2.8 has been determined by the local planning team using this methodology.

4.3.19.5 Vulnerability Assessment

The combination of high traffic volume and severe winter weather in the county increase the chances of traffic accidents occurring. Vulnerability for highway accidents falls within a ¼ mile of Interstate and US highways. Like highway incidents, rail incidents can impact populations living near rail lines. Vulnerability for rail incidents fall within a ¼ mile of the rail line. This includes populations in the Lebanon City, Cleona Borough, North Cornwall Township, Myerstown Borough, Annville Township, Jackson Township, and Palmyra Borough. Lebanon County is also prone to aviation incidents near municipalities in close proximity to airports and heliports.

Table 53 - Transportation Vulnerability

Transportation Vulnerability ***(Lebanon County GIS, 2018)***				
Municipalities	**1/4Mi of Roads & Railroads**		**5Mi of Airports**	
	Buildings	**Critical Facilities**	**Buildings**	**Critical Facilities**
Annville Township	1,850	25	1,895	25
Bethel Township	1,394	6	4,519	19
Cleona Borough	1,134	10	1,259	10
Cold Spring Township			11	
Cornwall Borough	722	5	2,027	15
East Hanover Township	1,458	3	3,234	7
Heidelberg Township	2,174	13	3,839	17
Jackson Township	2,890	16	6,410	38
Jonestown Borough	49		829	6
Lebanon City	6,569	98	7,954	105
Millcreek Township	1,292	12	3,157	19
Mount Gretna Borough	188	2	205	2
Myerstown Borough	1,425	18	1,786	18
North Annville Township	641	8	2,449	13
North Cornwall Township	1,350	15	3,289	16
North Lebanon Township	2,196	18	7,559	32
North Londonderry Township	1,168	4	4,389	15
Palmyra Borough	2,770	24	3,758	28
Richland Borough	528	7	1,053	9

Transportation Vulnerability *(Lebanon County GIS, 2018)*				
Municipalities	**1/4Mi of Roads & Railroads**		**5Mi of Airports**	
	Buildings	**Critical Facilities**	**Buildings**	**Critical Facilities**
South Annville Township	962	9	2,603	12
South Lebanon Township	2,403	28	5,599	44
South Londonderry Township	2,789	21	4,345	24
Swatara Township	860	2	3,559	11
Union Township	1,746	14	3,287	22
West Cornwall Township	1,170	9	1,347	12
West Lebanon Township	446	6	458	6
Total	**40,174**	**373**	**80,820**	**525**

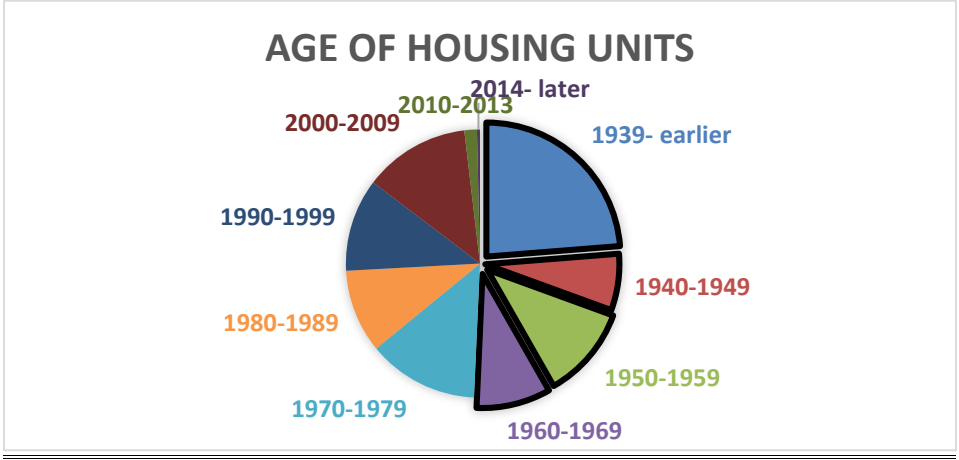
4.3.20. Urban Fire and Explosions

4.3.20.1Location and Extent

Urban fire and explosion hazards occur in dense, more urbanized areas countywide and most often occurs in residential structures, but can incorporate businesses, vehicles, and vessels that can have an overpressure rupture, overheat, or other explosions that do not ignite. Fires can spread easily from building to building in dense urban areas.

There is a more significant threat in buildings over fifty years of age. According to the U.S. Census Bureau, 20-12-2016 American Community Survey 5-year estimates Lebanon County has approximately 56,176 housing units. Of these housing units, 28,489 were built in 1969 or earlier, with the majority of housing units built in 1939 or earlier. This represents approximately half of all the housing units in Lebanon County are fifty years old or older, as shown in *Figure 41 - Age of Housing Units.*

Figure 41 - Age of Housing Units



Fires can start from numerous causes, such as human errors or electrical malfunctions. Small fires do not have a large impact on an area; just an increase in insurance rates. However, major fires are often the result of other hazards. Some of these hazards are: storms, droughts, transportation accidents, hazardous material spills, and criminal activity (arson) or terrorism.

4.3.20.2 Range of Magnitude

The greatest risk of urban fires is the rapid spread of a fire from one structure to another. Municipalities where homes and businesses are clustered post the greatest risks, in Lebanon County this would be in the City of Lebanon. A fire that occurred in 1990 in the 700 block of Cumberland Street, Lebanon City, caused an estimated $6.5 million in damages, and resulted in the death of one firefighter.

Damages from fire and explosions ranges from minor smoke and/or water damage to the destruction of buildings. The result of severe urban fires would be extensive damages to residential, commercial, and/or public property. A worst-case scenario for any fire and or explosion would be in injuries and/or death of the occupants of the structures, not to mention the potential of injury or death of firefighters.

Additionally, there are economic consequences related to a fire and explosion hazard, to include:

- Loss in wages due to temporarily or permanently closed businesses;
- Destruction and damage to business and personal assets;
- Loss of tax base;
- Recovery costs; and,
- Loss related to the ability of public, private, and non-profit entities to provide post-incident relief.

Effects to human services agencies can consist of physical damage to facilities and equipment, disruption of emergency communications, loss of health and medical facilities and supplies, and an overwhelming number of victims who have suffered from the effects of the urban fire.

4.3.20.3 Past Occurrence

Table 54 - Lebanon County Major Fires and Explosions reflects the major fires and explosions that have occurred in Lebanon County since 1960.

Table 54 - Lebanon County Major Fires and Explosions

Lebanon County Major Fires and Explosions			
Date/Year	**Location**	**Property Damage**	**Deaths**
1960	San Giorgio Plant	-	0
1975	Illusion Club, Annville	$400,000.00	0
1976	Botz Junk Yard, Annville	$100,000.00	2
1978	Gas explosion, W. Lebanon Twp.	-	0
1978	Muldoon's Restaurant, Palmyra	$200,000.00	0
1982	Miller Brothers Lumber	$200,000.00	0
1982	Lesher Mack, N. Lebanon Twp.	$150,000.00	0
1982	Apt. and stores, Palmyra	$500,000.00	1
1983	7th and Cumberland Streets	$600,000.00	0
1984	Park silk, 9th and Railroad	$1,000,000.00+	0
1984	Ono Industries, E. Hanover Twp.	$1,500,000.00	0
1985	Hotel Annville, Annville Twp.	$57,500.00	0
1986	House fire, N. Lebanon Twp. (3 residences destroyed)	$150,000.00	1
1986	Sunset Farmers Market, N. Lebanon Twp.	$1,000,000.00	0
1987	Quick Shop and Apartments	$100,000.00	0
1988	Apartment House, 139 S. 6th Street	$95,000.00	0
1988	Apt. building, Annville Twp.	$250,000.00	0
1990	Bethlehem Steel, Lincoln Ave.	$500,000.00	0
1990	HACC, 731 Cumberland Street	$6,500,000.00	1
1990	300 Block of N. 14th Street	$65,000.00	0
1991	Lebanon Chemical Corp., S. Lebanon Twp.	$2,000,000.00	0
1992	PDK Warehouse, North 9th Street	$300,000.00	0
1993	1328 Lehman Street	$145,000.00	0
1993	940 Cornwall Road	$300,000.00	0
1995	1001 Cumberland Street	$100,000.00	0
1995	Demford Mfg. 1103 N. 7th Street	$195,000.00	0
1996	613 S. 6th Street	$130,000.00	0
1997	Keystone Weaving Mills, 1349 Cumberland Street	$2,000,000.00	0
1998	Gravel Hill United Methodist Church, N. Londonderry Twp.	unknown	0
2000	34 N. 16th Street	$820,000.00	0
2000	335 E. Weidman Street	$100,000.00	0
2000	36 Cumberland	$211,000.00	0
2000	38 Cumberland Street	$270,000.00	0
2000	Kutztown Bologna	Unknown	0
2000	Brentwood building explosion West Lebanon Twp.	Unknown	0
2001	525 Walnut Street	$206,000.00	0
2001	306 N. 10th Street	$210,000.00	0
2001	308 N. 10th Street	$205,000.00	0

Lebanon County Major Fires and Explosions			
Date/Year	**Location**	**Property Damage**	**Deaths**
2001	302 N. 10th Street	$100,000.00	0
2001	230 E. Cumberland Street	$500,000.00	0
2001	1221 Willow Street	$104,000.00	0
2001	1219 Willow Street	$144,000.00	0
2001	1223 Willow Street	$106,000.00	0
2001	330 N. Gannon Street	$105,000.00	0
2001	9 N. 9th Street	$225,000.00	0
2002	254 N. College Street, Palmyra, apartment house fire	$120,000.00	0
2002	Recycle America Plant, Palmyra Borough	$1,000,000.00+	0
Lebanon County 911 recorded fire dispatch statistics for each of the 37 fire departments within the county. Below are the total amounts per year. There were no data reports for 2007			
YEAR	Total of fire dispatches		
2003	5,993		
2004	5,614		
2005	7,055		
2006	7,795		
Between 2008 and 2018 alarms through the Lebanon County 911 were logged on the computer aided dispatch (CAD). The exact event is unknown, but all events below occurred at a business/commercial property in the City of Lebanon (greatest risk) that required fire units. Property damages and injuries/deaths are also unknown.			
Date	**Location**		
04/21/08	529 Cumberland Street		
07/03/08	837 Quentin Road		
07/03/08	223 S. 4th Street		
07/15/08	945 Duke Street		
07/23/08	101 S. 8th Street		
09/12/08	243 Schneider Drive		
09/19/08	N. 5th Ave./ E. Lehman Street		
09/21/08	1124 Cumberland Street		
11/03/08	N. 5th Ave./ E. Lehman Street		
11/11/08	350 N. 8th Street		
11/23/08	N. 8th Street/ Maple Street		
12/17/08	800 Willow Street		
12/28/08	1041 Maple Street		
01/01/09	25 S. 9th Street		
01/20/09	N. 8th Ave./E Cumberland Street		
03/04/09	N. 2nd Ave. / E. Mifflin Street		
06/17/09	223 S. 4th Street		
08/10/09	34 N. 16th Street		
11/15/09	S. 10th Street/ Walton Street		
11/17/09	605 Cumberland Street		
12/08/09	1501 Willow Street		
12/11/09	N. 7th Street / Lehman Street		
03/25/10	225 N. 8th Street		
03/28/10	254 S. 11th Street		
04/28/10	521 N. 3rd Avenue		
05/18/10	1501 Willow Street		
09/10/10	N. 8th Avenue / E. Cumberland Street		
09/18/10	N. 12th Street / Cumberland Street		
11/04/10	502 Lehman Street		
11/21/10	1400 Lehman Street		
02/10/11	35 S. 8th Street		

Lebanon County Major Fires and Explosions			
Date/Year	**Location**	**Property Damage**	**Deaths**
03/04/11	1034 Maple Street		
03/15/11	N. 10th Street / Lehman Street		
03/29/11	720 Jonestown Road		
04/13/11	S. 10th Street / Chestnut Street		
11/04/11	129 Vanburen Street		
04/03/12	945 Duke Street		
04/12/12	701 Lehman Street		
05/03/12	1041 Maple Street		
06/03/12	N. 8th Street / Scull Street		
07/09/12	Lehman Street / Concentrator Road		
08/14/12	945 Duke Street		
09/14/12	220 E. Lehman Street		
09/14/12	N. 2nd Avenue / E. Mifflin Street		
09/20/12	E. Lehman Street / N. 5th Avenue		
10/08/12	1498 Willow Street		
10/24/12	S. 7th Street / Cumberland Street		
11/06/12	2 N. 8th Street		
12/01/12	N. 14th Street / Willow Street		
01/05/13	702 Quentin Road		
01/15/13	440 S. 9th Street		
02/19/13	849 Oak Street		
05/13/13	301 Schneider Drive		
06/23/13	1 Cumberland Street		
07/05/13	307 N. 9th Avenue		
07/09/13	N. 9th Street / Willow Street		
07/09/13	Church Street / N. 10th Street		
07/18/13	1501 Willow Street		
08/28/13	400 S. 8th Street		
09/03/13	439 S. 6th Street		
11/12/13	324 E. Cumberland Street		
11/25/13	319 S. 5th Street		
11/30/13	837 Quentin Road		
12/19/13	903 Cornwall Road		
01/06/14	631 E. Weidman Street		
02/01/14	625 Quentin Road		
02/04/14	945 Duke Street		
02/22/14	760 Cumberland Street		
03/21/14	N. 5th Ave./ E. Scull Street		
04/30/14	712 Chestnut Street		
06/16/14	1349 Cumberland Street		
07/23/14	301 Schneider Drive		
10/04/14	833 Bowman Street		
10/14/14	30 N. 16th Street		
10/21/14	400 S. 8th Street		
03/16/15	122 Schneider Drive		
04/28/15	N. 3rd Ave./E. Lehman Street		
08/05/15	220 E. Lehman Street		
08/08/15	1202 Maple Street		
08/22/15	1501 Willow Street		
08/26/15	244 N. Lincoln Avenue		
01/20/16	401 E. Cumberland Street		

Lebanon County Major Fires and Explosions			
Date/Year	**Location**	**Property Damage**	**Deaths**
01/27/16	811 Bowman Street		
02/24/16	440 Oak Street		
03/22/16	701 Lehman Street		
04/25/16	1501 Willow Street		
04/26/16	400 S. 8th Street		
07/23/16	S. 3rd Ave./E. Cumberland Street		
10/06/16	N. 16th Street/Cumberland Street		
11/03/16	601 Lehman Street		
11/18/16	757 E. Cumberland Street		
01/20/17	210 Weidman Street		
04/30/17	2 Weidman Street		
05/11/17	945 Duke Street		
05/19/17	426 Cumberland Street		
06/14/17	350 N. 8th Street		
07/04/17	631 N. 8th Street		
08/05/17	604 Cumberland Street		
08/22/17	1202 Maple Street		
09/27/17	2 Cumberland Street		
10/21/17	203 N. 5th Avenue		
12/07/17	400 S. 8th Street		
12/20/17	522 N. 2nd Avenue		
01/03/18	1223 Chestnut Street		
01/19/18	837 Quentin Road		
02/13/18	102 N. 8th Avenue		

4.3.20.4 Future Occurrence

There is a likely probability of an urban fire or explosion in Lebanon County. However, minor events will happen more frequently than major fires, and most urban fires are contained, causing little damage. Because of the age of buildings and close proximity of buildings, Lebanon City is the most vulnerable to urban fires and explosions.

