



Lehigh Valley Hazard Mitigation Plan Update

Volumes I & II



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Volume I

<u>Section</u>	<u>Page</u>
SECTION 1 INTRODUCTION.....	1-1
1.1 Background	1-1
1.1.2 DMA 2000 Origins – The Robert T. Stafford Disaster Relief and Emergency Assistance Act	1-1
1.2 Purpose.....	1-1
1.3 Scope	1-2
1.3.1 Organizations Involved in the Mitigation Planning Effort	1-2
1.4 Authority and References.....	1-4
1.5 Summary of Changes in Plan Update	1-5
1.5.1 Organization.....	1-5
1.5.2 Risk Assessment.....	1-5
1.5.3 Capability Assessment.....	1-5
1.5.4 Mitigation Strategies	1-6
1.5.5 Plan Integration into Other Planning Mechanisms.....	1-6
1.6 Organization of Mitigation Plan	1-6
 SECTION 2 REGIONAL PROFILE.....	 2-1
2.1 Location.....	2-1
2.2 History.....	2-2
2.3 Government and Political Subdivisions	2-2
2.4 Physical Setting	2-3
2.4.1 Hydrography and Hydrology	2-3
2.4.2 Topography	2-7
2.4.3 Geology	2-8
2.4.4 Climate.....	2-8
2.4.5 Land Use and Land Cover	2-9
2.5 Population and Demographics	2-11
2.6 General Building Stock.....	2-15
2.7 Critical Facilities.....	2-22
2.7.1 Essential Facilities.....	2-23
2.7.1.1 Emergency Facilities.....	2-23
2.7.1.2 Hospitals and Medical Centers	2-30
2.7.1.3 Shelters.....	2-34
2.7.1.4 Schools.....	2-36
2.7.1.5 Senior Care and Senior Living Facilities	2-47
2.7.2 Transportation Systems	2-49
2.7.2.1 Highway, Roadways and Associated Systems.....	2-50
2.7.2.2 Airports and Heliports	2-51
2.7.2.3 Railway.....	2-53
2.7.2.4 Public Transportation	2-53
2.7.3 Lifeline Utility Systems	2-53
2.7.3.1 Potable Water Supply.....	2-54
2.7.3.2 Wastewater Facilities	2-59
2.7.3.3 Energy Resources.....	2-60
2.7.3.4 Communication Resources	2-61
2.7.4 High-Potential Loss Facilities	2-62

2.7.4.1 Dams 2-62
 2.7.4.2 Levees..... 2-63
 2.7.4.3 HAZMAT Facilities 2-63
 2.8 Other Facilities (User Defined)..... 2-64
 2.9 Economic Profile 2-83

SECTION 3 PLANNING PROCESS..... 3-1

3.1 Introduction 3-1
 3.2 Organization of Planning Process 3-2
 3.3 Plan Update Activity 3-5
 3.4 Stakeholder Outreach and Involvement 3-9
 3.4.1 Federal, State and Regional Agencies 3-10
 3.4.2 Lehigh and Northampton County Government Agencies 3-11
 3.4.3 Surrounding Counties 3-12
 3.4.4 Fire Services..... 3-12
 3.4.5 Police and Law Enforcement Services 3-12
 3.4.6 School Districts and Higher Education..... 3-13
 3.4.7 Hospitals, Health Care and Emergency Medical Services 3-13
 3.4.8 Transportation 3-14
 3.4.9 Utilities 3-14
 3.4.10 Business and Commerce..... 3-14
 3.5 Public Outreach and Participation 3-14
 3.6 Integration/Coordination with Existing Plans and Programs 3-17
 3.6.1 Emergency Management Plans and Programs 3-17
 3.6.2 Comprehensive Planning and Land Use Regulation 3-18
 3.6.3 Act 167 Stormwater Management Plans..... 3-18
 3.6.4 National Flood Insurance and the Community Rating System 3-19
 3.6.5 Capital Improvement Planning..... 3-20
 3.6.6 Housing and Urban Development (HUD) and Community Development
 3.6.7 Community Development Block Grant (CDBG) Funding 3-20

SECTION 4 HAZARD PROFILES

4.1 Methodology and Tools 4.1-1
 4.2 Hazard Identification..... 4.2-1
 4.3 Hazard Profiles
 4.3.1 Drought 4.3.1-1
 4.3.2 Earthquake 4.3.2-1
 4.3.3 Extreme Temperature 4.3.3-1
 4.3.4 Flood..... 4.3.4-1
 4.3.5 Hailstorm 4.3.5-1
 4.3.6 Landslide..... 4.3.6-1
 4.3.7 Lightning Strike 4.3.7-1
 4.3.8 Radon Exposure 4.3.8-1
 4.3.9 Subsidence/Sinkhole..... 4.3.9-1
 4.3.10 Wildfire..... 4.3.10-1
 4.3.11 Windstorm, Tornado..... 4.3.11-1
 4.3.12 Winter Storm..... 4.3.12-1
 4.3.13 Structural Collapse 4.3.13-1
 4.3.14 Dam Failure 4.3.14-1
 4.3.15 Environmental Hazard..... 4.3.15-1

4.3.16	Fire (Urban/Structural Fire)	4.3.16-1
4.3.17	Levee Failure.....	4.3.17-1
4.3.18	Mass Gathering	4.3.18-1
4.3.19	Nuclear Incident	4.3.19-1
4.3.20	Terrorism	4.3.20-1
4.3.21	Transportation Accident	4.3.21-1
4.3.22	Utility Interruption	4.3.22-1
4.4	Hazard Ranking	4.4-1
SECTION 5	CAPABILITY ASSESSMENT	5-1
5.1	Emergency Management	5-2
5.1.1.	County Capabilities	5-2
5.1.2	Local Capabilities.....	5-8
5.2	Participation in the National Flood Insurance Program	5-11
5.3	Community Rating System (CRS).....	5-12
5.4	Planning and Regulatory Capability	5-12
5.4.1	Comprehensive Plan, The Lehigh Valley...2030.....	5-13
5.4.2	Stormwater Management Planning	5-15
5.4.3	Water Supply Planning	5-15
5.4.4	Natural Resource Planning	5-16
5.4.5	Open Space Planning.....	5-19
5.4.5	Informational Resources	5-19
5.5	Administrative and Technical Capability	5-19
5.6	Fiscal Capability	5-20
5.6.1	Capital Improvement Planning.....	5-21
5.6.2	Federal Hazard Mitigation Funding Opportunities	5-21
5.6.3	Federal Disaster Assistance Programs.....	5-21
5.6.4	Other Potential Funding Sources.....	5-22
5.7	Political Capability.....	5-23
5.8	Self-Assessment.....	5-23
5.9	Capability Assessment Recommendations.....	5-25
SECTION 6	MITIGATION STRATEGY	6-1
6.1	Review and Update of Hazard Mitigation Goals	6-1
6.2	Update of Municipal Mitigation Strategies	6-3
6.3	Update of County-Level Mitigation Strategies.....	6-5
6.4	Mitigation Strategy Prioritization and Implementation.....	6-6
SECTION 7	PLAN MAINTENANCE PROCEDURES.....	7-1
7.1	Monitoring, Evaluating and Updating the Plan	7-1
7.1.1	Monitoring and Evaluating	7-2
7.1.2	Annual Plan Review	7-2
7.1.3	Plan Maintenance and Updating.....	7-4
7.2	Implementation of Mitigation Plan through Existing Programs	7-5
7.2.1	Emergency Management Plans and Programs	7-5
7.2.2	Comprehensive Planning and Land Use Regulation	7-6
7.2.3	Act 167 Stormwater Management Plans.....	7-6
7.2.4	National Flood Insurance (NFIP) and the Community Rating System	7-6
7.2.5	FEMA Unified Hazard Mitigation Assistance (Unified HMA) Grant Programs.....	7-7

7.2.6	Capital Improvement Planning.....	7-7
7.2.7	Housing and Urban Development (HUD) and Community Development Block Grant (CDBG) Funding.....	7-7
7.3	Continued Public Involvement	7-8
SECTION 8	PLAN ADOPTION.....	8-1
8.1	Overview	8-1
8.1.1	Plan Adoption by Local Governing Bodies	8-1
SECTION 9	JURISDICTIONAL ANNEXES	9-1
9.1	Lehigh and Northampton Counties	9.1-1
9.2	Alburtis Borough	9.2-1
9.3	Allentown City	9.3-1
9.4	Catasauqua Borough.....	9.4-1
9.5	Coopersburg Borough	9.5-1
9.6	Coplay Borough.....	9.6-1
9.7	Emmaus Borough	9.7-1
9.8	Fountain Hill Borough.....	9.8-1
9.9	Hanover Township (LC).....	9.9-1
9.10	Heidelberg Township	9.10-1
9.11	Lower Macungie Township.....	9.11-1
9.12	Lower Milford Township.....	9.12-1
9.13	Lowhill Township.....	9.13-1
9.14	Lynn Township.....	9.14-1
9.15	Macungie Borough	9.15-1
9.16	North Whitehall Township.....	9.16-1
9.17	Salisbury Township	9.17-1
9.18	Slatington Borough	9.18-1
9.19	South Whitehall Township.....	9.19-1
9.20	Upper Macungie Township.....	9.20-1
9.21	Upper Milford Township	9.21-1
9.22	Upper Saucon Township.....	9.22-1
9.23	Washington Township	9.23-1
9.24	Weisenberg Township	9.24-1
9.25	Whitehall Township	9.25-1
9.26	Allen Township	9.26-1
9.27	Bangor Borough	9.27-1
9.28	Bath Borough	9.28-1
9.29	Bethlehem City.....	9.29-1
9.30	Bethlehem Township.....	9.30-1
9.31	Bushkill Township	9.31-1
9.32	Chapman Borough	9.32-1
9.33	Easton City	9.33-1
9.34	East Allen Township.....	9.34-1
9.35	East Bangor Borough	9.35-1
9.36	Forks Township	9.36-1
9.37	Freemansburg Borough.....	9.37-1
9.38	Glendon Borough	9.38-1
9.39	Hanover Township (NC).....	9.39-1
9.40	Hellertown Borough	9.40-1

9.41 Lehigh Township 9.41-1
9.42 Lower Mount Bethel Township 9.42-1
9.43 Lower Nazareth Township 9.43-1
9.44 Lower Saucon Township 9.44-1
9.45 Moore Township 9.45-1
9.46 Nazareth Borough 9.46-1
9.47 North Catasauqua Borough 9.47-1
9.48 Northampton Borough 9.48-1
9.49 Palmer Township 9.49-1
9.50 Pen Argyl Borough 9.50-1
9.51 Plainfield Township 9.51-1
9.52 Portland Borough 9.52-1
9.53 Roseto Borough 9.53-1
9.54 Stockertown Borough 9.54-1
9.55 Tatamy Borough 9.55-1
9.56 Upper Mount Bethel Township 9.56-1
9.57 Upper Nazareth Township 9.57-1
9.58 Walnutport Borough 9.58-1
9.59 Washington Township 9.59-1
9.60 West Easton Borough 9.60-1
9.61 Williams Township 9.61-1
9.62 Wilson Borough 9.62-1
9.63 Wind Gap Borough 9.63-1

ACRONYMS AC-1

GLOSSARY G-1

Appendices

Appendix A References
Appendix B Local Plan Review Crosswalk
Appendix C Meeting Documentation
Appendix D Municipal Forms and Worksheets
Appendix E Public and Stakeholder Outreach Documentation
Appendix F Sample Adoption Resolution
Appendix G Earthquake Vulnerability Assessment Results

TABLES

<u>Table</u>	<u>Page</u>
1-1	Jurisdictions Participating in the 2012 Update..... 1-2
1-2	FEMA Local Mitigation Plan Crosswalk 1-4
2-1	Stormwater Management Plans for Lehigh Valley 2-5
2-2	Existing Land Use - 2010 2-10
2-3	Lehigh Valley Population and Demographic Statistics Summary (2005-2009 ACS)... 2-11
2-4	Lehigh County Population and Demographic Statistics 2-11
2-5	Northampton County Population and Demographic Statistics..... 2-12
2-6	Lehigh County Building Stock Replacement Value by Occupancy Class 2-15
2-7	Northampton County Building Stock Replacement Value by Occupancy Class..... 2-16
2-8	Household History and Forecasts by Municipality, 1990-2030..... 2-19
2-9	Major Subdivisions (500 Units or More), as of April 2011 2-20
2-10	Proposed Shopping Centers (25,000 square feet or more), 2008-April 2011 2-21
2-11	Emergency Operation Centers (EOC) in the Lehigh Valley..... 2-22
2-12	Police Stations in Northampton County 2-22
2-13	Fire/EMS in the Lehigh Valley 2-24
2-14	Medical Facilities in the Lehigh Valley..... 2-29
2-15	Shelter Facilities in the Lehigh Valley 2-33
2-16	Schools in the Lehigh Valley 2-37
2-17	Senior Facilities in the Lehigh Valley 2-47
2-18	Transportation Facilities/Offices in Northampton County 2-51
2-19	Airports in the Lehigh Valley 2-52
2-20	Potable Water Facilities in Northampton County 2-55
2-21	Water Storage Tanks in Northampton County 2-58
2-22	Public Sewerage Treatment Plants 2-60
2-23	Electric and Natural Gas Facilities in the Lehigh Valley 2-61
2-24	Broadcasting Facilities/Equipment in the Lehigh Valley 2-62
2-25	User Defined Facilities in the Lehigh Valley..... 2-65
2-26	Largest Employers (non-governmental) 2-84
3-1	Jurisdictions Participating in the 2012 Update..... 3-1
3-2	Lehigh Valley Hazard Mitigation Plan Update Steering Committee Membership 3-3
3-3	Summary of Project Activity and Milestones 3-5
4.3.1-1	Precipitation Deficit Drought Indicators for Pennsylvania..... 4.3.1-5
4.3.1-2	Monthly and Annual Precipitation Normal (total in inches) from 1971 to 2000 for Select Municipalities in the Lehigh Valley 4.3.1-5
4.3.1-3	Palmer Drought Severity Index (PDSI) Classifications 4.3.1-6
4.3.1-4	Past Occurrences of Drought Events from 1960 to 2011 4.3.1-8
4.3.1-5	Crop Loss Insurance Claims Due to Drought 4.3.1-13
4.3.1-6	Impacts on the Economy 4.3.1-17
4.3.1-7	Estimated County Losses Relating to Agricultural Production..... 4.3.1-18
4.3.2-1	Richter Scale Magnitudes 4.3.2-3
4.3.2-2	Modified Mercalli Intensity Scale with Associated Impacts 4.3.2-4
4.3.2-3	Earthquake Events between 1871 and 2012 in the Lehigh Valley 4.3.2-10
4.3.2-4	Summary of Estimated Sheltering Needs for the Lehigh Valley 4.3.2-14

4.3.2-5 Estimated Sheltering Needs by Municipality for the Lehigh Valley..... 4.3.2-14

4.3.2-6 Estimated Number of Injuries and Casualties from the 500-Year MRP Earthquake
Event..... 4.3.2-16

4.3.2-7 Estimated Number of Injuries and Casualties from the
2,500-Year MRP Earthquake Event 4.3.2-16

4.3.2-8 Summary of Estimated Annualized Earthquake General Building Stock Losses
for the Lehigh Valley..... 4.3.2-17

4.3.2-9 Example of Structural Damage State Definitions for a Light Wood-Framed
Building 4.3.2-20

4.3.2-10 Estimated Number of Buildings Damaged by General Occupancy for 100-year, 500-year
and 2,500-year MRP Earthquake Events 4.3.2-21

4.3.2-11 Estimated Number of Buildings Damaged by Building Type for 100-year, 500-year and
2,500-year MRP Earthquake Events 4.3.2-21

4.3.2-12 Estimated Potential General Building Stock Loss (Structure and Contents) for the
500-Year MRP Earthquake Event 4.3.2-22

4.3.2-13 Estimated Potential General Building Stock Loss (Structure and Contents) for the
2,500-Year MRP Earthquake Event 4.3.2-24

4.3.2-14 Estimated Damage and Loss of Functionality for Critical Facilities in the Lehigh Valley
for the 500-Year MRP Earthquake Event 4.3.2-28

4.3.2-15 Estimated Damage and Loss of Functionality for Critical Facilities in the Lehigh Valley
for the 2,500-Year MRP Earthquake Event 4.3.2-71

4.3.2-16 Estimated Utility Impacts in the Lehigh Valley from the 500-year MRP Earthquake
Event..... 4.3.2-110

4.3.2-17 Estimated Utility Impacts in the Lehigh Valley from the 2,500-year MRP Earthquake
Event..... 4.3.2-119

4.3.2-18 Estimated Debris Generated by the 500- and 2,500-year MRP Earthquake
Events 4.3.2-129

4.3.3-1 Four Categories of Heat Stress..... 4.3.3-5

4.3.3-2 Extreme Temperature Events..... 4.3.3-8

4.3.4-1 Stormwater Management Plans for Lehigh Valley 4.3.4-6

4.3.4-2 Area Located in the 1% and 0.2% FEMA DFIRM Flood Boundaries 4.3.4-10

4.3.4-3 Flooding Events between 1950 and 2012 in the Lehigh Valley..... 4.3.4-16

4.3.4-4 Ice Jam Events in the Lehigh Valley between 1780 and 2012..... 4.3.4-22

4.3.4-5 Estimated Lehigh Valley Population Vulnerable to the 1% Flood Hazard..... 4.3.4-25

4.3.4-6 Estimated Lehigh Valley Population Displaced or Seeking Short-Term Shelter
from the 1% Chance Flood Event 4.3.4-28

4.3.4-7 Estimated Number of Parcels Located in the 1% and 0.2% FEMA DFIRM Flood
Boundaries 4.3.4-31

4.3.4-8 Estimated Building Exposure and Potential Losses to the 1% and 0.2%
Flood Events 4.3.4-34

4.3.4-9 NFIP Policies, Claims and Repetitive Loss Statistics 4.3.4-38

4.3.4-10 Critical Facilities Located in the DFIRM 1% and 0.2% Flood Boundaries and Estimated
Potential Damage from the 1% Flood Event..... 4.3.4-42

4.3.4-11 Estimated Debris Generated from the 1% Flood Event..... 4.3.4-48

4.3.5-1 History of Hailstorms in the Lehigh Valley..... 4.3.5-3

4.3.5-2 Estimated Jurisdictional Losses Relating to Agricultural Production (USDA
Census of Agriculture 2007)..... 4.3.5-7

4.3.6-1 Area Located in the Approximate High Susceptibility/Moderate Incidence
Landslide Hazard Area 4.3.6-4

4.3.6-2 Population Located in the High Susceptibility/Moderate Incidence Landslide Hazard
Area 4.3.6-6

4.3.6-3 General Building Stock Located in the High Susceptibility/Moderate Incidence Landslide
Hazard Area 4.3.6-8

4.3.6-4 Essential Critical Facilities in the High Susceptibility/Moderate Incidence
Landslide Hazard Area 4.3.6-10

4.3.7-1 Lehigh Valley Recorded Lightning Events..... 4.3.7-2

4.3.8-1 Radon Risk for Smokers and Non-Smokers 4.3.8-4

4.3.9-1 Reported Sinkholes in the Lehigh Valley, 2007-2011..... 4.3.9-12

4.3.9-2 Area Located in the Approximate Subsidence/Sinkhole Hazard Area 4.3.9-14

4.3.9-3 Population Located in the Approximate Subsidence/Sinkhole Hazard Area
(U.S. Census 2010)..... 4.3.9-17

4.3.9-4 Estimated General Building Stock Located in the Approximate
Subsidence/Sinkhole Hazard Area 4.3.9-19

4.3.9-5 Facilities Located in the Identified Hazard Area (Limestone)..... 4.3.9-21

4.3.10-1 Land Use Summary for the Lehigh Valley 4.3.10-1

4.3.10-2 Fire Danger Rating and Color Code 4.3.10-7

4.3.10-3 Reported Wildfires in the Lehigh Valley..... 4.3.10-12

4.3.10-4 Estimated Population Located within the WUI in the Lehigh Valley 4.3.10-16

4.3.10-5 Building Stock Replacement Value Located within the WUI in the Lehigh
Valley 4.3.10-18

4.3.10-6 Facilities in WUI in the Lehigh Valley..... 4.3.10-20

4.3.11-1 Wind Zones in the U.S. 4.3.11-4

4.3.11-2 Fujita Damage Scale..... 4.3.11-9

4.3.11-3 Enhanced Fujita Damage Scale..... 4.3.11-10

4.3.11-4 EF Scale Damage Indicators 4.3.11-11

4.3.11-5 Tornado and Windstorm Events between 1975 and 2010 in the Lehigh Valley... 4.3.11-14

4.3.11-6 Description of Damage Categories..... 4.3.11-20

4.3.11-7 Estimated Building Replacement Value (Structure Only) Damaged by the 100-Year and
500-Year MRP Hurricane-Related Winds for All Occupancy Classes 4.3.11-22

4.3.11-8 Summary of Estimated Annualized Wind General Building Stock Losses for the Lehigh
Valley 4.3.11-26

4.3.11-9 Estimated Impacts to Critical Facilities by the 500-Year MRP Hurricane Event (Wind
Only)..... 4.3.11-29

4.3.11-10 Debris Production for 100- and 500-Year MRP Hurricane-Related Winds 4.3.11-71

4.3.12-1 NESIS Ranking Categories 1 – 5 4.3.12-3

4.3.12-2 Winter Storm Events between 1950 and 2012 in the Lehigh Valley..... 4.3.12-5

4.3.12-3 General Building Stock Exposure (Structure Only) and Estimated Losses from
Winter Storm Events in the Lehigh Valley 4.3.12-12

4.3.13-1 Likelihood of Future Occurrences of Environmental / Explosion Hazards 4.3.13-2

4.3.14-1	Dams in Lehigh Valley	4.3.14-2
4.3.15-1	Reported Release of Hazardous Materials 2001-2011	4.3.15-3
4.3.15-2	Reported Explosion Incidents 2001-2011	4.3.15-3
4.3.15-3	Likelihood of Future Occurrences of Environmental / Explosion Hazards	4.3.15-4
4.3.16-1	Reported Structural Fires 2001-2011	4.3.16-2
4.3.16-2	Likelihood of Future Occurrences	4.3.16-2
4.3.18-1	Mass Gathering Pre-Planned Events	4.3.18-2
4.3.18-2	Non-planned Mass Gatherings	4.3.18-3
4.3.18-3	Likelihood of Future Occurrences of Mass Gathering	4.3.18-3
4.3.20-1	Terrorist Events Since 2001	4.3.20-2
4.3.21-1	Lehigh Valley Transportation Network	4.3.21-1
4.3.21-2	High-Priority Traffic Safety Locations	4.3.21-1
4.3.21-3	Bridges in the Lehigh Valley	4.3.21-4
4.3.21-4	Injuries and Fatalities from Automobile Crashes	4.3.21-8
4.3.21-5	Injuries and Fatalities of Pedestrians	4.3.21-8
4.3.21-6	Summary of Major Accidents	4.3.21-9
4.3.21-7	Accidents of Significance through 2011	4.3.21-10
4.3.22-1	Utility Interruptions from 2001-2011	4.3.22-1
4.3.22-2	Likelihood of Future Occurrence of Utility Interruptions	4.3.22-2
4.4-1	Summary of Risk Factor (RF) Approach	4.4-2
4.4-2	Risk Ranking for Lehigh and Northampton Counties	4.4-3
5-1	Development Ordinances and Regulations Adopted by Municipalities (as of March 2012)	5-14
5-2	Capability Self-Assessment Matrix	5-23
7-1	Lehigh Valley Hazard Mitigation Plan Update Steering Committee Membership	7-1

FIGURES

<u>Figure</u>		<u>Page</u>
2-1	Regional Setting	2-1
2-2	Classification of Municipalities	2-3
2-3	Stormwater Management Plans.....	2-4
2-4	Surface Terrain.....	2-7
2-5	Steep Slope and Carbonate Geology	2-8
2-6	Existing Land Use	2-9
2-7	Population Growth Projections	2-14
2-8	Municipal Zoning.....	2-18
2-9	General Land Use Plan	2-18
2-10	Emergency Facilities in the Lehigh Valley.....	2-32
2-11	Lehigh Valley School Districts	2-36
2-12	Schools, Shelters and Senior Facilities in the Lehigh Valley	2-49
2-13	Transportation Facilities	2-50
2-14	Airports in the Lehigh Valley	2-52
2-15	Community Water Supply Service.....	2-54
2-16	Public Sanitary Sewer Service	2-59
2-17	Dams in the Lehigh Valley	2-63
2-18	Employment Trends	2-83
4.3.1-1	Climate Divisions in the U.S.....	4.3.1-2
4.3.1-2	Climate Divisions of Pennsylvania	4.3.1-3
4.3.1-3	Palmer Drought Severity Index for Pennsylvania (1895 to 1995)	4.3.1-14
4.3.1-4	Existing Community Water Service Areas with Central Water Systems	4.3.1-16
4.3.2-1	Pennsylvania Earthquake Hazard Zones.....	4.3.2-2
4.3.2-2	Peak Ground Acceleration Modified Mercalli Scale in the Lehigh Valley for a 100-Year MRP Earthquake Event	4.3.2-5
4.3.2-3	Peak Ground Acceleration Modified Mercalli Scale in the Lehigh Valley for a 500-Year MRP Earthquake Event	4.3.2-6
4.3.2-4	Peak Ground Acceleration Modified Mercalli Scale in the Lehigh Valley for a 2,500-Year MRP Earthquake Event.....	4.3.2-7
4.3.3-1	Average Maximum Temperature throughout Pennsylvania (1971 and 2000).....	4.3.3-3
4.3.3-2	Average Minimum Temperature throughout Pennsylvania (1971 to 2000)	4.3.3-4
4.3.3-3	Extreme Heat and Heat Index	4.3.3-6
4.3.3-4	Extreme Cold and Wind Chill.....	4.3.3-6
4.3.4-1	Stormwater Management Plans.....	4.3.4-5
4.3.4-2	Floodplain Illustration.	4.3.4-9
4.3.4-3	NFIP Floodplains in the Lehigh Valley.....	4.3.4-10
4.3.4-4	Historic Ice Jams in the Lehigh Valley.....	4.3.4-22
4.3.4-5	NFIP Polices, Claims, Repetitive Loss and Severe Repetitive Loss Properties in the Lehigh Valley.....	4.3.4-41
4.3.5-1	Hail Events Per Square Mile in Pennsylvania.....	4.3.5-6

4.3.6-1	U.S Geological Survey. Landslide Incidence and Susceptibility	4.3.6-2
4.3.7-1	Weather Fatalities in the U. S.	4.3.7-6
4.3.8-1	Sketch of Radon Entry Points into a House.....	4.3.8-2
4.3.8-2	Radon Hazard Zones in Pennsylvania	4.3.8-2
4.3.8-3	Percentage of Pennsylvania homes having radon levels greater than 4 pCi/L.....	4.3.8-5
4.3.9-1	Lehigh Valley Geology	4.3.9-4
4.3.9-2	Areas of Pennsylvania Subject to Natural Subsidence Due to the Presence of Limestone Bedrock.....	4.3.9-5
4.3.9-3	Lehigh Valley Limestone Geology	4.3.9-6
4.3.9-4	Karst Features in the Lehigh Valley	4.3.9-7
4.3.9-5	Collapse of Creek Bank and Yard along Bushkill Creek	4.3.9-10
4.3.9-6	Norfolk Southern Railroad Bridge Wingwall Sinking into a Water-filled Sinkhole along Bushkill Creek.....	4.3.9-10
4.3.9-7	Sinkhole at Corporate Plaza Building in the City of Allentown, Lehigh County, PA in February, 1994	4.3.9-11
4.3.10-1	Land Cover in the Lehigh Valley	4.3.10-2
4.3.10-2	Location of Wildfire Events responded to by BOF from 2002-2008.....	4.3.10-3
4.3.10-3	WUI for the U.S. in 2000.....	4.3.10-5
4.3.10-4	WUI for the Lehigh Valley	4.3.10-6
4.3.10-5	Observed Fire Danger Map (February 22, 2012).....	4.3.10-8
4.3.10-6	Wildfire Priority Landscapes in the Lehigh Valley.....	4.3.10-10
4.3.11-2	Wind Zones in the U.S.	4.3.11-4
4.3.11-2	Annual Average Number of Tornadoes in the U.S., 1981 to 2010	4.3.11-6
4.3.11-3	Tornado Risk in the U.S.	4.3.11-7
4.3.11-4	Total Annual Threat of Tornado Events in the U.S., 1980-1999	4.3.11-8
4.3.11-5	U.S. Tornado Summaries by County.....	4.3.11-12
4.3.11-6	Wind Speeds and Storm Track for the 100-Year Mean Return Period Event in the Lehigh Valley	4.3.11-18
4.3.11-7	Wind Speeds and Storm Track for the 500-Year Mean Return Period Event in the Lehigh Valley	4.3.11-19
4.3.13-1	Dams in the Lehigh Valley	4.3.13-7
4.3.17-1	Allentown Levee	4.3.17-2
4.3.17-2	Salisbury Levee.....	4.3.17-3
4.3.17-3	Allentown-Jordan Creek Floodwall	4.3.17-4
4.3.17-4	Bethlehem Levee System.....	4.3.17-5
4.3.19-1	Jurisdictions within 50 Mile Ingestion Zone.....	4.3.19-4
4.3.19-2	SSES EPZ and Ingestion Zone.....	4.3.19-5
4.3.21-1	High Priority Traffic Safety Locations	4.3.21-3
4.3.21-2	Freight Rail Lines in the Lehigh Valley	4.3.21-5
4.3.21-3	Airports in the Lehigh Valley	4.3.21-7

5-1 Natural Resources Plan..... 5-18

SECTION 1: INTRODUCTION

1.1 Background

In response to the requirements of the Disaster Mitigation Act of 2000 (DMA 2000), Lehigh and Northampton counties, and their inclusive municipalities that comprise the Lehigh Valley, have developed this Multi-Jurisdictional Hazard Mitigation Plan (HMP) which is an update of the July 2006 Lehigh Valley HMP. DMA 2000 amends the Stafford Act and is designed to improve planning for, response to, and recovery from, disasters by requiring State and local entities to implement pre-disaster mitigation planning and develop HMPs. The Federal Emergency Management Agency (FEMA) has issued guidelines for HMPs. The Pennsylvania Emergency Management Agency (PEMA) also supports plan development for jurisdictions in the Commonwealth.

Hazard Mitigation is any sustained action taken to reduce or eliminate the long term risk and effects that can result from specific hazards.

FEMA defines a **Hazard Mitigation Plan** as the documentation of a state or local government evaluation of natural hazards and the strategies to mitigate such hazards.

Specifically, DMA 2000 requires that local governmental agencies, with support from their States and Federal government, update HMPs on a five year basis to prepare for and reduce the potential impacts of natural hazards. DMA 2000 is intended to facilitate cooperation between state and local authorities, prompting them to work together. This enhanced planning will better enable local and State governments to articulate accurate needs for mitigation, resulting in faster allocation of funding and more effective risk reduction projects.

1.1.2 DMA 2000 ORIGINS -THE ROBERT T. STAFFORD DISASTER RELIEF AND EMERGENCY ASSISTANCE ACT

In the early 1990s a new federal policy regarding disasters began to evolve. Rather than simply reacting whenever disasters strike communities, the federal government would encourage communities to first assess their vulnerability to various disasters and then take actions to reduce or eliminate potential risks. The logic is simply that a disaster-resistant community can rebound from a natural disaster with less loss of property or human injury, at much lower cost, and, consequently, more quickly. Moreover, other costs associated with disasters, such as the time lost from productive activity by business and industries, are minimized.

The **Federal Emergency Management Agency** (FEMA) estimates that for every dollar spent on damage prevention (mitigation), twice that amount is saved through avoided post-disaster damage repair.

1.2 Purpose

DMA 2000 provides an opportunity for States, tribes and local governments to take a new and revitalized approach to mitigation planning. DMA 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act by repealing the previous mitigation planning provisions (Section 409) and replacing them with a new set of requirements (Section 322). This section sets forth the requirements that communities evaluate natural hazards within their respective jurisdictions and develop an appropriate plan of action to mitigate those hazards, while emphasizing the need for State, tribal and local governments to closely coordinate mitigation planning and implementation efforts.

The amended Stafford Act requires that each local jurisdiction identify potential natural hazards to the health, safety and well-being of its residents and identify and prioritize actions that can be taken by the

community to mitigate those hazards—before disaster strikes. For communities to remain eligible for hazard mitigation assistance from the federal government, they must first prepare and maintain a FEMA-approved HMP (this plan).

The planning process will help prepare citizens and government agencies to better respond when disasters occur. Also, mitigation planning allows the counties and municipalities in the Lehigh Valley to remain eligible for mitigation grant funding for mitigation projects that will reduce the impact of future disaster events. The long-term benefits of mitigation planning include:

- An increased understanding of hazards faced by communities
- A more sustainable and disaster-resistant community
- Financial savings through partnerships that support planning and mitigation efforts
- Focused use of limited resources on hazards that have the biggest impact on the community
- Reduced long-term impacts and damages to human health and structures and reduced repair costs

1.3 Scope

DMA 2000 and its implementing regulations at 44 CFR 201.6 require that all local governments have a FEMA-approved Local Hazard Mitigation Plan, formally updated every five years, in order to be eligible for state and federal mitigation funding. Both counties and all municipalities were invited to participate in the 2012 regulatory update process in order to maintain their eligibility for mitigation funding. However, both active participation and subsequent adoption of the updated plan by each jurisdiction is required to meet FEMA’s local mitigation planning requirements and the expectations of FEMA plan reviewers.

1.3.1 ORGANIZATIONS INVOLVED IN THE MITIGATION PLANNING EFFORT

Lehigh and Northampton Counties and the participating jurisdictions intend to implement this plan with full coordination and participation of County and local departments, organizations and groups, as well as by coordinating with relevant State and Federal entities. Coordination helps to ensure that all such stakeholders have established communication channels and relationships necessary to support mitigation planning and mitigation actions included in Section 6 and in the Jurisdictional Annexes in Volume II, Section 9.

In addition to Lehigh and Northampton Counties, all jurisdictions within the Lehigh Valley have participated in the planning process as indicated in Table 1-1.

Table 1-1. Jurisdictions Participating in the 2012 Update

Participating Jurisdictions			
LEHIGH COUNTY			
Alburtis Borough	Allentown, City of	Bethlehem, City of (LC)(NC)	Catasauqua Borough
Coopersburg Borough	Coplay Borough	Emmaus Borough	Fountain Hill Borough
Hanover Township (LC)	Heidelberg Township	Lower Macungie Township	Lower Milford Township
Lowhill Township	Lynn Township	Macungie Borough	North Whitehall Township
Salisbury Township	Slatington Borough	South Whitehall Township	Upper Macungie Township

Participating Jurisdictions			
Upper Milford Township	Upper Saucon Township	Washington Township (LC)	Weisenberg Township
Whitehall Township			
NORTHAMPTON COUNTY			
Allen Township	Bangor Borough	Bath Borough	Bethlehem Township
Bushkill Township	Chapman Borough	East Allen Township	East Bangor Borough
Easton, City of	Forks Township	Freemansburg Borough	Glendon Borough
Hanover Township (NC)	Hellertown Borough	Lehigh Township	Lower Mt. Bethel Township
Lower Nazareth Township	Lower Saucon Township	Moore Township	Nazareth Borough
North Catasauqua Borough	Northampton Borough	Palmer Township	Pen Argyl Borough
Plainfield Township	Portland Borough	Roseto Borough	Stockertown Borough
Tatamy Borough	Upper Mt. Bethel Township	Upper Nazareth Township	Walnutport Borough
Washington Township (NC)	West Easton Borough	Williams Township	Wilson Borough
Wind Gap Borough			

LC = Lehigh County; NC = Northampton County

While primary responsibility for the development and implementation of mitigation strategies and policies lies with local governments, various partners and resources at the regional, state and federal levels are available to assist communities in the development and implementation of mitigation strategies. Within the Commonwealth of Pennsylvania, PEMA is the lead agency providing hazard mitigation planning assistance to local jurisdictions, through the State’s administration of the Federal mitigation grant programs, as well as providing guidance, tools and training to support mitigation planning and plan implementation.

Additional input and support for this planning effort was obtained from a range of agencies and through public involvement, as discussed in Section 3 (Planning Process). This plan update process was managed by the Northampton County Emergency Management Services (NCEMS), teaming with the Lehigh County Emergency Management Agency (LCEMA). Oversight for the preparation of this plan update was provided by the Lehigh Valley Hazard Mitigation Steering Committee assembled for this update process. The Lehigh Valley Planning Commission, primary author of the original 2006 HMP, served on the Steering Committee and provided a wealth of support and knowledge to this update.

Throughout the planning process, Lehigh and Northampton Counties utilized the services of Tetra Tech EM, Inc. (Tetra Tech) in the capacity of consultant to provide assistance in preparation of the plan. Tetra Tech was present and participated in meetings as noted in Section 3 (Planning Process). Tetra Tech developed the plan, reviewed and compiled hazard data, performed risk analyses, hazard identification and profiling, vulnerability analyses, supported the updating of plan goals, objectives and mitigation strategies, provided planning support, and authored the plan with input from the two Counties, municipalities, Steering Committee and stakeholders.

Responsibility for fulfilling the requirements of Section 322 of the Stafford Act and administering the FEMA Hazard Mitigation Program has been delegated to the Commonwealth, specifically to PEMA. FEMA also provides support through guidance, resources, and plan reviews.

1.4 Authority and References

This HMP was prepared in accordance with the following regulations and guidance:

- DMA 2000 (Public Law 106-390, October 30, 2000).
- 44 Code of Federal Regulations (CFR) Parts 201 and 206 (including: Feb. 26, 2002, Oct. 1, 2002, Oct. 28, 2003, and Sept. 13, 2004 Interim Final Rules).
- FEMA Local Mitigation Plan Review Guide, October 1, 2011
- Pennsylvania’s All-Hazard Mitigation Planning Standard Operating Guide (October 2010).

Table 1-2 summarizes the requirements outlined in the DMA 2000 Interim Final Rule and where each of these requirements is addressed in this HMP.

Table 1-2. FEMA Local Mitigation Plan Crosswalk

Plan Criteria	Primary Location in Plan
Prerequisites	
Adoption by the Local Governing Body: §201.6(c)(5)	Volume I, Section 8.0; Appendix F
Planning Process	
Documentation of the Planning Process: §201.6(b) and §201.6(c)(1)	Volume I, Section 3.0; Appendices C, D, E
Risk Assessment	
Identifying Hazards: §201.6(c)(2)(i)	Volume I, Section 4.2
Profiling Hazards: §201.6(c)(2)(i)	Volume I, Section 4.3
Assessing Vulnerability: Overview: §201.6(c)(2)(ii)	Volume I, Section 4.3
Assessing Vulnerability: Identifying Structures: §201.6(c)(2)(ii)(A)	Volume I, Sections 2 and 4.3
Assessing Vulnerability: Estimating Potential Losses: §201.6(c)(2)(ii)(B)	Volume I, Section 4.3
Assessing Vulnerability: Analyzing Development Trends: §201.6(c)(2)(ii)(C)	Volume I, Section 2; Volume II, Section 9 Annexes
Mitigation Strategy	
Local Hazard Mitigation Goals: §201.6(c)(3)(i)	Volume I, Section 6.1; Volume II, Section 9 Annexes
Identification and Analysis of Mitigation Actions: §201.6(c)(3)(ii)	Volume I, Section 6 Volume II, Section 9 Annexes
Implementation of Mitigation Actions: §201.6(c)(3)(iii)	Volume I, Section 6.4; Volume II, Section 9 Annexes
Multi-Jurisdictional Mitigation Actions: : §201.6(c)(3)(iv)	Volume I, Section 6; Volume II, Section 9 Annexes
Plan Maintenance Process	
Monitoring, Evaluating, and Updating the Plan: §201.6(c)(4)(i)	Volume I, Section 7.1
Incorporation into Existing Planning Mechanisms: §201.6(c)(4)(ii)	Volume I, Section 7.2
Continued Public Involvement: §201.6(c)(4)(iii)	Volume I, Section 7.3

A vast wealth of data, information, plans and reports were researched and used in the development of this plan update, as comprehensively documented in Appendix A, “References”.

1.5 Summary of Changes in Plan Update

This document represents a comprehensive update to the July 2006 Lehigh Valley Hazard Mitigation Plan. Significant changes and areas of update are summarized below.

1.5.1 Organization

One of the benefits of multi-jurisdictional planning is the ability to pool resources and eliminate redundant activities within a planning area that has uniform risk exposure and vulnerabilities. FEMA encourages multi-jurisdictional planning under its guidance for the DMA. This plan update has been set up in two volumes so that elements that are jurisdiction-specific can easily be distinguished from those that apply to the whole planning area:

Volume 1—Volume 1 meets the requirements of all elements of Section 201.6 of 44CFR that apply to the entire planning area. This includes the description of the planning process, public involvement strategy, hazard risk assessment, goals and objectives, regional mitigation capabilities and initiatives, and a plan maintenance strategy. To the greatest extent practical, Volume I has been organized according to the Model Plan Outline identified in Pennsylvania’s All-Hazard Mitigation Planning Standard Operating Guide (PEMA SOG).

Volume 2—Volume 2 includes all jurisdiction-specific elements required by Section 201.6 of 44CFR, presented in annexes for each jurisdiction (both counties and each municipality) participating in this process and adopting this plan. Each annex identifies that jurisdiction’s specific hazard risks, mitigation capabilities, and updated mitigation strategy. The annexes are intended to provide an expedient resource for each jurisdiction for implementation of mitigation projects and future grant opportunities.

A summary of the overall plan organization is provided at the end of this Section.

1.5.2 Risk Assessment

This 2012 update has expanded on the hazard profiling and risk assessment efforts in the 2006 plan. In addition to updating the hazard profiles and risk assessment for the natural hazards that pose significant risk to the Lehigh Valley, this update has greatly expanded its consideration of those man-made and technological (non-natural) hazards that pose risk to the region. The potential impacts of climate change as an exacerbating factor have been included for each hazard, where applicable.

While the 2006 plan presented the vulnerability assessment for specific natural hazards separately from their profiles, hazard profiling and risk assessment/vulnerability assessment information are provided in a single, unified profile for each hazard of concern addressed in this update.

This update has also provided County and local risk rankings, allowing a relative comparison of risk for the natural and non-natural hazards within each county and all participating municipalities, developed using the PEMA risk-factor methodology. Relative risk rankings may be used to focus and prioritize the individual jurisdictional mitigation strategies.

1.5.3 Capability Assessment

This update has updated the thorough regional and local capability assessment provided in the 2006 Plan. Regional capabilities are presented in Section 5 (Capability Assessment), along with a summary of local mitigation capabilities. Specific local capabilities are identified in each jurisdiction's annex in Section 9.

1.5.4 Mitigation Strategies

Progress on regional, county and local mitigation strategies identified in the 2006 plan are provided in each jurisdiction's annex in Section 9. Those actions and initiatives being carried forward in the 2013 update have been expanded with further information and details to support implementation. Actions being carried forward, as well as new actions identified during this update process, are included in each jurisdiction's annex in Section 9. Further, the PA STEEL mitigation action evaluation methodology specified in the PEMA SOG has been used to help prioritize each jurisdiction's strategy, as documented in each jurisdictional annex.

A major focus of this update effort has been to identify effective, actionable, and well-defined mitigation actions and initiatives at both the county and local level.

1.5.5 Plan Integration into Other Planning Mechanisms

It is the intention of this planning process that municipalities shall incorporate the findings and recommendations of this plan into future local planning efforts and into overall execution of their land-use planning process (e.g. comprehensive planning, site plan review, permitting, and code enforcement).

The integration of hazard mitigation, including the findings and recommendations of the 2006 HMP and this update, into other related planning mechanisms in the Lehigh Valley is identified throughout this plan update. The Section 5 Capability Assessment identifies and describes the various plans, programs and mechanisms to support and effect mitigation in the Lehigh Valley, including a discussion of those that have been updated or adopted since the 2006 plan. Section 3.4 of the Planning Process discusses how these plans, programs and mechanisms were integrated into the plan update process, and how this integration/coordination will continue in the Lehigh Valley as the 2013 update is implemented. Further, each jurisdictional annex identifies those planning and regulatory mechanisms that have been adopted and/or updated in each municipality, and identifies specific actions and initiatives to expand and enhance their local risk management capabilities.

1.6 Organization of Mitigation Plan

This plan was organized with consideration of both FEMA and PEMA guidance, and is presented in two volumes: Volume I includes all information that applies to the entire planning area (Lehigh Valley and its inclusive municipalities); and Volume II includes participating jurisdiction-specific information.

Volume I of this Plan includes the following sections:

Section 1: Introduction: Identifies the purpose and authorities for mitigation planning, the scope of this plan update effort, and provides a summary and overview of the plan update process and those changes that have been made to the 2006 plan.

Section 2: Regional Profile: An overview of the Lehigh Valley, including location, history, government and political subdivisions, physical setting, land use and development trends, population and demographics, general building stock inventory, and critical and essential facilities.

Section 3: Planning Process: A description of the Plan methodology and development process, Planning Committee and stakeholder involvement efforts, and a description of how this Plan will be incorporated into existing programs.

Section 4: Risk Assessment: Documentation of the hazard identification and hazard risk ranking process, hazard profiles, and findings of the vulnerability assessment (estimates of the impact of hazard events on life, safety and health; general building stock; critical facilities and the economy). Description of the status of local data and planned steps to improve local data to support mitigation planning.

Section 5: Capability Assessment: evaluates the capabilities and resources that are already in place in a community to reduce hazard risks. The capability assessment looks at the resources in place at the municipal, county, state and federal levels. The assessment also identifies where improvements can be made to increase disaster resistance in the community.

Section 6: Mitigation Strategies: A discussion of how the original mitigation goals and objectives were evaluated, and the process by which the county and local mitigation strategies were updated.

Section 7: Plan Maintenance Procedures: The system established by the Lehigh Valley Steering Committee to continue to monitor, evaluate, maintain and update the plan.

Section 8: Plan Adoption: Information regarding the adoption of the updated plan by both counties and each participating jurisdiction.

Volume II of this Plan includes the following sections:

Section 9: Jurisdictional Annexes: A jurisdiction-specific annex for each participating jurisdiction and the Counties containing their hazards of concern, hazard risk ranking, capability assessments, mitigation actions and action prioritization specific only to the County or that jurisdiction.

Appendices –

Appendix A - References: Comprehensive documentation of the sources of all data and information used in the development of this plan update.

Appendix B - Local Plan Review Crosswalk: Worksheet used by FEMA Region III plan reviewers to document compliance of this updated plan with 44 CFR 201.6 requirements.

Appendix C - Meeting Documentation: Agendas, minutes, and sign-in sheets of major meetings convened during the planning process.

Appendix D – Municipal Participation Documentation: Worksheets, survey forms and other information provided by municipalities and local stakeholders during the update process.

Appendix E – Public and Stakeholder Documentation: Copies of surveys, media releases, articles, public notices, websites and documentation of other mechanisms used to inform the public of the hazard mitigation planning effort and provide input, including specific public and stakeholder comments received throughout the planning process.

Appendix F – Sample Adoption Resolution: Draft resolution available for use by each jurisdiction during the plan adoption process.

Appendix G – Earthquake Vulnerability Assessment Results: Critical facility vulnerability assessment results for HAZUS-MH earthquake modeling runs.

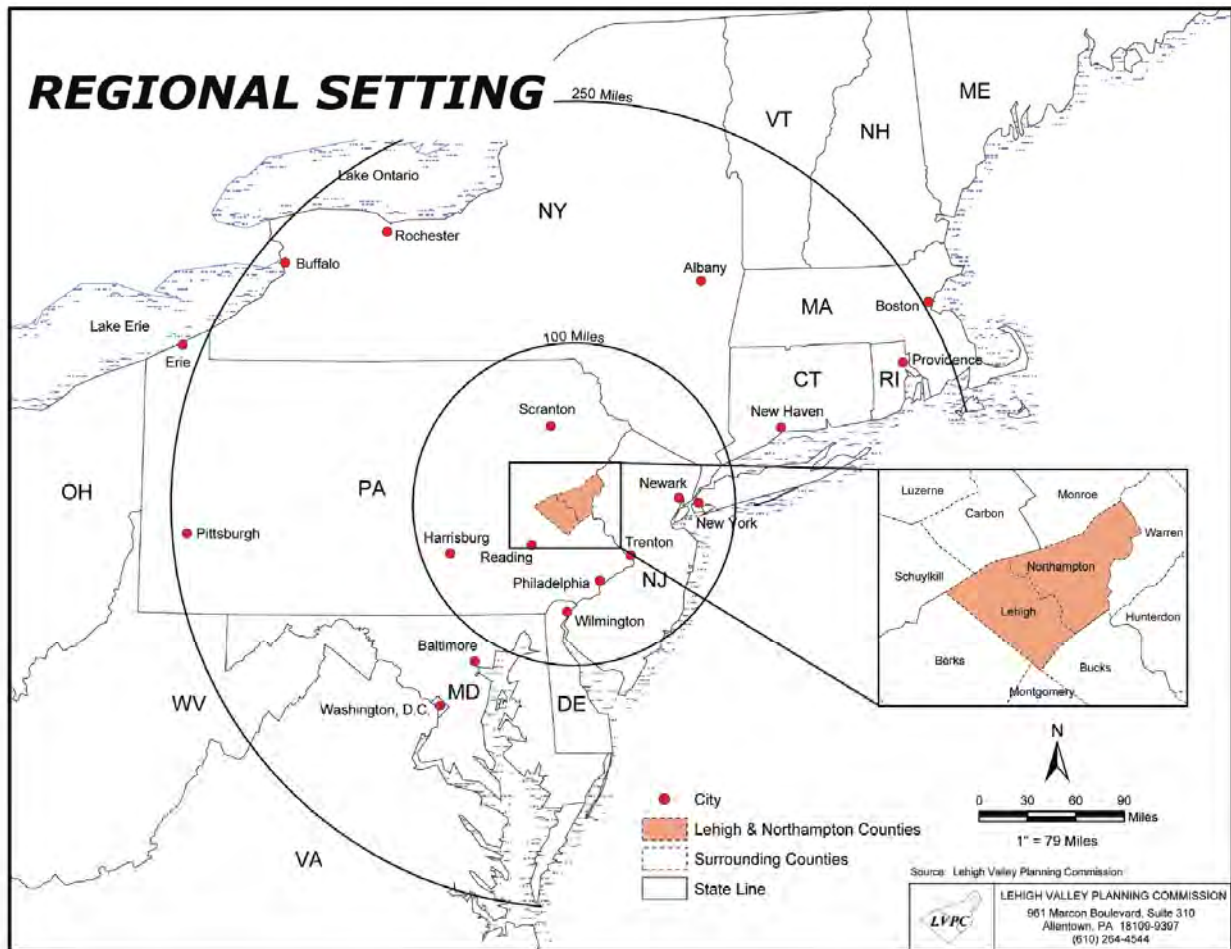
SECTION 2: Regional Profile

This section provides a political, physical, demographic and economic description of the Lehigh Valley, and details the inventory of assets (population, general building stock, and critical facilities and infrastructure) assembled to assess the vulnerability of the Lehigh Valley to natural, man-made and technological hazards.

2.1 Location

The counties of Lehigh and Northampton, together measuring about 729 square miles, are located in the central eastern portion of the Commonwealth of Pennsylvania about 80 miles west of New York City and 50 miles north of Philadelphia (see Figure 2-1).

Figure 2-1. Regional Setting



Source: LVPC

2.2 History

In the 1730s Scotch-Irish and German settlers began the agricultural development of the Lehigh Valley. During the 19th and 20th centuries, canals, railroads, and highways coupled with the manufacturing of steel, cement, heavy trucks and chemicals continued to transform the economy and the landscape.

The rivers and streams of the Lehigh Valley have played an important role in its history and development. The area's three cities and some of its major boroughs grew along the banks of the Lehigh or Delaware rivers. The Lehigh and Delaware Navigation Canals owed their existence to these rivers. Many streams served as the sites for early mills that were dependent on a supply of running water. Most major industries also were located along the banks of rivers or streams (LVPC, 2010).

Further details on the history of the Lehigh Valley may be found in the following sources:

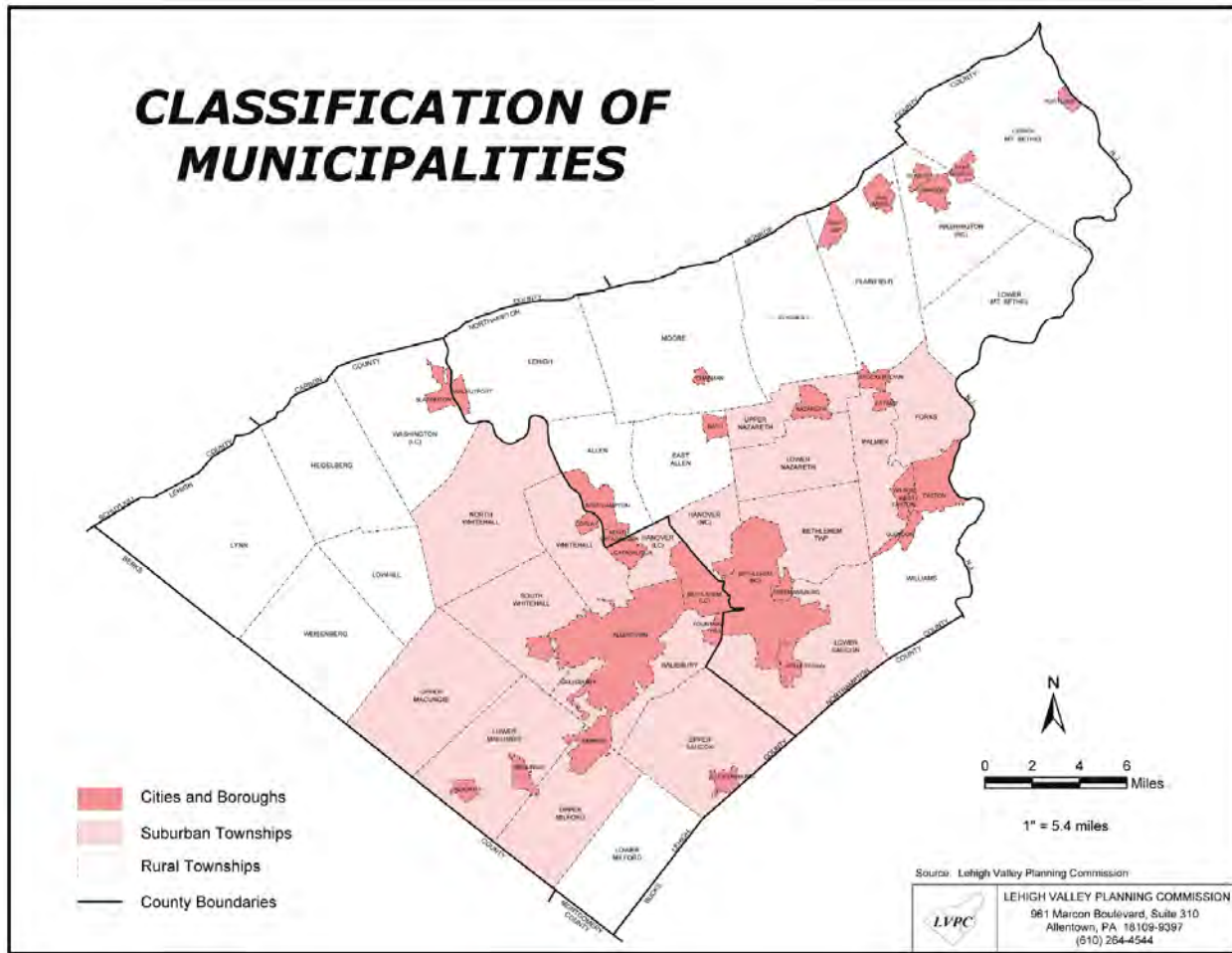
- Lehigh Valley Profile and Trends – 2012 Edition (www.lvpc.org)
- Lehigh Valley History Website: <http://lehighvalleyhistory.com>

2.3 Government and Political Subdivisions

The Lehigh Valley contains 62 incorporated municipalities, 25 in Lehigh County and 38 in Northampton County (the City of Bethlehem lies within both counties). There are a total of three cities (City of Allentown, City of Bethlehem and City of Easton), 27 boroughs and 32 townships (see Figure 2-2). The two counties form the core of a metropolitan area defined by the Bureau of the Census as the Allentown-Bethlehem-Easton Metropolitan Statistical Area (ABE MSA) (LVPC, 2012).

The Pennsylvania Constitution provides that the State Legislature classify local governments according to population size. Lehigh and Northampton counties are each Third Class Pennsylvania counties, as their population according to the 2010 U.S. Census was in the 250,000 to 500,000 range. Both counties adopted Home Rule charters in 1978, which provide for nine-member elected legislative bodies and elected county executives. The 3 cities are classified as third class cities as defined by the State of Pennsylvania based on their populations. Third class cities have populations below 250,000. The 32 townships are classified as either first class or second class townships. In the Lehigh Valley, there are only 5 townships classified as first class (Lower Macungie, Salisbury, South Whitehall, Whitehall, and Bethlehem townships) (LVPC, 2012).

Figure 2-2. Classification of Municipalities



Source: LVPC, 2010

2.4 Physical Setting

This section presents the physical setting of the Lehigh Valley, including: hydrography and hydrology, topography and geology, climate, and land use/land cover.

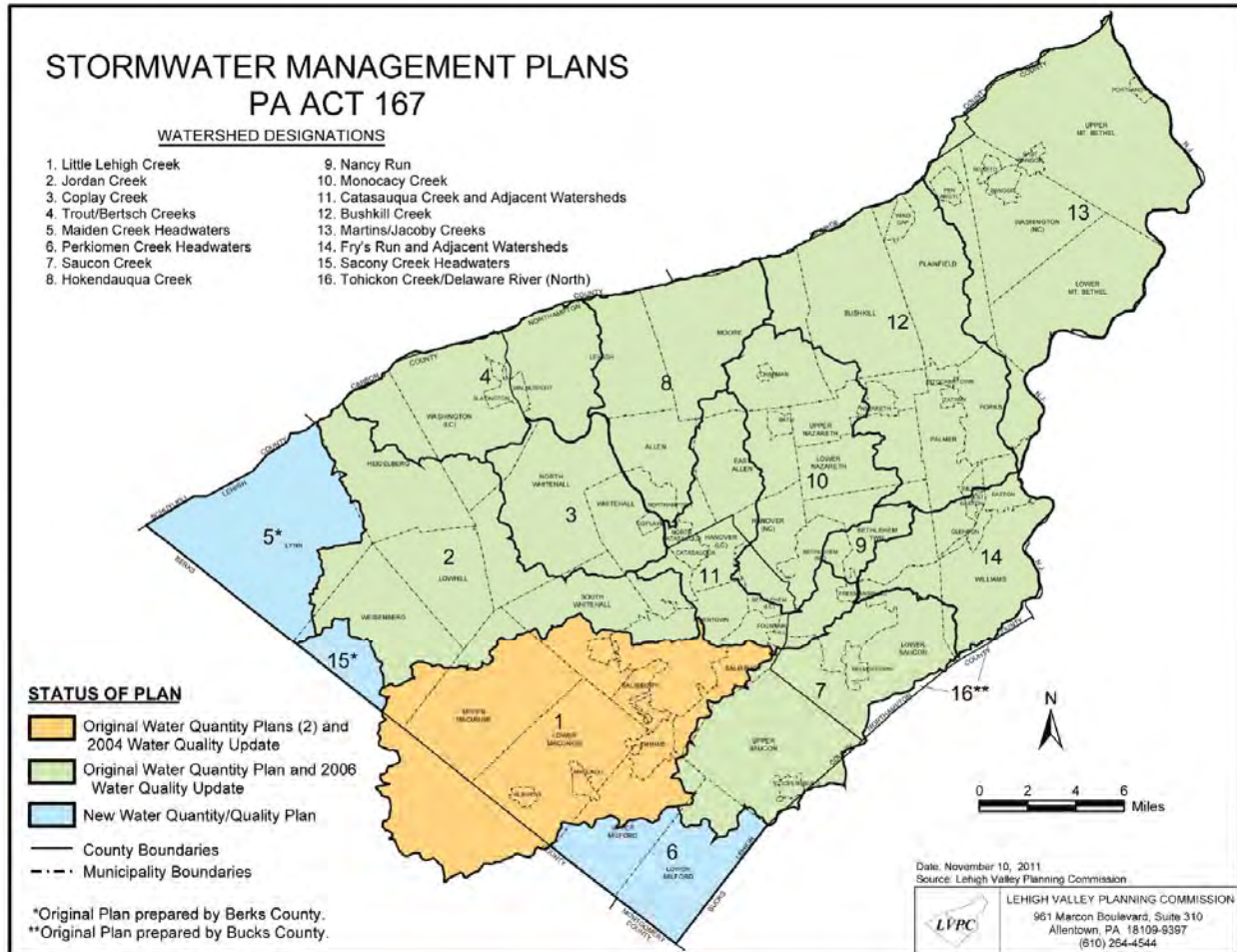
2.4.1 Hydrography and Hydrology

Two major rivers flow through the region, the Lehigh and Delaware. The Lehigh River flows through Lehigh Gap at the northern boundary of Lehigh and Northampton counties southbound to Allentown where it makes an abrupt turn eastward. From Allentown the Lehigh flows eastward to its confluence with the Delaware River at Easton. Major tributary streams flowing into the Lehigh River are Little Lehigh Creek, Hokendauqua Creek, Monocacy Creek and Saucon Creek. Bushkill Creek and Martins Creek flow directly into the Delaware.

The entire Lehigh Valley lies within the Delaware River Basin, which drains a total area of 13,539 square miles in the states of Pennsylvania, New York, New Jersey and Delaware (LVHMP, 2006).

Per the 1978 Pennsylvania Stormwater Management Act (Act 167), counties are required to prepare stormwater management plans on a watershed-by-watershed basis that provide for the improved management of the stormwater impacts associated with the development of land. Within Lehigh and Northampton counties, the state has designated 16 Act 167 study areas, as identified on Figure 2-3. Table 2-1 summarizes the municipalities each Stormwater Management Plan covers.