Any new construction has to comply with PA Department of Labor's statewide uniform construction codes. One requirement in the construction codes is automatic sprinkler requirements for buildings other than one- and two-family dwellings. In most cases, this requirement will contain fires to the point of origin.

4.3.20.5 Vulnerability Assessment

Most fires are a result as the secondary effect of another hazard. The vulnerability of fire and explosion greatly depends on the vulnerability to other hazards. The probability of a fire or explosion occurring has the potential to increase with population growth. This is due to human error and carelessness, and criminal and terroristic tendencies. With the increased use of wood burning and kerosene space heaters, the risk of residential fires increases.

Those that are most vulnerable to fires are the elderly (65 and older) and children ages 14 and younger. Most often the older homes in a community are those that are destroyed

by urban fires. See *Figure 41 - Age of Housing Units.* Communities with a higher concentration of housing are at a greater risk for fires spreading from one structure to another.

Potential secondary effects of an urban fire include utilities failure and hazardous materials spills.

4.3.21. Utility Interruptions

4.3.21.1 Location and Extent

Utility interruptions include any damage to electricity, natural gas, telecommunications, and water. Energy interruptions can be caused by severe solar storms, regional or national fuel or resource shortages, an electromagnetic pulse, public works failure, transmission facility accidents, and other major utility failures. Lebanon County has utility services for electric, water, fuel and telecommunications, all of which can experience interruptions for several different reasons.

Often, utility interruptions are a secondary impact of other hazards such as severe thunderstorms, windstorms, tornadoes, winter storms and even traffic accidents. Heat waves may also result in rolling blackouts causing electric to not be available for an extended period of time. All municipalities within the county have a probability of experiencing a utility interruption.

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

Minor solar flares have no negative impacts on Earth thanks to the protection afforded by Earth's magnetic field and atmosphere. In fact, minor solar flares cause beautiful visual displays known as the Northern Lights or Aurora Borealis. However, severe solar storms can cause an electromagnetic pulse (EMP) that is able to break through Earth's magnetic field and send current to Earth's surface, inducing geomagnetic currents. Geomagnetic ally induced currents (GICs) impact the electrical grid and can cause transformers to burn and fail, potentially knocking out wide swatches of electricity infrastructure resulting in blackouts (Phillips, 2009).

4.3.21.2 Range of Magnitude

At a minimum, energy emergencies can cause short term disruption in the daily operation of business, government, healthcare, and private citizens. A loss of energy and other utility services can have numerous impacts including, losing perishable foods and medicines, loss of functionality at health care and emergency medical facilities, limited water distribution capabilities, losing heating and air conditioning, losing telecommunication and internet services, basement flooding (sump pump failure), and lack of lighting. Energy emergencies can be most troubling when temperatures are at extremes due to the loss of heating or cooling capabilities and the added hazard that extreme heat and extreme cold present. Fuel shortages can result in increased cost of automotive gasoline, long lines at gas stations, disruptions in freight traffic, and shortage of heating fuels. On a small scale, these hazards can be a nuisance, but impacts can be devastating when an energy emergency has a large scope and impacts wide areas and a large population. Severe energy emergencies are often regional or national events.

4.3.21.3 Past Occurrence

The OPEC oil embargo of 1973 – 1974 caused fuel shortages and long lines at gasoline pumps nationwide. Government actions were taken to ensure that fuels and power were available for emergency and priority users. Between 1976 and 1977 there was a rapid increase in fuel prices accompanied by a severe winter resulting in a similar if less extreme fuel shortage. Those two events as well as the national gasoline shortage in 1979 emphasized the vulnerability of all residents in Lebanon County to energy emergencies.

Minor outages of electric and phone services occur annually. Due to tracking and documentation, minimal past occurrence data was available for this update. *Table 55 - Electrical Service Interruptions* show events reported to WebEOC from May 2016 until December 2017.

Electricity

Table 55 - Electrical Service Interruptions

Electrical Service Interruptions		
Description	**Location**	**Date**
Power Outage	South Lebanon Township	11/05/2017

Telecommunications

Table 56 - Telephone Service Interruptions

Telephone Service Interruptions		
Description	**Location**	**Date**
Telephone Outage	Multi-Jurisdictional	12/01/2017

Water

Table 57 - Water Service Interruptions

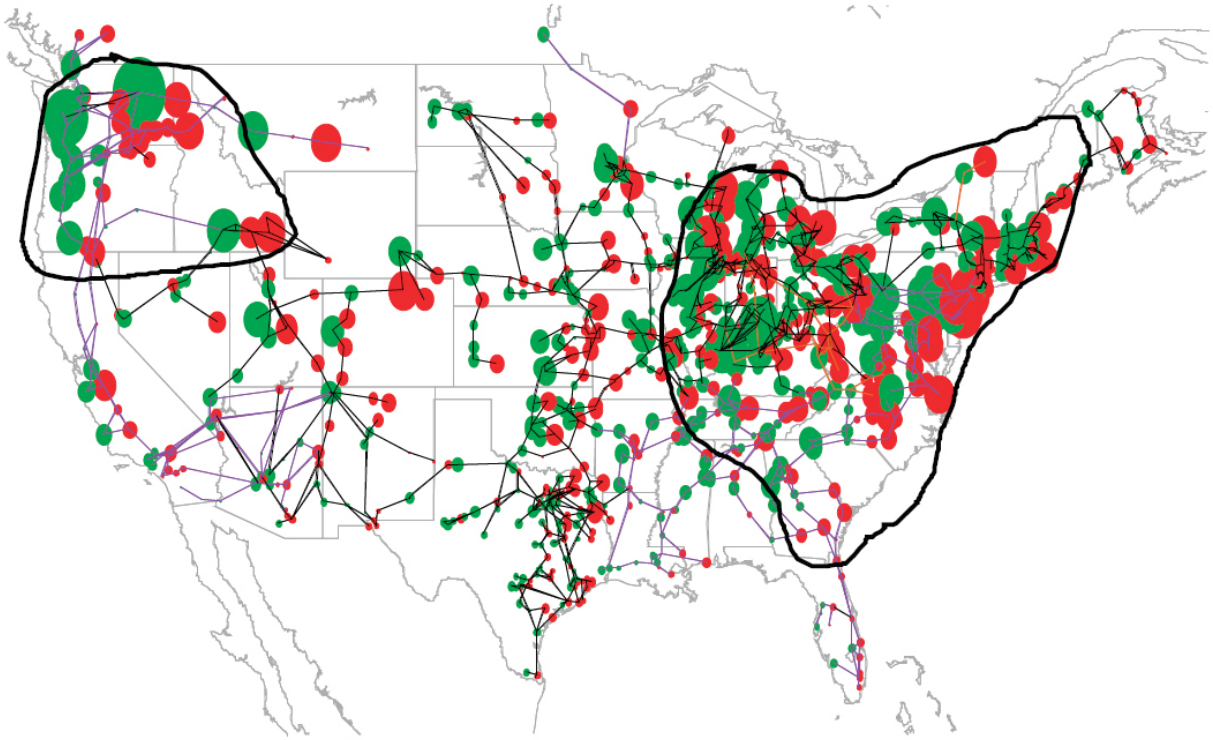
Water Service Interruptions		
Description	**Location**	**Date**
Water Outage/shortage	Myerstown Borough	12/21/2016
Water Outage/shortage	North Lebanon Township	05/09/2017

4.3.21.4 Future Occurrence

Minor, short-term outage events may occur several times a year for any given area in Lebanon County, while major, widespread and long-term events may take place once every few years. Utility interruptions are difficult to predict, even though minor interruptions to utilities may occur several times a year. Utility interruptions are most often by-products of severe weather events. Therefore, citizens should also prepare for such interruptions in addition to severe weather events alone.

As utility infrastructure ages, interruption events could occur more frequently. Utility providers can reduce Lebanon County's vulnerability to power outages by implementing improvements. The probability of transportation accidents is characterized as highly likely as defined by the risk factor methodology probability criteria. An overall risk factor of 3.2 has been determined by the local planning team using this methodology.

Figure 42 - Potential Electricity Grid Failure



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

4.3.21.5 Vulnerability Assessment

All municipalities in Lebanon County are vulnerable to utility interruptions. Critical facilities such as emergency medical facilities, retirement homes and senior centers are particularly vulnerable to power outages. While back-up generators are often used at these facilities, loss of electricity accompanied by temperature extremes can be dangerous for elderly and other high-risk populations. Appendix E provides a list of critical facilities located in Lebanon County.

Extreme temperatures can disrupt fuel and electricity supplies, with extreme cold weather triggering a higher demand for heating oil and natural gas as well as causing low gas pressure, and extreme hot weather possibly overloading electrical grids resulting in blackouts.

Pennsylvania Power and Lighting implemented a dispatch communications system called Mobile Operations Management (MOM). This system links every Pennsylvania

Power and Lighting crew to a central emergency response coordination center. This technology has reduced average outage times in Pennsylvania from an average of 108 minutes between 2004 and 2008 to seventy-one minutes in 2009.

The National Oceanic and Atmospheric Administration (NOAA) monitors solar activity from the Space Weather Prediction Center (SWPC) and is able to alert power grid operators of the impending geomagnetic storm so they may make efforts to protect the grid from GICs (Baker et al., 2008). Events such as the 1989 Hydro-Quebec blackout have illuminated the hazard that solar storms pose to electricity infrastructure, however modern power grids are more vulnerable than ever. Power grids have become increasingly interconnected, improving efficiency in many ways, but also making them more vulnerable to wide ranging rolling failures as illustrated in *Figure 42 - Potential Electricity Grid Failure* (Baker et al., 2008).

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

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

4.4. Hazard Vulnerability Summary

4.4.1. Methodology

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

RF values were obtained by assigning varying degrees of risk to five categories for each of the hazards profiled in the HMP update. Those categories include *probability*, *impact*, *spatial extent*, *warning time and duration*. Each degree of risk was assigned a value ranging from one to four. The weighting factor agreed upon by the planning team is shown in *Table 58 - Risk Factor Approach Summary*. To calculate the RF value for a given hazard, the assigned risk value for each category was multiplied by the weighting factor. The sum of all five categories equals the final RF value, as demonstrated in the following example equation:

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

Table 58 - Risk Factor Approach Summary summarizes each of the five categories used for calculating a RF for each hazard. According to the weighting scheme applied, the highest possible RF value is 4.0.

Table 58 - Risk Factor Approach Summary

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

4.4.2. Ranking Results

Using the methodology described in Section 4.4.1, *Table 59 - Risk Factor Assessment* lists the Risk Factor calculated for each of the twenty-five potential hazards identified in the 2018 HMP. *It should be noted that the tornado hazard and windstorm hazard were ranked individually instead of together.* Hazards identified as *high* risk have risk factors greater than 2.5. Risk Factors ranging from 2.0 to 2.4 were deemed *moderate* risk hazards. Hazards with Risk Factors 1.9 and less are considered *low* risk.

Table 59 - Risk Factor Assessment

Lebanon County Hazard Ranking Based on RF Methodology.							
HAZARD RISK	HAZARD NATURAL(N) OR MANMADE(M)	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
		PROBABILITY	ECONOMIC IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
HIGH	Opioid Epidemic (NEW)	4	3	4	4	1	**3.4**
	Transportation Accident	3	3	4	4	4	**3.4**
	Utility Interruption	4	2	3	4	4	**3.2**
	Nuclear Incident	1	4	4	4	4	**3.1**
	Nor'Easter	4	2	4	1	3	**3**
	Flash Flood	4	2	2	4	2	**2.8**
	Winter Storm	4	1	4	1	3	**2.7**
	Hurricane, Tropical Storm	2	2	4	1	4	**2.5**
	Subsidence and Sinkhole	3	2	1	4	4	**2.5**
MODERATE	Extreme Temperature	2	2	4	1	3	**2.4**
	Radon Exposure	3	1	3	1	4	**2.3**
	Dam Failure	1	3	3	4	1	**2.3**
	Environmental Hazard	2	2	2	4	3	**2.3**
	Drought	2	1	4	1	4	**2.2**
	Flood	2	2	2	1	4	**2.1**
	Windstorms	2	2	1	4	3	**2.1**
	Urban Fire and Explosion	2	2	1	4	2	**2**
LOW	Tornado	1	2	1	4	4	**1.9**
	Pandemic	2	1	1	1	4	**1.6**
	Earthquake	1	1	1	4	1	**1.3**
	Landslide	1	1	1	4	1	**1.3**
	Wildfire	1	1	1	4	1	**1.3**
	Civil Disturbance	1	1	1	4	1	**1.3**
	Terrorism	1	1	1	4	1	**1.3**
	Ice Jam Flooding	1	1	1	1	2	**1.1**

Based on these results, there are nine *high* risk hazards, eight *moderate* risk hazards and eight *low* risk hazards in Lebanon County. Mitigation actions were developed for all high, moderate and low risk hazards (see Section 6.4). The threat posed to life and property for moderate and high-risk hazards is considered significant enough to warrant the

need for establishing hazard-specific mitigation actions. Mitigation actions related to future public outreach and emergency service activities are identified to address low risk hazard events.

A risk assessment result for the entire county does not mean that each municipality is at the same amount of risk to each hazard. *Table 60 - Countywide Risk Factor by Hazard* shows the different municipalities in Lebanon County and whether their risk is greater than (>), less than (<), or equal to (=) the risk factor assigned to the county as a whole. This table was developed by the consultant based on the findings in the hazard profiles located in sections 4.3.1 through 4.3.21.

Table 60 - Countywide Risk Factor by Hazard

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk									
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
JURISDICTION	Opioid Epidemic (M)	Transportation Accident (M)	Utility Interruption (M)	Nuclear Incident (M)	Nor'Easter (N)	Flash Flood (N)	Winter Storm (N)	Hurricanes, Tropical Storm (N)	Subsidence and Sinkholes (N)
	3.4	***3.4***	***3.2***	***3.1***	***3.0***	***2.8***	***2.7***	***2.5***	***2.5***
Annville Township	=	=	=	=	=	=	=	=	=
Bethel Township	Not completed by municipality								
Cleona Borough	=	=	=	=	=	=	=	=	=
Cold Spring Township	Not completed by municipality								
Cornwall Borough	Not completed by municipality								
East Hanover Township	=	<	=	>	=	>	=	=	<
Heidelberg Township	=	=	>	=	=	=	=	=	<
Jackson Township	<	=	=	<	=	=	=	=	>
Jonestown Borough	Not completed by municipality								
Lebanon City	>	=	=	=	=	>	>	=	=
Millcreek Township	=	=	=	=	=	=	=	=	=
Mt. Gretna Borough	<	<	>	=	=	=	=	=	<
Myerstown Borough	=	>	<	=	=	>	=	=	<
North Annville Township	<	=	=	=	=	=	=	=	<
North Cornwall Township	=	=	=	=	=	=	=	=	=
North Lebanon Township	=	=	=	=	=	=	=	=	=
North Londonderry Township	=	=	=	=	=	=	=	=	>

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk									
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
JURISDICTION	Opioid Epidemic (M)	Transportation Accident (M)	Utility Interruption (M)	Nuclear Incident (M)	Nor'Easter (N)	Flash Flood (N)	Winter Storm (N)	Hurricanes, Tropical Storm (N)	Subsidence and Sinkholes (N)
	3.4	***3.4***	***3.2***	***3.1***	***3.0***	***2.8***	***2.7***	***2.5***	***2.5***
Palmyra Borough	=	>	=	<	=	=	=	=	>
Richland Borough	Not completed by municipality								
South Annville Township	=	=	=	=	=	=	=	=	=
South Lebanon Township	=	<	<	=	=	=	=	=	=
South Londonderry Township	<	<	=	=	<	=	<	=	>
Swatara Township	>	>	=	=	=	>	=	=	<
Union Township	Not completed by municipality								
West Cornwall Township	=	=	=	=	=	=	=	=	=
West Lebanon Township	=	=	=	=	=	=	=	=	=

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk															
JURISDICTION	Extreme Temperature (N)	Radon Exposure (N)	Dam Failure (M)	Environmental Hazard (M)	Drought (N)	Flood (N)	Windstorms(N)	Urban Fire and Explosion (M)	Tornado (N)	Pandemic (N)	Earthquake (N)	Landslide (N)	Wildfire (N)	Civil Disturbance (M)	Terrorism (M)	Ice Jam Flooding (N)
	2.4	*2.3*	*2.3*	*2.3*	*2.2*	*2.1*	*2.0*	*1.9*	*1.6*	*1.3*	*1.3*	*1.3*	*1.3*	*1.3*	*1.1*	*1.1*
Annville Township	=	=	<	=	=	>	=	=	=	=	=	=	=	>	=	=
Bethel Township	Not completed by municipality															
Cleona Borough	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk

JURISDICTION	Extreme Temperature (N)	Radon Exposure (N)	Dam Failure (M)	Environmental Hazard (M)	Drought (N)	Flood (N)	Windstorms(N)	Urban Fire and Explosion (M)	Tornado (N)	Pandemic (N)	Earthquake (N)	Landslide (N)	Wildfire (N)	Civil Disturbance (M)	Terrorism (M)	Ice Jam Flooding (N)
	2.4	*2.3*	*2.3*	*2.3*	*2.2*	*2.1*	*2.0*	*1.9*	*1.6*	*1.3*	*1.3*	*1.3*	*1.3*	*1.3*	*1.1*	*1.1*
Cold Spring Township	Not completed by municipality															
Cornwall Borough	Not completed by municipality															
East Hanover Township	=	=	=	>	=	>	=	=	=	=	=	=	>	=	>	>
Heidelberg Township	=	<	>	=	=	=	=	<	=	=	=	=	<	=	=	=
Jackson Township	=	=	<	=	=	=	=	<	=	<	<	<	>	<	<	<
Jonestown Borough	Not completed by municipality															
Lebanon City	=	=	=	=	=	>	>	=	=	=	=	=	=	=	=	=
Millcreek Township	=	>	<	=	=	=	=	=	=	=	=	=	=	=	=	=
Mt. Gretna Borough	=	>	=	=	=	<	>	>	=	=	=	=	>	=	=	<
Myerstown Borough	<	>	<	=	=	>	>	>	=	<	=	=	=	>	=	=
North Annville Township	=	=	=	=	>	=	=	<	=	=	=	=	=	=	=	=
North Cornwall Township	=	=	=	=	=	>	=	=	=	=	=	=	=	=	=	=
North Lebanon Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
North Londonderry Township	=	=	<	=	=	=	=	=	=	=	=	=	=	=	=	=
Palmyra Borough	=	>	<	<	=	=	=	=	=	=	=	<	=	=	=	<
Richland Borough	Not completed by municipality															
South Annville Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
South Lebanon Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
South Londonderry Township	<	<	<	<	=	=	=	=	>	<	=	<	=	=	<	<
Swatara Township	=	>	>	=	>	=	=	=	=	>	=	=	=	=	=	>
Union Township	Not completed by municipality															
West Cornwall Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
West Lebanon Township	=	=	=	=	=	=	=	=	=	=	=	<	=	=	=	<

4.4.3. Potential Loss Estimates

Based on various kinds of available data, potential loss estimates were established for flood, flash flood, and ice jam, tornado and windstorms. Estimates provided in this section are based on HAZUS-MH, version MR4, geospatial analysis, and previous events. Estimates are considered *potential* in that they generally represent losses that could occur in a countywide hazard scenario. In events that are localized, losses may be lower, while regional events could yield higher losses.

Potential loss estimates have four basic components, including:

- Replacement Value: Current cost of returning an asset to its pre-damaged condition, using present-day cost of labor and materials.
- Content Loss: Value of building's contents, typically measured as a percentage of the building replacement value.
- Functional Loss: The value of a building's use or function that would be lost if it were damaged or closed.
- Displacement Cost: The dollar amount required for relocation of the function (business or service) to another structure following a hazard event.

The parcel data used in this plan includes building values provided in the county tax assessment database. These values are representative of replacement value alone; content loss, functional loss, and displacement cost are not included.

Flooding Loss Estimation:

Flooding is a high-risk natural hazard in Lebanon County. The estimation of potential loss in this assessment focuses on the monetary damage that could result from flooding. The potential property loss was determined for each municipality and for the entire county. The quantity of commercial and residential structures in each Lebanon County municipality is outlined in section 4.3.4 of the flooding hazard profile.

MCM Consulting Group conducted a county wide flood study using the Hazards U.S. Multi-Hazard (HAZUS-MH) software that is provided by the Federal Emergency Management Agency. This software is a standardized loss estimation software deriving economic loss, building damage, content damage and other economic impacts that can be used in local flood mitigation planning activities.

Using HAZUS-MH, total building-related losses from a 1%-annual-chance flood in Lebanon County are estimated to equal $44, 150, 000. Residential occupancies make up 24.75% of the total estimated building-related losses. Total economic loss, including replacement value, content loss, functional loss and displacement cost, from a countywide 1%-annual-chance flood are estimated to equal $93,650,000.

4.4.4. Future Development and Vulnerability

Risk and vulnerability to natural and human-caused 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. Lebanon 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.

Total population in Lebanon County increased by about ten percent between 2000 and 2010 from 120,327 to 133,568. The population changes can be seen in *Table 61 - 2000-2015 Population Change.* This overall change reflects an increase in population in all twenty-six municipalities based on the 2015 estimated population. Most of the municipalities experienced an increase of three percent or greater with the exception of Annville Township, Heidelberg Township, Lebanon City, Mount Gretna Borough, Palmyra Borough, South Annville Township, Swatara Township, Union Township, West Cornwall Township and West Lebanon Township. The 2015 estimated population for Lebanon County is 137,729 which is 4,161 more than the 2010 census. There was an overall increase of 3.1% in population based on the estimate.

Table 61 - 2000-2015 Population Change

2000-2015 Population Change				
Municipality	**2000 Population**	**2010 Population**	**2015 Estimated Population**	**Percent of Change**
Annville Township	4,518	4,767	4,883	2.4%
Bethel Township	4,526	5,007	5,158	3.0%
Cleona Borough	2,148	2,080	2,148	3.3%
Cold Spring Township	49	52	54	3.8%
Cornwall Borough	3,486	4,112	4,251	3.4%
East Hanover Township	2,858	2,801	2,886	3.0%
Heidelberg Township	3,832	4,069	4,178	2.7%
Jackson Township	6,338	8,163	8,643	5.9%
Jonestown Borough	1,028	1,905	1,967	3.3%
Lebanon City	24,461	25,477	25,686	0.8%
Millcreek Township	2,921	3,892	4,017	3.2%
Mt. Gretna Borough	242	196	200	2.0%
Myerstown Borough	3,171	3,062	3,159	3.2%
North Annville Township	2,279	2,381	2,456	3.1%
North Cornwall Township	6,403	7,553	7,818	3.5%
North Lebanon Township	10,629	11,429	11,795	3.2%
North Londonderry Township	6,771	8,068	8,379	3.9%
Palmyra Borough	7,096	7,320	7,495	2.4%
Richland Borough	1,508	1,519	1,569	3.3%
South Annville Township	2,946	2,850	2,931	2.8%
South Lebanon Township	8,383	9,463	9,758	3.1%
South Londonderry Township	5,458	6,991	7,712	10.3%
Swatara Township	3,941	4,555	4,656	2.2%
Union Township	2,590	3,099	3,136	1.2%
West Cornwall Township	1,909	1,976	1,993	0.9%

2000-2015 Population Change				
Municipality	**2000 Population**	**2010 Population**	**2015 Estimated Population**	**Percent of Change**
West Lebanon Township	836	781	801	2.6%
TOTAL	120,327	133,568	137,729	3.1%

Recently a 2017 population estimation was released for Lebanon County. The 2017 report identified that the estimated population in Lebanon County as of July 1, 2017 was 139,754. This is an estimated increase of 6,177 people, 4.6% since the 2010 census. All estimations since the 2010 census indicate the population in Lebanon County is growing.

The Lebanon County Planning Department has identified that an increase in new residential homes has occurred and is anticipated to continue to occur in the future. Lebanon County has been identified as one of the fastest growing counties in Pennsylvania since 2010. It is anticipated that the increase will continue through 2023 and potentially beyond 2023. The Lebanon County Planning Department has identified nine municipalities to have significant projected residential development through 2023. *Table 62 - Lebanon County Projected Residential Development* identifies these nine municipalities and the projected residential development units through 2023. *Figure 43 - Projected Areas of New Development* identifies the geographic areas within the county where the projected new residential development through 2023 will occur. Commercial development is not as prevalent as residential in Lebanon County.