Figure 2-3. Stormwater Management Plans



Source: LVPC, 2012

Table 2-1. Stormwater Management Plans for the Lehigh Valley

Title	Lehigh County	Northampton County
Bushkill Creek Watershed- Act 167- Storm Water Management Plan, May 1992		Bethlehem Township Bushkill Township City of Easton Forks Township Lower Nazareth Township Moore Township Nazareth Borough Palmer Township Plainfield Township Stockertown Borough Tatamy Borough Upper Nazareth Township Wilson Borough Wind Gap Borough
Catasauqua Creek Watershed and Lehigh River Sub-Basin 4- Act 167- Storm Water Management Plan, February 1997	City of Allentown Catasauqua Borough Fountain Hill Borough Hanover Township Salisbury Township Whitehall Township	Allen Township City of Bethlehem East Allen Township Freemansburg Borough Hanover Township Lower Saucon Township Moore Township Northampton Borough North Catasauqua Borough
Coplay Creek Watershed and Lehigh River Sub-Basin 2- Act 167-Storm Water Management Plan, November 1994	Coplay Borough North Whitehall Township South Whitehall Township Washington Township Whitehall Township	
Delaware River Sub-Basin 2 and Lehigh River Sub-Basin 5 (Fry's Run Study Area)-Act 167-Storm Water Management Plan, February 1999		Bethlehem Township City of Easton Glendon Borough Lower Saucon Township Palmer Township West Easton Borough Williams Township Wilson Borough
Hokendauqua Creek Watershed and Lehigh River Sub-Basin 3- Act 167- Storm Water Management Plan, September 1997		Allen Township East Allen Township Lehigh Township Moore Township Northampton Borough North Catasauqua Borough
Jordan Creek Watershed- Act 167- Storm Water Management Plan, May 1992	City of Allentown Heidelberg Township Lowhill Township Lynn Township North Whitehall Township South Whitehall Township Upper Macungie Township Washington Township Weisenberg Township Whitehall Township	

SECTION 2: REGIONAL PROFILE

Title	Lehigh County	Northampton County
Little Lehigh Creek Watershed - Act 167-Storm Water Management Plan Update, June 1999	Alburtis Borough City of Allentown Emmaus Borough Lower Macungie Township Macungie Borough Salisbury Township South Whitehall Township Upper Macungie Township Upper Milford Township Weisenberg Township	
Maiden Creek Headwaters- Act 167-Storm Water Management Plan, April 2010	Heidelberg Township Lynn Township Weisenberg Township	
Martins/Jacoby Creeks Watershed and Delaware Sub-Basin 1 - Act 167-Storm Water Management Plan, February 1996		Bangor Borough East Bangor Borough City of Easton Forks Township Lower Mount Bethel Township Pen Argyl Borough Plainfield Township Portland Borough Roseto Borough Upper Mount Bethel Township
Monocacy Creek - Act 167 - Stormwater Management Plan, March 1989	Hanover Township	Bath Borough City of Bethlehem Bethlehem Township Bushkill Township Chapman Borough East Allen Township Hanover Township Lower Nazareth Township Moore Township Nazareth Borough Upper Nazareth Township
Nancy Run Watershed - Act 167-Storm Water Management Plan, March 1989		City of Bethlehem Bethlehem Township Freemansburg Borough
Perkiomen Creek Headwaters- Act 167-Storm Water Management Plan, October 2009	Lower Macungie Township Lower Milford Township Upper Milford Township Upper Saucon Township	
Sacony Creek Headwaters- Act 167-Storm Water Management Plan, April 2010	Weisenberg Township	
Sacon Creek - Act 167 - Stormwater Management Plan, April, 1991	Coopersburg Borough Lower Milford Township Salisbury Township Upper Milford Township Upper Saucon Township	City of Bethlehem Hellertown Borough Lower Saucon Township Williams Township
Trout/Bertsch Creeks and Lehigh River Sub-Basin- Act 167-Storm Water Management Plan, April 1995	Heidelberg Township Slatington Borough Washington Township	Lehigh Township Walnutport Borough

Source: LVPC



2.4.2 Topography

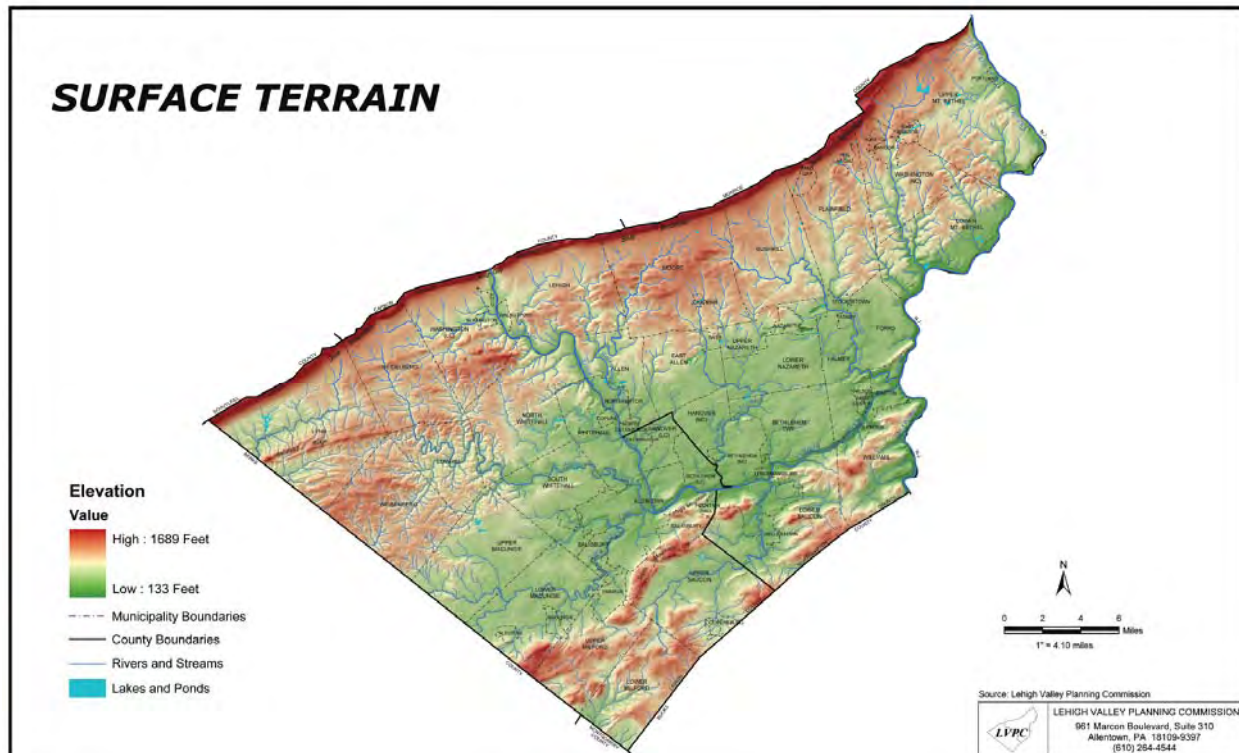
The Lehigh Valley is bounded on the north by the Blue Mountain and on the east by the Delaware River. To the south lies the Lehigh Mountain Range, known as South Mountain. To the west, the plain breaks into low, rolling hills which rise to form a divide between lands drained by the Lehigh and Schuylkill rivers (LVHMP, 2006).

Blue Mountain, otherwise known as Kittatinny Ridge, extends southwest to the Maryland border. The mountain forms the northern boundary of Lehigh and Northampton counties. Lehigh Mountain and South Mountain are two landmark ridges on the southern border of Allentown. There are parts of a section of the mountains called the Reading Prong which extend south of Emmaus, Macungie and Alburtis into Berks County. The eastward extension of these mountains extend through southern Northampton County and then northeast to Massachusetts.

Between Blue Mountain and South Mountain is a seven mile wide limestone valley where most people in the Lehigh Valley live and work. To the north of this valley is a low shale plateau with undulating hills, stream headwaters and a rural environment.

Elevations vary from 200 feet above mean sea level (MSL) along some parts of the Lehigh and Delaware rivers to greater than 1,695 feet MSL on the Blue Mountain and 1,042 feet MSL on South Mountain. (LVHMP, 2006) Figure 2-4 indicates the surface terrain of the Lehigh Valley.

Figure 2-4. Surface Terrain

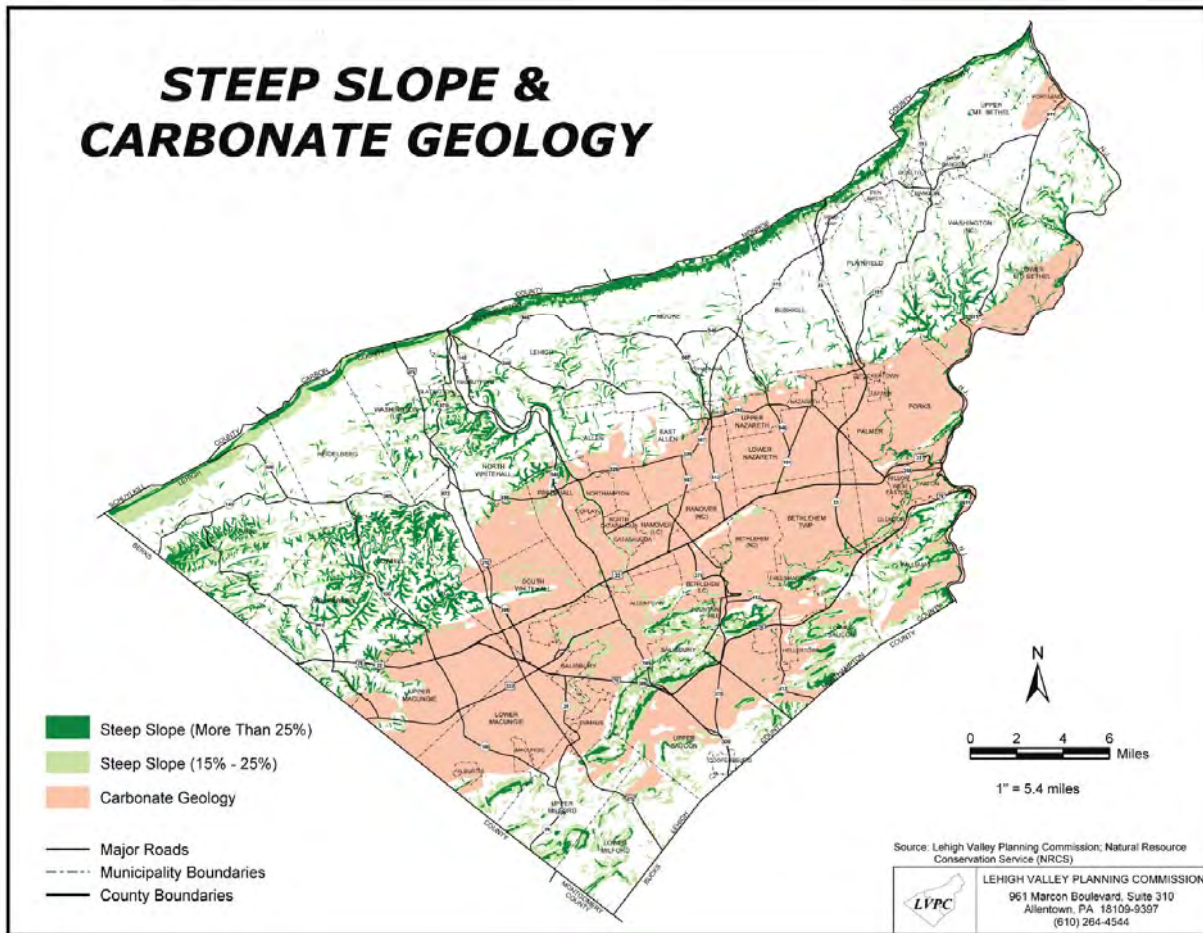


Source: LVPC, 2006

Figure 2-5 shows the general location of slopes of 15% and over. The steepest slopes and the greatest concentration of steep slopes are found on the Blue Mountain and South Mountain. There are sizable

areas of steep slope in townships along the northern and southern borders of Lehigh and Northampton counties (LVPC, 2010).

Figure 2-5. Steep Slope and Carbonate Geology



Source: LVPC, 2010

2.4.3 Geology

From the perspective of hazard mitigation planning, the most significant geologic feature in the Lehigh Valley is the carbonate geology (limestone) which underlies nearly all of the areas where urban development has taken place. In Lehigh and Northampton counties, 46 of the 62 municipalities are underlain entirely or in part by carbonate rock (see Figure 2-5). These carbonate formations provide the primary raw material for the local cement industry and they lie under the most fertile soils. Carbonate rock has the potential for sinkhole formations which are fairly common in the Lehigh Valley (LVPC, 2010).

2.4.4 Climate

The area enjoys a moderate climate, with an annual average temperature of about 51 degrees Fahrenheit. Temperatures are rarely above 100 degrees or below 0 degrees Fahrenheit. Precipitation is generally ample and dependable; destructive storms seldom occur. The growing season is 170 to 185 days (LVPC, 2011).

Additional information and data on climate in the Lehigh Valley may be found at the following sources:

- Lehigh Valley Profile and Trends – 2012 Edition (www.lvpc.org)
- Pennsylvania State Climatologist Website - <http://climate.met.psu.edu>

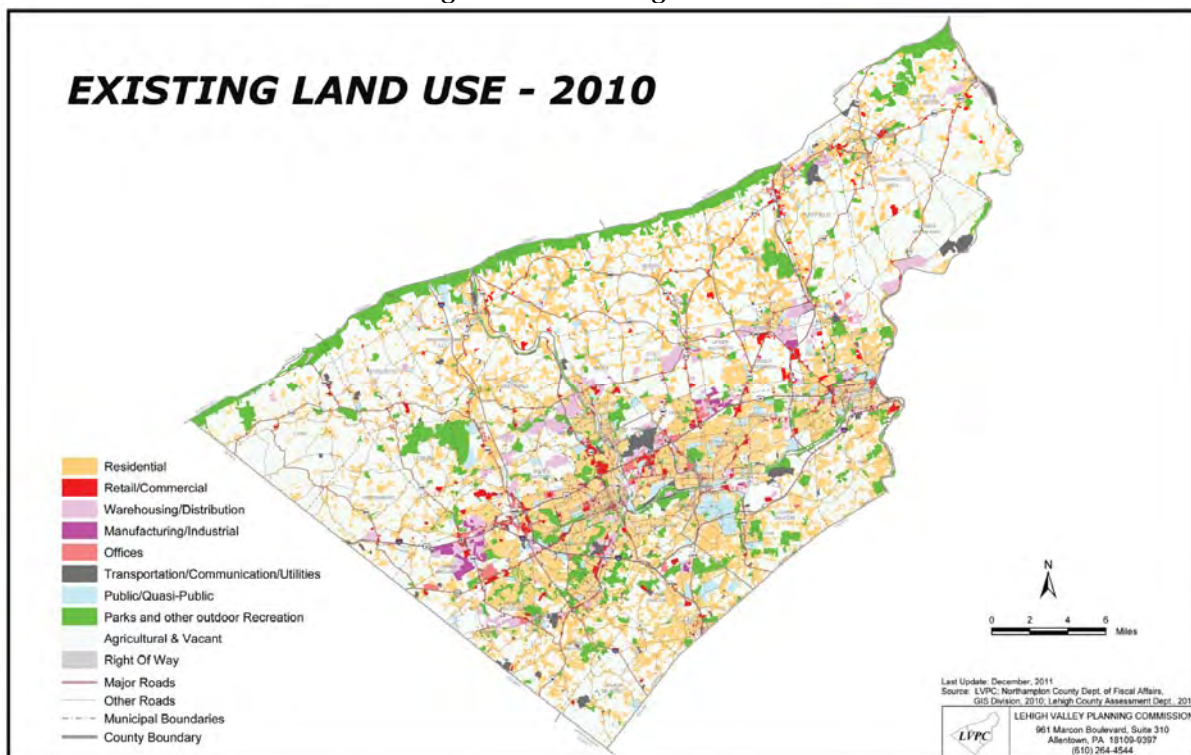
2.4.5 Land Use and Land Cover

Most urban development in the region is between Route 22 and I-78 from Route 100 east to the Delaware River. Interchange locations in this corridor have been popular sites for business and industrial locations since the late 1950s. The corridor is also bounded by rapidly developing suburbs such as Hanover and Bethlehem townships in Northampton County and Upper and Lower Macungie townships in western Lehigh County. Development in western Lehigh County was strongly influenced by the development of a long sewer interceptor from western Allentown to the industrial area around the I-78/Route 100 interchange in the late 1960s.

Expanses of farmland and other open space still exist in northwestern Lehigh County, southwestern Lehigh County, northeastern Northampton County and southeastern Northampton County. There is also an area of prime farmland south of Bath and Nazareth. However, farmland is disappearing rapidly. Rural single family subdivisions on large lots served by on-lot sewer and water are scattered throughout the region. In the less developed areas individual lots or small groups of lots are found along existing roads and at rural road intersections (LVPC, 2010).

Figure 2-6 and Table 2-2 show existing land use in the Lehigh Valley as of 2010.

Figure 2-6. Existing Land Use



Source: LVPC, 2011

2.5 Population and Demographics

According to U.S. Census figures, the Lehigh Valley had a population of 647,232 in 2010. The Disaster Mitigation Act of 2000 (DMA 2000) requires that Hazard Mitigation Plans (HMPs) consider socially vulnerable populations. These populations can be more susceptible to hazard events, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. For the purposes of this study, vulnerable populations shall include (1) the elderly (persons aged 65 and over) and (2) those living in low-income households.

Tables 2-3 through 2-5 present a summary and municipal breakdown of the general and socially-vulnerable population statistics for the Lehigh Valley based on U.S. Census data. Municipal-level population and demographic statistics may be found in recent Lehigh Valley Planning Commission (LVPC) planning documents, including the “Lehigh Valley Profile & Trends, 2012 Edition”, and “Municipal Profiles (April 2012)” available online at www.lvpc.org.

Table 2-3. Lehigh Valley Population and Demographic Statistics Summary (2005-2009 ACS and 2010 US Census)

Region	2010 Population (2010 US Census)	2010 Population 65 and older (2010 US Census)	2010 Population below Poverty Level (2005-09 ACS)
Lehigh County	349,497	51,604	36,176
Northampton County	297,735	46,606	21,894
Lehigh Valley Total	647,232	98,210	58,070

Source: Municipal Profiles, LVPC (April 2012)

Table 2-4. Lehigh County Population and Demographic Statistics

Municipality	U.S. Census 2010 Population	U.S. Census 2000 Population (HAZUS)	U.S. Census 2000 Population 65 and older (HAZUS)	U.S. Census 2000 Population Income < \$20K/year (HAZUS)
Lehigh County				
Alburtis Borough	2,361	2,123	157	20
Allentown, City of	118,032	106,789	16,172	5078
Bethlehem, City of	19,343	19,029	4,405	693
Catasauqua Borough	6,436	6,588	824	170
Coopersburg Borough	2,386	2,589	536	41
Coplay Borough	3,192	3,373	702	93
Emmaus Borough	11,211	11,071	2,118	251
Fountain Hill Borough	4,597	4,614	909	122
Hanover Township	1,571	1,776	225	24
Heidelberg Township	3,416	3,279	351	35
Lower Macungie Township	30,633	19,322	2,711	131
Lower Milford Township	3,775	3,617	400	9
Lowhill Township	2,173	1,917	228	17
Lynn Township	4,229	3,849	339	38
Macungie Borough	3,074	3,039	401	42
North Whitehall Township	15,703	14,731	1,488	125
Salisbury Township	13,505	13,514	2,445	149
Slatington Borough	4,232	4,406	586	222

Municipality	U.S. Census 2010 Population	U.S. Census 2000 Population (HAZUS)	U.S. Census 2000 Population 65 and older (HAZUS)	U.S. Census 2000 Population Income < \$20K/year (HAZUS)
South Whitehall Township	19,180	18,012	4,427	272
Upper Macungie Township	20,063	13,847	1,902	143
Upper Milford Township	7,292	6,996	898	34
Upper Saucon Township	14,808	11,945	1,397	58
Washington Township	6,624	6,616	778	176
Weisenberg Township	4,923	4,144	378	26
Whitehall Township	26,738	24,904	4,485	594
Lehigh County Total	349,497	312,090	49,262	24,079

Source: HAZUS-MH 2.1; U.S. Census, 2010

Table 2-5. Northampton County Population and Demographic Statistics

Municipality	U.S. Census 2010 Population	U.S. Census 2000 Population (HAZUS)	U.S. Census 2000 Population 65 and older (HAZUS)	U.S. Census 2000 Population Income < \$20K/year (HAZUS)
Northampton County				
Allen Township	4,269	2,656	350	9
Bangor Borough	5,273	5,319	864	249
Bath Borough	2,693	2,678	365	105
Bethlehem Township	23,730	21,190	3,133	154
Bethlehem, City of	55,639	52,134	8,231	2633
Bushkill Township	8,178	6,982	638	71
Chapman Borough	199	212	20	1
East Allen Township	4,903	4,903	629	28
East Bangor Borough	1,172	979	129	30
Easton, City of	26,800	26,252	3,096	1224
Forks Township	14,721	8,402	1,088	70
Freemansburg Borough	2,636	1,857	243	39
Glendon Borough	440	367	50	4
Hanover Township	10,866	9,619	1,840	53
Hellertown Borough	5,898	5,606	1,206	139
Lehigh Township	10,526	9,752	1,327	107
Lower Mt. Bethel Township	3,101	3,228	430	73
Lower Nazareth Township	5,674	5,265	497	33
Lower Saucon Township	10,772	9,891	1,434	72
Moore Township	9,198	8,695	1,190	171
Nazareth Borough	5,746	6,023	1,460	216
North Catasauqua Borough	2,849	2,806	447	49
Northampton Borough	9,926	9,380	1,731	161
Palmer Township	20,691	16,828	3,456	231
Pen Argyl Borough	3,595	3,552	534	107
Plainfield Township	6,138	5,739	963	102
Portland Borough	519	579	93	20

Municipality	U.S. Census 2010 Population	U.S. Census 2000 Population (HAZUS)	U.S. Census 2000 Population 65 and older (HAZUS)	U.S. Census 2000 Population Income < \$20K/year (HAZUS)
Roseto Borough	1,567	1,689	340	47
Stockertown Borough	927	687	96	8
Tatamy Borough	1,203	930	120	12
Upper Mt. Bethel Township	6,706	6,063	956	187
Upper Nazareth Township	6,231	4,560	1,329	8
Walnutport Borough	2,070	2,026	346	55
Washington Township	5,122	4,071	765	109
West Easton Borough	1,257	1,168	166	30
Williams Township	5,884	4,463	575	39
Wilson Borough	7,896	7,666	1,168	233
Wind Gap Borough	2,720	2,849	545	145
Northampton County	297,735	267,066	41,850	18,910

Source: HAZUS-MH 2.1; U.S. Census, 2010

For the purposes of this plan update, the latest available version of HAZUS-MH (v2.1) and associated population and demographics have been used to conduct vulnerability assessments. The population and demographic data currently available for direct processing in HAZUS-MH is based on the 2000 U.S. Census.

Concerns about the use of 2000 population and demographic data in the vulnerability assessment for this update were reviewed with the Steering Committee. In order to limit inaccuracies, the results of the vulnerability assessment exposure estimates are based on 2010 Census data. However, loss estimates generated by HAZUS are based on the 2000 Census. Further details on this are presented in the Vulnerability Assessment - Methodology section of each natural hazard profile provided in Section 4.

Population and Demographic Trends:

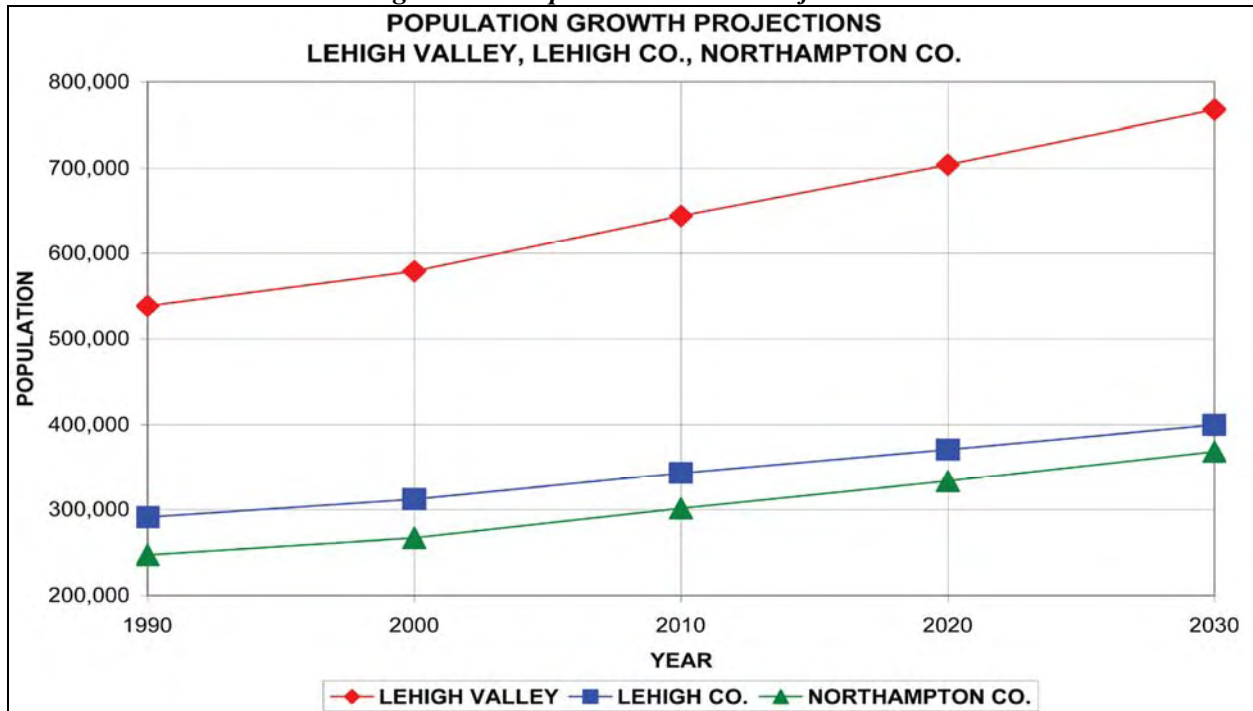
This section discusses population trends to use as a basis for estimating future changes that could significantly change the character of the area. Population trends can provide a basis for making decisions on the type of mitigation approaches to consider and the locations in which these approaches should be applied. This information can also be used to support planning decisions regarding future development in vulnerable areas.

According to 2000 and 2010 U.S. Census figures, the Lehigh Valley experienced an 11.8% increase in population, from 579,156 in 2000 to 647,232 in 2010. The change in population and demographics since 2000 has not been consistent across the planning area. Municipal population increases in the Lehigh Valley have ranged from +75% (Forks Township, Northampton County) to -18% (Hanover Township, Lehigh County).

The following information on county and municipal population forecasts was created by the LVPC in 2006 and 2007, respectively. The LVPC is currently in the process of updating these forecasts. Figure 2-7 shows the official LVPC forecast of future population growth for Lehigh County, Northampton County, and the Lehigh Valley as a whole. If past trends in migration, births and deaths continue, the Lehigh Valley will grow by 33% between 2000 and 2030. The population of the Lehigh Valley will grow from

579,156 in 2000 to 767,856 in 2030. Northampton County is expected to grow 38% compared with 28% in Lehigh County.

Figure 2-7. Population Growth Projections



Source: LVPC, 2011

LVPC forecasts of municipal population growth between 2000 and 2030 indicate the top five population growth municipalities in Lehigh County are expected to be Lower Macungie, Upper Macungie, North Whitehall, Upper Saucon and South Whitehall. Population growth pressures are also expected to extend to several of the rural townships such as Washington, Weisenberg, Lynn and Lower Milford.

In Northampton County the top five growth municipalities are expected to be Bethlehem Township, Forks, Palmer, Lower Nazareth and Upper Nazareth. However, rural townships will experience growing development and growth pressure in the next thirty years. In general development patterns in Northampton County are much more dispersed than in Lehigh County.

With the exception of North Whitehall in Lehigh County and Bushkill in Northampton County, high growth municipalities in both counties were those on the perimeter of the three cities where public sewer, public water, and road capacity have been generally available. LVPC population forecasts show virtually no growth in the three cities in the next thirty years and low growth in the boroughs (LVHMP, 2006).

With regard to socially-vulnerable populations, LVPC forecasts significant changes in the population of certain groups. Between 2000 and 2030, LVPC forecasts the population over 65 will grow by about 73%.

2.6 General Building Stock

According to 2010 U.S. Census figures, the Lehigh Valley had a total 262,976 housing units; with 142,613 and 120,363 in Lehigh and Northampton counties, respectively. Further, the Lehigh Valley had a total of 247,548 households; with 133,983 and 113,565 in Lehigh and Northampton counties, respectively.

The U.S. Census defines a household as all the persons who occupy a housing unit, and a housing unit as a house, an apartment, a mobile home, a group of rooms, or a single room that is occupied (or if vacant, is intended for occupancy) as separate living quarters. Therefore, you may have more than one household per housing unit. The 2010 U.S. Census figures identify an average of 2.54 persons per household in the Lehigh Valley.

An updated building inventory was developed for the Lehigh Valley using available assessor data from each County, as well as parcel and structure GIS files. The replacement cost value for the building inventory was calculated based on the square footage for each building and RSMeans 2011 (Reed Construction Data, Inc.) cost estimating data. This data was then integrated into HAZUS-MH 2.1 at the Census block level to replace the default HAZUS-MH 2.1 general building stock inventory. Tables 2-6 and 2-7 present the updated building stock statistics for the Lehigh Valley, based on the provided data.

Table 2-6. Lehigh County Building Stock Replacement Value by Occupancy Class

Municipality	All Occupancies		Residential Buildings (Structure and Contents)	Commercial Buildings (Structure and Contents)
	Total (Structure and Contents)	Structure Only		
Lehigh County				
Alburtis Borough	\$280,994,000	\$174,822,000	\$213,477,000	\$26,870,000
Allentown, City of	\$20,982,347,000	\$11,903,318,000	\$10,549,750,000	\$6,635,235,000
Bethlehem, City of	\$4,769,721,000	\$2,628,517,000	\$2,122,953,000	\$2,078,787,000
Catasauqua Borough	\$934,748,000	\$560,521,000	\$605,155,000	\$121,121,000
Coopersburg Borough	\$421,475,000	\$249,541,000	\$250,368,000	\$116,234,000
Coplay Borough	\$406,752,000	\$254,287,000	\$311,617,000	\$64,730,000
Emmaus Borough	\$2,088,277,000	\$1,218,443,000	\$1,179,686,000	\$485,061,000
Fountain Hill Borough	\$1,101,911,000	\$577,138,000	\$439,740,000	\$597,559,000
Hanover Township	\$2,254,652,000	\$1,121,295,000	\$267,615,000	\$1,402,319,000
Heidelberg Township	\$550,037,000	\$332,855,000	\$347,857,000	\$84,042,000
Lower Macungie Township	\$5,924,050,000	\$3,559,416,000	\$3,935,403,000	\$1,238,755,000
Lower Milford Township	\$534,598,000	\$345,853,000	\$471,230,000	\$35,274,000
Lowhill Township	\$371,530,000	\$235,030,000	\$296,774,000	\$60,202,000
Lynn Township	\$612,033,000	\$385,596,000	\$480,676,000	\$74,413,000
Macungie Borough	\$533,007,000	\$322,034,000	\$370,559,000	\$83,446,000
North Whitehall Township	\$2,850,746,000	\$1,689,865,000	\$1,816,936,000	\$576,232,000
Salisbury Township	\$3,606,044,000	\$1,959,935,000	\$1,599,339,000	\$1,687,584,000
Slatington Borough	\$715,470,000	\$426,505,000	\$430,759,000	\$120,604,000
South Whitehall Township	\$4,885,829,000	\$2,828,990,000	\$2,573,582,000	\$1,649,098,000
Upper Macungie Township	\$10,206,499,000	\$5,403,642,000	\$2,606,510,000	\$6,376,074,000
Upper Milford Township	\$1,178,767,000	\$743,671,000	\$947,500,000	\$150,810,000
Upper Saucon Township	\$3,171,479,000	\$1,886,155,000	\$1,962,819,000	\$685,675,000
Washington Township	\$893,760,000	\$556,271,000	\$670,973,000	\$163,240,000
Weisenberg Township	\$1,189,552,000	\$694,670,000	\$632,225,000	\$455,164,000
Whitehall Township	\$5,424,311,000	\$3,158,161,000	\$2,948,134,000	\$1,809,373,000
Lehigh County	\$75,888,589,000	\$43,216,531,000	\$38,031,637,000	\$26,777,902,000

Table 2-7. Northampton County Building Stock Replacement Value by Occupancy Class

Municipality	All Occupancies		Residential Buildings (Structure and Contents)	Commercial Buildings (Structure and Contents)
	Total (Structure and Contents)*	Structure Only*		
Northampton County				
Allen Township	\$712,840,000	\$445,297,000	\$555,824,000	\$48,508,000
Bangor Borough	\$926,661,000	\$525,547,000	\$459,280,000	\$237,220,000
Bath Borough	\$471,748,000	\$274,039,000	\$250,062,000	\$105,028,000
Bethlehem Township	\$5,752,889,000	\$3,162,096,000	\$2,764,461,000	\$915,907,000
Bethlehem, City of	\$9,934,952,000	\$5,546,292,000	\$4,573,310,000	\$2,328,756,000
Bushkill Township	\$1,289,529,000	\$801,807,000	\$1,002,708,000	\$145,992,000
Chapman Borough	\$32,434,000	\$18,923,000	\$18,266,000	\$5,040,000
East Allen Township	\$1,104,833,000	\$591,225,000	\$486,583,000	\$183,693,000
East Bangor Borough	\$118,151,000	\$74,102,000	\$93,220,000	\$13,470,000
Easton, City of	\$4,848,037,000	\$2,737,880,000	\$2,166,032,000	\$1,472,092,000
Forks Township	\$3,177,595,000	\$1,799,126,000	\$1,802,582,000	\$320,579,000
Freemansburg Borough	\$361,483,000	\$213,832,000	\$211,941,000	\$64,858,000
Glendon Borough	\$89,841,000	\$48,296,000	\$37,381,000	\$16,556,000
Hanover Township	\$3,484,970,000	\$1,928,856,000	\$1,584,160,000	\$1,147,135,000
Hellertown Borough	\$888,848,000	\$530,213,000	\$557,504,000	\$219,225,000
Lehigh Township	\$1,487,389,000	\$920,632,000	\$1,115,413,000	\$174,786,000
Lower Mt. Bethel Township	\$502,664,000	\$301,860,000	\$329,278,000	\$114,040,000
Lower Nazareth Township	\$2,194,429,000	\$1,188,483,000	\$788,307,000	\$962,745,000
Lower Saucon Township	\$1,968,200,000	\$1,236,498,000	\$1,562,894,000	\$268,565,000
Moore Township	\$1,223,870,000	\$769,048,000	\$978,865,000	\$92,330,000
Nazareth Borough	\$1,312,606,000	\$727,171,000	\$572,759,000	\$393,753,000
North Catasauqua Borough	\$386,289,000	\$232,638,000	\$253,028,000	\$86,411,000
Northampton Borough	\$1,843,226,000	\$1,066,241,000	\$1,025,456,000	\$344,023,000
Palmer Township	\$4,169,701,000	\$2,403,380,000	\$2,405,082,000	\$747,617,000
Pen Argyl Borough	\$651,065,000	\$371,778,000	\$342,359,000	\$126,141,000
Plainfield Township	\$1,086,698,000	\$635,856,000	\$657,021,000	\$188,910,000
Portland Borough	\$162,069,000	\$84,500,000	\$54,558,000	\$40,538,000
Roseto Borough	\$276,318,000	\$160,834,000	\$158,382,000	\$50,646,000
Stockertown Borough	\$298,470,000	\$153,518,000	\$82,150,000	\$112,431,000
Tatamy Borough	\$216,261,000	\$118,758,000	\$111,826,000	\$11,702,000
Upper Mt. Bethel Township	\$1,311,378,000	\$751,898,000	\$753,703,000	\$229,245,000
Upper Nazareth Township	\$1,071,480,000	\$628,679,000	\$663,058,000	\$84,848,000
Walnutport Borough	\$506,739,000	\$263,501,000	\$194,041,000	\$80,129,000
Washington Township	\$875,751,000	\$519,523,000	\$562,062,000	\$181,531,000
West Easton Borough	\$267,628,000	\$144,633,000	\$105,073,000	\$75,529,000
Williams Township	\$1,200,406,000	\$726,583,000	\$857,973,000	\$110,713,000
Wilson Borough	\$1,731,473,000	\$934,854,000	\$661,867,000	\$636,688,000
Wind Gap Borough	\$532,380,000	\$297,174,000	\$246,016,000	\$164,655,000
Northampton County	\$58,471,301,000	\$33,335,571,000	\$31,044,485,000	\$12,502,035,000

Source: Lehigh County; Northampton County

* Agriculture buildings were not clearly identified in the Northampton County Assessor data. The HAZUS-MH 2.1 default agricultural building stock replacement values total \$117,206,000 for the County and are not included in the total above.