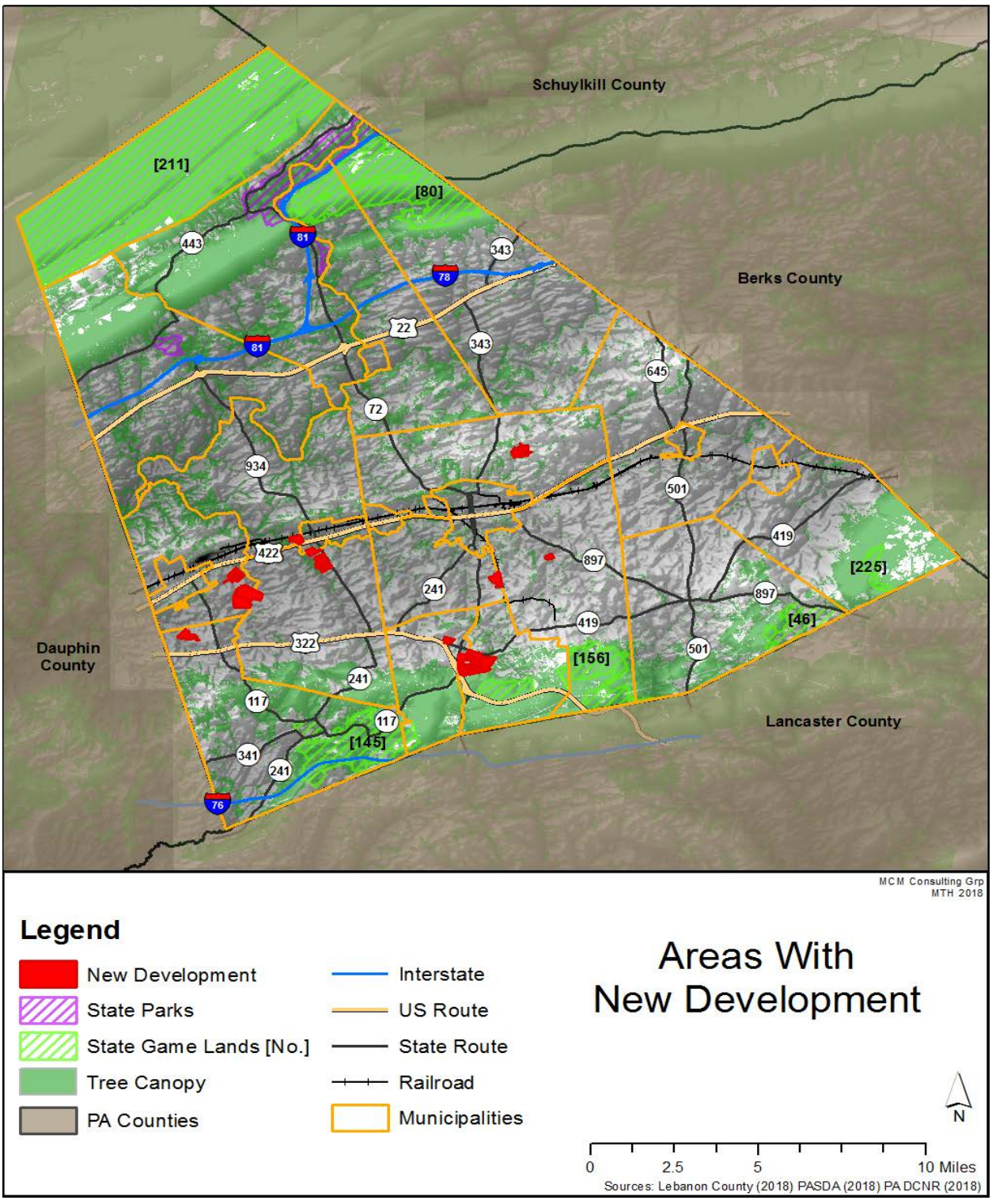
Although new development is vulnerable to all hazards identified in section 4.3 of this hazard mitigation plan update, increase in vulnerability to transportation accidents, flash flooding and other natural and human caused hazards could potentially occur at any time. No specific hazards have been identified as high vulnerability but the Lebanon County Hazard Mitigation Local Planning Team will conduct annual reviews of this plan and the impacts all hazards have on the county and new development every year and within a time frame after a disaster or major emergency. Action 3.5.1 identifies that municipalities will continue to be engaged to identify and incorporate hazard mitigation opportunity forms to include into the hazard mitigation plan during the next five years. Project opportunities would be developed to decrease any vulnerabilities that are identified.

Special flood hazard area flooding is not anticipated to be considered an increased risk since municipalities have adopted and enforce floodplain ordinances. New construction in the special flood hazard area can only be completed with a special permit and action 1.1.3. of the 2018 Lebanon County Hazard Mitigation Plan identifies that municipalities will track any development that has been authorized by permit in the special flood hazard area to determine any flooding related hazards.

Table 62 - Lebanon County Projected Residential Development

Lebanon County Residential Development Projections				
Municipality	**Development Name**	**Single Family Dwellings**	**Apartment Units**	**Townhouse Units**
Annville Township	Stone Hill Village	0	100	0
Cornwall Borough	Alden Place	156	0	0
	The Woods at Cornwall Manor	30	0	0
North Cornwall Township	North Cornwall Commons	0	0	156
North Lebanon Township	Crossings at Sweetbriar	125	0	0
North Londonderry Township	Londoncroft	40	0	0
	Landmark Builders	540	0	0
South Annville Township	Meadows of Bachman Run	106	0	0
	Olde South Crossing	20	0	0
	Townes of Mayapple	154	0	0
South Lebanon Township	Lindcrest Subdivision	26	0	0
South Londonderry Township	Springbrook Farms	0	76	142
	Windermere	33	0	33
West Cornwall Township	Scenic Ridge	75	0	0
Total		**1305**	**176**	**331**

Figure 43 - Projected Areas of New Development



5. Capability Assessment

5.1. Update Process Summary

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

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

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

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

Lebanon County has a number of resources it can access to implement hazard mitigation initiatives including emergency response measures, local planning and regulatory tools, administrative assistance and technical expertise, fiscal capabilities and participation in local, regional, state and federal programs. The presence of these resources enables community resiliency through actions taken before, during and after a hazardous event. While the capability assessment serves as a good instrument for identifying local capabilities, it also provides a means for recognizing gaps and weaknesses that

can be resolved through future mitigation actions. The results of this assessment lend critical information for developing an effective mitigation strategy.

5.2. Capability Assessment Findings

Of the twenty-six municipalities within Lebanon County twenty-five completed and submitted a capability assessment survey. The results of the survey were collected, aggregated and analyzed.

5.2.1. Planning and Regulatory Capability

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

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

Building Codes

Building codes are important in mitigation because they are developed for a region of the country in respect to the hazards existing in that area. Consequently, structures that are built according to applicable codes are inherently resistant to many hazards, such as strong winds, floods and earthquakes; and can help mitigate regional hazards, such as wildfires. In 2003, Pennsylvania implemented the Uniform Construction Code

(UCC) (Act 45), a comprehensive building code that establishes minimum regulations for most new construction, including additions and renovations to existing structures.

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

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

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

The municipalities in Lebanon County adhere to the standards of the Pennsylvania Uniform Construction Code (Act 45). Of the twenty-six municipalities in Lebanon County, twenty-five have opted in on building code enforcement.

Zoning Ordinance

Article VI of the Municipalities Planning Code (MPC) authorizes municipalities to prepare and enact zoning to regulate land use. Its regulations can apply to: the permitted use of land; the height and bulk of structures; the percentage of a lot that may be occupied by buildings and other impervious surfaces; yard setbacks; the density of development; the height and size of signs; the parking regulations. A zoning ordinance has two parts, including the zoning map that delineates zoning districts and the text that sets forth the regulations that apply to each district. Twenty-five of the twenty-six municipalities have zoning regulations; fourteen utilize the county planning department for zoning enforcement; eleven provide their own enforcement. Cold Spring Township has no governing body and no zoning ordinance.

Subdivision Ordinance

Subdivision and land development ordinances include regulations to control the layout of streets, the planning of lots and the provision of utilities and other site improvements.

The objectives of a subdivision and land development ordinance are to: coordinate street patterns; assure adequate utilities and other improvements are provided in a manner that will not pollute streams, wells and/or soils; reduce traffic congestion; and provide sound design standards as a guide to developers, the elected officials, planning commissions and other municipal officials. Article V of the Municipality Planning Code authorizes municipalities to prepare and enact a subdivision and land development ordinance. Subdivision and land development ordinances provide for the division and improvement of land. All municipalities in Lebanon County utilize some form of land use and land development regulation. The Lebanon County Subdivision and Land Development Ordinance provides regulatory guidance for thirteen of the twenty-six municipalities. Annville Township, Bethel Township, Cornwall Borough, Heidelberg Township, Jackson Township, Lebanon City, North Cornwall Township, Palmyra Borough, South Lebanon Township, South Londonderry Township, Swatara Township, Union Township, and West Lebanon Township have their own subdivision and land development ordinances.

Stormwater Management Plan/Stormwater Ordinance

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

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

Of the designated watersheds in Lebanon County, only the Tulpehocken Creek and Cocalico Creek watersheds have approved Act 167 Stormwater Management Plan, as required by the Stormwater Management Act (Act 167.

Comprehensive Plan

A comprehensive plan is a policy document that states objectives and guides the future growth and physical development of a municipality. The comprehensive plan is a blueprint for housing, transportation, community facilities, utilities and land use. It examines how the past led to the present and charts the community's future path. The Pennsylvania Municipalities Planning Code (MPC Act 247 of 1968, as reauthorized and amended) requires counties to prepare and maintain a county comprehensive plan. In addition, the MPC requires counties to update the comprehensive plan every ten years.

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

Lebanon County has a county comprehensive plan that was adopted on December 13, 2007. Although the 2007 plan is currently overdue for an update, the Lebanon County Planning Department is currently seeking funding to complete an update to the comprehensive plan.

Article III of the Municipality Planning Code (MPC) enables municipalities to prepare a comprehensive plan; however, development of a comprehensive plan is voluntary. Ten of the twenty-six municipalities have no municipal plan or have plans that are more than twenty years old. After the adoption of the Lebanon County Comprehensive Plan in 2007, several municipalities decided to work together to create regional comprehensive plans based on school district boundaries: Annville-Cleona School District - Annville Township, Cleona Borough, North Annville Township, and South Annville Township - adopted in 2012; Cornwall-Lebanon School District – North Cornwall Township, North Lebanon Township, and South Lebanon Township – adopted in 2013; and the Palmyra Area School District – Palmyra Borough and South Londonderry Township – adopted 2013. East Hanover Township and Myerstown Borough also updated their comprehensive plans in 2013 and 2012 respectively.

Capital Improvements Plan

The capital improvements plan is a multi-year policy guide that identifies needed capital projects and is used to coordinate the financing and timing of public improvements. Capital improvements relate to streets, storm water systems, water distribution, sewage

treatment and other major public facilities. A capital improvements plan should be prepared by the respective county's planning department and should include a capital budget. This budget identifies the highest priority projects recommended for funding in the next annual budget. The capital improvements plan is dynamic and can be tailored to specific circumstances. Of the twenty-five municipalities that submitted a capability assessment, four indicated that they have a capital improvement plan in place.

Participation in the National Flood Insurance Program (NFIP)

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

The Pennsylvania DCED provides communities, based on their CFR, Title 44, Section 60.3 level of regulations, with a suggested ordinance document to assist municipalities in meeting the minimum requirements of the NFIP along with the Pennsylvania Flood Plain Management Act (Act 166). These suggested or model ordinances contain provisions that are more restrictive than state and federal requirements. Suggested provisions include, but are not limited to:

1. Prohibiting manufactured homes in the floodway.
2. Prohibiting manufactured homes within the area measured 50 feet landward from the top-of bank of any watercourse within a special flood hazard area.
3. Special requirements for recreational vehicles within the special flood hazard area.
4. Special requirement for accessory structures.
5. Prohibiting new construction and development within the area measured 50 feet landward from the top-of bank of any watercourse within a special flood hazard area.
6. Providing the County Conservation District an opportunity to review and comment on all applications and plans for any proposed construction or development in any identified floodplain area.

Act 166 mandates municipal participation in and compliance with the NFIP. It also establishes higher regulatory standards for new or substantially improved structures which are used for the production or storage of dangerous materials (as defined by Act 166) by prohibiting them in the floodway. Additionally, Act 166 establishes the requirement that a special permit be obtained prior to any construction or expansion of any

manufactured home park, hospital, nursing home, jail and prison if said structure is located within a special flood hazard area.

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

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

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

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

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

FEMA Region III makes available to communities, an ordinance review checklist which lists required provisions for floodplain management ordinances. This checklist helps communities develop an effective floodplain management ordinance that meets federal requirements for participation in the NFIP. The Pennsylvania Department of Community and Economic Development (DCED) provides communities, based on their 44 CFR 60.3 level of regulations, with a suggested ordinance document to assist municipalities in

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

Of the twenty-six municipalities that reside in Lebanon County, twenty-two have floodplain regulations in place that meet requirements set forth by the NFIP. The only municipality that does not participate in the NFIP is Cold Spring Township. Currently, no municipalities have completed or started to complete the CRS program. Additional research will be conducted on the CRS program and mitigation actions will be developed in support of the CRS.

5.2.2. Administrative and Technical Capability

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

County Planning Department

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

Municipal Engineer

A municipal engineer performs duties as directed in the areas of construction, reconstruction, maintenance and repair of streets, roads, pavements, sanitary sewers,

bridges, culverts and other engineering work. The municipal engineer prepares plans, specifications and estimates of the work undertaken by the township. Nineteen municipalities in Lebanon County contract a municipal engineer.

Personnel Skilled in GIS or FEMA HAZUS Software

A geographic information system (GIS) is an integrated, computer-based system designed to capture, store, edit, analyze and display geographic information. Some examples of uses for GIS technology in local government are: land records management, land use planning, infrastructure management and natural resources planning. A GIS automates existing operations such as map production and maintenance, saving a great deal of time and money. The GIS also includes information about map features such as the capacity of a municipal water supply or the acres of public land. GIS data is managed, maintained and developed by the Lebanon County GIS Department. There are members of the Lebanon County GIS Department who have completed Basic HAZUS-MH.

Emergency Management Coordinator

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

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

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

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

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

The Emergency Management Services Code (PA Title 35) requires that all municipalities in the Commonwealth have a local emergency operations plan (EOP) which is updated every two years. Each municipality is required to adopt the countywide EOP. The Notification and Resource Section of the plan was developed individually by each municipality. Lebanon County is currently in the process of updating their EOP.

Political Capability

One of the most difficult capabilities to evaluate involves the political will of a jurisdiction to enact meaningful policies and projects designed to mitigate hazard events. The adoption of hazard mitigation measures may be seen as an impediment to growth and economic development. In many cases, mitigation may not generate interest among local officials when compared with competing priorities. Therefore, the local political climate must be considered when designing mitigation strategies, as it could be the most difficult hurdle to overcome in accomplishing the adoption or implementation of specific actions.

The capability assessment survey was used to capture information on each jurisdiction's political capability. Survey respondents were asked to identify examples of political capability, such as guiding development away from hazard areas, restricting public investments or capital improvements within hazard areas, or enforcing local development standards that go beyond minimum state or federal requirements (i.e. building codes, floodplain management ordinances, etc.). These examples were used to guide respondents in scoring their community on a scale of "unwilling" (0) to "very willing" (5) to adopt policies and programs that reduce hazard vulnerabilities. Of the municipalities that responded, none of the municipalities completed this section with a numerical response.

Self-Assessment

In addition to the inventory and analysis of specific local capabilities, the *Capability Assessment Survey* required each local jurisdiction to conduct its own self-assessment of its capability to effectively implement hazard mitigation activities. As part of this process, county and municipal officials were encouraged to consider the barriers to implementing proposed mitigation strategies in addition to the mechanisms that could enhance or further such strategies. In response to the survey questionnaire, local officials classified each of the capabilities as either "L = limited" "M = moderate" or "H = high." *Table 63 - Capability Self-Assessment Matrix* summarizes the results of the self-assessment survey.

Table 63 - Capability Self-Assessment Matrix

Lebanon County Capability Self-Assessment Matrix				
Municipality Name	**Capability Category**			
	Planning and Regulatory Capability	**Administrative and Technical Capability**	**Fiscal Capability**	**Community Political Capability**
Annville Township	M	M	L	M
Bethel Township	Not completed by municipality			
Cleona Borough	M	L	M	M
Cold Spring Township	Not completed by municipality			
Cornwall Borough	L	L	L	L
East Hanover Township	L	L	L	L
Heidelberg Township	H	H	H	H
Jackson Township	Not completed by municipality			
Jonestown Borough	L	L	L	L
Lebanon City	M	M	L	L
Millcreek Township	Not completed by municipality			
Mt. Gretna Borough	M	M	M	M
Myerstown Borough	M	M	L	M
North Annville Township	H	M	L	M
North Cornwall Township	L	L	L	L
North Lebanon Township	L	L	L	M
North Londonderry Township	H	H	M	H
Palmyra Borough	H	H	H	H
Richland Borough	M	M	M	M
South Annville Township	M	L	M	M
South Lebanon Township	H	M	M	M
South Londonderry Township	M	M	M	M
Swatara Township	M	M	M	M
Union Township	L	L	M	M
West Cornwall Township	L	L	L	L
West Lebanon Township	M	M	M	M

Existing Limitations

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

5.2.3. Financial Capability

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

State and Federal Grants

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

Capital Improvement Financing

Because most capital investments involve the outlay of substantial funds, local governments can seldom pay for these facilities through annual appropriations in the annual operating budget. Therefore, numerous techniques have evolved to enable local government to pay for capital improvements over a time period exceeding one year. Public finance literature and state laws governing local government finance classify techniques that are used to finance capital improvements. The techniques include: revenue bonds; lease-purchase, authorities and special district; current revenue (pay-as-you-go); reserve funds; and tax increment financing. Most municipalities have very limited local tax funds for capital projects. Grants and other funding is always a priority.

Indebtedness through General Obligation Bonds

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

Municipal Authorities

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

Sewer Authorities

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

Water Authorities

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

Circuit Riding Program (Engineer)

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

5.2.4. Education and Outreach

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

Educational activities that directly impact hazard mitigation in Lebanon County predominantly revolve around the first responders. Providing fire, medical and search and

rescue training and education enhances the response and recovery capabilities of response agencies in the county. Additional training is always a goal within Lebanon County.

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

5.2.5. Plan Integration

There are numerous existing regulatory and planning mechanisms in place at the state, county and municipal level of government which support hazard mitigation planning efforts. These tools include the 2013 Commonwealth of Pennsylvania Standard All-Hazard Mitigation Plan, local floodplain management ordinances, the Lebanon County Comprehensive Plan, Lebanon County Emergency Operations Plan, local emergency operation plans, local zoning ordinances, local subdivision and land development ordinances.

Information from several of these documents has been incorporated into this plan and mitigation actions have been developed to further integrate these planning mechanisms into the hazard mitigation planning process. In particular, information on identified development constraints and potential future growth areas was incorporated from the Lebanon County Comprehensive Plan and the Lebanon County Planning Department so that vulnerability pertaining to future development could be established. Floodplain management ordinance information was used to aid in the establishment of local capabilities in addition to participation in The National Flood Insurance Program (NFIP).

The Lebanon County Comprehensive Plan, the Lebanon County Emergency Operations Plan, and various municipal regulatory tools as identified in the capability assessment section of this plan, require alignment with this updated hazard mitigation plan. The county comprehensive plan has not been updated since 2007. This plan is very limited on the amount of hazard mitigation principles that are incorporated into the plan. Discussions on specific hazard areas within municipalities that may be used for future development must be addressed. Municipalities should also identify mitigation projects that could decrease the impact of hazards in these specific areas in the annual municipal capital improvement plan.

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

Lebanon County is a small county with a limited population and a limited amount of resources to appropriately ensure and implement hazard mitigation principles into all regulatory tools. Lebanon County will continue to explore options to further enhance

the implementation of these principles utilizing already multi-tasked staff and resources. Lebanon County will review other local and state plans that could be impacted with hazard mitigation principles over the next five-year planning period.

Pennsylvania All-Hazard Mitigation Plan - 2013

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

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

National Flood Insurance Program and Municipal Floodplain Ordinance

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

A GIS dataset of the 1% annual chance floodplain as identified by FEMA Digital Flood Insurance Rate Maps (DFIRM) from 2016 was used to identify structures and critical facilities that fall within the floodplain in Lebanon County for the vulnerability assessment of the Flooding Profiles (section 4.3.3). While DFIRM maps are a useful tool and important to integrate into this planning process, it should also be noted that these are not completely accurate, and are estimates and models of vulnerability. A map of these floodplains for each municipality in Lebanon County can be found in Appendix D.

In the future, Lebanon County should ensure that all floodplain ordinance updates have integrated hazard mitigation principles by participation in NFIP programs and integrating the NFIP program data into any applicable hazard mitigation sections.

Lebanon County Comprehensive Plan

Article III of the Pennsylvania Municipalities Planning code (Act 247 of 1968, as reenacted and amended) requires all Pennsylvania counties (except Philadelphia) to adopt a comprehensive plan and update it at least every ten years. The Lebanon County Commissioners adopted the updated Lebanon County Comprehensive Plan in 2007.

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

The Lebanon County Comprehensive Plan has not been updated since 2007 so much of the development and growth data from the 2007 plan did not accurately reflect recent growth and anticipated growth in the next five years. Currently, the Lebanon County Planning Department is attempting to identify funding to complete an update to the plan. During the planning process for the 2018 Lebanon County Hazard Mitigation Plan Update, the Lebanon County Planning Director was a participant of the Lebanon County Local Planning Team. Updated future growth information was integrated into the hazard mitigation planning process. Annville Township, Cornwall Borough, North Lebanon Township, North Londonderry Township, South Annville Township, South Lebanon Township and West Cornwall Township were identified as the municipalities with increased planned future new construction of single-family dwellings, apartment units and townhouses. This information is reflected in section 4.4.4. of this hazard mitigation plan update. The future growth and development areas of the county were utilized in the development of hazard vulnerability subsections for each of the appropriate hazards profiled in section 4.3.

Lebanon County Emergency Operations

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

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

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

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

Other Resources and Interconnectivity

Other resources utilized in the planning process include the PA DEP 2015 Oil and Gas Annual Report, which provided valuable information about Pennsylvania and Lebanon County in the Environmental Hazards Profile (section 4.3.16). The USDA 2012 Census of Agriculture was referenced in the Drought Profile (section 4.3.1) to provide community information about Lebanon County. The PA West Nile Control Program, a collaboration between the PA DEP, PA DOH & the PA DOA, was a valuable resource for the Pandemic and Infectious Diseases Profile (4.3.9), providing background information and detailed past occurrence data for West Nile Virus in Lebanon County.

Plan Interrelationships

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

To that end, Lebanon County and its municipalities must ensure that the components of the hazard mitigation plan are integrated into existing community planning mechanisms and are generally consistent with goals, policies and recommended actions. Lebanon County and the hazard mitigation planning team will utilize the existing maintenance schedule of each plan to incorporate the goals, policies and recommended actions as each plan is updated.

6. Mitigation Strategy

6.1. Update Process Summary

Mitigation goals are general guidelines that explain what the county wants to achieve. Goals are usually expressed as broad policy statements representing desired long-term results. Mitigation objectives describe strategies or implementation steps to attain the identified goals. Objectives are more specific statements than goals; the described steps are usually measurable and can have a defined completion date. There were six goals and twenty-two objectives identified in the 2013 hazard mitigation plan. The 2018 Lebanon County Hazard Mitigation Plan Update has five goals and twenty-three objectives. Objectives have been added and arranged in order to associate them with the most appropriate goal. These changes are noted in *Table 64 - 2013 Mitigation Goals and* Objectives. A list of these goals and objectives as well as a review summary based on comments received from stakeholders who participated in the HMP update process is included in *Table 64 - 2013 Mitigation Goals and* Objectives. These reviews are based on the 5-Year hazard mitigation plan review worksheet, which includes a survey on existing goals and objectives, completed by the local planning team. Municipal officials then provided feedback on the changes to the goals and objectives via a mitigation strategy update meeting. Copies of these meetings and all documentation associated with the meetings are located in Appendix C.

Actions provide more detailed descriptions of specific work tasks to help the county and its municipalities achieve prescribed goals and objectives. There were sixty actions identified in the 2013 mitigation strategy. A review of the 2013 mitigation actions was completed by the local planning team. The results of this review are identified in *Table 64 - 2013 Mitigation Goals and* Objectives. Actions were evaluated by the local planning team with the intent of carrying over any actions that were not started or continuous for the next five years.

Table 64 - 2013 Mitigation Goals and Objectives

Lebanon County 2013 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
GOAL 1	**Strengthen County and Local capabilities to reduce the potential impacts of flooding on existing and future public/private assets, including structures, critical facilities and infrastructure**	
Objective 1.1	Develop an Act 167 Stormwater Management Plan for all municipalities.	All municipalities have stormwater ordinances. No activities with 167 plans. Would like to keep this in the 2018 plan.
Objective 1.2	Develop first floor elevations for all structures in the flood plain.	Still valid.

Lebanon County 2013 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
Objective 1.3	Encourage all Lebanon County municipalities to participate in the NFIP Community Rating System Program.	Still valid. Focus on education.
Objective 1.4	Develop and train County Damage Assessment Teams.	No changes
GOAL 2	**Increase intergovernmental cooperation and build public/private partnerships to implement activities that will reduce the impact of natural, man-made, and technological hazards.**	Change to human-caused hazards.
Objective 2.1	Regionalization of Public Safety Services to increase preparation and response capabilities.	No changes.
Objective 2.2	Conduct outreach and assist businesses with continuity planning.	Keep in the plan. No activities.
Objective 2.3	Review and update government continuity of operations plans.	Keep in the plan. No activities.
Objective 2.4	Conduct outreach and increase utility company relationships and communications.	Keep in the plan. EMA does this.
Objective 2.5	Develop additional news media relationships to enhance public outreach for the hazard mitigation program.	Keep in the plan.
GOAL 3	**Enhance planning and emergency response efforts among state, county and local emergency management personnel to protect public health and safety.**	Keep in plan
Objective 3.1	Enhance relationships with local response personnel.	Keep
Objective 3.2	Conduct annual county and municipal emergency operations plan updates.	In progress. No changes.
Objective 3.3	Conduct outreach to school districts and assist with school emergency plan development.	Complete annual weather exercise. Still valid.
NEW Objective 3.4	Develop a strategy to combat the opioid epidemic in Lebanon County.	
GOAL 4	**Continue to build Lebanon County's spatial information resources to strengthen public and private hazard mitigation planning and decision-support capabilities.**	
Objective 4.1	Conduct aerial photography updates.	Move to maintain. Move to an action.
Objective 4.2	Update all GIS hardware and software.	Keep in the plan.
Objective 4.3	Research funding opportunities to enhance the GIS program.	Keep in the plan.
Objective 4.4	Develop data layers of utilities in Lebanon County.	Develop and maintain various data layers in GIS to enhance hazard mitigation planning and emergency response. Move utilities layer to action based item.

Lebanon County 2013 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
GOAL 5	**Increase public awareness on both the potential impacts of natural hazards and activities to reduce those impacts.**	Add in human-caused. Increase public awareness on potential impacts of natural and human caused.
Objective 5.1	Upgrade the County Emergency Management website and the county's website to use the site for hazard mitigation and response efforts.	Utilize various county and municipal websites for hazard mitigation info dissemination.
Objective 5.2	Augment fire prevention activities and events in Lebanon County.	
Objective 5.3	Increase participation in First Night Out events in all municipalities.	Change objective to read, Increase public outreach throughout the county. Change First Night to an action.
Objective 5.4	Develop procedures to utilize social media in prevention, response and mitigation efforts.	
GOAL 6	**Protect lives and properties from all hazards.**	Remove this goal.
Objective 6.1	Acquire, demolish or elevate flood prone properties to remove or mitigate risks to homeowners and property.	Renumber to objective 1.5.