Development Trends and New Development:

Land use regulatory authority is vested in Pennsylvania's cities, boroughs and townships. However, many development and preservation issues transcend political boundaries. DMA 2000 requires that communities consider land use trends, which can impact the need for, and priority of, mitigation options over time. Land use trends significantly impact exposure and vulnerability to various hazards. For example, significant development in a hazard area increases the building stock and population exposed to that hazard.

This section provides a general overview of trends in land use change and types of development occurring within the Lehigh Valley. An understanding of these development trends can assist in planning for further development and ensuring that appropriate mitigation, planning, and preparedness measures are in place to protect human health and community infrastructure.

Tax assessment data over the past 30 years indicates that agricultural and vacant land in the Lehigh Valley is being developed for housing, business and industry at an average rate of about 3.0 square miles per year. There is evidence that this rate has been increasing in each decade since the 1970s. It is projected that land consumption will exceed 4 square miles per year by 2030. By 2030 about 55% of the land will be in housing, commercial and industrial (LVPC, 2010).

Cities and boroughs in the Lehigh Valley face very different land use and development problems than suburban and rural townships. With a few exceptions cities and boroughs in the Lehigh Valley are not growing. There are three cities and 27 boroughs in the Lehigh Valley. About 89% of the total area of all cities and boroughs is already developed. Some of the remaining 11% may not be suitable or available for development (LVPC, 2010).

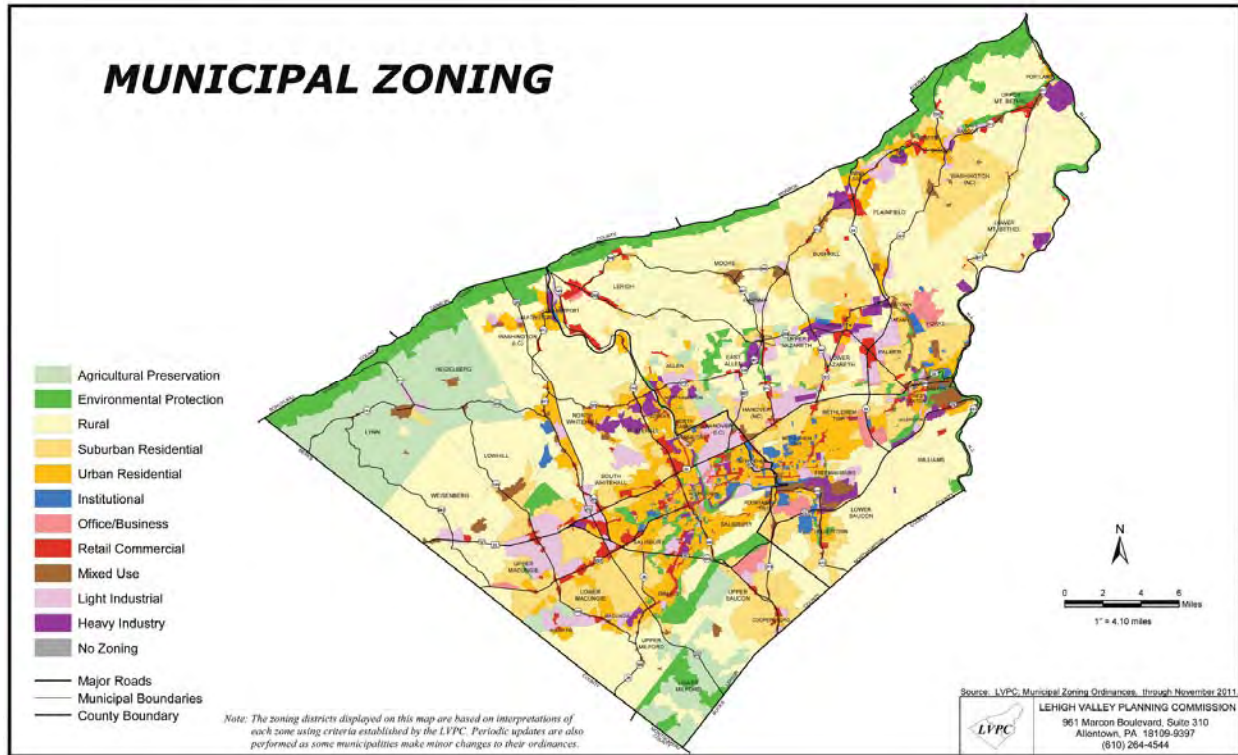
Residential growth is greatest in suburban townships with public sewer and water on the perimeter of the cities of Allentown, Bethlehem and Easton. Development in suburban townships is characterized mainly by low density, single family residential subdivisions, various types of shopping centers, and greenfield industrial parks. In comparison with cities and boroughs in the region, many suburban townships must deal with too much growth happening too fast.

The sixteen rural townships under 350 persons per square mile are shown in Figure 2-2 earlier in this section. Most are experiencing increased development pressure. Unless rural municipalities act to preserve farmland, most will be a lot less rural in 2030. From the perspective of the LVPC regional plan, most sprawl in the Lehigh Valley is in rural townships (LVPC, 2010).

Figure 2-8 shows municipal zoning in the Lehigh Valley in 2010. In preparing this map, the LVPC paid particular attention to the existing regulations in various zones and not zoning district labels which are frequently misleading.

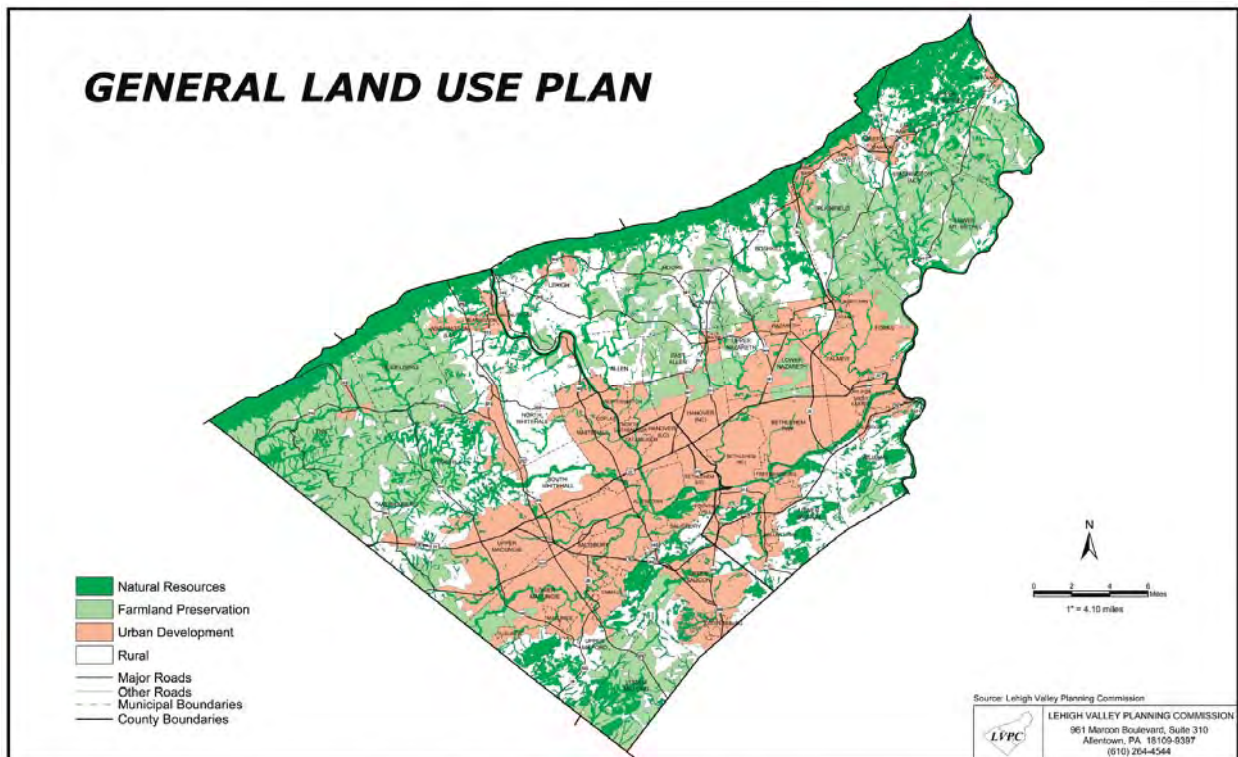
Figure 2-9 shows the recommended General Land Use Plan identified by the LVPC in the 2010 Lehigh Valley Comprehensive Plan.

Figure 2-8. Municipal Zoning



Source: LVPC, 2011

Figure 2-9. General Land Use Plan



Source: LVPC, 2011

Table 2-8 provides household history and forecasts by municipality (1990-2030). The LVPC is currently in the process of updating these forecasts.

Table 2-8. Household History and Forecasts by Municipality, 1990-2030

Municipality	1990 Households	2000 Households	2010 Households	2020 Households	2030 Households
Alburtis	491	774	881	885	945
Allentown	42,775	42,032	42,804	44,041	44,501
Bethlehem (part)	7,967	8,188	8,486	8,759	8,941
Catasauqua	2,346	2,616	2,635	2,705	2,714
Coopersburg	935	983	954	1,017	1,020
Coplay	1,325	1,431	1,422	1,480	1,485
Emmaus	4,674	4,985	4,931	5,197	5,214
Fountain Hill	1,866	1,911	1,894	1,977	1,984
Hanover Twp.	981	892	715	928	931
Heidelberg Twp.	1,051	1,187	1,274	1,502	1,644
Lower Macungie Twp.	5,965	7,158	11,494	12,770	16,114
Lower Milford Twp.	1,125	1,277	1,364	1,806	2,222
Lowhill Twp.	554	677	808	1,187	1,523
Lynn Twp.	1,154	1,397	1,600	2,391	3,115
Macungie	1,086	1,366	1,393	1,455	1,459
North Whitehall Twp.	3,948	5,250	5,766	8,251	8,906
Salisbury Twp.	4,836	5,138	5,333	5,565	5,594
Slatington	1,776	1,743	1,766	1,802	1,808
South Whitehall Twp.	6,521	6,943	7,814	8,622	9,425
Upper Macungie Twp.	3,226	5,128	7,368	10,094	12,800
Upper Milford Twp.	2,156	2,514	2,793	2,958	3,033
Upper Saucon Twp.	3,249	3,970	5,039	6,090	6,459
Washington Twp.	2,261	2,512	2,650	3,479	3,830
Weisenberg Twp.	1,084	1,458	1,760	2,319	2,786
Whitehall Twp.	9,335	10,376	11,039	11,679	12,111
LEHIGH COUNTY	112,887	121,906	133,983	148,958	160,563
Allen Twp.	925	1,001	1,686	2,553	3,500
Bangor	2,147	2,105	2,074	2,259	2,345
Bath	862	1,061	1,048	1,259	1,426
Bethlehem (part)	19,301	19,928	20,879	21,278	21,313
Bethlehem Twp.	5,719	7,619	8,777	10,969	12,764
Bushkill Twp.	1,819	2,333	2,825	3,493	3,891
Chapman	90	89	84	93	93
East Allen Twp.	1,599	1,864	1,943	2,389	2,633
East Bangor	368	387	424	457	462
Easton	9,397	9,548	9,307	10,019	10,086
Forks Twp.	2,186	3,035	5,399	6,269	7,711
Freemansburg	880	687	956	748	750
Glendon	139	135	136	141	142
Hanover Twp.	2,581	3,633	4,245	4,572	5,159
Hellertown	2,415	2,448	2,604	2,566	2,574
Lehigh Twp.	3,267	3,680	4,159	5,685	6,591
Lower Mt. Bethel Twp.	1,135	1,223	1,254	1,475	1,612
Lower Nazareth Twp.	1,448	1,788	2,024	3,656	4,464
Lower Saucon Twp.	3,046	3,735	4,120	4,998	5,422
Moore Twp.	3,005	3,303	3,618	4,723	5,443
Nazareth	2,456	2,560	2,729	2,792	2,958
Northampton	3,472	3,869	4,203	4,170	4,183
North Catasauqua	1,083	1,136	1,181	1,210	1,213
Palmer Twp.	5,521	6,716	8,086	9,156	10,989
Pen Argyl	1,377	1,427	1,393	1,543	1,596
Plainfield Twp.	1,958	2,130	2,353	3,397	4,201
Portland	212	236	223	318	330
Roseto	602	640	635	673	676
Stockertown	245	279	347	321	322
Tatamy	323	352	432	414	415
Upper Mount Bethel Twp.	2,057	2,363	2,581	3,719	4,398
Upper Nazareth Twp.	1,008	1,327	1,944	2,246	2,666
Walnutport	757	809	805	885	888
Washington Twp.	1,431	1,601	1,919	2,732	3,258
West Easton	437	452	488	480	482
Williams Twp.	1,428	1,657	2,363	2,877	3,242
Wilson	3,162	3,164	3,091	3,342	3,352
Wind Gap	1,097	1,221	1,230	1,285	1,289
Bethlehem (Total L&N)	27,268	28,116	29,365	30,037	30,254
NORTHAMPTON COUNTY	90,955	101,541	113,565	131,162	144,844
LEHIGH VALLEY	203,842	223,447	247,548	280,120	305,407

Source: 1990, 2000 and 2010 households — U.S. Department of Commerce, Bureau of the Census; forecasts by the Lehigh Valley Planning Commission for 2020 and 2030.

Source: LVPC, 2011

Table 2-9 identifies major subdivisions, approved or proposed, in the Lehigh Valley as of April 2011.

Table 2-9. Major Subdivisions (500 Units or More), as of April 2011

Name	Number of Units	Acreage	Municipality
Ancient Oak	851	254	Lower Macungie Twp.
Clearview Manor	606	160	Lower Macungie Twp.
Fairways at Brookside	597	99	Lower Macungie Twp.
Field of Dreams at Wagner Farms*	832	101	Bethlehem Twp.
Green Acres Mobile Home Park	596	152	Upper Macungie Twp.
Green Hills	578	208	Upper Macungie Twp.
Mill Creek	558	163	Bethlehem Twp.
Morgan Hill	564	327	Williams Twp.
Old Orchard	652	514	Palmer Twp.
Peachtree	638	140	Whitehall Twp.
Penn's Ridge PRD	540	111	Forks Twp.
Pointe North	1,096	N/A	Hanover Twp. (NC)
Riverview Estates PRD	579	189	Forks Twp.
Shepherd Hills	697	394	Lower Macungie Twp.
The Hills at Lock Ridge	700	272	Lower Macungie Twp.
Washington Crossing	553	43	Allentown
Westbrook Park	752	N/A	Allentown

Source: Lehigh Valley Planning Commission, 2011

* = Proposed N/A = not available

Table 2-10 identifies major commercial development (shopping centers of 25,000 sq. or more) approved or proposed, in the Lehigh Valley from 2008 to April 2011.

Table 2-10. Proposed Shopping Centers (25,000 square feet or more), 2008-April 2011

Name	Municipality	Area (Sq. Ft.)	Status
Bethlehem Plaza Expansion	Bethlehem Twp.	6,986	Under construction
DHD Ventures (Bottom Dollar Food)	Lower Nazareth Twp.	25,004	Proposed in 2010
East Allen Marketplace	East Allen Twp.	63,650	Proposed in 2008
Fairmont S. C. Expansion	Upper Saucon Twp.	9,675	Proposed in 2010
Hamilton Crossings	Lower Macungie Twp.	265,700	Proposed in 2009
Lowe's of Lower Nazareth	Lower Nazareth Twp.	150,000	Proposed in 2010
North Whitehall Commercial Center	North Whitehall Twp.	176,846	Proposed in 2010
Plaza on 8th	Bethlehem (L)	37,763	Under construction
Shoppes at Route 512	East Allen Twp.	53,450	Proposed in 2008
Trexletown S. C. Redevelopment	Lower Macungie Twp.	483,305	Proposed in 2010
Village West Expansion	South Whitehall Twp.	9,128	Proposed in 2010
Wal-Mart	Lehigh Twp.	127,129	Proposed in 2008
Wegman's Food Market Expansion	Allentown	16,000	Proposed in 2011
Weis Market Store	Forks Twp.	70,011	Under construction
Weis Market Store	Upper Macungie Twp.	99,410	Proposed in 2010
Wescosville Commons	Lower Macungie Twp.	269,521	Proposed in 2009

Source: Lehigh Valley Planning Commission, 2011

There is little industrial development identified in the Lehigh Valley at this time. Significant former industrial properties (“brownfields”) are likely areas for redevelopment.

Known and anticipated development, along with their proximity to hazard risk zones, is identified for each municipality within their municipal annexes (Section 9) of this plan update.

Historical and future growth and development may also be found in the Act 167 Stormwater Management Plans, organized by watershed, available on the LVPC website (www.lvpc.org).

2.7 Critical Facilities

A comprehensive inventory of critical facilities in the Lehigh Valley was developed from various sources including HAZUS-MH, data provided by both county GIS departments, and county assessor’s databases, as reviewed by the Steering Committee and municipal representatives. The inventory of critical facilities presented in this section represents the current state of the critical facility database developed for this plan update at the time of publication, and is used for the risk assessment in Section 4.

Critical Facilities are those facilities considered critical to the health and welfare of the population and that are especially important following a hazard. As defined for this HMP, critical facilities include essential facilities, transportation systems, lifeline utility systems, high-potential loss facilities, and hazardous material facilities.

Essential facilities are a subset of critical facilities that include those facilities that are important to ensure a full recovery following the occurrence of a hazard event. For the County risk assessment, this category was defined to include police, fire, EMS, schools/colleges, shelters, senior facilities, and medical facilities.

2.7.1 Essential Facilities

This section provides information on emergency facilities, hospital and medical facilities, shelters, schools, and senior care and living facilities.

2.7.1.1 Emergency Facilities

For the purposes of this plan update, emergency facilities include Emergency Operation Centers (EOC), police, fire and emergency medical services (EMS). Tables 2-11 through 2-13 provide an inventory of EOC, police stations (Northampton County; Lehigh County police are stations identified in Table 2-25), fire stations and EMS facilities in the Lehigh Valley. Figure 2-10 displays the location of these facilities based on the project critical facility inventory.

Table 2-11. Emergency Operation Centers (EOC) in the Lehigh Valley

Name	Address	Municipality	Replacement Cost	Building Type*	Backup Power
Bethlehem City EOC		Bethlehem (C)	TBD	Concrete	TBD
Lehigh County EOC	640 W. Hamilton Street	Allentown (C)	TBD	Concrete	TBD
Northampton County EOC	100 Gracedale Ave.	Upper Nazareth (T)	TBD	Concrete	TBD

Source: Lehigh Valley HMP Update Critical Facility Database

Notes: *HAZUS-MH 2.1 default building type

C = City T = Township

Table 2-12. Police Stations in Northampton County (see Table 2-25 for Lehigh County Police Stations)

Name	Address	Municipality	Replacement Cost	Building Type*	Backup Power
Northampton County					
BANGOR PD	30 N 1ST ST	Bangor (B)	TBD	Concrete	TBD
COLONIAL REGIONAL PD	215 E MAIN ST	Bath (B)	TBD	Concrete	TBD
BETHLEHEM TWP PD	4186 EASTON AVE	Bethlehem (T)	TBD	Concrete	TBD
BUSHKILL TWP PD	1114 BUSHKILL CENTER RD	Bushkill (T)	TBD	Concrete	TBD
EAST BANGOR PD	17 W CENTRAL AVE	East Bangor (B)	TBD	Concrete	TBD
EASTON CITY PD	25 S 3RD ST	Easton (C)	TBD	Concrete	TBD
NORTHAMPTON COUNTY SHERIFF DEPT	669 WASHINGTON ST	Easton (C)	TBD	Concrete	TBD
FORKS TWP PD	1606 SULLIVAN TRL	Forks (T)	TBD	Concrete	TBD
FREEMANSBURG PD	600 MONROE ST	Freemansburg (B)	TBD	Concrete	TBD
HELLERTOWN PD	685 MAIN ST	Hellertown (B)	TBD	Concrete	TBD
LEHIGH TWP PD	1069 MUNICIPAL RD	Lehigh (T)	TBD	Concrete	TBD
LOWER SAUCON PD	3700 OLD PHILADELPHIA PIKE	Lower Saucon (T)	TBD	Concrete	TBD
MOORE TWP PD	2491 COMMUNITY DR	Moore (T)	TBD	Concrete	TBD
NAZARETH PD	30 BELVIDERE ST	Nazareth (B)	TBD	Concrete	TBD
NORTH CATASAUQUA PD	1066 4TH ST	North Catasauqua (B)	TBD	Concrete	TBD
NORTHAMPTON BORO PD	1401 LAUBACH AVE	Northampton (B)	TBD	Concrete	TBD
PALMER TWP PD	5 WELLER PL	Palmer (T)	TBD	Concrete	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Replacement Cost	Building Type*	Backup Power
PEN ARGYL PD	13 N ROBINSON AVE	Pen Argyl (B)	TBD	Concrete	TBD
PLAINFIELD TWP PD	6292 SULLIVAN TRL	Plainfield (T)	TBD	Concrete	TBD
PORTLAND PD	1 DIVISION ST	Portland (B)	TBD	Concrete	TBD
ROSETO PD	147 ROSETO AVE	Roseto (B)	TBD	Concrete	TBD
STOCKERTOWN PD	212 MAIN ST	Stockertown (B)	TBD	Concrete	TBD
TATAMY PD	425 BROAD ST	Tatamy (B)	TBD	Concrete	TBD
UPPER NAZARETH TWP PD	100 NEWPORT AVE	Upper Nazareth (T)	TBD	Concrete	TBD
WALNUTPORT BORO PD	417 LINCOLN AVE	Walnutport (B)	TBD	Concrete	TBD
WASHINGTON TWP PD	4 FLICKSVILLE RD	Washington (T)	TBD	Concrete	TBD
WILSON BORO PD	2035 BUTLER ST	Wilson (B)	TBD	Concrete	TBD
WIND GAP PD	104 WATER ST	Wind Gap (B)	TBD	Concrete	TBD

Source: Lehigh Valley HMP Update Critical Facility Database

Notes: *HAZUS-MH 2.1 default building type

B = Borough

C = City

PD = Police Department

T = Township

TBD = To be determined

Table 2-13. Fire/EMS in the Lehigh Valley

Name	Address	Municipality	Type	Replacement Cost	Building Type*	Backup Power
Lehigh County						
ALBURTIS FIRE CO	328 S MAIN ST	Alburtis (B)	Fire	TBD	Concrete	TBD
SALISBURY TWP	3000 S PIKE AVE	Allentown (C)	Fire	TBD	Concrete	TBD
HANOVER TOWNSHIP	2202 GROVE RD	Allentown (C)	Fire	TBD	Concrete	TBD
SALISBURY TWP SCHOOL AUTH	1140 SALISBURY RD	Allentown (C)	Fire	TBD	Concrete	TBD
CITY OF ALLENTOWN	435 W HAMILTON ST	Allentown (C)	Fire	TBD	Concrete	TBD
CITY OF ALLENTOWN	435 W HAMILTON ST	Allentown (C)	Fire	TBD	Concrete	TBD
CITY OF ALLENTOWN	435 W HAMILTON ST	Allentown (C)	Fire	TBD	Concrete	TBD
CITY OF ALLENTOWN	435 W HAMILTON ST	Allentown (C)	Fire	TBD	Concrete	TBD
CITY OF ALLENTOWN	435 W HAMILTON ST	Allentown (C)	Fire	TBD	Concrete	TBD
W SALISBURY VOL FIRE CO#3	3425 EISENHOWER AVE	Allentown (C)	Fire	TBD	Concrete	TBD
WOODLAWN FIRE CO #1	2217 BELMONT ST	Allentown (C)	Fire	TBD	Concrete	TBD
COMM FIRE CO #1 S WH TWP	2500 FOCHT AVE	Allentown (C)	Fire	TBD	Concrete	TBD
WOODLAWN FIRE CO #1	2217 BELMONT ST	Allentown (C)	Fire	TBD	Concrete	TBD
WESCOSVILLE FIRE COMPANY	PO BOX 3002	Allentown (C)	Fire	TBD	Concrete	TBD
CETRONIA FIRE COMPANY	3950 BROADWAY	Allentown (C)	Fire	TBD	Concrete	TBD
SALISBURY FIRE CO #1	1220 MARLOW ST	Allentown (C)	Fire	TBD	Concrete	TBD
WESTERN SALISBURY FIRE CO	3425 EISENHOWER AVE	Allentown (C)	Fire	TBD	Concrete	TBD
CITY OF ALLENTOWN	435 W HAMILTON ST	Allentown (C)	Fire	TBD	Concrete	TBD
CITY OF BETHLEHEM	10 E CHURCH ST	Bethlehem (C)	Fire	TBD	Concrete	TBD
CITY OF BETHLEHEM	10 E CHURCH ST	Bethlehem (C)	Fire	TBD	Concrete	TBD
EAST END FIRE CO	512 RACE ST	Catasauqua (B)	Fire	TBD	Concrete	TBD
SOUTHWARK HOSE CO #9	338 2ND ST	Catasauqua (B)	Fire	TBD	Concrete	TBD
COOPERSBURG FIRE CO	13 S MAIN ST	Coopersburg (B)	Fire	TBD	Concrete	TBD
BORO OF COPLAY	98 S 4TH ST	Coplay (B)	Fire	TBD	Concrete	TBD
BORO OF EMMAUS	28 S 4TH ST	Emmaus (B)	Fire	TBD	Concrete	TBD
CITIZENS FIRE CO	4090 MAIN RD W	Emmaus (B)	Fire	TBD	Concrete	TBD
CITIZENS FIRE CO	4093 MAIN RD W	Emmaus (B)	Fire	TBD	Concrete	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Cost	Building Type*	Backup Power
FOUNTAIN HILL HOSE CO 1	C-0 DONALD BRAMWELL	Fountain Hill (B)	Fire	TBD	Concrete	TBD
BORO OF FOUNTAIN HILL	941 LONG ST	Fountain Hill (B)	Fire	TBD	Concrete	TBD
GOODWILL FIRE CO	PO BOX 69	Heidelberg (T)	Fire	TBD	Concrete	TBD
LOWER MACUNGIE TWP	3400 BROOKSIDE RD	Lower Macungie (T)	Fire	TBD	Concrete	TBD
LOWER MILFORD TWP FIRE CO #1	PO BOX 1	Lower Milford (T)	Fire	TBD	Concrete	TBD
COMMUNITY FIRE CO OF NEW TRIPOLI	7242 DECATUR ST	Lynn (T)	Fire	TBD	Concrete	TBD
NEW TRIPOLI FIRE CO	PO BOX 468	Lynn (T)	Fire	TBD	Concrete	TBD
LYNNPORT COMM FIRE CO #1	PO BOX 14	Lynn (T)	Fire	TBD	Concrete	TBD
MACUNGIE FIRE CO #1	31 S WALNUT ST	Macungie (B)	Fire	TBD	Concrete	TBD
TRI-CLOVER FIRE CO	4801 KERNSVILLE RD	North Whitehall (T)	Fire	TBD	Concrete	TBD
TRI-CLOVER FIRE CO	4801 KERNSVILLE RD	North Whitehall (T)	Fire	TBD	Concrete	TBD
LAURY'S STATION VOLUNTEER FIRE CO #1	PO BOX 321	North Whitehall (T)	Fire	TBD	Concrete	TBD
NEFFS VOLUNTEER FIRE COMPANY	3755 PARK AVE	North Whitehall (T)	Fire	TBD	Concrete	TBD
BORO OF SLATINGTON	125 S WALNUT ST	Slatington (B)	Fire	TBD	Concrete	TBD
BORO OF SLATINGTON	125 S WALNUT ST	Slatington (B)	Fire	TBD	Concrete	TBD
BORO OF SLATINGTON	125 S WALNUT ST	Slatington (B)	Fire	TBD	Concrete	TBD
UPPER MACUNGIE TWP	8330 SCHANTZ RD	Upper Macungie (T)	Fire	TBD	Concrete	TBD
TREXLERTOWN GOOD WILL FIRE CO #1	PO BOX 13	Upper Macungie (T)	Fire	TBD	Concrete	TBD
FOGELSVILLE VOL FIRE CO	7850 LIME ST	Upper Macungie (T)	Fire	TBD	Concrete	TBD
UPPER MILFORD WESTERN DIST FIRE CO 1	PO BOX 302	Upper Milford (T)	Fire	TBD	Concrete	TBD
SOUTH MOUNTAIN AREA MEDIC V INC	3950 OAKHURST DR	Upper Saucon (T)	Fire	TBD	Concrete	TBD
UPPER SAUCON TWP	5500 CAMP MEETING RD	Upper Saucon (T)	Fire	TBD	Concrete	TBD
UPPER SAUCON TWP VOLUNTEER FIRE CO 1	4888 LANARK RD	Upper Saucon (T)	Fire	TBD	Concrete	TBD
FRIEDENS FIRE COMPANY		Washington (T)	Fire	TBD	Concrete	TBD
EMERALD STAR HOSE COMPANY #1	PENN ST	Washington (T)	Fire	TBD	Concrete	TBD
CITIZENS FIRE CO	GENERAL DELIVERY	Washington (T)	Fire	TBD	Concrete	TBD
WEISENBERG TWP	C-0 TWP SECRETARY	Weisenberg (T)	Fire	TBD	Concrete	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Cost	Building Type*	Backup Power
FULLERTON FIRE CO #1	851 2ND ST	Whitehall (T)	Fire	TBD	Concrete	TBD
EGYPT FIRE CO #1	4099 KUHN LN	Whitehall (T)	Fire	TBD	Concrete	TBD
W CATASAUQUA FIRE CO	2012 2ND AVE	Whitehall (T)	Fire	TBD	Concrete	TBD
HOKENDAUQUA FIRE CO #1	3022 S 2ND ST	Whitehall (T)	Fire	TBD	Concrete	TBD
LAUREL FIRE CO #1 INC	5114 3RD ST	Whitehall (T)	Fire	TBD	Concrete	TBD
LAUREL FIRE CO #1	5114 3RD ST	Whitehall (T)	Fire	TBD	Concrete	TBD
Northampton County						
ALLEN TWP FIRE CO	3350 HOWERTOWN RD	Allen (T)	FIRE	TBD	Concrete	TBD
BANGOR FIRE DEPT - SECOND WARD	517 S NORTHAMPTON ST	Bangor (B)	FIRE	TBD	Concrete	TBD
BANGOR FIRE DEPT - LIBERTY	67 N 8TH ST	Bangor (B)	FIRE	TBD	Concrete	TBD
BANGOR FIRE DEPT - RESCUE	209 PENNSYLVANIA AVE	Bangor (B)	FIRE	TBD	Concrete	TBD
BLUE VALLEY RESCUE	65 N 8TH ST	Bangor (B)	RESCUE	TBD	Concrete	TBD
BATH BORO FIRE FIGHTERS AMBULANCE	121 CENTER ST	Bath (B)	EMS	TBD	Concrete	TBD
BATH BORO FIRE FIGHTERS	121 CENTER ST	Bath (B)	FIRE	TBD	Concrete	TBD
BETHLEHEM TWP EMS	1919 8TH ST	Bethlehem (T)	EMS	TBD	Concrete	TBD
BETHLEHEM TWP FIRE CO	1919 8TH ST	Bethlehem (T)	FIRE	TBD	Concrete	TBD
NANCY RUN FIRE DEPT	3564 EASTON AVE	Bethlehem (T)	FIRE	TBD	Concrete	TBD
BUSHKILL TWP FIRE CO	155 FIREHOUSE LN	Bushkill (T)	FIRE	TBD	Concrete	TBD
BUSHKILL TWP EMS	155 FIREHOUSE LN	Bushkill (T)	EMS	TBD	Concrete	TBD
EAST ALLEN TWP AMBULANCE CORPS	4945 NOR-BATH BLVD	East Allen (T)	EMS	TBD	Concrete	TBD
EAST ALLEN TWP FIRE CO	5354 NOR-BATH BLVD	East Allen (T)	FIRE	TBD	Concrete	TBD
EAST BANGOR FIRE CO	30 E CENTRAL AVE	East Bangor (B)	FIRE	TBD	Concrete	TBD
EASTON CITY FIRE DEPT - COLLEGE HILL	327 PARSONS ST	Easton (C)	FIRE	TBD	Concrete	TBD
EASTON CITY FIRE DEPT - CENTRAL	11 N 6TH ST	Easton (C)	FIRE	TBD	Concrete	TBD
PA WATER RECUE	13TH ST	Easton (C)	RESCUE	TBD	Concrete	TBD
EASTON EMERGENCY SQUAD	908 PACKER ST	Easton (C)	EMS	TBD	Concrete	TBD
EASTON CITY FIRE DEPT - SOUTH SIDE	424 REYNOLDS ST	Easton (C)	FIRE	TBD	Concrete	TBD
FORKS TWP FIRE DEPT	1606 SULLIVAN TRL	Forks (T)	FIRE	TBD	Concrete	TBD



SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Cost	Building Type*	Backup Power
MEDIC 9 - SOUTH	2076 SULLIVAN TRL	Forks (T)	EMS	TBD	Concrete	TBD
FORKS TWP EMS	2076 SULLIVAN TRL	Forks (T)	EMS	TBD	Concrete	TBD
FREEMANSBURG FIRE	600 MONROE ST	Freemansburg (B)	FIRE	TBD	Concrete	TBD
HANOVER TWP FIRE	300 HIGHLAND AVE	Hanover (T)	FIRE	TBD	Concrete	TBD
HANOVER TWP EMS	300 HIGHLAND AVE	Hanover (T)	EMS	TBD	Concrete	TBD
DEWEY FIRE COMPANY	501 DURHAM ST	Hellertown (B)	FIRE	TBD	Concrete	TBD
DEWEY FIRE COMPANY AMBULANCE	501 DURHAM ST	Hellertown (B)	EMS	TBD	Concrete	TBD
METRO EMS	216 KICHLINE AVE	Hellertown (B)	EMS	TBD	Concrete	TBD
LEHIGH TWP FIRE CO	4188 LEHIGH DR	Lehigh (T)	FIRE	TBD	Concrete	TBD
LOWER MT BETHEL TWP FIRE	DELAWARE DR	Lower Mt. Bethel (T)	FIRE	TBD	Concrete	TBD
LOWER MT BETHEL FIRE CO	4771 DELAWARE DR	Lower Mt. Bethel (T)	FIRE	TBD	Concrete	TBD
HECKTOWN EMS	4519 HANOVERVILLE RD	Lower Nazareth (T)	EMS	TBD	Concrete	TBD
HECKTOWN FIRE CO	230 NAZARETH PIKE	Lower Nazareth (T)	FIRE	TBD	Concrete	TBD
SOUTHEASTERN FIRE CO	2687 WASSERGASS RD	Lower Saucon (T)	FIRE	TBD	Concrete	TBD
LEITHSVILLE FIRE CO	1995 LEITHSVILLE RD	Lower Saucon (T)	FIRE	TBD	Concrete	TBD
SE-WY-CO FIRE	3621 OLD PHILADELPHIA PIKE	Lower Saucon (T)	FIRE	TBD	Concrete	TBD
STEEL CITY FIRE CO	2121 RIVERSIDE DR	Lower Saucon (T)	FIRE	TBD	Concrete	TBD
MOORE TWP EMS	2718 MOUNTAIN VIEW DR	Moore (T)	EMS	TBD	Concrete	TBD
KLECKNERSVILLE RANGERS FIRE CO	2718 MOUNTAIN VIEW DR	Moore (T)	FIRE	TBD	Concrete	TBD
NAZARETH BORO EMS	49 S BROAD ST	Nazareth (B)	EMS	TBD	Concrete	TBD
VIGILANCE HOSE CO	495S BROAD ST	Nazareth (B)	FIRE	TBD	Concrete	TBD
CHARITON HOSE CO	1068 4TH ST	North Catasauqua (B)	FIRE	TBD	Concrete	TBD
NORTHAMPTON REGIONAL EMS	1525 CANAL ST	Northampton (B)	EMS	TBD	Concrete	TBD
NORTHAMPTON BORO FIRE DEPT	4 LERCHENMILLER DR	Northampton (B)	FIRE	TBD	Concrete	TBD
SUBURBAN EMS	3231 FREEMANSBURG AVE	Palmer (T)	EMS	TBD	Concrete	TBD
PALMER TWP FIRE	3235 OLD NAZARETH RD	Palmer (T)	FIRE	TBD	Concrete	TBD
PALMER TWP FIRE - STATION 2	3255 FREEMANSBURG AVE	Palmer (T)	FIRE	TBD	Concrete	TBD
PEN ARGYL FIRE CO	44 W BELL AVE	Pen Argyl (B)	FIRE	TBD	Concrete	TBD
PLAINFIELD TWP FIRE & AMBULANCE	6480 SULLIVAN TRL	Plainfield (T)	EMS	TBD	Concrete	TBD



SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Cost	Building Type*	Backup Power
PLAINFIELD TWP FIRE & AMBULANCE	6480 SULLIVAN TRL	Plainfield (T)	FIRE	TBD	Concrete	TBD
PORTLAND & VICINITY AMBULANCE CORPS	106 STATE ST	Portland (B)	EMS	TBD	Concrete	TBD
PORTLAND HOOK & LADDER	372 DELAWARE AVE	Portland (B)	FIRE	TBD	Concrete	TBD
ROSETO FIRE CO	164 GARIBALDI AVE	Roseto (B)	FIRE	TBD	Concrete	TBD
LIBERTY HOSE CO	102 WERKHEISER AVE	Stockertown (B)	FIRE	TBD	Concrete	TBD
TATAMY BORO FIRE DEPT	164 BUSHKILL ST	Tatamy (B)	FIRE	TBD	Concrete	TBD
NORTH BANGOR FIRE DEPT	130 LAKE MINSI DR	Upper Mt. Bethel (T)	FIRE	TBD	Concrete	TBD
MOUNT BETHEL FIRE CO	2341 N DELAWARE DR	Upper Mt. Bethel (T)	FIRE	TBD	Concrete	TBD
EAST LAWN FIRE CO	25 NEWPORT AVE	Upper Nazareth (T)	FIRE	TBD	Concrete	TBD
DIAMOND FIRE CO	209 WASHINGTON ST	Walnutport (B)	FIRE	TBD	Concrete	TBD
LIBERTY EMS	311 BLUE VALLEY DR	Washington (T)	EMS	TBD	Concrete	TBD
MEDIC 9 - NORTH	311 BLUE VALLEY DR	Washington (T)	EMS	TBD	Concrete	TBD
WASHINGTON TWP FIRE CO	920 WASHINGTON BLVD	Washington (T)	FIRE	TBD	Concrete	TBD
WEST EASTON FIRE DEPT	307 6TH ST	West Easton (B)	FIRE	TBD	Concrete	TBD
WILLIAMS TWP FIRE DEPT	2500 MORGAN HILL RD	Williams (T)	FIRE	TBD	Concrete	TBD
WILLIAMS TWP EMS	110 RAUBSVILLE RD	Williams (T)	EMS	TBD	Concrete	TBD
WILSON BORO FIRE DEPT	2041 BUTLER ST	Wilson (B)	FIRE	TBD	Concrete	TBD
BLUE MT EMS	228 S BROADWAY	Wind Gap (B)	EMS	TBD	Concrete	TBD
WIND GAP EMS	433 N BROADWAY	Wind Gap (B)	EMS	TBD	Concrete	TBD
WIND GAP FIRE DEPT	147 N BROADWAY	Wind Gap (B)	FIRE	TBD	Concrete	TBD

Source: Lehigh Valley HMP Update Critical Facility Database

*HAZUS-MH 2.1 default building type

B = Borough

C = City

FD = Fire Department

T = Township

TBD = To be determined

2.7.1.2 Hospitals and Medical Facilities

Table 2-14 provides an inventory of hospitals and major medical facilities in the Lehigh Valley.

Table 2-14. Hospitals and Medical Facilities in the Lehigh Valley

Name	Address	Municipality	Replacement Cost	Building Type*	Backup Power
Lehigh County					
Sacred Heart Hospital	421 Chew Street	Allentown (C)	TBD	Concrete	TBD
Lehigh Valley Hospital - 17th & Chew	17th & Chew Streets	Allentown (C)	TBD	Concrete	TBD
St. Luke's Hospital Allentown	1736 W. Hamilton Street	Allentown (C)	TBD	Concrete	TBD
Lehigh Valley Hospital - Muhlenberg	2545 Schoenersville Road	Bethlehem (C)	TBD	Concrete	TBD
St. Luke's Hospital - Bethlehem	801 Ostrum Street	Fountain Hill (B)	TBD	Concrete	TBD
Lehigh Valley Hospital - Cedar Crest	1200 S. Cedar Crest Boulevard	Salisbury (T)	TBD	Concrete	TBD
Westfield Hospital	4815 W. Tilghman Street	South Whitehall (T)	TBD	Concrete	TBD
St. Luke's Hospital - Anderson Campus	1872 Riverside Circle	Easton (C)	TBD	Concrete	TBD
Northampton County					
Medical Center	147 N 11TH ST	Bangor (B)	\$93,200	Concrete	TBD
Medical Center	129 N 11TH ST	Bangor (B)	\$98,800	Concrete	TBD
BANGOR DENTAL ASSO.	854 MARKET ST	Bangor (B)	\$52,500	Concrete	TBD
Bath Drug	310 S WALNUT ST	Bath (B)	TBD	Concrete	TBD
ST LUKES UNION STATION	240 UNION STATION PLAZA	Bethlehem (C)	\$1,242,800	Concrete	TBD
ST LUKES PHYSICAL THERAPY	2301 CHERRY LN	Bethlehem (C)	\$176,500	Concrete	TBD
Medical Center	2223 LINDEN ST	Bethlehem (C)	\$349,500	Concrete	TBD
DENTIST OFFICE	2431 EASTON AVE	Bethlehem (C)	\$96,300	Concrete	TBD
Medical Center	1458 STEFKO BLVD	Bethlehem (C)	\$40,100	Concrete	TBD
NEW ST. MEDICAL CNT	940 N NEW ST	Bethlehem (C)	\$363,900	Concrete	TBD
Medical Center	1313 CENTER ST	Bethlehem (C)	\$90,400	Concrete	TBD
Quest Diagnostic Inc.	4333 EASTON AVE	Bethlehem (C)	TBD	Concrete	TBD
Quest Diagnostics Inc.	406 DELAWARE AVE	Bethlehem (C)	TBD	Concrete	TBD
Superior Cardiac Imaging Mobile Svs	705 E 4TH ST	Bethlehem (C)	TBD	Concrete	TBD
Baxter Healthcare	65 E ELIZABETH AVE	Bethlehem (C)	TBD	Concrete	TBD
Bio Med Sciences Inc.	101 TECHNOLOGY DR	Bethlehem (C)	TBD	Concrete	TBD
C & S Medical Supply Inc.	739 N NEW ST	Bethlehem (C)	TBD	Concrete	TBD
Hess Healthcare Services	643 E BROAD ST	Bethlehem (C)	TBD	Concrete	TBD
Orasure Technologies Inc.	220 East 1st Street	Bethlehem (C)	TBD	Concrete	TBD
ST LUKES RIVERSIDE	1872 RIVERSIDE CIR	Bethlehem (T)	\$2,652,100	Concrete	TBD
COORDINATED HEALTH SERVICES	2310 HIGHLAND AVE	Bethlehem (T)	\$7,064,100	Concrete	TBD
Health Network Laboratories	2101 Emrick Boulevard	Bethlehem (T)	TBD	Concrete	TBD
St. Lukes Hospital	4379 EASTON AVE	Bethlehem (T)	TBD	Concrete	TBD
Digirad Imaging Solutions	3084 Emrick Boulevard	Bethlehem (T)	TBD	Concrete	TBD
Invatec	3101 Emrick Boulevard	Bethlehem (T)	TBD	Concrete	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Replacement Cost	Building Type*	Backup Power
BATH COMMUNITY MED	CHRISPHALT DR	East Allen (T)	\$508,700	Concrete	TBD
Health Network Laboratories	6649 CHRISPHALT DR	East Allen (T)	TBD	Concrete	TBD
Medical Center	412 MONROE ST	Easton (C)	\$30,400	Concrete	TBD
EASTON CHIROPRACTIC	825 OLD PHILA RD	Easton (C)	\$61,200	Concrete	TBD
Quest Diagnostics Inc.	3601 NAZARETH RD	Forks (T)	TBD	Concrete	TBD
ST. LUKES NORTH	153 BROADHEAD RD	Hanover (T)	\$2,243,400	Concrete	TBD
Medical Center	52 HIGHLAND AVE	Hanover (T)	\$269,000	Concrete	TBD
CAMPBELL MEDICAL CEN	2380 SCHOENERSVILLE RD	Hanover (T)	\$150,500	Concrete	TBD
Radiology & MRI of Bethlehem	5325 NORTHGATE BLVD	Hanover (T)	TBD	Concrete	TBD
St. Lukes Hospital	153 BROADHEAD RD	Hanover (T)	TBD	Concrete	TBD
Boas Surgical Inc.	3535 High Point Boulevard	Hanover (T)	TBD	Concrete	TBD
Helping Hands Medical Supply	10 S COMMERCE WAY	Hanover (T)	TBD	Concrete	TBD
Homestar Medical Equip & Infusion Center	77 S COMMERCE WAY	Hanover (T)	TBD	Concrete	TBD
Lincare	5 HIGHLAND AVE	Hanover (T)	TBD	Concrete	TBD
Miller Keystone Blood Center	1465 Valley Center Parkway	Hanover Township (T)	TBD	Concrete	TBD
Visiting Nurse Association	1510 Valley Center Parkway	Hanover Township (T)	TBD	Concrete	TBD
SAUCON VALLEY FAMILY PRACTICE	255 FRONT ST	Hellertown (B)	\$226,400	Concrete	TBD
Quest Diagnostics Inc.	25 MAIN ST	Hellertown (B)	TBD	Concrete	TBD
St. Lukes Hospital	225 FRONT ST	Hellertown (B)	TBD	Concrete	TBD
Yeagers Pharmacy	654 MAIN ST	Hellertown (B)	TBD	Concrete	TBD
NORTHWOOD MED. ARTS	3735 NAZARETH RD	Lower Nazareth (T)	\$2,600,000	Concrete	TBD
Any Lab Test Now	3812 EASTON NAZARETH HWY	Lower Nazareth (T)	TBD	Concrete	TBD
Easton Hospital Laboratory Services	3735 EASTON NAZARETH HWY	Lower Nazareth (T)	TBD	Concrete	TBD
Health Network Laboratories	3729 Easton Nazareth Highway	Lower Nazareth (T)	TBD	Concrete	TBD
Progressive Physicians Vascular Lab	3735 EASTON NAZARETH HWY	Lower Nazareth (T)	TBD	Concrete	TBD
Medical Center	W NORTH ST	Nazareth (B)	\$31,700	Concrete	TBD
Quest Diagnostics, Inc.	25 S BROAD ST	Nazareth (B)	TBD	Concrete	TBD
St. Lukes Hospital	305 W NORTH ST	Nazareth (B)	TBD	Concrete	TBD
Nazareth Medical Equipment	25 S BROAD ST	Nazareth (B)	TBD	Concrete	TBD
N CATASAUQUA MEDICAL	GROVE ST	North Catasauqua (B)	\$158,200	Concrete	TBD
NORTH. MEDICAL ARTS	2014 LAUBACH AVE	Northampton (B)	\$684,700	Concrete	TBD
Health Network Laboratories	1825 FRANKLIN ST	Northampton (B)	TBD	Concrete	TBD
Sacred Heart Outpatient Lab Services	602 E 21ST ST	Northampton (B)	TBD	Concrete	TBD
Newhard Pharmacy	1001 MAIN ST	Northampton (B)	TBD	Concrete	TBD
Webb Medical Systems	1540 MAIN ST	Northampton (B)	TBD	Concrete	TBD
DIAGNOSTIC IMAGING	2690 KINGSTON RD	Palmer (T)	\$453,200	Concrete	TBD
UNIT 3 PALMER MED	21 -3 CORPORATE DR	Palmer (T)	\$143,000	Concrete	TBD
Medical Center	30 COMMUNITY DR	Palmer (T)	\$527,800	Concrete	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Replacement Cost	Building Type*	Backup Power
UNIT 5 PALMER MED	21 -5 CORPORATE DR	Palmer (T)	\$144,100	Concrete	TBD
UNIT 2 PALMER MED	21 -2 CORPORATE DR	Palmer (T)	\$146,800	Concrete	TBD
UNIT 6 PALMER MED	21 CORPORATE DR	Palmer (T)	\$129,000	Concrete	TBD
GASTROENTEROLOGY CENTER	20 COMMUNITY DR	Palmer (T)	\$337,000	Concrete	TBD
UNIT 4 PALMER MED	21 -4 CORPORATE DR	Palmer (T)	\$144,300	Concrete	TBD
UNIT 1 PALMER MED	21 -1 CORPORATE DR	Palmer (T)	\$147,700	Concrete	TBD
DENTAL OFFICE	3004 WILLIAM PENN HWY	Palmer (T)	\$100,500	Concrete	TBD
DR. BODY, DENTIST	3800 WILLIAM PENN HWY	Palmer (T)	\$151,100	Concrete	TBD
BOONSWANG MED OFF	2358 GRUVER AVE	Palmer (T)	\$109,400	Concrete	TBD
Easton Hospital Laboratory Services	2925 WILLIAM PENN HWY	Palmer (T)	TBD	Concrete	TBD
Pinnacle Lab	41 COMMUNITY DR	Palmer (T)	TBD	Concrete	TBD
Youngs Medical Equipment	3320 NAZARETH RD	Palmer (T)	TBD	Concrete	TBD
Redi-Care Medical Center	25th Street Shopping Center	Palmer Township (T)	TBD	Concrete	TBD
FAMILY CARE CENT INC	EPPS ST	Plainfield (T)	\$89,100	Concrete	TBD
WIND GAP PROF CENTER	SULLIVAN TRL	Plainfield (T)	\$453,400	Concrete	TBD
WALNUTPORT MED. OFFI	330 N BEST AVE	Walnutport (B)	\$187,700	Concrete	TBD
NORTHERN LEHIGH MED	215 N BEST ST	Walnutport (B)	\$193,300	Concrete	TBD
Easton Hospital	250 South 21st Street	Wilson (B)	TBD	Concrete	TBD
EASTON HOSPITAL	S 21ST ST	Wilson (B)	\$10,017,100	Concrete	TBD
DOUGLAS D DITMARS MD	2111 WASHINGTON BLVD	Wilson (B)	\$139,500	Concrete	TBD
Easton Hospital Laboratory Services	250 S 21ST ST	Wilson (B)	TBD	Concrete	TBD
Northampton Imaging Specialists	250 S 21ST ST	Wilson (B)	TBD	Concrete	TBD
Quest Diagnostics Inc.	229 S 22ND ST	Wilson (B)	TBD	Concrete	TBD
Bell Apothecary	2045 FAIRVIEW AVE	Wilson (B)	TBD	Concrete	TBD
FRENENIUS MEDICAL CARE	525 E WEST ST	Wind Gap (B)	\$183,900	Concrete	TBD
Medical Center	S BROADWAY	Wind Gap (B)	\$140,600	Concrete	TBD

Source: Lehigh Valley HMP Update Critical Facility Database

*HAZUS-MH 2.1 default building type

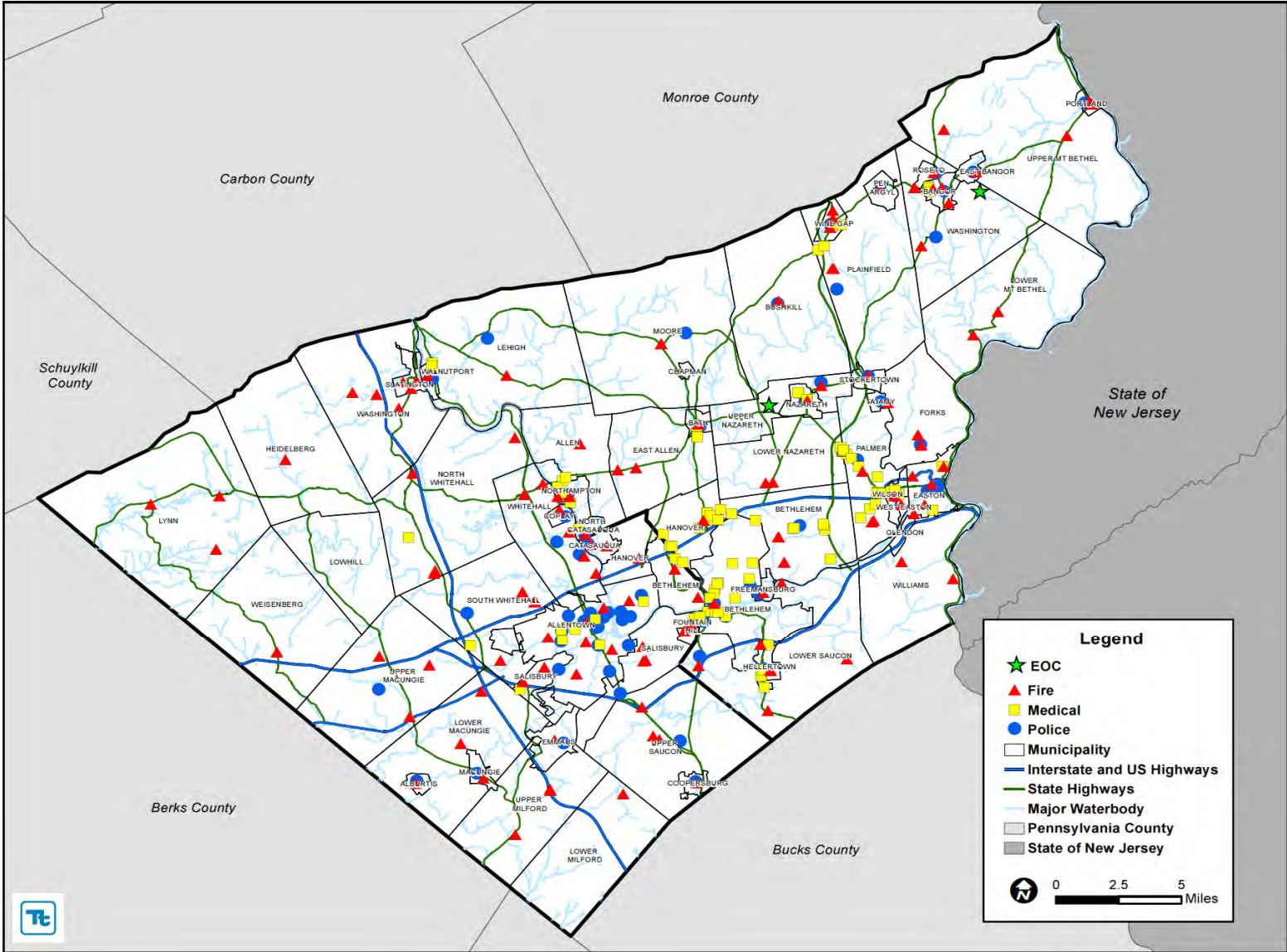
B = Borough

C = City

T = Township

TBD = To be determined

Figure 2-10. Emergency and Medical Facilities in the Lehigh Valley



Source: Lehigh Valley HMP Update Critical Facility Database



2.7.1.3 Shelters

Table 2-15 lists the shelters located in the Lehigh Valley as identified by the Planning Committee. Figure 2-12 shows shelter locations. In the event of an emergency, it is best to consult your municipality to find out where to seek shelter.

Table 2-15. Shelter Facilities in the Lehigh Valley

Name	Address	Municipality	Replacement Cost	Building Type	Backup Power
Lehigh County					
Catasauqua High School	2500 W. Bullshead Rd	Catasauqua (B)	TBD	TBD	TBD
CALVARY BIBLE FELLOWSHIP CHURCH	6782 N MAIN ST	Coopersburg (B)	\$1,187,820	TBD	TBD
ZION LEHIGH E L CHURCH	8291 RUTH RD	Lower Macungie (T)	\$594,728	TBD	TBD
Northampton County					
Saint John's Lutheran Church	206 East Main Street	Bath (B)	TBD	TBD	TBD
Christ Church United Church of Christ	109 South Chestnut Street	Bath (B)	TBD	TBD	TBD
Saint Peter's Lutheran Church	474 Vine Street	Bethlehem (C)	TBD	TBD	TBD
Holy Cross Evangelical Lutheran Church	2700 Jacksonville Road	Bethlehem (C)	TBD	TBD	TBD
Zion First Hungarian Lutheran Church	938 East Fourth Street	Bethlehem (C)	TBD	TBD	TBD
Christ Church- United Church of Christ	75 East Market Street	Bethlehem (C)	TBD	TBD	TBD
Saint John's Windish Evangelical Church	617 East Fourth Street	Bethlehem (C)	TBD	TBD	TBD
Trinity Episcopal Church	44 East Market Street	Bethlehem (C)	TBD	TBD	TBD
Saint Mark's Evangelical Lutheran Church	3771 Easton Avenue	Bethlehem (C)	TBD	TBD	TBD
Holy Infancy Roman Catholic Church	312 East Fourth Street	Bethlehem (C)	TBD	TBD	TBD
First United Church of Christ	15 West Fourth Street	Bethlehem (C)	TBD	TBD	TBD
Fritz Memorial United Methodist Church	303 West Packer Avenue	Bethlehem (C)	TBD	TBD	TBD
Bethlehem Township Community Center	2900 Farmersville Road	Bethlehem (C)	TBD	TBD	TBD
Concordia Lutheran Church	1240 East Fourth Street	Bethlehem (C)	TBD	TBD	TBD
Bethlehem Township's Coolidge Building	2740 Fifth Street	Bethlehem (C)	TBD	TBD	TBD
Wesley United Methodist Church	2540 Center Street	Bethlehem (C)	TBD	TBD	TBD
First Presbyterian Church	2344 Center Street	Bethlehem (C)	TBD	TBD	TBD
Ebenezer Bible Fellowship Church	3100 Hecktown Road	Bethlehem (C)	TBD	TBD	TBD
Saints Cyril and Methodius Roman Catholic Church	617 Pierce Street	Bethlehem (C)	TBD	TBD	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Replacement Cost	Building Type	Backup Power
Bethlehem Township Municipal Bldg.	4225 Easton Ave	Bethlehem (T)	TBD	TBD	TBD
Lehigh Valley Friends Meetinghouse	Rts. 22& 512	Bethlehem (T)	TBD	TBD	TBD
First Church of Christ	15 W Fourth St	Bethlehem (T)	TBD	TBD	TBD
Bethany Wesleyan Church	Box 999 675 Blue Mountain Drive	Lehigh (T)	TBD	TBD	TBD
Olivet United Presbyterian Church	1151 Northampton Street	Easton (C)	TBD	TBD	TBD
River of God Fellowship Church	813 Reynolds Street	Easton (C)	TBD	TBD	TBD
Faith Unity Church	1017 Lehigh Street	Easton (C)	TBD	TBD	TBD
Church of The Nazarene	1201 Spring Garden Street	Easton (C)	TBD	TBD	TBD
Second Baptist Church	40 South Sixth Street	Easton (C)	TBD	TBD	TBD
Saint John's United Church of Christ	2720 Morgan Hill Rd	Easton (C)	TBD	TBD	TBD
Arndt's Lutheran Church	1851 Arndts Rd	Easton (C)	TBD	TBD	TBD
Saint Anthony's Youth Center	901 Washington Street	Easton (C)	TBD	TBD	TBD
Church of God by Faith Inc.	665 Walnut Avenue	Easton (C)	TBD	TBD	TBD
Saint Paul's Lutheran Church	610 Berwick Street	Easton (C)	TBD	TBD	TBD
Our Lady of Lebanon Church	55 South Fourth Street	Easton (C)	TBD	TBD	TBD
Christ Lutheran Church	1100 Ferry Street	Easton (C)	TBD	TBD	TBD
Shiloh Baptist Church-Enrichment Center	508 Canal Street	Easton (C)	TBD	TBD	TBD
First Presbyterian Church	333 Spring Garden Street	Easton (C)	TBD	TBD	TBD
Saint John's Evangelical Lutheran Church	330 Ferry Street	Easton (C)	TBD	TBD	TBD
Christ Evangelical Congregational Church of Williams T	2100 Morgan Hill Road	Easton (C)	TBD	TBD	TBD
Saint Bernard's Roman Catholic Church	132 S. Fifth Street	Easton (C)	TBD	TBD	TBD
New Life Presbyterian Church	531 Milford Street	Easton (C)	TBD	TBD	TBD
Faith Lutheran Church	2012 Sullivan Trail	Easton (C)	TBD	TBD	TBD
Holy Ghost Ukranian Catholic Church	315 Fourth Street	Easton (C)	TBD	TBD	TBD
First Moravian Church	225 North Tenth Street	Easton (C)	TBD	TBD	TBD
Saint Paul's Third Lutheran Church	2561 Newburg Road	Easton (C)	TBD	TBD	TBD
First United Church of Christ	27 North Third Street	Easton (C)	TBD	TBD	TBD
Saint John's Evangelical Lutheran Church	2745 Morgan Hill Road	Easton (C)	TBD	TBD	TBD

Name	Address	Municipality	Replacement Cost	Building Type	Backup Power
First Evangelical Congregational Church	28 North Tenth Street	Easton (C)	TBD	TBD	TBD
Memorial United Church of Christ	1913 Freemansburg Avenue	Easton (C)	TBD	TBD	TBD
Saint John's United Church of Christ	183 South Broad Street	Nazareth (B)	TBD	TBD	TBD
Saint John's Lutheran Church	200 South Broad Street	Nazareth (B)	TBD	TBD	TBD
Assumption of The Virgin Mary Ukranian Orthodox Church	1301 Newport Avenue	Northampton (B)	TBD	TBD	TBD
Our Lady of Hungary Church	1324 Newport Avenue	Northampton (B)	TBD	TBD	TBD
Grace United Church of Christ	9th St & Lincoln Ave	Northampton (B)	TBD	TBD	TBD
Seventh Day Adventist Church	Rt 145 & Willow Rd	Walnutport (B)	TBD	TBD	TBD

Source: Lehigh Valley HMP Update Critical Facility Database

*HAZUS-MH 2.1 default building type

B = Borough

C = City

T = Township

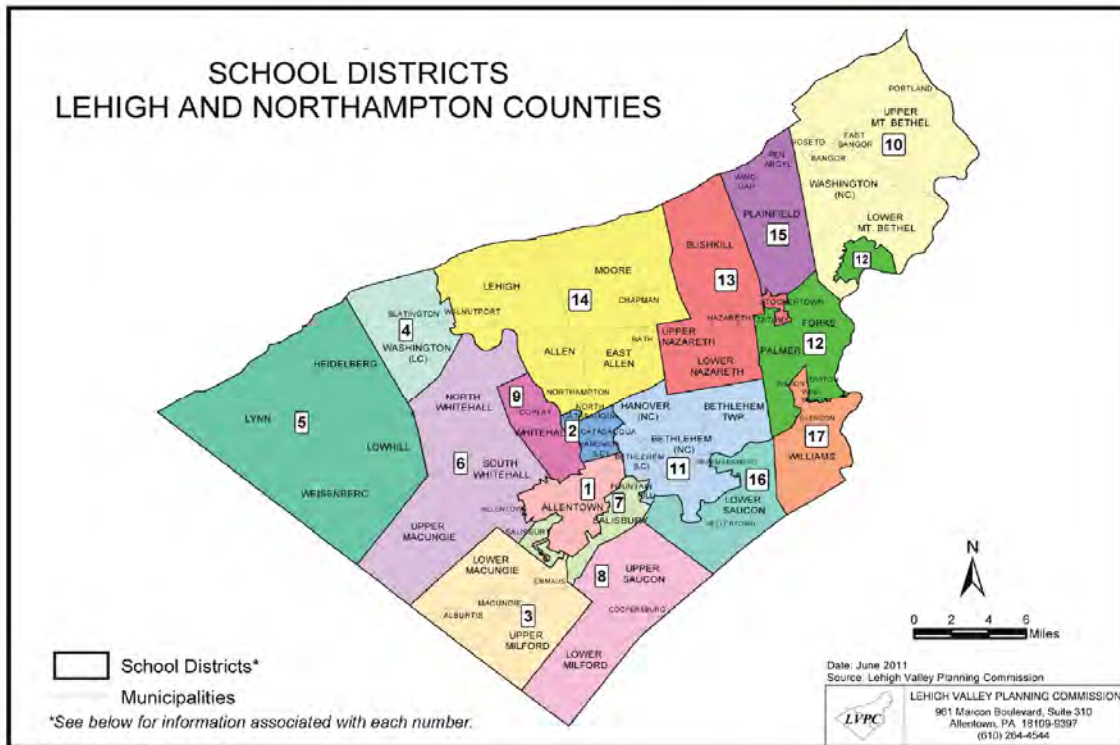
TBD = To be determined

2.7.1.4 Schools

There are 17 school districts in the Lehigh Valley, as identified in Figure 2-11. Figure 2-12 shows schools, shelters and senior facility locations, while Table 2-16 identifies schools in the Lehigh Valley.