Table 65 - 2013 Mitigation Actions Review

2013 Lebanon County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
1. Create and maintain a web-based inventory of the County's special needs population to strengthen emergency response and evacuation operations.						
2. Develop and train a core team to conduct county wide damage assessment after emergencies or disasters.		**X**				CERT and planning/assessment people. 1.4.1
3. Update the Lebanon County EOP to be consistent with the National Response Plan.			**X**			Continuous. 3.2.1
4. Implement a countywide electronic damage assessment management tool to increase the efficiency of county and municipal damage survey and reporting.		**X**				WebEOC software 1.4.2
5. Strengthen the county's domestic animal health surveillance by familiarizing the Lebanon County					**X**	

2013 Lebanon County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
agricultural community with the list of reportable diseases and conditions related to animal health per the Office of International Epizootics (OIS) and the Pennsylvania Domestic Animal Act (Act 100 of 1996).						
6. Continue to work with the Pennsylvania Department of Health and the Pennsylvania Emergency Management Agency to implement a Strategic National Stockpile Plan for Lebanon County and the South Central Task Force (SCTF).			**X**			New name 3.1.1
7. Maintain the county's commodity flow study to ensure the county LEPC, first responders, and local officials understand the types, frequencies, and amounts of hazardous materials being transported through its borders.			**X**			Next due in 2019 2.3.1
8. Ensure the county's standardized street addressing project is completed and maintained to support accurate and timely emergency response.					**X**	This action has been removed and will be replaced with a new action.
9. Ensure all county GIS staff receive regular HAZUS training from EMI.					**X**	
10. Develop and maintain a GIS dataset of all municipal TCPs and ACPs for evacuation route planning.			**X**			4.4.2
11. Continue to work with the county's agricultural community to develop and implement the county animal response team (CART) to strengthen the county's comprehensive emergency management program.		**X**				Add through he SCTF 3.1.1
12. Prepare a countywide emergency communications procedure manual (ECPM) to establish a consolidated and uniform set of communications policies and procedures for Lebanon County's fire, EMS, and police services.		**X**				2.3.2
13. Integrate the 5-year maintenance cycle of the Hazard Mitigation Plan with both the 10-year and biennial review and maintenance cycles of the county Comprehensive Plan and county Regional Emergency Operations Plan, respectively (see Plan Maintenance Process Section of the HMP).			**X**			Break them apart. 2 Actions. 2.3.3: Integrate the 2018 hazard mitigation plan data and principles with the next update of the Lebanon County Comprehensive Plan. 2.3.4: Integrate the 2018 hazard mitigation plan data and principles with the next update of the Lebanon County Emergency Operations Plan

2013 Lebanon County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
14. Continue to solicit input from municipalities and public and private stakeholders, including local schools and colleges, the Chamber of Commerce, and other groups, for the Hazard Mitigation Plan update.			**X**			3.3.1
15. Continue to work with municipalities to identify and incorporate hazard mitigation project opportunity forms to include in the 5-year update of the HMP.			**X**			3.5.1
16. Prepare Act 167 Stormwater Management Plans for the DEP-designated stormwater management watersheds draining Lebanon County.	**X**					Lebanon County Planning Department will update. 1.1.1
17. Prepare and enact stormwater management ordinances consistent with Act 167 Stormwater management Plans.			**X**			Change maintain 1.1.2
18. Conduct Regional Assessments of Public Safety Services to determine funding abilities for regional systems.			**X**			2.1.1
19. Meet with government leaders to provide sample continuity of government plans.					**X**	Covered under action 25
20. Consider adopting a county-wide post-disaster recovery and reconstruction ordinance using the model ordinance included in the APA/FEMA PAS Report No. 483/484.	**X**					Remove the APA/FEMA PAS Report Number 483/484 2.3.5
21. Consider implementing a circuit-rider program to staff and fund a full-time county engineer that would be shared by both the county and participating municipalities to provide technical reviews of municipal subdivision and land development plans, conduct bridge inspections, and perform routine and emergent municipal engineering inspections/reviews.					**X**	County utilizes 3rd party services now. And no full-time employee will be hired.
22. Work with the Chambers of Commerce to encourage all business owners to prepare and implement a Business Continuity Plan to provide safeguards against business activity interruptions.	**X**					2.2.1
23. Conduct annual outreach to utility companies to review hazard mitigation projects and procedures.			**X**			GIS has completed some data layer items. 2.4.1
24. Conduct a thorough critical facilities vulnerability assessment and impact analysis using the HMP's GIS -based critical infrastructure inventory.			**X**			GIS layers for critical facilities are continuously. 4.4.3

2013 Lebanon County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
25. Prepare and implement a Continuity of Government Plan for Lebanon County government.	**X**					Add municipal govs. 3.2.2
26. Maintain a countywide capital improvements plan to program, schedule, prioritize, and budget both county and municipal capital improvements.			**X**			Started adding capital budgets in last 3 budgets. 3.2.3
27. Obtain first floor flood elevation data for the county's inventoried critical infrastructure and intersect this information with the base flood elevations to identify high risk facilities and formulate mitigation strategies.	**X**					1.2.1
28. Collect and analyze data on the specific impacts earthquakes have on Lebanon County and its municipalities to include in the 5-year update of the Hazard Mitigation Plan.					**X**	No longer supported by the local planning team
29. Collect and analyze data on the specific locations and damages caused by flooding in each of the municipalities in Lebanon County to include in the 5-year update of the Hazard Mitigation Plan.					**X**	No longer supported by the local planning team
30. Collect and analyze data on the specific impacts severe temperatures have on Lebanon County and its municipalities to include in the 5-yar update of the Hazard Mitigation Plan.					**X**	No longer supported by the local planning team
31. Collect and analyze data on the specific impacts hurricanes and tropical storms have on Lebanon County and its municipalities to include in the 5-year update of the Hazard Mitigation Plan.					**X**	No longer supported by the local planning team
32. Collect and analyze data on the specific impacts severe winter weather has on Lebanon County and its municipalities to include in the 5-year update of the Hazard Mitigation Plan.					**X**	No longer supported by the local planning team
33. Collect and analyze data on the specific impacts tornados have on Lebanon County and its municipalities to include in the 5-year update of the hazard Mitigation Plan.					**X**	No longer supported by the local planning team
34. Collect and analyze data on the specific impacts dam failures have on Lebanon County and its municipalities to include in the 5-year update of the Hazard Mitigation Plan.					**X**	No longer supported by the local planning team
35. Collect and analyze data on the specific impacts droughts have on Lebanon County and its municipalities to include in the 5-year update of the Hazard Mitigation Plan.					**X**	No longer supported by the local planning team

2013 Lebanon County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
36. Collect and analyze data on the specific impacts wildfires have on Lebanon County and its municipalities to include in the 5-year update of the Hazard Mitigation Plan.					**X**	No longer supported by the local planning team
37. Collect and analyze data on the occurrences and impacts of civil disorders in Lebanon County and its municipalities to include in the 5-year update of the Hazard Mitigation Plan.					**X**	No longer supported by the local planning team
38. Collect and analyze data on the specific threats nuclear power presents to Lebanon County and its municipalities to include in the 5-year update of the Hazard Mitigation Plan.					**X**	No longer supported by the local planning team
39. Collect and analyze data on potential terrorism targets in Lebanon County and its municipalities and the impacts that a terrorist act would have to include in the 5-year update of the Hazard Mitigation Plan.					**X**	No longer supported by the local planning team
40. Collect and analyze data on the specific impacts urban fires have on Lebanon County and its municipalities to include in the 5-year update of the Hazard Mitigation Plan.					**X**	No longer supported by the local planning team
41. Collect and analyze data on the location of most transportation incidents and their impacts to Lebanon County and its municipalities to include in the 5-year update of the hazard Mitigation Plan.					**X**	No longer supported by the local planning team
42. Collect and analyze data on the specific impacts power failures have on Lebanon County and its municipalities to include in the 5-year update of the Hazard Mitigation Plan.					**X**	No longer supported by the local planning team
43. Collect and analyze data on the specific impacts sinkholes and subsidence have on Lebanon County and its municipalities to include in the 5-year update of the Hazard Mitigation Plan.					**X**	No longer supported by the local planning team
44. Collect and analyze data on the specific impacts landslides have on Lebanon County and its municipalities to include in the 5-yaer update of the Hazard Mitigation Plan.					**X**	No longer supported by the local planning team
45. Evaluate and refine the county's repetitive loss structures list by ranking properties based on the number of losses and the value of the claims paid and target the priority properties for buyout opportunities.			**X**			

2013 Lebanon County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
46. Maintain a list of repetitive loss structures from the Governor's Center for Local Government Service's NFIP Coordinator and incorporate the data into the county's Hazard Mitigation Planning project.						Change to PEMA 2.5.1
47. Encourage the county's National Flood Program communities to participate in the NFIP Community Rating System (CRS) and attain discount opportunities on flood insurance premiums.	**X**					1.3.1
48. Conduct outreach to municipalities to ensure continued compliance with NFIP.			**X**			1.3.2
49. Maintain the county's Hazard Mitigation Planning GIS datasets and disseminate the information to municipalities through ESRI's free ArcGIS Explorer software.			**X**			Remove highlighted. 4.4.4
50. Update the Lebanon County tax parcel database to allow for more detailed analysis of potential property losses.						Maintain tax parcel database. 4.4.5
51. Develop a team of first responders and emergency management personnel to assist schools with developing emergency plans.			**X**			3.3.2
52. Collaborate with the DEP Bureau of Radiation Protection to ensure the state's Radon Awareness Campaign and public service announcements are disseminated throughout Lebanon County.	**X**					5.3.1
53. Conduct analysis on the future demand for expanded infrastructure and critical facilities in Lebanon County.					**X**	
54. Maintain and disseminate a list of DEP-certified radon testers, mitigators, and laboratories (current lists are available through DEP at http://www.dep.state.pa.us/dep/deputate/airwaste/rp/Radon_Division/Radon_Homepage.htm).			**X**			Develop a County web link. Add comments about test kits and dissemination. 5.1.1
55. Develop water, gas, electric and communications GIS data layers.			**X**			Develop and maintain. 4.4.6
56. Develop county EMA profiles on social media sites and develop checklists to complete for using these sites for emergency notification.			**X**			Change to maintain 5.4.1

2013 Lebanon County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
57. Determine the average radon levels per municipality for inclusion in the next hazard mitigation plan update.					**X**	
58. Review the nation inventory of dams list and complete an inventory of all dams in Lebanon County to identify dams not on the national inventory list.					**X**	
59. Inventory and review all critical facilities' emergency generator capabilities for run time duration, load capacity and fuel source in the event of an emergency or disaster.	**X**					3.5.2
60. Municipalities will track any development that has been authorized by special permit in the special flood hazard area.			**X**			1.1.3

6.2. Mitigation Goals and Objectives

Based on results of the goals and objectives evaluation exercise and input from the local planning team, a list of five goals and twenty-three corresponding objectives was developed. *Table 66 - 2018 Goals and Objectives* details the mitigation goals and objectives established for the 2018 Lebanon County Hazard Mitigation Plan.

Table 66 - 2018 Goals and Objectives

2018 Lebanon County Goals and Objectives	
GOAL Objective	**Description**
GOAL 1	**Strengthen county and local capabilities to reduce the potential impacts of flooding on existing and future public/private assets, including structures, critical facilities and infrastructure**
Objective 1.1	Develop and maintain plans and regulations for storm water management and MS4 requirements.
Objective 1.2	Develop first floor elevations for all structures in the flood plain.
Objective 1.3	Encourage all Lebanon County municipalities to participate in the National Flood Insurance Program (NFIP) and various programs offered by the NFIP
Objective 1.4	Develop and train County Damage Assessment Teams.

2018 Lebanon County Goals and Objectives	
GOAL Objective	**Description**
Objective 1.5	Acquire, elevate, demolish or demolish/reconstruct flood prone properties to remove or mitigate risks to homeowners and property.
GOAL 2	**Increase intergovernmental cooperation and build public/private partnerships to implement activities that will reduce the impact of natural and human-caused hazards.**
Objective 2.1	Regionalization of Public Safety Services to increase preparation and response capabilities.
Objective 2.2	Conduct outreach and assist businesses with continuity planning.
Objective 2.3	Review and update emergency plans, regulations and ordinances to enhance hazard mitigation capabilities.
Objective 2.4	Conduct outreach and increase utility company relationships and communications.
Objective 2.5	Develop additional news media relationships to enhance public outreach for the hazard mitigation program.
GOAL 3	**Enhance planning and emergency response efforts among state, county and local emergency management personnel to protect public health and safety.**
Objective 3.1	Enhance relationships with regional and local response personnel.
Objective 3.2	Conduct annual county and municipal emergency operations plan updates.
Objective 3.3	Conduct outreach to school districts and assist with school emergency plan development.
Objective 3.4	Develop a strategy to combat the opioid epidemic in Lebanon County.
Objective 3.5	Develop and conduct various actions and projects to enhance hazard mitigation planning
GOAL 4	**Continue to build Lebanon County's spatial information resources to strengthen public and private hazard mitigation planning and decision-support capabilities.**
Objective 4.1	Maintain aerial photography updates.
Objective 4.2	Update all GIS hardware and software.
Objective 4.3	Research funding opportunities to enhance the GIS program.
Objective 4.4	Develop and maintain various data layers in GIS to enhance hazard mitigation planning and emergency response.
GOAL 5	**Increase public awareness on potential impacts of natural and human-caused hazards.**
Objective 5.1	Utilize various county and municipal websites for hazard mitigation info dissemination.
Objective 5.2	Augment fire prevention activities and events in Lebanon County.
Objective 5.3	Increase public outreach throughout the county.
Objective 5.4	Develop procedures to utilize social media in prevention, response and mitigation efforts.

6.3. Identification and Analysis of Mitigation Techniques

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

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

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

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

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

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

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

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

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

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

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

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

- Radio and television spots
- Websites with maps and information
- Real estate disclosure
- Provide information and training
- NFIP outreach
- StormReady
- Firewise Communities

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

Table 67 - Mitigation Strategy Technique Matrix provides a matrix identifying the mitigation techniques used for all low, moderate and high-risk hazards in the county. The specific actions associated with these techniques are included in *Table 68 - 2018 Mitigation Action Plan*.

Table 67 - Mitigation Strategy Technique Matrix

Lebanon County Mitigation Strategy Technique Matrix				
HAZARD	**MITIGATION TECHNIQUE**			
	Local Plans and Regulations	**Structural and Infra-structure**	**Natural Systems Protection**	**Education and Awareness**
Drought			X	X
Earthquake	X			X
Extreme Temperatures	X	X		X
Flood, Flash Flood, Ice Jam Flooding	X	X	X	X
Pandemic and Infectious Disease	X		X	X
Radon Exposure	X	X		X
Tornados and Wind Storms	X	X		X
Wildfire	X	X		X
Winter Storms	X	X		X
Civil Disturbance	X			X
Opioid Epidemic	X			X
Environmental hazards	X	X		X
Nuclear Incidents	X			X
Terrorism	X			X
Transportation Acci-dents	X	X		X
Urban Fire and Explo-sions	X	X		X
Utility Interruptions	X	X		X
Dam Failure	X	X		X
Hurricane/Tropical Storm	X	X		X
Landslides		X	X	X

6.4. Mitigation Action Plan

The Lebanon County Hazard Mitigation Local Planning Team (LPT) immediately began work on the mitigation strategy section of the 2018 hazard mitigation plan (HMP) update after the risk assessment section was completed. The LPT started this section by reviewing the 2013 HMP mitigation strategy section. A review of the previous goals, objectives, actions and project opportunities documented in the 2108 HMP was conducted. The next step the LPT completed was the brainstorming of possible new actions based on new identified risks. The LPT compiled all this information for presentations to the municipalities.