Colleges and Universities in the Lehigh Valley include Cedar Crest College, DeSales University, Lafayette College, Lehigh Carbon Community College, Lehigh University, Moravian College, Muhlenberg College, Northampton Community College and Pennsylvania State University – Lehigh.

Figure 2-11. Lehigh Valley School Districts



LEHIGH COUNTY

- 1 - Allentown**
Allentown (part)
- 2 - Catasauqua Area**
Catasauqua
Hanover Twp. (L)
North Catasauqua
- 3 - East Penn**
Alburtis
Emmaus
Lower Macungie Twp.
Macungie
Upper Milford Twp.
- 4 - Northern Lehigh**
Slatington
Walnutport
Washington Twp. (L)
- 5 - Northwestern Lehigh**
Heidelberg Twp.
Lowhill Twp.
Lynn Twp.
Weisenberg Twp.
- 6 - Parkland**
Allentown (part)
North Whitehall Twp.
South Whitehall Twp.
Upper Macungie Twp.
- 7 - Salisbury**
Salisbury Twp.

- 8 - Southern Lehigh**
Coopersburg
Lower Milford Twp.
Upper Saucon Twp.
- 9 - Whitehall-Coplay**
Coplay
Whitehall Twp.

NORTHAMPTON COUNTY

- 10 - Bangor Area**
Bangor
East Bangor
Lower Mt. Bethel Twp. (part)
Portland
Roseto
Upper Mt. Bethel Twp.
Washington Twp. (N)
- 11 - Bethlehem Area**
Bethlehem
Bethlehem Twp.
Fountain Hill
Freemansburg
Hanover Twp. (N)
- 12 - Easton Area**
Easton
Forks Twp.
Lower Mt. Bethel Twp. (part)
Palmer Twp.
Riegelsville (Bucks Co.)
- 13 - Nazareth Area**
Bushkill Twp.
Lower Nazareth Twp.
Nazareth
Stockertown
Tatamy
Upper Nazareth Twp.
- 14 - Northampton Area**
Allen Twp.
Bath
Chapman
East Allen Twp.
Lehigh Twp.
Moore Twp.
Northampton
- 15 - Pen Argyl**
Pen Argyl
Plainfield Twp.
Wind Gap
- 16 - Saucon Valley**
Hellertown
Lower Saucon Twp.
- 17 - Wilson Area**
Glendon
West Easton
Williams Twp.
Wilson

Source: LVPC, 2011

Table 2-16. Schools in the Lehigh Valley

Name	Address	Municipality	Type of Facility	Enroll.	Designated Shelter	Replacement Cost	Building Type*	Backup Power
Lehigh County								
ALBURTIS ELEMENTARY SCHOOL	TBD	Alburtis (B)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
WILEY HOUSE	TBD	Allentown (C)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
ROBERTO CLEMENTE CHARTER SCHOOL	TBD	Allentown (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
SACRED HEART ELEMENTARY SCHOOL	TBD	Allentown (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
SHERIDAN ELEMENTARY SCHOOL	TBD	Allentown (C)	SPECIAL PURPOSE SCHOOL	TBD	TBD	TBD	Masonry	TBD
HOLY SPIRIT SCHOOL	TBD	Allentown (C)	PAROCHIAL ELEMENTARY & MIDDLE	TBD	TBD	TBD	Masonry	TBD
MOSSER ELEMENTARY SCHOOL	TBD	Allentown (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
WILSON EARLY CHILDHOOD CENTER	TBD	Allentown (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
LEHIGH VALLEY CHRISTIAN HIGH SCHOOL	TBD	Allentown (C)	PAROCHIAL HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
HARRISON-MORTON MIDDLE SCHOOL	TBD	Allentown (C)	PAROCHIAL ELEMENTARY & MIDDLE	TBD	TBD	TBD	Masonry	TBD
MIDWAY MANOR EARLY EDUCATION CENTER	TBD	Allentown (C)	PAROCHIAL ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
KINGS WAY ACADEMY	TBD	Allentown (C)	PAROCHIAL HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
THE LUTHERAN ACADEMY	TBD	Allentown (C)	PAROCHIAL MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
ST PAULS SCHOOL	TBD	Allentown (C)	PAROCHIAL ELEMENTARY & MIDDLE	TBD	TBD	TBD	Masonry	TBD
MERCY DAY SCHOOL	TBD	Allentown (C)	PAROCHIAL SCHOOL	TBD	TBD	TBD	Masonry	TBD
OUR LADY HELP OF CHRISTIANS SCHOOL	TBD	Allentown (C)	PAROCHIAL HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
HOLY SPIRIT ELEMENTARY SCHOOL	TBD	Allentown (C)	PAROCHIAL ELEMENTARY & MIDDLE	TBD	TBD	TBD	Masonry	TBD
HIRAM DODD ELEMENTARY SCHOOL	TBD	Allentown (C)	PAROCHIAL ELEMENTARY & MIDDLE	TBD	TBD	TBD	Masonry	TBD
RITTER ELEMENTARY SCHOOL	TBD	Allentown (C)	PAROCHIAL ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
WILLIAM ALLEN HIGH SCHOOL	TBD	Allentown (C)	HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
DIERUFF HIGH SCHOOL	TBD	Allentown (C)	PAROCHIAL MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
UNION TERRACE ELEMENTARY SCHOOL	TBD	Allentown (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type of Facility	Enroll.	Designated Shelter	Replacement Cost	Building Type*	Backup Power
ROOSEVELT ELEMENTARY SCHOOL	TBD	Allentown (C)	PRIVATE MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
ST CATHERINE OF SIENA	TBD	Allentown (C)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
ST CATHERINE OF SIENA	TBD	Allentown (C)	HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
RAUB MIDDLE SCHOOL	TBD	Allentown (C)	HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
WILLIAM ALLEN HIGH SCHOOL	TBD	Allentown (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
WILLIAM ALLEN HIGH SCHOOL	TBD	Allentown (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
LEHIGH PARKWAY ELEMENTARY SCHOOL	TBD	Allentown (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
LINCOLN ELEMENTARY SCHOOL	TBD	Allentown (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
WASHINGTON ELEMENTARY SCHOOL	TBD	Allentown (C)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
MUHLENBERG ELEMENTARY SCHOOL	TBD	Allentown (C)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
SOUTH MOUNTAIN MIDDLE SCHOOL	TBD	Allentown (C)	PRIVATE ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
CENTRAL ELEMENTARY SCHOOL	TBD	Allentown (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
CLEVELAND ELEMENTARY SCHOOL	TBD	Allentown (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
MCKINLEY ELEMENTARY SCHOOL	TBD	Allentown (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
ST FRANCIS OF ASSISI	TBD	Allentown (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
TREXLER MIDDLE SCHOOL	TBD	Allentown (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
JACKSON ELEMENTARY SCHOOL	TBD	Allentown (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
JEFFERSON ELEMENTARY SCHOOL	TBD	Allentown (C)	PRIVATE ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
JAMES BUCHANAN ELEMENTARY SCHOOL	TBD	Bethlehem (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
ST SIMON & JUDE SCHOOL	TBD	Bethlehem (C)	PAROCHIAL ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
NITSCHMANN MIDDLE SCHOOL	TBD	Bethlehem (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
NOTRE DAME SCHOOL	TBD	Bethlehem (C)	PAROCHIAL ELEMENTARY & MIDDLE	TBD	TBD	TBD	Masonry	TBD
CENTRAL CHRISTIAN ACADEMY	TBD	Bethlehem (C)	SPECIAL PURPOSE SCHOOL	TBD	TBD	TBD	Masonry	TBD
VITALISTIC THERAPEUTIC SCHOOL	TBD	Bethlehem (C)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
REGIONAL ACADEMIC STANDARDS ACADEMY	TBD	Bethlehem (C)	PAROCHIAL ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
WILEY HOUSE	TBD	Bethlehem (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type of Facility	Enroll.	Designated Shelter	Replacement Cost	Building Type*	Backup Power
CLEARVIEW ELEMENTARY SCHOOL	TBD	Bethlehem (C)	SPECIAL PURPOSE SCHOOL	TBD	TBD	TBD	Masonry	TBD
CENTENNIAL SCHOOL	TBD	Bethlehem (C)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
CALYPSO ELEMENTARY SCHOOL	TBD	Bethlehem (C)	SPECIAL PURPOSE SCHOOL	TBD	TBD	TBD	Masonry	TBD
ST MARYS CATHOLIC SCHOOL	TBD	Catasauqua (B)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
LINCOLN MIDDLE SCHOOL	TBD	Catasauqua (B)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
CATASAUQUA HIGH SCHOOL	TBD	Catasauqua (B)	HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
SHECKLER ELEMENTARY SCHOOL	TBD	Catasauqua (B)	PAROCHIAL ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
LIBERTY BELL ELEMENTARY SCHOOL	TBD	Coopersburg (B)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
ST ANNES PAROCHIAL SCHOOL	TBD	Emmaus (B)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
EMMAUS HIGH SCHOOL	TBD	Emmaus (B)	HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
EMMAUS HIGH SCHOOL	TBD	Emmaus (B)	HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
JEFFERSON ELEMENTARY SCHOOL	TBD	Emmaus (B)	HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
LINCOLN ELEMENTARY SCHOOL	TBD	Emmaus (B)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
FOUNTAIN HILL ELEMENTARY SCHOOL	TBD	Fountain Hill (B)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
HOLY CHILD SCHOOL	TBD	Fountain Hill (B)	PAROCHIAL ELEMENTARY & MIDDLE	TBD	TBD	TBD	Masonry	TBD
NORTHWESTERN LEHIGH HIGH SCHOOL	TBD	Heidelberg (T)	HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
NORTHWESTERN LEHIGH MIDDLE SCHOOL	TBD	Heidelberg (T)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
LOWER MACUNGIE MIDDLE SCHOOL	TBD	Lower Macungie (T)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
MACUNGIE ELEMENTARY SCHOOL	TBD	Lower Macungie (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
SHOEMAKER ELEMENTARY SCHOOL	TBD	Lower Macungie (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
EYER MIDDLE SCHOOL	TBD	Lower Macungie (T)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
LOWER MACUNGIE ELEMENTARY SCHOOL	TBD	Lower Macungie (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
THE HILLSIDE SCHOOL	TBD	Lower	SPECIAL NEEDS SCHOOL	TBD	TBD	TBD	Masonry	TBD



SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type of Facility	Enroll.	Designated Shelter	Replacement Cost	Building Type*	Backup Power
		Macungie (T)						
WESCOSVILLE ELEMENTARY SCHOOL	TBD	Lower Macungie (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
LOWER MILFORD ELEMENTARY SCHOOL	TBD	Lower Milford (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
NORTHWESTERN LEHIGH ELEMENTARY SCHOOL	TBD	Lynn (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
IRONTON ELEMENTARY SCHOOL	TBD	North Whitehall (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
SCHNECKSVILLE ELEMENTARY SCHOOL	TBD	North Whitehall (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
KERNSVILLE ELEMENTARY SCHOOL	TBD	North Whitehall (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
LEHIGH CAREER & TECHNICAL INSTITUTE	TBD	North Whitehall (T)	VOCATIONAL SCHOOL	TBD	TBD	TBD	Masonry	TBD
SALISBURY MIDDLE SCHOOL	TBD	Salisbury (T)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
WESTERN SALISBURY ELEMENTARY SCHOOL	TBD	Salisbury (T)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
THE SWAIN SCHOOL	TBD	Salisbury (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
SALISBURY HIGH SCHOOL	TBD	Salisbury (T)	HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
HARRY S TRUMAN ELEMENTARY SCHOOL	TBD	Salisbury (T)	HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
WILEY HOUSE	TBD	Salisbury (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
WILEY HOUSE	TBD	Salisbury (T)	SPECIAL PURPOSE SCHOOL	TBD	TBD	TBD	Masonry	TBD
LEHIGH CHRISTIAN ACADEMY	TBD	Salisbury (T)	SPECIAL PURPOSE SCHOOL	TBD	TBD	TBD	Masonry	TBD
ST THOMAS MORE	TBD	Salisbury (T)	PAROCHIAL ELEMENTARY & MIDDLE	TBD	TBD	TBD	Masonry	TBD
NORTHERN LEHIGH MIDDLE SCHOOL	TBD	Slatington (B)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
ST JOHN NEUMANN REGIONAL SCHOOL	TBD	Slatington (B)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
SLATINGTON ELEMENTARY SCHOOL	TBD	Slatington (B)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
NORTHERN LEHIGH HIGH SCHOOL	TBD	Slatington (B)	HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
CETRONIA ELEMENTARY SCHOOL	TBD	South Whitehall (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
DATZYK MONTESSORI SCHOOL	TBD	South Whitehall (T)	PRIVATE ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type of Facility	Enroll.	Designated Shelter	Replacement Cost	Building Type*	Backup Power
ALLENTOWN CHRISTIAN SCHOOL	TBD	South Whitehall (T)	PAROCHIAL ELEMENTARY & MIDDLE	TBD	TBD	TBD	Masonry	TBD
JEWISH DAY SCHOOL	TBD	South Whitehall (T)	PRIVATE ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
KRATZER ELEMENTARY SCHOOL	TBD	South Whitehall (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
PARKLAND HIGH SCHOOL	TBD	South Whitehall (T)	HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
OREFIELD MIDDLE SCHOOL	TBD	South Whitehall (T)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
SPRINGHOUSE MIDDLE SCHOOL	TBD	South Whitehall (T)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
PARKWAY MANOR ELEMENTARY SCHOOL	TBD	South Whitehall (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
ST JOSEPH THE WORKER ELEMENTARY SCHOOL	TBD	South Whitehall (T)	PAROCHIAL ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
FRED J JAINDL ELEMENTARY SCHOOL	TBD	Upper Macungie (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
FOGELSVILLE ELEMENTARY SCHOOL	TBD	Upper Macungie (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
EMMAUS BAPTIST ACADEMY	TBD	Upper Milford (T)	PAROCHIAL HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
SOUTHERN LEHIGH MIDDLE SCHOOL	TBD	Upper Saucon (T)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
SOUTHERN LEHIGH HIGH SCHOOL	TBD	Upper Saucon (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
ASSUMPTION BVM SCHOOL	TBD	Upper Saucon (T)	HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
ST MICHAELS SCHOOL	TBD	Upper Saucon (T)	HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
HOPEWELL ELEMENTARY SCHOOL	TBD	Upper Saucon (T)	PAROCHIAL ELEMENTARY & MIDDLE	TBD	TBD	TBD	Masonry	TBD
PETERS ELEMENTARY SCHOOL	TBD	Washington (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
WEISENBERG ELEMENTARY SCHOOL	TBD	Weisenberg (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
ST STEPHENS SCHOOL	TBD	Whitehall (T)	PAROCHIAL ELEMENTARY & MIDDLE	TBD	TBD	TBD	Masonry	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type of Facility	Enroll.	Designated Shelter	Replacement Cost	Building Type*	Backup Power
CHRIST THE KING SCHOOL	TBD	Whitehall (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
GOCKLEY ELEMENTARY SCHOOL	TBD	Whitehall (T)	ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
STECKEL ELEMENTARY SCHOOL	TBD	Whitehall (T)	MIDDLE SCHOOL	TBD	TBD	TBD	Masonry	TBD
WHITEHALL-COPLAY MIDDLE SCHOOL	TBD	Whitehall (T)	HIGH SCHOOL	TBD	TBD	TBD	Masonry	TBD
LEHIGH VALLEY 7TH DAY ADVENTIST SCHOOL	TBD	Whitehall (T)	PAROCHIAL ELEMENTARY & MIDDLE	TBD	TBD	TBD	Masonry	TBD
ST ELIZABETH SCHOOL	TBD	Whitehall (T)	PAROCHIAL SCHOOL	TBD	TBD	TBD	Masonry	TBD
WHITEHALL-COPLAY HIGH SCHOOL	TBD	Whitehall (T)	PRIVATE ELEMENTARY SCHOOL	TBD	TBD	TBD	Masonry	TBD
Northampton County								
Lehigh Valley Lutheran School	TBD	Allen (T)	ES & MS/Jr HS	TBD	TBD	TBD	Masonry	TBD
Pius X High School	TBD	Bangor (B)	High School	TBD	TBD	TBD	Masonry	TBD
George Wolf Elementary School	TBD	Bath (B)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Sacred Heart Elementary School	TBD	Bath (B)	ES & MS/Jr & HS	TBD	TBD	TBD	Masonry	TBD
Donegan Elementary School	TBD	Bethlehem (C)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Governor Wolf Elementary School	TBD	Bethlehem (C)	Elementary School	TBD	TBD	TBD	Masonry	TBD
East Hills Middle School	TBD	Bethlehem (C)	Middle School	TBD	TBD	TBD	Masonry	TBD
Holy Infancy School	TBD	Bethlehem (C)	ES & MS/Jr HS	TBD	TBD	TBD	Masonry	TBD
Lehigh University	TBD	Bethlehem (C)	Universities & College	TBD	TBD	TBD	Masonry	TBD
Lehigh University - Saucon Field Complex	TBD	Bethlehem (C)	Universities & College	TBD	TBD	TBD	Masonry	TBD
Broughal Middle School	TBD	Bethlehem (C)	Middle School/Junior High School	TBD	TBD	TBD	Masonry	TBD
Lehigh University	TBD	Bethlehem (C)	Universities & College	TBD	TBD	TBD	Masonry	TBD
STS Cyril & Methodius Parochial School	TBD	Bethlehem (C)	ES & MS/Jr HS	TBD	TBD	TBD	Masonry	TBD
Northeast Middle School	TBD	Bethlehem (C)	Middle School/Junior High School	TBD	TBD	TBD	Masonry	TBD
William Penn Elementary School	TBD	Bethlehem (C)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Marvine Elementary School	TBD	Bethlehem (C)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Edgeboro School	TBD	Bethlehem (C)	ES & MS/Jr & HS	TBD	TBD	TBD	Masonry	TBD
St. Anne's School	TBD	Bethlehem (C)	ES & MS/Jr HS	TBD	TBD	TBD	Masonry	TBD
Moravian College-North	TBD	Bethlehem (C)	Universities & College	TBD	TBD	TBD	Masonry	TBD
Lincoln Elementary School	TBD	Bethlehem (C)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Gateway School of the Lehigh Valley	TBD	Bethlehem (C)	ES & MS/Jr & HS	TBD	TBD	TBD	Masonry	TBD



SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type of Facility	Enroll.	Designated Shelter	Replacement Cost	Building Type*	Backup Power
Spring Garden Elementary School	TBD	Bethlehem (C)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Liberty Senior High School	TBD	Bethlehem (C)	High School	TBD	TBD	TBD	Masonry	TBD
Moravian Academy Middle School	TBD	Bethlehem (C)	Middle School	TBD	TBD	TBD	Masonry	TBD
Moravian Academy Lower School	TBD	Bethlehem (C)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Thomas Jefferson Elementary School	TBD	Bethlehem (C)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Bethlehem Catholic High School	TBD	Bethlehem (C)	High School	TBD	TBD	TBD	Masonry	TBD
Moravian College-South	TBD	Bethlehem (C)	Universities & College	TBD	TBD	TBD	Masonry	TBD
Freedom High School	TBD	Bethlehem (T)	High School	TBD	TBD	TBD	Masonry	TBD
Bethlehem Area Vocational Tech School	TBD	Bethlehem (T)	Vocational/Technical School	TBD	TBD	TBD	Masonry	TBD
Northampton Community College	TBD	Bethlehem (T)	Community College	TBD	TBD	TBD	Masonry	TBD
Our Lady of Perpetual Church and School	TBD	Bethlehem (T)	ES & MS/Jr HS	TBD	TBD	TBD	Masonry	TBD
Moravian Academy	TBD	Bethlehem (T)	ES & MS/Jr & HS	TBD	TBD	TBD	Masonry	TBD
Notre Dame High School	TBD	Bethlehem (T)	High School	TBD	TBD	TBD	Masonry	TBD
Farmersville Elementary School	TBD	Bethlehem (T)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Miller Heights Elementary School	TBD	Bethlehem (T)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Bushkill Elementary School	TBD	Bushkill (T)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Cheston Elementary School	TBD	Easton (C)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Easton Catholic and EC-ST Joseph ES	TBD	Easton (C)	ES & MS/Jr HS	TBD	TBD	TBD	Masonry	TBD
Lafayette College	TBD	Easton (C)	Universities & College	TBD	TBD	TBD	Masonry	TBD
Easton Area Middle School	TBD	Easton (C)	Middle School/Junior High School	TBD	TBD	TBD	Masonry	TBD
Lafayette College	TBD	Easton (C)	Universities & College	TBD	TBD	TBD	Masonry	TBD
March Elementary School	TBD	Easton (C)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Forks Elementary School	TBD	Forks (T)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Career Institute of Technology	TBD	Forks (T)	Vocational/Technical School	TBD	TBD	TBD	Masonry	TBD
Paxinosa ES and Shawnee Intermediate	TBD	Forks (T)	ES & MS/Jr HS	TBD	TBD	TBD	Masonry	TBD
Freemansburg Elementary School	TBD	Freemansburg (B)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Hanover Elementary School	TBD	Hanover (T)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Asa Packer Elementary School	TBD	Hanover (T)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Saint Theresa School	TBD	Hellertown (B)	ES & MS/Jr HS	TBD	TBD	TBD	Masonry	TBD
Lehigh Township Elementary School	TBD	Lehigh (T)	Elementary School	TBD	TBD	TBD	Masonry	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type of Facility	Enroll.	Designated Shelter	Replacement Cost	Building Type*	Backup Power
Lower Nazareth Elementary School	TBD	Lower Nazareth (T)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Saucon Valley School District Campus	TBD	Lower Saucon (T)	ES & MS/Jr & HS	TBD	TBD	TBD	Masonry	TBD
Lehigh University	TBD	Lower Saucon (T)	Universities & College	TBD	TBD	TBD	Masonry	TBD
Moore Township Elementary School	TBD	Moore (T)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Holy Family School	TBD	Nazareth (B)	ES & MS/Jr HS	TBD	TBD	TBD	Masonry	TBD
Shafer Elementary School	TBD	Nazareth (B)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Bethlehem Area Vo-Tech School	TBD	Northampton (B)	Vocational/Technical School	TBD	TBD	TBD	Masonry	TBD
Franklin Elementary School	TBD	Northampton (B)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Our Lady of Hungary Elementary School	TBD	Northampton (B)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Saint John the Baptist Elementary School	TBD	Northampton (B)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Northampton Area Jr and Sr HS	TBD	Northampton (B)	Junior & Senior High School	TBD	TBD	TBD	Masonry	TBD
Wolf Elementary School	TBD	Northampton (B)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Washington Elementary School	TBD	Northampton (B)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Palmer Elementary School	TBD	Palmer (T)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Easton Area High School	TBD	Palmer (T)	High School	TBD	TBD	TBD	Masonry	TBD
Edward Tracy Elementary School	TBD	Palmer (T)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Pen Argyl Junior-Senior High School	TBD	Pen Argyl (B)	Junior & Senior High School	TBD	TBD	TBD	Masonry	TBD
Immaculate Conception School	TBD	Pen Argyl (B)	ES & MS/Jr HS	TBD	TBD	TBD	Masonry	TBD
Wind Gap Middle School	TBD	Plainfield (T)	Middle School	TBD	TBD	TBD	Masonry	TBD
Plainfield Elementary School	TBD	Plainfield (T)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Our Lady of Mount Carmel School	TBD	Roseto (B)	ES & MS/Jr HS	TBD	TBD	TBD	Masonry	TBD
Bangor Sr/Jr/Five Points/Dom DeFranco	TBD	Upper Mt. Bethel (T)	ES & MS/Jr & HS	TBD	TBD	TBD	Masonry	TBD
Nazareth Area Junior and Senior HS	TBD	Upper Nazareth (T)	Junior & Senior High School	TBD	TBD	TBD	Masonry	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type of Facility	Enroll.	Designated Shelter	Replacement Cost	Building Type*	Backup Power
Nazareth Area Middle School	TBD	Upper Nazareth (T)	Middle School	TBD	TBD	TBD	Masonry	TBD
Walnutport Elementary School	TBD	Walnutport (B)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Washington Elementary School	TBD	Washington (T)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Williams Township Elementary School	TBD	Williams (T)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Avona Elementary School	TBD	Wilson (B)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Philip F. Lauer Middle School	TBD	Wilson (B)	Middle School	TBD	TBD	TBD	Masonry	TBD
Easton Children's Home	TBD	Wilson (B)	ES & MS/Jr & HS	TBD	TBD	TBD	Masonry	TBD
Wilson Elementary School	TBD	Wilson (B)	Elementary School	TBD	TBD	TBD	Masonry	TBD
Wilson Area High School	TBD	Wilson (B)	High School	TBD	TBD	TBD	Masonry	TBD

Source: Lehigh Valley HMP Update Critical Facility Database

*HAZUS-MH 2.1 default building type

B = Borough

C = City

T = Township

TBD = To be determined

2.7.1.5 Senior Care and Senior Living Facilities

Table 2-17 provides an inventory of senior facilities in the Lehigh Valley. Figure 2-12 displays the distribution of these facilities throughout the region.

Table 2-17. Senior Facilities in the Lehigh Valley

Name	Address	Municipality	Replacement Cost	Building Type	Backup Power
Lehigh County					
SALISBURY HOUSE OF NORTHEAST PA INC	25 HOOKS LN STE 202	Allentown (C)	TBD	TBD	TBD
RITTER DEAN L & MARYBETH A	7694 BAKE OVEN RD	Heidelberg (T)	TBD	TBD	TBD
Four Seasons at Farmington	TBD	Lower Macungie (T)	TBD	TBD	TBD
Legacy Oaks at Lehigh Valley	TBD	Lower Macungie (T)	TBD	TBD	TBD
Traditions at Wild Cherry Knoll	TBD	Lower Macungie (T)	TBD	TBD	TBD
Briarwood Commons	TBD	Whitehall (T)	TBD	TBD	TBD
Northampton County					
Willow Green	TBD	Allen (T)	TBD	TBD	TBD
ALEXANDRIA MANOR	313 S WALNUT ST	Bath (B)	TBD	TBD	TBD
NURSING HOME	310 -16 E MARKET ST	Bethlehem (C)	TBD	TBD	TBD
ALEXANDRIA LIVING	3534 LINDEN ST	Bethlehem (C)	TBD	TBD	TBD
Moravian Village of Bethlehem	TBD	Bethlehem (C)	TBD	TBD	TBD
KIRKLAND VILLAGE (EASTWOOD)	MADISON AVE	Bethlehem (C)	TBD	TBD	TBD
	111 W 4TH ST	Bethlehem (C)	TBD	TBD	TBD
L V COMM HEALTH CNTR	863 -65 E 4TH ST	Bethlehem (C)	TBD	TBD	TBD
MANOR CARE	4100 FREEMANSBURG AVE	Bethlehem (T)	TBD	TBD	TBD
BLDG 1 & 2 COUNTRY MEADOWS BET	4009 GREEN POND RD	Bethlehem (T)	TBD	TBD	TBD
PRAXIS NURSING HOME	S 6TH ST	Easton (C)	TBD	TBD	TBD
EASTON HOME/PRESBY SENIORS	1022 NORTHAMPTON ST	Easton (C)	TBD	TBD	TBD
EASTON NURSING CENT	498 WASHINGTON ST	Easton (C)	TBD	TBD	TBD
Riverview Estates	TBD	Forks (T)	TBD	TBD	TBD
The Village at Upstream Farm	TBD	Forks (T)	TBD	TBD	TBD
Jacob's Farm	TBD	Forks (T)	TBD	TBD	TBD
VILLAGE AT SULLIVAN TRAIL	2222 SULLIVAN TRL	Forks (T)	TBD	TBD	TBD
Hanover Glen	TBD	Hanover (T)	TBD	TBD	TBD
Traditions of America at Hanover	TBD	Hanover (T)	TBD	TBD	TBD
SR QUARTERS AT MUHLE	1745 MACADA RD	Hanover (T)	TBD	TBD	TBD
SAUCON VALLEY MANOR/SENIORLIVI	1050 MAIN ST	Hellertown (B)	TBD	TBD	TBD
PERSONAL CARE HOME	1357 BLUE MOUNTAIN DR	Lehigh (T)	TBD	TBD	TBD
CHANDLER III	900 BLUE MT DR	Lehigh (T)	TBD	TBD	TBD
Trio Farms		Lower Nazareth (T)	TBD	TBD	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Replacement Cost	Building Type	Backup Power
IMMED.CARE FCTY/M/R	2393 BLACK RIVER RD	Lower Saucon (T)	TBD	TBD	TBD
MARY ELLEN CONVALESC	1896 LEITHSVILLE RD	Lower Saucon (T)	TBD	TBD	TBD
VNA HOSPICE @ ST LUKES	2455 BLACK RIVER RD	Lower Saucon (T)	TBD	TBD	TBD
IMMED.CARE FCTY M/R	2045 YOB LN	Lower Saucon (T)	TBD	TBD	TBD
ALEXANDRIA MANOR	7 S NEW ST	Nazareth (B)	TBD	TBD	TBD
MORAVIAN HALL MORNING STAR	175 W NORTH ST	Nazareth (B)	TBD	TBD	TBD
SACRED HEART LIVING	602 E 21ST ST	Northampton (B)	TBD	TBD	TBD
NORTHAMPTON VILLAGE	1001 WASHINGTON AVE	Northampton (B)	TBD	TBD	TBD
Unknown name	TBD	Northampton (B)	TBD	TBD	TBD
Enclave at Knob Hill	TBD	Palmer (T)	TBD	TBD	TBD
Highlands at Glenmoor North	TBD	Palmer (T)	TBD	TBD	TBD
Traditions of Glenmoor	TBD	Palmer (T)	TBD	TBD	TBD
MANOR CARE # 574	2600 NORTHAMPTON ST	Palmer (T)	TBD	TBD	TBD
MORNING STAR MANOR	306 W MAIN ST	Pen Argyl (B)	TBD	TBD	TBD
CHANDLER ESTATES IV	1569 TEELS RD	Plainfield (T)	TBD	TBD	TBD
BETHANY HOME	1519 BELVIDERE CORNER RD	Upper Mt. Bethel (T)	TBD	TBD	TBD
911 OFFICE BLDG	PENN ALLEN RD	Upper Nazareth (T)	TBD	TBD	TBD
GRACEDALE	PENN ALLEN RD	Upper Nazareth (T)	TBD	TBD	TBD
CANAL SIDE MANOR	1 MAIN ST	Walnutport (B)	TBD	TBD	TBD
Country Classics at Morgan Hill		Williams (T)	TBD	TBD	TBD
EASTWOOD CONVALESCEN	2125 FAIRVIEW AVE	Wilson (B)	TBD	TBD	TBD
EASTERN COMFORT ASSISTED LIV	2040 NORTHAMPTON ST	Wilson (B)	TBD	TBD	TBD
WALDEN III ASSTD LIVING	325 N BROADWAY	Wind Gap (B)	TBD	TBD	TBD

Source: Lehigh Valley HMP Update Critical Facility Database

*HAZUS-MH 2.1 default building type

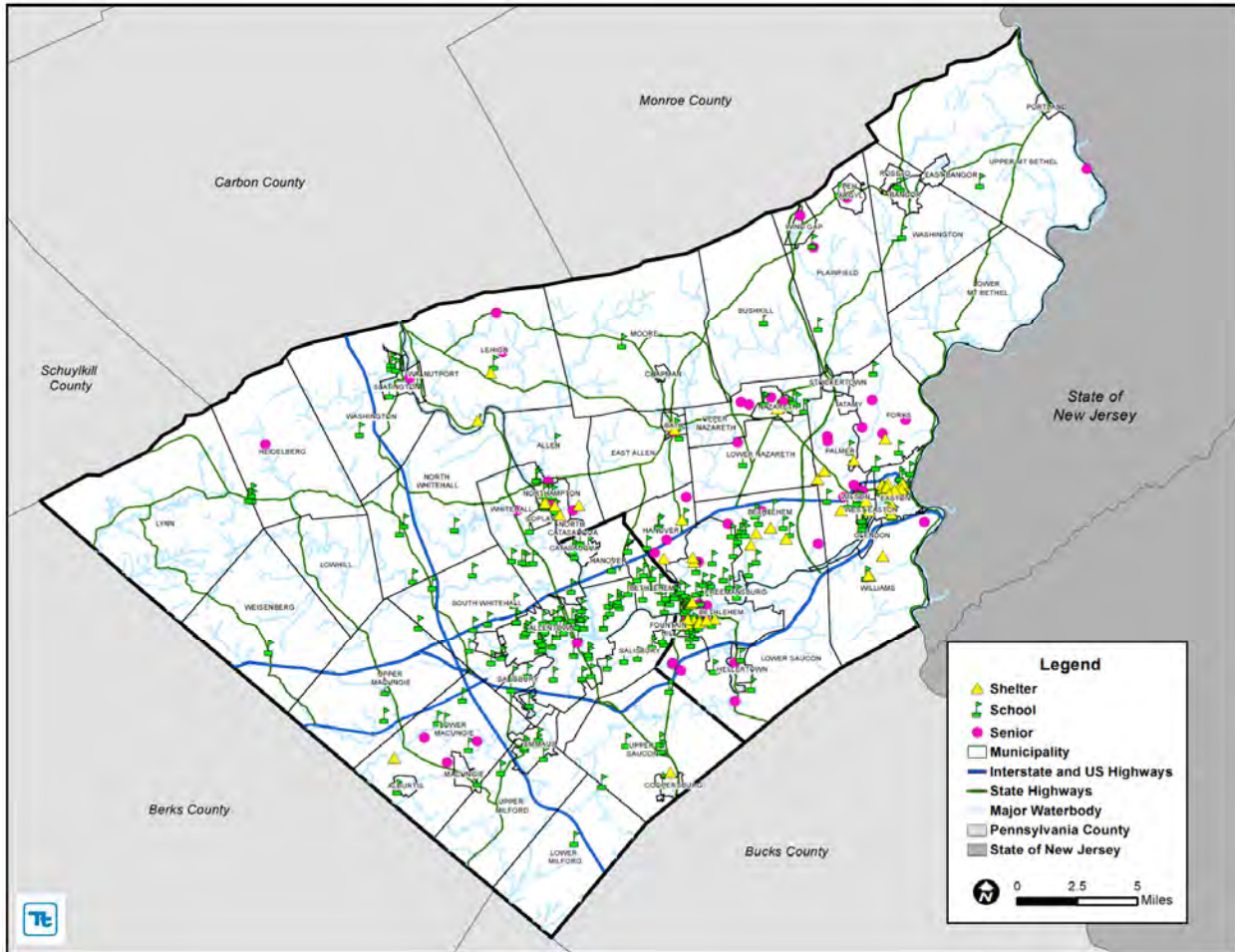
B = Borough

C = City

T = Township

TBD = To be determined

Figure 2-12. Schools, Shelters and Senior Facilities in the Lehigh Valley

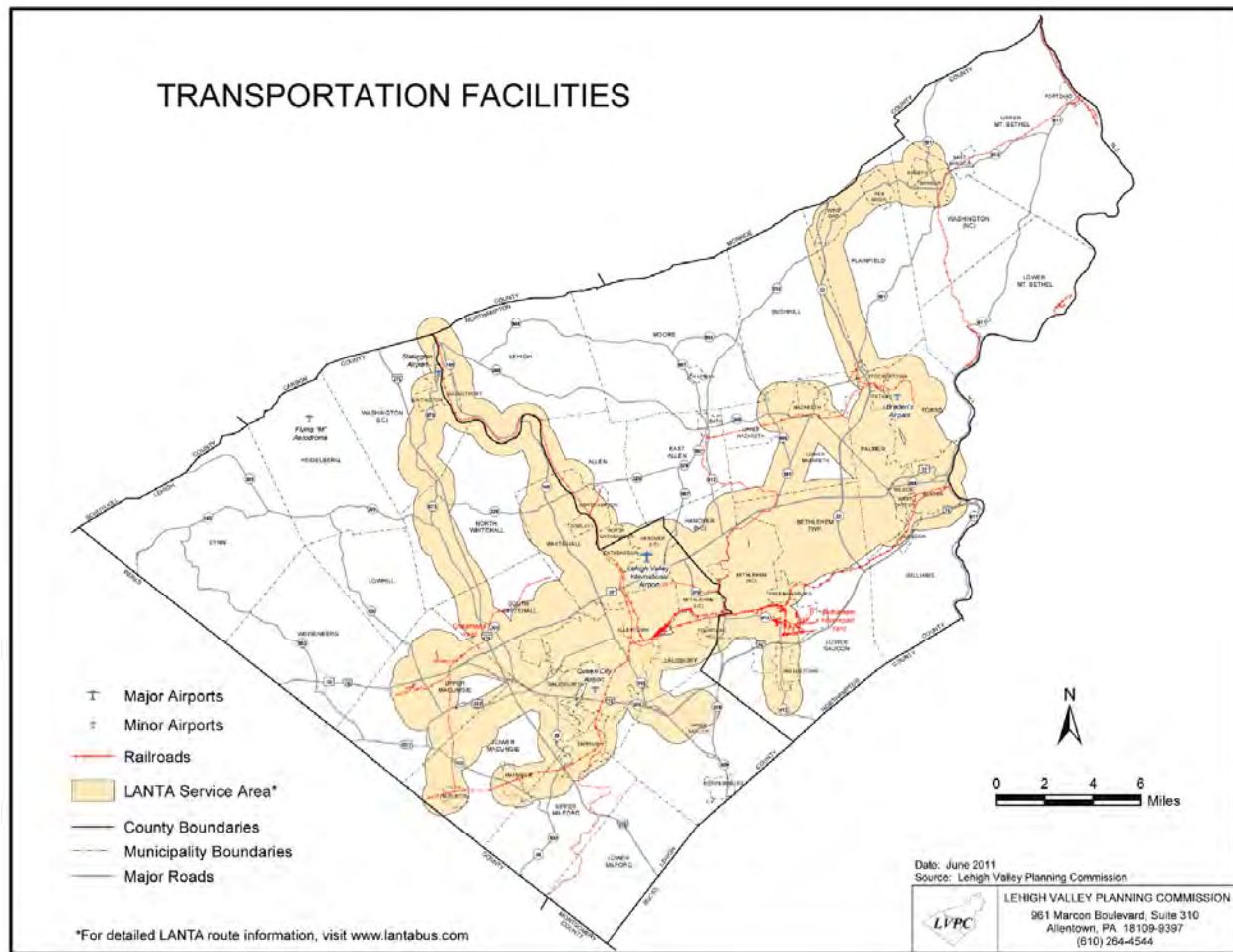


Source: Lehigh Valley HMP Update Critical Facility Database

2.7.2 Transportation Systems

This section presents available inventory data for roadways, airports, railways and other transportation systems for the Lehigh Valley. Figure 2-13 shows regional transportation systems serving the Lehigh Valley.

Figure 2-13. Transportation Facilities



Source: LVPC, 2011

2.7.2.1 Highways, Roadways and Associated Systems

The highway network is by far the dominant system of travel infrastructure. It serves passenger vehicles, trucks, and public bus transportation needs in the region. In 2010, there were 13,772,000 daily vehicle miles of travel on the regional highway network. In 2030, this figure is anticipated to grow to 19,600,000 (LVPC, 2010).

The Lehigh Valley contains 57 miles of interstate highways, 35 miles of freeways/expressways, 188 miles of principal arterials, 223 miles of minor arterials, 419 miles of major collectors, 106 miles of minor collectors, and 3,015 miles of local roads for a total of 4,044 miles.

The Lehigh Valley is served by six expressways, two of which are interstate highways. The interstate roads are I-78 and I-476. Other expressways are Route 22, Route 33, a portion of Route 309, and a portion of Route 378 through the City of Bethlehem (LVPC, 2010).

Most major roads in the Lehigh Valley are built and maintained by Pennsylvania Department of Transportation (PennDOT) (LVPC, 2010).

There are more than 1,000 bridges in the Lehigh Valley. Numerous entities own bridges in the Lehigh Valley. The Commonwealth of Pennsylvania, Lehigh County, Northampton County, municipalities, Pennsylvania Turnpike Commission, Delaware River Joint Toll Bridge Commission, and railroads all own bridges in the two counties. Bridges with high traffic volumes in the area include the Route 22 Lehigh River Bridge, Hamilton Street and Tilghman Street bridges in the City of Allentown, Hill-to-Hill, Fahy, and Minsi Trail bridges in the City of Bethlehem, 25th Street Bridge in Palmer Township, and the 3rd Street Bridge in the City of Easton. The average age of a bridge in the Lehigh Valley is approximately 50 years old (LVPC, 2010).

Table 2-18 below lists the transportation facilities/offices located in Northampton County.

Table 2-18. Transportation Facilities/Offices in Northampton County

Name	Address	Municipality	Replacement Cost	Backup Power
Northampton County				
LANTA - Metro	W BROAD ST & GUETTER ST	Bethlehem (C)	TBD	TBD
Trans-Bridge Lines, Inc.	2012 INDUSTRIAL DR	Bethlehem (C)	TBD	TBD
Golden Eagle Courier Systems, Inc.	2124 JOHNSTON DR	Bethlehem (C)	TBD	TBD
Bethlehem Area School Dist - Trans Office	1901 CHESTER RD	Bethlehem (C)	TBD	TBD
Greyhound Bus Lines	35 S 3RD ST	Easton (C)	TBD	TBD
Easton Coach Company	1200 CONROY PL	Forks (T)	TBD	TBD
Palmeri Transportation	6887 South Delaware Drive	Lower Mt Bethel (T)	TBD	TBD
Saucon Valley School Dist - Trans Office	2097 POLK VALLEY RD	Lower Saucon (T)	TBD	TBD
Easton Area School Dist - Trans Dept	1243 TATAMY RD	Palmer (T)	TBD	TBD
First Student, Inc.	6261 SULLIVAN TRL	Plainfield (T)	TBD	TBD
Laidlaw Transit Inc.	6261 SULLIVAN TRL	Plainfield (T)	TBD	TBD
Bangor Area School Dist - Trans Office	123 FIVE POINTS RICHMOND RD	Upper Mt Bethel (T)	TBD	TBD
Nazareth Area School Dist - Trans Office	1 EDUCATION PLAZA	Upper Nazareth (T)	TBD	TBD

Source: Lehigh Valley HMP Update Critical Facility Database

C = City

T = Township

TBD = To be determined

2.7.2.2 Airports and Heliports

Lehigh and Northampton counties are well served by air passenger carrier, air cargo, and general aviation services. The Lehigh Valley International Airport (LVIA), located on a 1,000 acre site in Hanover Township, Lehigh County, provides a full range of passenger, general aviation, and air cargo services. LVIA is operated by the Lehigh-Northampton Airport Authority. In addition, the Queen City Airport in Allentown, Braden Airpark in Forks Township, the Slatington Airport, and the Flying “M” Aerodrome in Heidelberg Township also serve general aviation aircraft needs. Table 2-19 provides a list of airports in the Lehigh Valley with the locations provided in Figure 2-14.

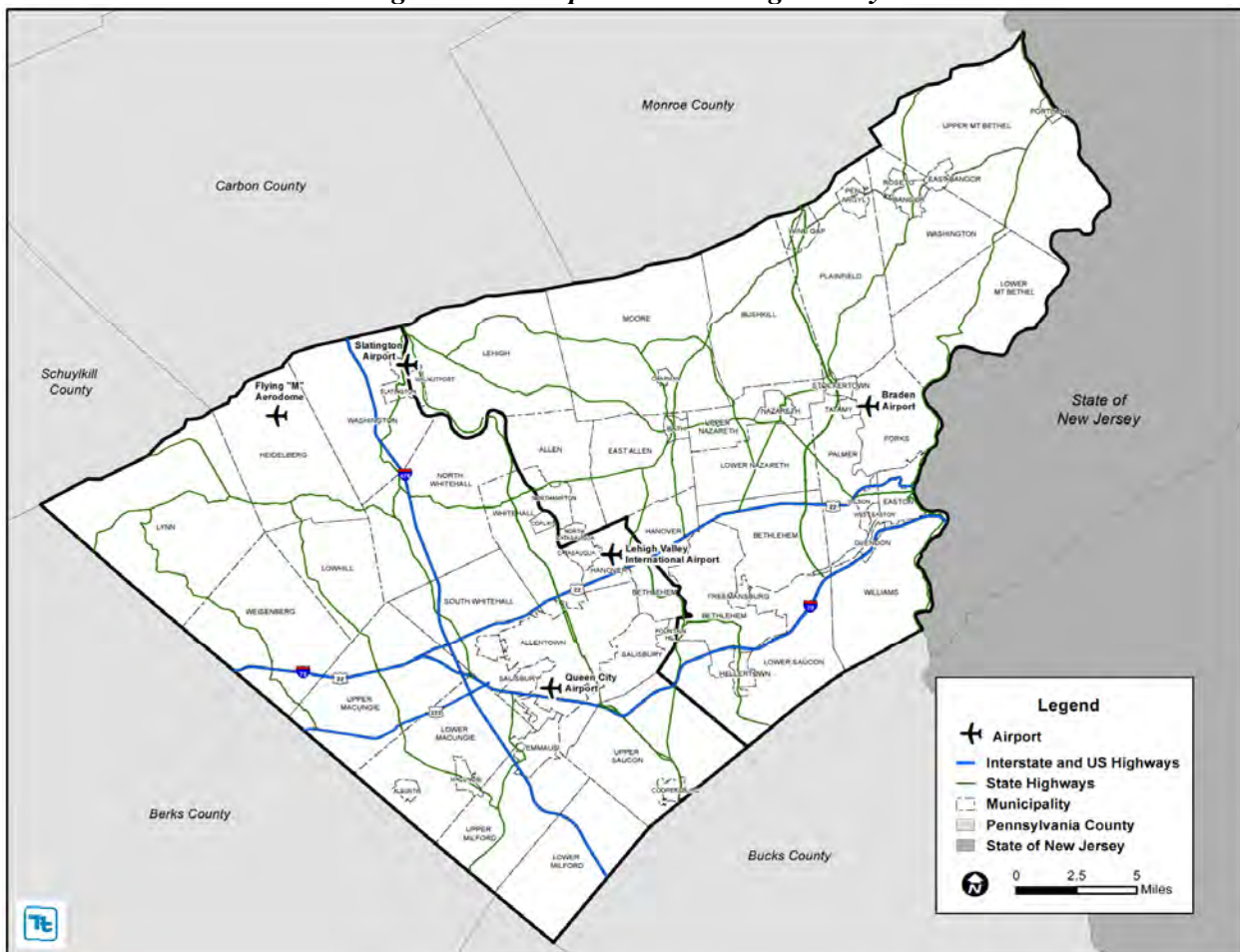
Table 2-19. Airports in the Lehigh Valley

Name	Address	Municipality	Replacement Cost	Backup Power
Lehigh County				
Lehigh Valley International Airport	Route 987 North (Airport Road)	Hanover (T)	TBD	TBD
Queen City Airport	Lehigh St.; Vultee St.	Allentown (C)	TBD	TBD
Flying "M" Aerodrome	5363 Mountain Road	Heidelberg (T)	TBD	TBD
Slatington Airport	Airport Lane	Slatington (B)	TBD	TBD
Northampton County				
Braden Airpark	3800 Sullivan Trail	Forks Township	TBD	TBD

Source: Lehigh Valley HMP Update Critical Facility Database

B = Borough
 C = City
 T = Township
 TBD = To be determined

Figure 2-14. Airports in the Lehigh Valley



Source: Lehigh Valley HMP Update Critical Facility Database

2.7.2.3 Railway

The dominant class 1 rail freight carrier in the Lehigh Valley is the Norfolk Southern Railroad, which operates lines that were formerly operated by Conrail. The railroad's Newark, New Jersey to Harrisburg main line passes through the two counties. The 2009 *Pennsylvania Intercity Passenger and Freight Rail Plan* identify this line as part of the Central Corridor, the largest of the six priority freight corridors in the state. A secondary main line extends north from Allentown to the Scranton area.

Numerous branch lines provide Norfolk Southern service to area shippers. The Cement Secondary which serves the Forks Industrial area and the C&F Secondary which serves the Fogelsville area are the most prominent of the branch lines. A second class 1 carrier also serves the Lehigh Valley via trackage rights. CP Rail has assumed the operations once provided by the Delaware and Hudson Railway.

The area is also served by six short line railroads: RJ Corman-Allentown, the East Penn Railroad, the Northampton Development Corp. Railroad, the Belvidere & Delaware River Railroad, the Delaware Lackawanna Railroad and the Lehigh Valley Rail Management (LVRM) railroad.

These railroads operate several significant rail facilities within the Lehigh Valley. The Allentown Classification Yard is one of the major yards in the Norfolk Southern System. The LVRM operates an intermodal terminal and container terminal, both located in the City of Bethlehem.

No commuter or intercity passenger service is available in the two counties (LVPC, 2010b).

2.7.2.4 Public Transportation

The Lehigh and Northampton Transportation Authority (LANTA), was formed by Lehigh and Northampton counties in 1972 to provide public transportation services for the inhabitants of the Lehigh Valley. LANTA's operations are comprised of two operating divisions — LANTA Bus and LANTA Van. The LANTA Bus division provides fixed-route services along 26 routes and operates about 5.2 million trips annually. It serves the Lehigh Valley metropolitan area including the cities of Allentown, Bethlehem, and Easton and their surrounding municipalities. The LANTA Van division provides door-to-door service for the region's elderly and those with disabilities. This coordinated transportation system is operated through a contract with a private transportation provider and provides over 500,000 trips annually.

In the 1980's an intermodal center was developed in the City of Bethlehem to serve as a transportation hub. In the summer of 2007 a transportation hub was developed in Center City Allentown. The center provides a protected terminal and transfer center for transit passengers and includes items of convenience such as ticket vending, electronic bus information, beverages, and newspapers. A similar facility is being planned in Easton.

A sufficient supply of convenient, affordable, and reliable inter-city bus service exists to popular destinations such as New York City and Philadelphia. This service is provided by private, unsubsidized bus operators Carl R. Beiber, Greyhound, Susquehanna Trailways and TransBridge Lines, Inc. (LVPC, 2010).

2.7.3 Lifeline Utility Systems

This section presents potable water, wastewater, and energy resource utility system data. Due to heightened security concerns, local lifeline utility data sufficient to complete the analysis has only partially been obtained.

2.7.3.1 Potable Water Supply

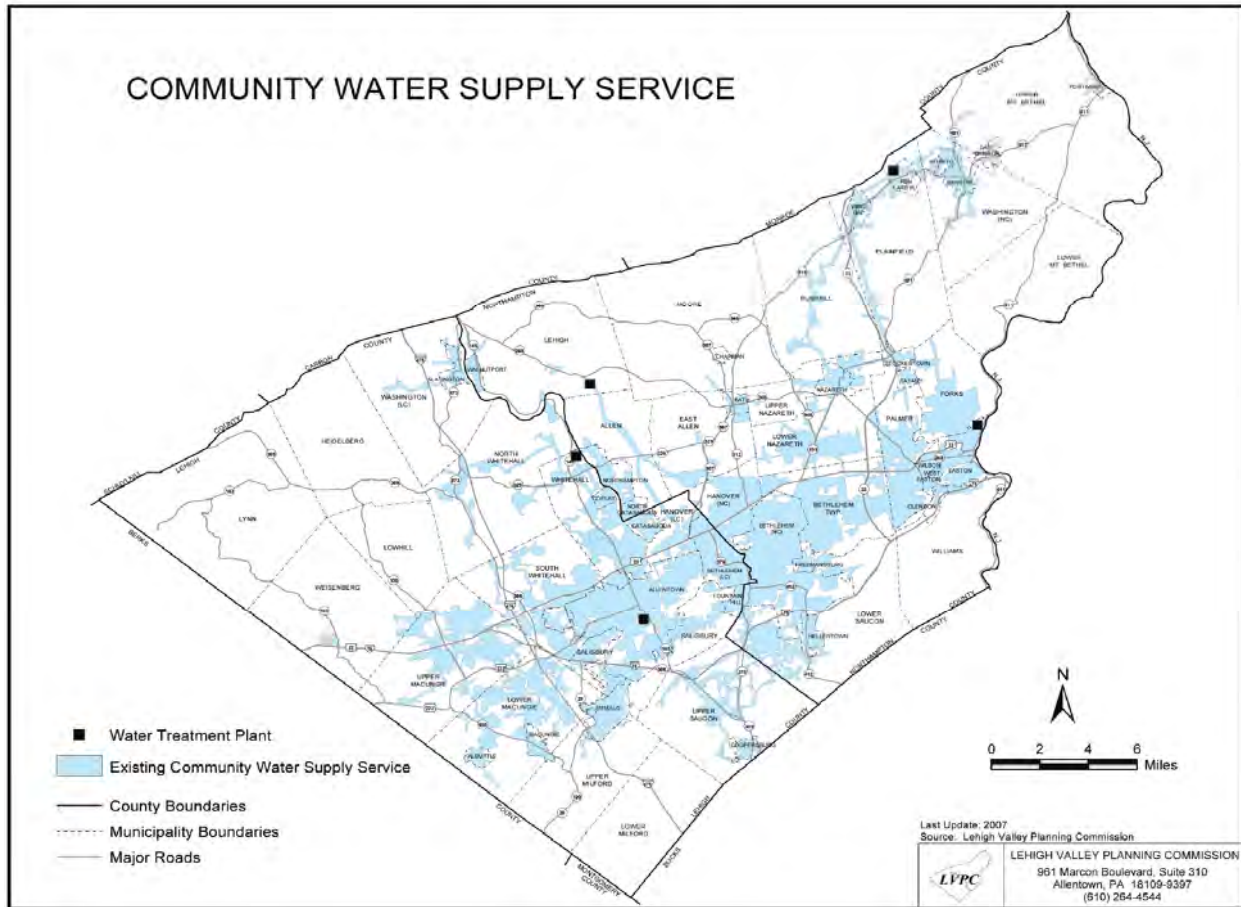
Community and central water systems are defined as follows:

- *Community water systems* — publicly or privately-owned systems which serve a generalized service area and are designed independently of specific land developments or subdivisions.
- *Central water systems* — publicly or privately-owned systems designed primarily to serve a single subdivision, land development or rural public use involving two or more lots or domestic water use in excess of one Equivalent Dwelling Unit (EDU) on a single lot.

According to 2008 LVPC documentation, there are 26 community water systems in the two counties with their own supply source(s). Many community systems serve multiple municipalities. There are 62 central water systems serving subdivisions, institutions and mobile home parks. These systems are widely dispersed.

Figure 2-15 below indicates community water supply services within the Lehigh Valley. Tables 2-20 and Table 2-21 lists the potable water facilities and water storage tanks, respectively, in Northampton County.

Figure 2-15. Community Water Supply Service



Source: LVPC, 2011



Table 2-20. Potable Water Facilities in Northampton County

Name	Municipality	Replacement Value	Backup Power
Northampton County			
BATH BORO WATER SYS	Bath (B)	TBD	TBD
BETHLEHEM CITY WATER SYS	Bethlehem (C)	TBD	TBD
BETHLEHEM CITY WATER SYS	Bethlehem (C)	TBD	TBD
BETHLEHEM CITY WATER SYS	Bethlehem (C)	TBD	TBD
BETHLEHEM CITY WATER SYS	Bethlehem (C)	TBD	TBD
BETHLEHEM CITY WATER SYS	Bethlehem (T)	TBD	TBD
BETHLEHEM CITY WATER SYS	Bethlehem (T)	TBD	TBD
SCHWEPS MHP	Bethlehem (T)	TBD	TBD
EASTON SUBURBAN WATER AUTH	Bethlehem (T)	TBD	TBD
MILLER MANOR WATER SYS	East Allen (T)	TBD	TBD
BEATRICE LN WATER SYS	East Allen (T)	TBD	TBD
SHADY LANE WATER SYS	East Allen (T)	TBD	TBD
EATMA EAST ALLEN GARDENS WATER SYS	East Allen (T)	TBD	TBD
EATMA EAST ALLEN GARDENS WATER SYS	East Allen (T)	TBD	TBD
EATMA EAST ALLEN GARDENS WATER SYS	East Allen (T)	TBD	TBD
EATMA WIL MAR MANOR WATER SYS	East Allen (T)	TBD	TBD
GREENBRIAR VILLAGE MHP	East Allen (T)	TBD	TBD
EATMA EAST ALLEN GARDENS WATER SYS	East Allen (T)	TBD	TBD
EATMA WIL MAR MANOR WATER SYS	East Allen (T)	TBD	TBD
EATMA EAST ALLEN GARDENS WATER SYS	East Allen (T)	TBD	TBD
EATMA EAST ALLEN GARDENS WATER SYS	East Allen (T)	TBD	TBD
SPRING LAKE VILLAGE WATER SYS	East Allen (T)	TBD	TBD
EATMA COUNTRY SQUIRE ESTATES WATER SYS	East Allen (T)	TBD	TBD
EATMA COUNTRY SQUIRE ESTATES WATER SYS	East Allen (T)	TBD	TBD
EAST ALLEN TWP MUNI AUTH VICTORIA SQUARE	East Allen (T)	TBD	TBD
MILLERS EDGEWOOD MHP	East Allen (T)	TBD	TBD
BEATRICE LN WATER SYS	East Allen (T)	TBD	TBD
GROFFS MHP	East Allen (T)	TBD	TBD
E BANGOR MUNI AUTH WATER SYS	East Bangor (B)	TBD	TBD
Collins and Maxwell	Easton (C)	TBD	TBD
EASTON CITY WATER TRMT PLT	Easton (C)	TBD	TBD
EASTON CITY WATER TRMT PLT	Easton (C)	TBD	TBD
EASTON CITY WATER TRMT PLT	Easton (C)	TBD	TBD
EASTON CITY WATER TRMT PLT	Easton (C)	TBD	TBD
EASTON CITY WATER TRMT PLT	Easton (C)	TBD	TBD
EASTON CITY WATER TRMT PLT	Easton (C)	TBD	TBD
EASTON SUBURBAN WATER AUTH	Easton (C)	TBD	TBD
EASTON CITY WATER TRMT PLT	Forks (T)	TBD	TBD
EASTON CITY WATER TRMT PLT	Forks (T)	TBD	TBD
VILLAGE VIEW WATER SYS	Hanover (T)	TBD	TBD
WESTGATE WATER SYS	Hanover (T)	TBD	TBD
WESTGATE WATER SYS	Hanover (T)	TBD	TBD
WESTGATE WATER SYS	Hanover (T)	TBD	TBD
WESTGATE WATER SYS	Hanover (T)	TBD	TBD
WESTGATE WATER SYS	Hanover (T)	TBD	TBD

SECTION 2: REGIONAL PROFILE

Name	Municipality	Replacement Value	Backup Power
WESTGATE WATER SYS	Hanover (T)	TBD	TBD
WESTGATE WATER SYS	Hanover (T)	TBD	TBD
WESTGATE WATER SYS	Hanover (T)	TBD	TBD
BETHLEHEM CITY WATER SYS	Lehigh (T)	TBD	TBD
GAP VIEW MHP	Lehigh (T)	TBD	TBD
MOUNTAINVIEW MHP	Lehigh (T)	TBD	TBD
WALNUTPORT MHP	Lehigh (T)	TBD	TBD
WALNUTPORT MHP	Lehigh (T)	TBD	TBD
WALNUTPORT AUTH WATER SUPPLY	Lehigh (T)	TBD	TBD
WALNUTPORT AUTH WATER SUPPLY	Lehigh (T)	TBD	TBD
BETHLEHEM CITY WATER SYS	Lehigh (T)	TBD	TBD
LEHIGH TWP MUNI AUTH CHERRYVILLE	Lehigh (T)	TBD	TBD
TREICHLERS WATER SYS	Lehigh (T)	TBD	TBD
HERITAGE VILLAGE	Lehigh (T)	TBD	TBD
James Palmeri	Lower Mt Bethel (T)	TBD	TBD
O.G. Capriotti	Lower Mt Bethel (T)	TBD	TBD
RIVERSEDGE MHP	Lower Mt. Bethel (T)	TBD	TBD
RIVERSEDGE MHP	Lower Mt. Bethel (T)	TBD	TBD
RIVERSEDGE MHP	Lower Mt. Bethel (T)	TBD	TBD
RIVERSEDGE MHP	Lower Mt. Bethel (T)	TBD	TBD
HILLENDALE ON THE DELAWARE WATER SYS	Lower Mt. Bethel (T)	TBD	TBD
BERRY HOLLOW ESTATES WATER SYS	Lower Mt. Bethel (T)	TBD	TBD
CEDAR GROVE MHP	Lower Mt. Bethel (T)	TBD	TBD
DRIFTWOOD COURT MHP	Lower Mt. Bethel (T)	TBD	TBD
LOWER NAZARETH TWP MUNI AUTH	Lower Nazareth (T)	TBD	TBD
EASTON SUBURBAN WATER AUTH	Lower Nazareth (T)	TBD	TBD
EASTON SUBURBAN WATER AUTH	Lower Nazareth (T)	TBD	TBD
BETHLEHEM CITY WATER SYS	Lower Saucon (T)	TBD	TBD
BETHLEHEM CITY WATER SYS	Lower Saucon (T)	TBD	TBD
LOWER SAUCON WATER SYS	Lower Saucon (T)	TBD	TBD
LOWER SAUCON WATER SYS	Lower Saucon (T)	TBD	TBD
LOWER SAUCON WATER SYS	Lower Saucon (T)	TBD	TBD
BETHLEHEM CITY WATER SYS	Lower Saucon (T)	TBD	TBD
BETHLEHEM CITY WATER SYS	Lower Saucon (T)	TBD	TBD
HELLERTOWN BORO WATER SYS	Lower Saucon (T)	TBD	TBD
HELLERTOWN BORO WATER SYS	Lower Saucon (T)	TBD	TBD
ROYAL OAKS MHP	Moore (T)	TBD	TBD
ROYAL OAKS MHP	Moore (T)	TBD	TBD
CLEARVIEW FARM ESTATES WATER SYS	Moore (T)	TBD	TBD
CLEARVIEW FARM ESTATES WATER SYS	Moore (T)	TBD	TBD
CLEARVIEW FARM ESTATES WATER SYS	Moore (T)	TBD	TBD
EVANWOOD ACRES WATER SYS	Moore (T)	TBD	TBD
HICKORY HILLS MHP	Moore (T)	TBD	TBD
HICKORY HILLS MHP	Moore (T)	TBD	TBD
CROSSROADS MHP	Moore (T)	TBD	TBD
WHISPERING HOLLOW NORTH MHP	Moore (T)	TBD	TBD
WHISPERING HOLLOW NORTH MHP	Moore (T)	TBD	TBD