MCM Consulting Group, Inc. completed municipality meetings at various time periods at the Lebanon County Emergency Management Agency. During all these meetings, an overview of mitigation strategy was presented and the municipalities were informed that they needed to have at least one hazard-related mitigation action for their municipality. All municipalities were invited to attend these meetings.

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

Mitigation measures for the 2018 Lebanon County HMP are listed in the mitigation action plan. *Table 68 - 2018 Mitigation Action Plan* is the 2017 Lebanon County Mitigation Action Plan. This plan outlines mitigation actions and projects that comprise a strategy for Lebanon County. The action plan includes actions, a benefit and cost prioritization, a schedule for implementation, any funding sources to complete the action, a responsible agency or department and an estimated cost. All benefit and cost analysis were completed using the Pennsylvania Emergency Management Agency recommended PASTEEL analysis tool. The completed PASTEEL analysis is located in Appendix I. *Table 69 - Municipal Hazard Mitigation Actions Checklist* is a matrix that identifies the county and/or municipalities responsible for mitigation actions in the new mitigation action plan.

Table 68 - 2018 Mitigation Action Plan

Lebanon County 2018 Mitigation Action Plan									
Action Number	**Mitigation Actions**			**Prioritization**			**Implementation**		
	Category	**Description/ Action Items**	**Hazard Vulnerability**	**High**	**Medium**	**Low**	**Schedule**	**Funding**	**Responsibility**
1.1.1	Local Plans and Regulations	Prepare and maintain Act 167 Stormwater Management Plans for the DEP-designated stormwater management watersheds draining Lebanon County.	Flooding Hazards			**X**	Ongoing	Grant Required	Lebanon County
1.1.2	Local Plans and Regulations	Maintain and update stormwater management ordinances consistent with Act 167 Stormwater Management Plans.	Flooding Hazards	**X**			2019-2020	Local	Lebanon County Planning Department

Lebanon County 2018 Mitigation Action Plan									
Action Number	**Mitigation Actions**			**Prioritization**			**Implementation**		
	Category	**Description/ Action Items**	**Hazard Vulnerability**	**High**	**Medium**	**Low**	**Schedule**	**Funding**	**Responsibility**
1.1.3	Local Plans and Regulations	Municipalities will track any development that has been authorized by permit in the special flood hazard area.	Flooding Hazards		**X**		Ongoing	Permit fees and PDM	LCPD and Munis
1.1.4	Local Plans and Regulations	Attend Lebanon County Clean Water Alliance meetings to address public education/outreach regarding MS4 requirements.	Flooding Hazards			**X**	Quarterly Meetings, On-going	Local or DEP EE Grants	LCPD and Munis
1.1.5	Local Plans and Regulations	Participate with the Lebanon County Stormwater Consortium regarding construction of BMP projects for compliance with MS4 permit requirements.	Flooding Hazards			**X**	Monthly Meetings, Ongoing	Stormwater Fees or local	LCPD and Munis
1.2.1	Structural and Infrastructure	Obtain first floor flood elevation data for the county's inventoried critical infrastructure and intersect this information with the base flood elevations to identify high risk facilities and formulate mitigation strategies.	Flooding Hazards		**X**		Ongoing	Local and PDM	Lebanon County Local Planning Team
1.3.1	Education and Awareness	Encourage the county's National Flood Program communities to participate in the NFIP Community Rating System (CRS) and attain discount opportunities on flood insurance premiums.	Flooding Hazards			**X**	Ongoing	Local	Lebanon County Municipalities
1.3.2	Education and Awareness	Conduct outreach to municipalities to ensure continued compliance with NFIP.	Flooding Hazards		**X**		Ongoing	Local	Lebanon County Local Planning Team

Lebanon County 2018 Mitigation Action Plan									
Action Number	**Mitigation Actions**			**Prioritization**			**Implementation**		
	Category	**Description/ Action Items**	**Hazard Vulnerability**	**High**	**Medium**	**Low**	**Schedule**	**Funding**	**Responsibility**
1.3.3	Local Plans and Regulations	Update municipal floodplain ordinances with the new effective data from the DFIRMS	Flooding Hazards	**X**			2019-2020	Local	LCPD and Munis
1.4.1	Education and Awareness	Develop and train a core team to conduct county wide damage assessment after emergencies or disasters.	All Hazards		**X**		Ongoing	Local and EMPG	LCDES and municipalities
1.4.2	Local Plans and Regulations	Implement a countywide electronic damage assessment management tool to increase the efficiency of county and municipal damage survey and reporting.	All Hazards		**X**		2019-2020	Local and EMPG	LCDES and municipalities
1.5.1	Structural and Infrastructure	Maintain a list of repetitive loss structures from PEMA and incorporate the data into the county's Hazard Mitigation Planning project.	Flooding Hazards	**X**			Ongoing	Local	GIS, Planning and Munis
1.5.2	Local Plans and Regulations	Evaluate and refine the county's repetitive loss structures list by ranking properties based on the number of losses and the value of the claims paid and target the priority properties for buyout opportunities.	Flooding Hazards	**X**			Ongoing	PDM and/or FMA Grant required	Planning Department and Munis
2.1.1	Local Plans and Regulations	Conduct Regional Assessments of Public Safety Services to determine funding abilities for regional systems.	All Hazards		**X**		Ongoing	Act 12 Funds	LCDES

Lebanon County 2018 Mitigation Action Plan									
Action Number	**Mitigation Actions**			**Prioritization**			**Implementation**		
	Category	**Description/ Action Items**	**Hazard Vulnerability**	**High**	**Medium**	**Low**	**Schedule**	**Funding**	**Responsibility**
2.2.1	Local Plans and Regulations	Work with the Chamber of Commerce to encourage all business owners to prepare and implement a Business Continuity Plan to provide safeguards against business activity interruptions.	All Hazards	**X**			Ongoing	Local	LCDES and LEPC
2.3.1	Local Plans and Regulations	Maintain the county's commodity flow study to ensure the county LEPC, first responders, and local officials understand the types, frequencies, and amounts of hazardous materials being transported through its borders.	Environmental Hazards and Transportation Accidents		**X**		2019	Act 165 Funds and HMEP Grant	LCDES and LEPC
2.3.2	Local Plans and Regulations	Prepare a countywide emergency communications procedure manual (ECPM) to establish a consolidated and uniform set of communications policies and procedures for Lebanon County's fire, EMS, and police services.	All Hazards		**X**		Ongoing	Local	LCDES
2.3.3	Local Plans and Regulations	Integrate the 2018 hazard mitigation plan data and principles with the next update of the Lebanon County Comprehensive Plan.	All Hazards	**X**			2018-2023	DCED Grant required	Lebanon County Planning Department

Lebanon County 2018 Mitigation Action Plan									
Action Number	**Mitigation Actions**			**Prioritization**			**Implementation**		
	Category	**Description/ Action Items**	**Hazard Vulnerability**	**High**	**Medium**	**Low**	**Schedule**	**Funding**	**Responsibility**
2.3.4	Local Plans and Regulations	Integrate the 2018 hazard mitigation plan data and principles with the next update of the Lebanon County Emergency Operations Plan	All Hazards	**X**			2018-2020	Local	LCDES
2.3.5	Local Plans and Regulations	Consider adopting a county-wide post-disaster recovery and reconstruction ordinance	All Hazards			**X**	Ongoing	Grant required	Lebanon County LPT
2.3.6	Local Plans and Regulations	Implement 911 addressing standards and regulations for all municipalities in Lebanon County	All Hazards	**X**			2018-2023	Act 12 and Local	Lebanon County Departments and Municipalities
2.4.1	Local Plans and Regulations	Conduct annual outreach to utility companies to review hazard mitigation projects and procedures	All Hazards			**X**	Ongoing	Local	Lebanon County DES
3.1.1	Education and Awareness	Continue to work with the task force agricultural committee to develop and implement an animal response team to strengthen the comprehensive emergency management program through the South Central Task Force	All Hazards		**X**		Ongoing	HSGP	LCDES
3.1.2	Local Plans and Regulations	Task force GIS subcommittee will continue to collaborate, update and disseminate GIS data with all task force stakeholders.	All Hazards	**X**			Ongoing	HSGP	Lebanon County GIS
3.2.1	Local Plans and Regulations	Update the Lebanon County EOP to be consistent with the National Response Plan.	All Hazards	**X**			Ongoing	EMPG and Local	Lebanon County DES

Lebanon County 2018 Mitigation Action Plan									
Action Number	**Mitigation Actions**			**Prioritization**			**Implementation**		
	Category	**Description/ Action Items**	**Hazard Vulnerability**	**High**	**Medium**	**Low**	**Schedule**	**Funding**	**Responsibility**
3.2.2	Education and Awareness	Prepare and implement a Continuity of Government Plan for Lebanon County and assist municipal governments	All Hazards	**X**			Ongoing	EMPG and Local	Lebanon County Departments and municipalities
3.2.3	Education and Awareness	Maintain a countywide capital improvements plan to program, schedule, prioritize, and budget county capital improvements	All Hazards		**X**		Ongoing	Local	Lebanon County Commissioners
3.3.1	Local Plans and Regulations	Continue to solicit input from municipalities and public and private stakeholders, including local schools and colleges, the Chamber of Commerce, and other groups, for the Hazard Mitigation Plan update.	All Hazards	**X**			Ongoing	PDM, HMGP and Local	Local Planning Team
3.3.2	Structural and Infrastructure	Develop a team of first responders and emergency management personnel to assist schools with developing emergency plans	All Hazards	**X**			Ongoing	EMPG and Local	Lebanon County DES and local first responders
3.4.1	Local Plans and Regulations	Encourage participation in the Lebanon County Opioid Prevention Task Force to decrease the impact of opioid emergencies	Opioid Epidemic	**X**			Ongoing	PCCD and Local	Lebanon County DES
3.4.2	Local Plans and Regulations	Continue to provide Narcan to first responder agencies and other agencies as determined necessary	Opioid Epidemic	**X**			Ongoing	PCCD and Local	Lebanon County DES

Lebanon County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
3.5.1	Structural and Infrastructure	Continue to work with municipalities to identify and incorporate hazard mitigation project opportunity forms to include in the 5-year update of the HMP.	All Hazards	**X**			Ongoing	PDM, HMGP and Local	LPT
3.5.2	Local Plans and Regulations	Inventory and review all critical facilities' emergency generator capabilities for run time duration, load capacity and fuel source in the event of an emergency or disaster.	Utility Interruptions	**X**			Ongoing	EMPG and Local	Lebanon County DES
3.5.3	Local Plans and Regulations	Collect and analyze data on all high risk hazards in Lebanon County and its municipalities to utilize for additional mitigation action and project development during the next five years.	All Hazards	**X**			Ongoing	Local	LPT
3.5.4	Local Plans and Regulations	Collect and analyze data on all moderate and low risk hazards in Lebanon County and its municipalities to include in the 5-year update of the Hazard Mitigation Plan.	All Hazards		**X**		Ongoing	Local	LPT
4.1.1	Local Plans and Regulations	Lebanon County will participate in the Pennsylvania Statewide Imagery Acquisition project based on guidance issued in March 2018.	All Hazards	**X**			Ongoing	State and Local	Lebanon County GIS and PEMA

Lebanon County 2018 Mitigation Action Plan									
Action Number	**Mitigation Actions**			**Prioritization**			**Implementation**		
	Category	**Description/ Action Items**	**Hazard Vulnerability**	**High**	**Medium**	**Low**	**Schedule**	**Funding**	**Responsibility**
4.1.2	Local Plans and Regulations	Pictometry data update with new flight data	All Hazards		**X**		2019	GIS, Planning City of Leb Auth and munis	GIS/Assessment
4.2.1	Local Plans and Regulations	GIS to update SQL and all operating software on servers		**X**			2019	Local	County GIS
4.2.2	Local Plans and Regulations	GIS to update ESRI software licenses on all servers and workstations.		**X**			2018-2023	Local	County GIS
4.3.1	Local Plans and Regulations	County GIS to work with Lebanon County Department of Emergency Services and PEMA to identify grants to update GIS data to NexGen 911 standards	All Hazards	**X**			Ongoing	Act 12 Funding and Local	Lebanon County GIS and DES
4.4.1	Local Plans and Regulations	Update all GIS data to NexGen 911 standards	All Hazards	**X**			Ongoing	Act 12 Funding and Local	Lebanon County GIS and DES
4.4.2	Local Plans and Regulations	Develop and maintain a GIS dataset of all municipal traffic control points and access control points for evacuation route planning.	All Hazards	**X**			Ongoing	Local	Lebanon County GIS and DES
4.4.3	Local Plans and Regulations	Conduct a thorough critical facilities vulnerability assessment and impact analysis using the HMP's GIS - based critical infrastructure inventory	All Hazards	**X**			Ongoing	Local	Municipalities, Lebanon County GIS and LPT
4.4.4	Local Plans and Regulations	Maintain the county's Hazard Mitigation Planning GIS datasets and disseminate the information to municipalities	All Hazards	**X**			Ongoing	Local	Lebanon County GIS and DES

Lebanon County 2018 Mitigation Action Plan									
Action Number	**Mitigation Actions**			**Prioritization**			**Implementation**		
	Category	**Description/ Action Items**	**Hazard Vulnerability**	**High**	**Medium**	**Low**	**Schedule**	**Funding**	**Responsibility**
4.4.5	Local Plans and Regulations	Maintain the Lebanon County computer aided mass appraisal (CAMA) database to be used for detailed analysis of potential property losses.	All Hazards	**X**			Ongoing	Local	LC Assess
4.4.6	Local Plans and Regulations	Develop and maintain water, gas, electric and communications GIS data layers.	All Hazards			**X**	Ongoing	Local	Lebanon County GIS and DES
4.4.7	Local Plans and Regulations	Develop an address point layer countywide in accordance with NexGen 911 standards	All Hazards	**X**			Ongoing	Act 12 and Local	GIS, DES, County and munis
5.1.1	Education and Awareness	Develop a county web link to disseminate a list of DEP-certified radon testers, mitigators, and laboratories and how to acquire test kits (current lists are available through DEP)	Radon			**X**	Ongoing	Local	DES and Muni EMA
5.2.1	Education and Awareness	Attend public events like National Night Out	All Hazards			**X**	Ongoing	EMPG and Local	DES
5.3.1	Education and Awareness	Collaborate with the DEP Bureau of Radiation Protection to ensure the state's Radon Awareness Campaign and public service announcements are disseminated throughout Lebanon County.	Radon		**X**		Ongoing	EMPG and Local	DES
5.4.1	Education and Awareness	Maintain county DES profiles on social media sites and develop checklists to complete for using these sites for emergency notification.	All Hazards	**X**			Ongoing	EMPG and Local	DES

Funding acronym definitions:

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

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

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

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

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

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

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

Table 69 - Municipal Hazard Mitigation Actions Checklist

Municipal Hazard Mitigation Actions Checklist										
Municipality	**1.1.1**	**1.1.2**	**1.1.3**	**1.1.4**	**1.1.5**	**1.2.1**	**1.3.1**	**1.3.2**	**1.3.3**	**1.4.1**
Annville Township			x	x	x	x	x	x	x	x
Bethel Township			x	x	x	x	x	x	x	x
Cleona Borough			x	x	x	x	x	x	x	x
Cold Spring Township			x	x	x	x	x	x	x	x
Cornwall Borough			x	x	x	x	x	x	x	x
East Hanover Township			x	x	x	x	x	x	x	x
Heidelberg Township			x	x	x	x	x	x	x	x
Jackson Township			x	x	x	x	x	x	x	x
Jonestown Borough			x	x	x	x	x	x	x	x
City of Lebanon			x	x	x	x	x	x	x	x
Millcreek Township			x	x	x	x	x	x	x	x
Mt. Gretna Borough			x	x	x	x	x	x	x	x
Myerstown Borough			x	x	x	x	x	x	x	x
North Annville Township			x	x	x	x	x	x	x	x
North Cornwall Township			x	x	x	x	x	x	x	x
North Lebanon Township			x	x	x	x	x	x	x	x
North Londonderry Township			x	x	x	x	x	x	x	x
Palmyra Borough			x	x	x	x	x	x	x	x
Richland Borough			x	x	x	x	x	x	x	x
South Annville Township			x	x	x	x	x	x	x	x
South Lebanon Township			x	x	x	x	x	x	x	x
South Londonderry Township			x	x	x	x	x	x	x	x
Swatara Township			x	x	x	x	x	x	x	x
Union Township			x	x	x	x	x	x	x	x
West Cornwall Township			x	x	x	x	x	x	x	x
West Lebanon Township			x	x	x	x	x	x	x	x
Lebanon County	x	x	x	x	x	x	x	x	x	x

Municipal Hazard Mitigation Actions Checklist										
Municipality	**1.4.2**	**1.5.1**	**1.5.2**	**2.1.1**	**2.2.1**	**2.3.1**	**2.3.2**	**2.3.3**	**2.3.4**	**2.3.5**
Annville Township	x	x	x	x	x	x	x		x	x
Bethel Township	x	x	x	x	x	x	x		x	x
Cleona Borough	x	x	x	x	x	x	x		x	x
Cold Spring Township	x	x	x	x	x	x	x		x	x
Cornwall Borough	x	x	x	x	x	x	x		x	x
East Hanover Township	x	x	x	x	x	x	x		x	x
Heidelberg Township	x	x	x	x	x	x	x		x	x
Jackson Township	x	x	x	x	x	x	x		x	x
Jonestown Borough	x	x	x	x	x	x	x		x	x
City of Lebanon	x	x	x	x	x	x	x		x	x
Millcreek Township	x	x	x	x	x	x	x		x	x
Mt. Gretna Borough	x	x	x	x	x	x	x		x	x
Myerstown Borough	x	x	x	x	x	x	x		x	x
North Annville Township	x	x	x	x	x	x	x		x	x
North Cornwall Township	x	x	x	x	x	x	x		x	x
North Lebanon Township	x	x	x	x	x	x	x		x	x
North Londonderry Township	x	x	x	x	x	x	x		x	x
Palmyra Borough	x	x	x	x	x	x	x		x	x
Richland Borough	x	x	x	x	x	x	x		x	x
South Annville Township	x	x	x	x	x	x	x		x	x
South Lebanon Township	x	x	x	x	x	x	x		x	x
South Londonderry Township	x	x	x	x	x	x	x		x	x
Swatara Township	x	x	x	x	x	x	x		x	x
Union Township	x	x	x	x	x	x	x		x	x
West Cornwall Township	x	x	x	x	x	x	x		x	x
West Lebanon Township	x	x	x	x	x	x	x		x	x
Lebanon County	x	x	x	x	x	x	x	x	x	x

Municipal Hazard Mitigation Actions Checklist										
Municipality	**2.3.6**	**2.4.1**	**3.1.1**	**3.1.2**	**3.2.1**	**3.2.2**	**3.2.3**	**3.3.1**	**3.3.2**	**3.4.1**
Annville Township	x	x	x			x		x		x
Bethel Township	x	x	x			x		x		x
Cleona Borough	x	x	x			x		x		x
Cold Spring Township	x	x	x			x		x		x
Cornwall Borough	x	x	x			x		x		x
East Hanover Township	x	x	x			x		x		x
Heidelberg Township	x	x	x			x		x		x
Jackson Township	x	x	x			x		x		x
Jonestown Borough	x	x	x			x		x		x
City of Lebanon	x	x	x			x		x		x
Millcreek Township	x	x	x			x		x		x
Mt. Gretna Borough	x	x	x			x		x		x
Myerstown Borough	x	x	x			x		x		x
North Annville Township	x	x	x			x		x		x
North Cornwall Township	x	x	x			x		x		x
North Lebanon Township	x	x	x			x		x		x
North Londonderry Township	x	x	x			x		x		x
Palmyra Borough	x	x	x			x		x		x
Richland Borough	x	x	x			x		x		x
South Annville Township	x	x	x			x		x		x
South Lebanon Township	x	x	x			x		x		x
South Londonderry Township	x	x	x			x		x		x
Swatara Township	x	x	x			x		x		x
Union Township	x	x	x			x		x		x
West Cornwall Township	x	x	x			x		x		x
West Lebanon Township	x	x	x			x		x		x
Lebanon County	x	x	x	x	x	x	x	x	x	x

Municipal Hazard Mitigation Actions Checklist										
Municipality	**3.4.2**	**3.5.1**	**3.5.2**	**3.5.3**	**3.5.4**	**4.1.1**	**4.1.2**	**4.2.1**	**4.2.2**	**4.3.1**
Annville Township	x	x		x	x					
Bethel Township	x	x		x	x					
Cleona Borough	x	x		x	x					
Cold Spring Township	x	x		x	x					
Cornwall Borough	x	x		x	x					
East Hanover Township	x	x		x	x					
Heidelberg Township	x	x		x	x					
Jackson Township	x	x		x	x					
Jonestown Borough	x	x		x	x					
City of Lebanon	x	x		x	x					
Millcreek Township	x	x		x	x					
Mt. Gretna Borough	x	x		x	x					
Myerstown Borough	x	x		x	x					
North Annville Township	x	x		x	x					
North Cornwall Township	x	x		x	x					
North Lebanon Township	x	x		x	x					
North Londonderry Township	x	x		x	x					
Palmyra Borough	x	x		x	x					
Richland Borough	x	x		x	x					
South Annville Township	x	x		x	x					
South Lebanon Township	x	x		x	x					
South Londonderry Township	x	x		x	x					
Swatara Township	x	x		x	x					
Union Township	x	x		x	x					
West Cornwall Township	x	x		x	x					
West Lebanon Township	x	x		x	x					
Lebanon County	x	x	x	x	x	x	x	x	x	x

Municipal Hazard Mitigation Actions Checklist										
Municipality	**4.4.1**	**4.4.2**	**4.4.3**	**4.4.4**	**4.4.5**	**4.4.6**	**4.4.7**	**5.1.1**	**5.2.1**	**5.3.1**
Annville Township			x				x	x	x	
Bethel Township			x				x	x	x	
Cleona Borough			x				x	x	x	
Cold Spring Township			x				x	x	x	
Cornwall Borough			x				x	x	x	
East Hanover Township			x				x	x	x	
Heidelberg Township			x				x	x	x	
Jackson Township			x				x	x	x	
Jonestown Borough			x				x	x	x	
City of Lebanon			x				x	x	x	
Millcreek Township			x				x	x	x	
Mt. Gretna Borough			x				x	x	x	
Myerstown Borough			x				x	x	x	
North Annville Township			x				x	x	x	
North Cornwall Township			x				x	x	x	
North Lebanon Township			x				x	x	x	
North Londonderry Township			x				x	x	x	
Palmyra Borough			x				x	x	x	
Richland Borough			x				x	x	x	
South Annville Township			x				x	x	x	
South Lebanon Township			x				x	x	x	
South Londonderry Township			x				x	x	x	
Swatara Township			x				x	x	x	
Union Township			x				x	x	x	
West Cornwall Township			x				x	x	x	
West Lebanon Township			x				x	x	x	
Lebanon County	x	x	x	x	x	x	x	x	x	x

Municipal Hazard Mitigation Actions Checklist										
Municipality	**5.4.1**									
Annville Township										
Bethel Township										
Cleona Borough										
Cold Spring Township										
Cornwall Borough										
East Hanover Township										
Heidelberg Township										
Jackson Township										
Jonestown Borough										
City of Lebanon										
Millcreek Township										
Mt. Gretna Borough										
Myerstown Borough										
North Annville Township										
North Cornwall Township										
North Lebanon Township										
North Londonderry Township										
Palmyra Borough										
Richland Borough										
South Annville Township										
South Lebanon Township										
South Londonderry Township										
Swatara Township										
Union Township										
West Cornwall Township										
West Lebanon Township										
Lebanon County	**x**									

National Flood Insurance Program (NFIP) Related Mitigation Actions

The Federal Emergency Management Agency (FEMA) requires that every participating jurisdiction that either participates in the NFIP or has identified Special Flood Hazard Areas (SFHAs) have at least one specific action in its mitigation action plan that relates to continued compliance with the NFIP. Action numbers 1.1.1; 1.1.2; 1.1.3; 1.1.4; 1.1.5; 1.2.1; 1.3.1; 1.3.2; 1.3.3; 1.5.1 and 1.5.2 comply for Lebanon County and all its municipalities.

Evaluate and Prioritize Mitigation Actions

Mitigation Action Evaluation:

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

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

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

Mitigation Action Prioritization:

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

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

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

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

The cumulative results of the prioritization of mitigation actions is identified in the mitigation action evaluation and prioritization tool. The results for the mitigation action evaluation and prioritization are located in Appendix H of this plan.

7. Plan Maintenance

7.1. Update Process Summary

Monitoring, evaluating and updating this plan, is critical to maintaining its value and success in Lebanon County's hazard mitigation efforts. Ensuring effective implementation of mitigation activities paves the way for continued momentum in the planning process and gives direction for the future. This section explains who will be responsible for maintenance activities and what those responsibilities entail. It also provides a methodology and schedule of maintenance activities including a description of how the public will be involved on a continued basis. The Lebanon County HMP Local Planning Team decided to alter the current maintenance procedures. The 2018 HMP update establishes a review of the plan within thirty days of a disaster event in addition to continuing with an annual plan evaluation. This HMP update also defines the municipalities' role in updating and evaluating the plan. Finally, the 2018 HMP Update encourages continued public involvement and how this plan may be integrated into other planning mechanisms in the county.

7.2. Monitoring, Evaluating and Updating the Plan

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

The Lebanon County Local Planning Team will complete an annual Hazard Mitigation Progress Report to evaluate the status and accuracy of the Multi-Jurisdictional HMP and record the local planning team's review process. The Lebanon County Emergency Management Agency will maintain a copy of these records and place them in Appendix J of this plan and send copies to PEMA and FEMA Region 3. Lebanon County will continue to work with all municipalities regarding hazard mitigation projects, especially those municipalities that did not submit projects for inclusion in this plan.

7.3. Continued Public Involvement

The Lebanon County Emergency Management Agency will ensure that the 2018 Lebanon County Hazard Mitigation Plan is posted and maintained on the Lebanon County website and will continue to encourage public review and comment on the plan. The Lebanon County website that the plan will be located at is as follows: http://hmp.lebanonema.org/

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

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

8. Plan Adoption

8.1. Resolutions

In accordance with federal and state requirements, the governing bodies of each participating jurisdiction must review and adopt by resolution, the 2018 Lebanon County Hazard Mitigation Plan. Copies of the adopting resolutions are included in this plan in Appendix K. FEMA Region III in Philadelphia is the final approval authority for the Hazard Mitigation Plan. PEMA also reviews the plan before submission to FEMA.

9. Appendices

APPENDIX A: References

APPENDIX B: FEMA Local Mitigation Review Tool

APPENDIX C: Meetings and Support Documents

APPENDIX D: Municipal Flood Maps

APPENDIX E: Critical and Special Needs Facilities

APPENDIX F: 2018 HAZUS Reports

APPENDIX G: 2018 Mitigation Project Opportunities

APPENDIX H: 2018 Mitigation Action Evaluation & Prioritization

APPENDIX I: Dam Failure Profile

APPENDIX J: Annual Review Documentation

APPENDIX K: Lebanon County & Municipal Adoption Resolutions