SECTION 2: REGIONAL PROFILE

Name	Municipality	Replacement Value	Backup Power
HICKORY HILLS MHP	Moore (T)	TBD	TBD
HICKORY HILLS MHP	Moore (T)	TBD	TBD
BATH BORO WATER SYS	Moore (T)	TBD	TBD
BATH BORO WATER SYS	Moore (T)	TBD	TBD
BATH BORO WATER SYS	Moore (T)	TBD	TBD
CHRISTIAN SPRINGS WATER SYS	Moore (T)	TBD	TBD
CROSSROADS MHP	Moore (T)	TBD	TBD
HICKORY HILLS MHP	Moore (T)	TBD	TBD
HICKORY HILLS MHP	Moore (T)	TBD	TBD
HERD MANUFACTURED HOMES	Moore (T)	TBD	TBD
HERD MANUFACTURED HOMES	Moore (T)	TBD	TBD
HERD MANUFACTURED HOMES	Moore (T)	TBD	TBD
CITIZENS UTILILITIES BLUE MNT WATER SYS	Nazareth (B)	TBD	TBD
CITIZENS UTILILITIES BLUE MNT WATER SYS	Nazareth (B)	TBD	TBD
CITIZENS UTILILITIES BLUE MNT WATER SYS	Palmer (T)	TBD	TBD
PALMER TWP MUNI WATER SYS	Palmer (T)	TBD	TBD
CITIZENS UTILILITIES BLUE MNT WATER SYS	Palmer (T)	TBD	TBD
EASTON SUBURBAN WATER AUTH	Palmer (T)	TBD	TBD
EASTON SUBURBAN WATER AUTH	Palmer (T)	TBD	TBD
CITIZENS UTILILITIES BLUE MNT WATER SYS	Pen Argyl (B)	TBD	TBD
CITIZENS UTILILITIES BLUE MNT WATER SYS	Pen Argyl (B)	TBD	TBD
EASTON SUBURBAN WATER AUTH	Plainfield (T)	TBD	TBD
BANGOR PLT	Plainfield (T)	TBD	TBD
BANGOR PLT	Roseto (B)	TBD	TBD
GAP VIEW TRAILER PARK	Upper Mt. Bethel (T)	TBD	TBD
PORTLAND MHP	Upper Mt. Bethel (T)	TBD	TBD
TUSCARORA VILLAGE WATER SYS	Upper Mt. Bethel (T)	TBD	TBD
PORTLAND BORO AUTH	Upper Mt. Bethel (T)	TBD	TBD
E BANGOR MUNI AUTH WATER SYS	Upper Mt. Bethel (T)	TBD	TBD
EVERGREEN VILLAGE MHP	Upper Mt. Bethel (T)	TBD	TBD
EVERGREEN VILLAGE MHP	Upper Mt. Bethel (T)	TBD	TBD
BANGOR PLT	Upper Mt. Bethel (T)	TBD	TBD
BANGOR PLT	Upper Mt. Bethel (T)	TBD	TBD
BANGOR PLT	Upper Mt. Bethel (T)	TBD	TBD
BANGOR PLT	Upper Mt. Bethel (T)	TBD	TBD
BANGOR PLT	Upper Mt. Bethel (T)	TBD	TBD
GAP VIEW TRAILER PARK	Upper Mt. Bethel (T)	TBD	TBD
Beatty Contractors	Upper Nazareth (T)	TBD	TBD
KELLOWS MHP	Upper Nazareth (T)	TBD	TBD
MEADOWBROOK MHP	Washington (T)	TBD	TBD
BANGOR PLT	Washington (T)	TBD	TBD
RIEGELSVILLE WATER CO	Williams (T)	TBD	TBD
EASTON CITY WATER TRMT PLT	Williams (T)	TBD	TBD
DEL AIRE MHP	Williams (T)	TBD	TBD
GREEN ACRES MHP	Williams (T)	TBD	TBD
EASTON CITY WATER TRMT PLT	Williams (T)	TBD	TBD
GREEN ACRES MHP	Williams (T)	TBD	TBD

SECTION 2: REGIONAL PROFILE

Name	Municipality	Replacement Value	Backup Power
EASTON CITY WATER TRMT PLT	Wilson (B)	TBD	TBD
EASTON CITY WATER TRMT PLT	Wilson (B)	TBD	TBD
EASTON SUBURBAN WATER AUTH	Wilson (B)	TBD	TBD
J.H. Beers, Inc.	Wind Gap (B)	TBD	TBD

Source: Lehigh Valley HMP Update Critical Facility Database

B = Borough

C = City

T = Township

TBD = To be determined

Table 2-21. Water Storage Tanks in Northampton County

Name	Municipality	Replacement Value	Backup Power
Northampton County			
BANGOR PLT	Bangor (B)	TBD	TBD
BATH BORO WATER SYS	Bath (B)	TBD	TBD
BATH BORO WATER SYS	Bath (B)	TBD	TBD
EASTON SUBURBAN WATER AUTH	Bethlehem (T)	TBD	TBD
EATMA EAST ALLEN GARDENS WATER SYS	East Allen (T)	TBD	TBD
EATMA WIL MAR MANOR WATER SYS	East Allen (T)	TBD	TBD
EATMA EAST ALLEN GARDENS WATER SYS	East Allen (T)	TBD	TBD
EATMA EAST ALLEN GARDENS WATER SYS	East Allen (T)	TBD	TBD
SPRING LAKE VILLAGE WATER SYS	East Allen (T)	TBD	TBD
EATMA COUNTRY SQUIRE ESTATES WATER SYS	East Allen (T)	TBD	TBD
EATMA COUNTRY SQUIRE ESTATES WATER SYS	East Allen (T)	TBD	TBD
EAST ALLEN TWP MUNI AUTH VICTORIA SQUARE	East Allen (T)	TBD	TBD
WESTGATE WATER SYS	Hanover (T)	TBD	TBD
WESTGATE WATER SYS	Hanover (T)	TBD	TBD
WESTGATE WATER SYS	Hanover (T)	TBD	TBD
WESTGATE WATER SYS	Hanover (T)	TBD	TBD
WALNUTPORT AUTH WATER SUPPLY	Lehigh (T)	TBD	TBD
LEHIGH TWP MUNI AUTH CHERRYVILLE	Lehigh (T)	TBD	TBD
TREICHLERS WATER SYS	Lehigh (T)	TBD	TBD
LOWER SAUCON WATER SYS	Lower Saucon (T)	TBD	TBD
LOWER SAUCON WATER SYS	Lower Saucon (T)	TBD	TBD
LOWER SAUCON WATER SYS	Lower Saucon (T)	TBD	TBD
HELLERTOWN BORO WATER SYS	Lower Saucon (T)	TBD	TBD
CITIZENS UTILILITIES BLUE MNT WATER SYS	Palmer (T)	TBD	TBD
CITIZENS UTILILITIES BLUE MNT WATER SYS	Palmer (T)	TBD	TBD
EASTON SUBURBAN WATER AUTH	Palmer (T)	TBD	TBD
CITIZENS UTILILITIES BLUE MNT WATER SYS	Pen Argyl (B)	TBD	TBD
CITIZENS UTILILITIES BLUE MNT WATER SYS	Pen Argyl (B)	TBD	TBD
EASTON SUBURBAN WATER AUTH	Plainfield (T)	TBD	TBD
PORTLAND BORO AUTH	Upper Mt. Bethel (T)	TBD	TBD
E BANGOR MUNI AUTH WATER SYS	Upper Mt. Bethel (T)	TBD	TBD
EASTON CITY WATER TRMT PLT	Williams (T)	TBD	TBD
EASTON CITY WATER TRMT PLT	Williams (T)	TBD	TBD
EASTON CITY WATER TRMT PLT	Wilson (B)	TBD	TBD

Name	Municipality	Replacement Value	Backup Power
EASTON CITY WATER TRMT PLT	Wilson (B)	TBD	TBD

Source: Lehigh Valley HMP Update Critical Facility Database

B = Borough
 C = City
 T = Township
 TBD = To be determined

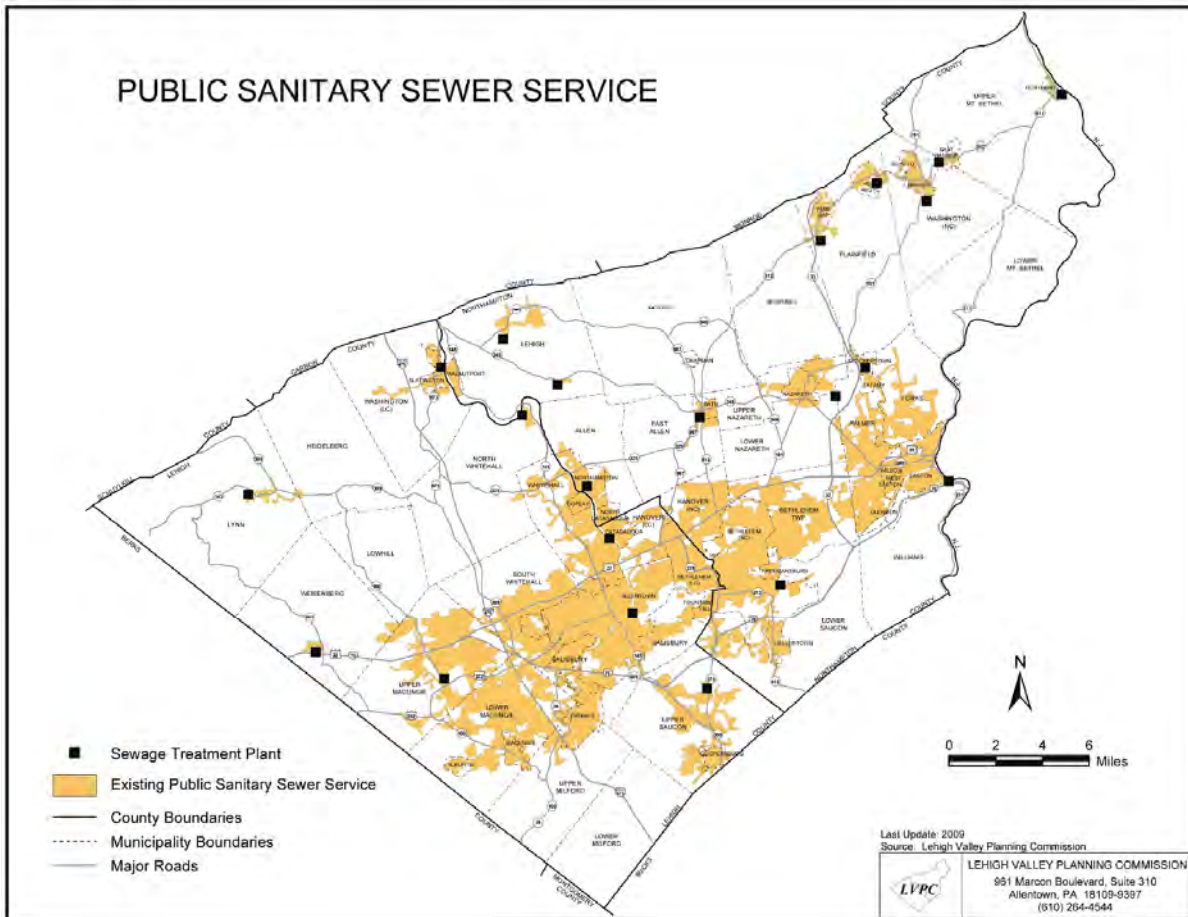
2.7.3.2 Wastewater Facilities

The systems are divided into two categories based on the type of service area involved as follows:

- *Public sewer systems* — publicly-owned systems which serve a generalized service area and designed independently of specific land developments or subdivisions.
- *Central sewer systems* — publicly or privately-owned systems designed primarily to serve a single subdivision, land development or rural public use involving two or more lots or domestic sewage disposal in excess of one equivalent dwelling unit (EDU) per lot.

According to 2008 LVPC documentation, there are currently 19 public and 25 central sewage treatment facilities in the two-county region. Figure 2-16 shows the location of public sewer service areas and treatment plants in the Lehigh Valley which are summarized in Table 2-22 below.

Figure 2-16. Public Sanitary Sewer Service



Source: LVPC, 2011

Table 2-22. Public Sewerage Treatment Plants

Treatment Plant	Treatment Capacity	Sewage Flows ¹ (2010)
Lehigh County		
Allentown	40.000	35.070
Catasauqua	2.250	1.010
Lehigh County Authority		
Arcadia West (Weisenberg)	Plant offline	Not applicable
Wastewater Treatment Plant ²	5.740	2.800 ³
Wynnewood Terrace (North Whitehall)	0.060	0.049
Lynn	0.080	0.069
Slatington	1.500	1.279
Upper Saucon	2.500	1.680
Northampton County		
Bangor	1.900	1.550
Bath	0.510	0.317
Bethlehem	20.000	12.400
East Bangor	0.100	0.073
Easton	10.000	5.990
Lehigh		
Danielsville	0.300	0.176
Pennsville	0.060	0.010
Nazareth	1.600	1.320
Northampton	1.500	1.061
Pen Argyl	0.950	0.790
Portland	0.105	Not available
Stockertown	0.087	0.062
Wind Gap	1.000	0.866

¹Flows reflect maximum 3 consecutive month average flows based on DEP's reporting procedure.

²Facility operated by Lehigh County Authority for pretreatment of industrial sewage prior to final treatment at the Allentown plant. Located in Upper Macungie Township.

³Average daily flow.

Note: All flows expressed in MGD (million gallons per day).

Sources: Lehigh Valley Planning Commission, PA Department of Environmental Protection and municipal/authority records.

Source: LVPC, 2011

2.7.3.3 Energy Resources

Electric Service in the Lehigh Valley is provided by PPL Corporation and Met-Ed Electric (GPU/First Energy Corp.). Natural gas service is provided by UGI Utilities, Inc. There are nine propane/gas facilities located in Northampton County. Table 2-23 identifies electric and gas facilities in the Lehigh Valley, as compiled in the critical facility database developed for this plan update.

Table 2-23. Electric and Natural Gas Facilities in the Lehigh Valley

Name	Municipality	Capacity	Cost	Backup Power
Lehigh County				
U G I CORP-LEHIGH DIV	ALLENTOWN (C)	TBD	TBD	TBD
CITY OF ALLENTOWN	ALLENTOWN (C)	TBD	TBD	TBD
PENNA POWER & LIGHT CO	ALLENTOWN (C)	TBD	TBD	TBD
CITY OF ALLENTOWN	ALLENTOWN (C)	TBD	TBD	TBD
BORO OF CATASAUQUA	CATASAUQUA (B)	TBD	TBD	TBD
PENNA POWER & LIGHT CO	CATASAUQUA (B)	TBD	TBD	TBD
PENNA POWER & LIGHT CO	CATASAUQUA (B)	TBD	TBD	TBD
EMMAUS MUNICIPAL AUTH-TOWN HALL	EMMAUS (B)	TBD	TBD	TBD
CONTEL OF PENNSYLVANIA INC	LOWER MACUNGIE (T)	TBD	TBD	TBD
ALBURTIS BORO AUTHORITY	LOWER MACUNGIE (T)	TBD	TBD	TBD
NORTHAMPTON BORO MUN AUTH	NORTH WHITEHALL (T)	TBD	TBD	TBD
NORTHAMPTON BORO MUN AUTH	NORTH WHITEHALL (T)	TBD	TBD	TBD
PFG GAS INC	SLATINGTON (B)	TBD	TBD	TBD
PENNA POWER & LIGHT CO	SOUTH WHITEHALL (T)	TBD	TBD	TBD
PENNA POWER & LIGHT CO	UPPER MACUNGIE (T)	TBD	TBD	TBD
COUNTY OF LEHIGH	UPPER MACUNGIE (T)	TBD	TBD	TBD
UPPER MACUNGIE TWP AUTH	UPPER MACUNGIE (T)	TBD	TBD	TBD
PENNA POWER & LIGHT CO	UPPER MILFORD (T)	TBD	TBD	TBD
Northampton County				
Calpine Bethlehem Energy Center	Bethlehem (C)	TBD	TBD	TBD
GPU - Easton	Forks (T)	TBD	TBD	TBD
PPL - Martins Creek Power Plant	Lower Mt Bethel (T)	TBD	TBD	TBD
PPL - Lower Mount Bethel Energy Plant	Lower Mt Bethel (T)	TBD	TBD	TBD
Cogentrix Energy - Northampton Gen Co	Northampton (B)	TBD	TBD	TBD
RRI Energy - Portland Generating Plant	Upper Mt Bethel (T)	TBD	TBD	TBD
Calpine Bethlehem Energy Center	Bethlehem (C)	TBD	TBD	TBD
GPU - Easton	Forks (T)	TBD	TBD	TBD
PPL - Martins Creek Power Plant	Lower Mt Bethel (T)	TBD	TBD	TBD
PPL - Lower Mount Bethel Energy Plant	Lower Mt Bethel (T)	TBD	TBD	TBD
Cogentrix Energy - Northampton Gen Co	Northampton (B)	TBD	TBD	TBD
RRI Energy - Portland Generating Plant	Upper Mt Bethel (T)	TBD	TBD	TBD

Source: Lehigh Valley HMP Update Critical Facility Database

B = Borough

C = City

T = Township

TBD = To be determined

2.7.3.4 Communication Resources

Telephone service in the Lehigh Valley is provided by Verizon, AT&T, Sprint and MCI. Cable service is provided by RCN, Service Electric, Time Warner-Berks, and Blue Ridge. Table 2-24 below summarizes

the telephone, cable and radio broadcasting locations in the Lehigh Valley, as compiled in the critical facility database developed for this plan update.

Table 2-24. Broadcasting Facilities/Equipment in the Lehigh Valley

Name	Address	Municipality	Type	Replacement Cost Value	Backup Power
Lehigh County					
PENNA POWER & LIGHT CO	2037 S 12TH ST	Allentown (C)	TBD	TBD	TBD
LIBERTY RECYCLING INC	236 W TILGHMAN ST	Allentown (C)	TBD	TBD	TBD
GOLDSTEIN LEE A ET AL	1458 CHESTNUT ST	Emmaus (B)	TBD	TBD	TBD
HEIDELBERG TWP	6539 CENTRAL RD	Heidelberg (T)	TBD	TBD	TBD
DIETRICH BRIAN C & FAY R	8494 KISTLER VALLEY RD	Lynn (T)	TBD	TBD	TBD
HAAF CHARLES J ESTATE	1141 BULLFROG LN	Upper Macungie (T)	TBD	TBD	TBD
QUAKER STATE TELEPHONE CO	TBD	Weisenberg (T)	TBD	TBD	TBD
QUAKER STATE TELEPHONE CO	TBD	Weisenberg (T)	TBD	TBD	TBD
Northampton County					
RCN Television	2124 AVE C	Bethlehem (C)	Cable Broadcasting	TBD	TBD
Service Electric Cable TV & Comm	2260 AVE A	Bethlehem (C)	Cable Broadcasting	TBD	TBD
TV 2 - Entertainment and News	3910 ADLER PL	Bethlehem (C)	Cable Broadcasting	TBD	TBD
WLVR 91.3 FM Radio Station	39 UNIVERSITY DR	Bethlehem (C)	Radio Broadcasting	TBD	TBD
WGPA 1100 AM Radio Station	528 N NEW ST	Bethlehem (C)	Radio Broadcasting	TBD	TBD
WDIY 88.1 FM Public Radio Station	301 Broadway	Bethlehem (C)	Radio Broadcasting	TBD	TBD
WODE 99.9 FM Radio Station	107 PAXINOSA RD W	Easton (C)	Radio Broadcasting	TBD	TBD
Blue Ridge Communications	239 LEHIGH GAP ST	Lehigh (T)	Cable Broadcasting	TBD	TBD

Source: Lehigh Valley HMP Update Critical Facility Database

2.7.4 High-Potential Loss Facilities

High-potential loss facilities include dams, levees, nuclear power plants, military installations and hazardous materials (HAZMAT) facilities. No nuclear power plants or military installations were identified in the Lehigh Valley. Dams, levees and HAZMAT facilities are discussed below.

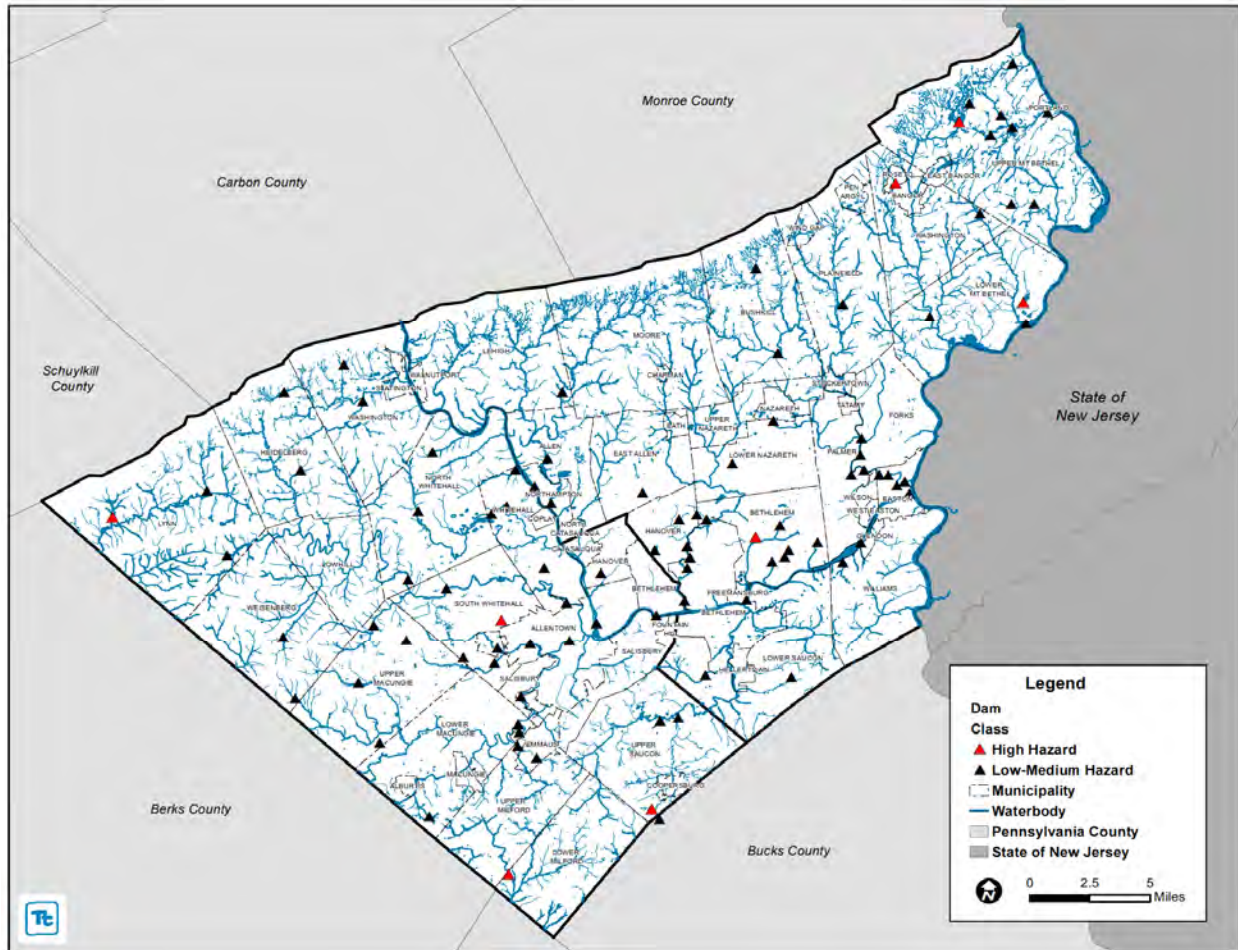
2.7.4.1 Dams

The Pennsylvania Department of Environmental Protection holds responsibility for dam safety. Hazard Potential Category 1 dams are those “where its failure could result in significant loss of life, excessive economic losses, and significant public inconvenience.” Hazard Potential Category 2 dams are those “where its failure could result in the loss of a few lives, appreciable property damage, and short-duration public inconvenience.” Owners of dams classified as Hazard Potential Categories 1 or 2 (i.e., “high-hazard” dams) are required to create an emergency action plan that describes the dam, the inundation area

if the dam was to catastrophically fail, and procedures for responding to the dam failure (e.g., notification of the vulnerable population).

There are 101 dams in the Lehigh Valley as illustrated on Figure 2-17. Eight dams are considered Hazard Potential Category 1 “high-hazard” dams and require Emergency Action Plans (EAPs). Further information on dams in the Lehigh Valley can be found in Section 4.3.14, “Dam Failure” hazard profile.

Figure 2-17. Dams in the Lehigh Valley



Source: PA DEP Dam Safety

2.7.4.2 Levees

There are four US Army Corps of Engineers levees/floodwalls in the Lehigh Valley: Allentown (Sewer Treatment Plant) Levee, Salisbury Levee, Allentown-Jordan Creek Floodwall, and Bethlehem Levee System. Further information on levees in the Lehigh Valley can be found in Section 4.3.17, “Levee Failure” hazard profile.

2.7.4.3 HAZMAT Facilities

Facilities that use or produce toxic chemicals above specific thresholds are required to report annually under Section 313 of the Superfund Amendments Reauthorization Act (SARA) Title III. Lehigh County

and Northampton County identified 259 and 158 SARA facilities, respectively. Due to heightened security concerns, these facilities and their locations are not listed in this plan update.

2.8 Other Facilities (User-Defined)

The user-defined facilities category includes all assets that the Steering Committee and participating municipalities deemed critical to include in the inventory and that do not fit within a pre-defined HAZUS-MH facility category. Table 2-25 below lists all user-defined facilities identified in the Lehigh Valley, which includes government and municipal buildings in Lehigh County.

Table 2-25. User-Defined Facilities in the Lehigh Valley

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
Lehigh County						
COMMONWEALTH OF PA	TBD	Allentown (C)	Municipal	TBD	TBD	TBD
CITY OF ALLENTOWN	TBD	Allentown (C)	Municipal	\$443,224	TBD	TBD
CITY OF ALLENTOWN	TBD	Allentown (C)	Municipal	TBD	TBD	TBD
COMMONWEALTH OF PA	TBD	Allentown (C)	Municipal	TBD	TBD	TBD
COMMONWEALTH OF PA	TBD	Allentown (C)	Municipal	TBD	TBD	TBD
CITY OF ALLENTOWN	TBD	Allentown (C)	Municipal	TBD	TBD	TBD
OCASIO RAYMOND S & BERTHA L	301 N JORDAN ST	Allentown (C)	Daycare	\$56,984	TBD	TBD
LEHIGH COUNTY HUMANE SOC	TBD	Allentown (C)	Municipal	\$966,144	TBD	TBD
CITY OF ALLENTOWN	TBD	Allentown (C)	Municipal	\$54,944	TBD	TBD
COMMONWEALTH OF PA	TBD	Allentown (C)	Municipal	TBD	TBD	TBD
COMMONWEALTH OF PA	TBD	Allentown (C)	Municipal	TBD	TBD	TBD
CITY OF BETHLEHEM	TBD	Bethlehem (C)	Municipal	\$202,368	TBD	TBD
COUNTY OF LEHIGH	TBD	Bethlehem (C)	Municipal	\$379,984	TBD	TBD
CORROCHER JOHN C & ARLANA L	621 SAINT JOHN ST	Catasauqua (B)	Daycare	\$66,912	TBD	TBD
BORO OF CATASAUQUA	TBD	Catasauqua (B)	Municipal	\$605,608	TBD	TBD
U S POSTAL SERVICE	TBD	Coopersburg (B)	Municipal	\$812,600	TBD	TBD
BORO OF EMMAUS	TBD	Emmaus (B)	Municipal	\$1,117,104	TBD	TBD
BORO OF EMMAUS	TBD	Emmaus (B)	Municipal	\$130,968	TBD	TBD
HANOVER TOWNSHIP	TBD	Hanover (T)	Municipal	\$68,408	TBD	TBD
HEIDELBERG TWP	TBD	Heidelberg (T)	Municipal	\$456,688	TBD	TBD
COMMONWEALTH OF PA	TBD	Heidelberg (T)	Municipal	TBD	TBD	TBD
LOWER MACUNGIE TWP	TBD	Lower Macungie (T)	Municipal	TBD	TBD	TBD
LOWER MACUNGIE TWP	TBD	Lower Macungie (T)	Municipal	TBD	TBD	TBD
LOWER MACUNGIE TWP	TBD	Lower Macungie (T)	Municipal	\$61,472	TBD	TBD
LOWER MACUNGIE TWP	TBD	Lower Macungie (T)	Municipal	\$163,608	TBD	TBD
LOWER MACUNGIE TWP	TBD	Lower Macungie (T)	Municipal	TBD	TBD	TBD
LOWER MACUNGIE TWP	TBD	Lower Macungie (T)	Municipal	TBD	TBD	TBD
LOWER MACUNGIE TWP	TBD	Lower Macungie (T)	Municipal	TBD	TBD	TBD
LOWER MACUNGIE TWP	TBD	Lower Macungie (T)	Municipal	TBD	TBD	TBD
LOWER MACUNGIE TWP	TBD	Lower Macungie (T)	Municipal	TBD	TBD	TBD
PENNA DEPT OF TRANSPORTATION	TBD	Lower Milford (T)	Municipal	TBD	TBD	TBD
LYNN TOWNSHIP	TBD	Lynn (T)	Municipal	\$66,640	TBD	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
NORTH WHITEHALL TWP	TBD	North Whitehall (T)	Municipal	\$1,579,232	TBD	TBD
COUNTY OF LEHIGH	TBD	North Whitehall (T)	Municipal	TBD	TBD	TBD
COUNTY OF LEHIGH	TBD	Salisbury (T)	Municipal	\$2,895,712	TBD	TBD
BORO OF SLATINGTON	TBD	Slatington (B)	Municipal	\$10,880	TBD	TBD
CITY OF ALLENTOWN	TBD	South Whitehall (T)	Municipal	TBD	TBD	TBD
CITY OF ALLENTOWN	TBD	Upper Macungie (T)	Municipal	TBD	TBD	TBD
CITY OF ALLENTOWN	TBD	Upper Macungie (T)	Municipal	\$233,920	TBD	TBD
COMMONWEALTH OF PA	TBD	Upper Macungie (T)	Municipal	TBD	TBD	TBD
CITY OF ALLENTOWN	TBD	Upper Macungie (T)	Municipal	TBD	TBD	TBD
WASHINGTON TWP	TBD	Washington (T)	Municipal	TBD	TBD	TBD
WASHINGTON TWP	TBD	Washington (T)	Municipal	\$718,760	TBD	TBD
WHITEHALL TWP	TBD	Whitehall (T)	Municipal	\$7,265,936	TBD	TBD
Northampton County						
Allen Township	4714 INDIAN TRAIL RD	Allen (T)	Govt bldg	TBD	TBD	TBD
Zion's Stone Cemetery	51 CHURCH RD	Allen (T)	Cemeteries	TBD	TBD	TBD
Thrash Family Day Care	3206 KENNEDY DR	Allen (T)	Child Day Care	TBD	TBD	TBD
Childhood Dreams Daycare	2690 HOWERTOWN RD	Allen (T)	Child Day Care	TBD	TBD	TBD
Bangor Borough	197 PENNSYLVANIA AVE	Bangor (B)	Govt bldg	TBD	TBD	TBD
Learning Locomotion	215 S 1ST ST	Bangor (B)	Child Day Care	TBD	TBD	TBD
Fiore Funeral Home	230 MARKET ST	Bangor (B)	Funeral Homes	TBD	TBD	TBD
Gaffney Funeral Home	314 S 1ST ST	Bangor (B)	Funeral Homes	TBD	TBD	TBD
District Court 03-3-03	718 S MAIN ST	Bangor (B)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
Bangor Public Library	39 S MAIN ST	Bangor (B)	Libraries	TBD	TBD	TBD
United States Post Office	212 S 1ST ST	Bangor (B)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Bath Borough	215 E MAIN ST	Bath (B)	Govt bldg	TBD	TBD	TBD
Lehigh Valley Animal Hospital	7122 Bethlehem Bath Pike	Bath (B)	Animal Care	TBD	TBD	TBD
Sacred Heart Parish's Cemetery	210 E NORTHAMPTON ST	Bath (B)	Cemeteries	TBD	TBD	TBD
Learn-N-Play Daycare	301 W MAIN ST	Bath (B)	Child Day Care	TBD	TBD	TBD
Mid-County Senior Center	234 S WALNUT ST	Bath (B)	Community Organization Facilities	TBD	TBD	TBD
Bartholomew Funeral Home	243 S WALNUT ST	Bath (B)	Funeral Homes	TBD	TBD	TBD
Christ Church United Church of Christ	109 S CHESTNUT ST	Bath (B)	Religious (Churches,	TBD	TBD	TBD



SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
			Temples)			
United States Post Office	175 N CHESTNUT ST	Bath (B)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Bethlehem City	10 E CHURCH ST	Bethlehem (C)	Govt bldg	TBD	TBD	TBD
Northampton County Area Agency on Aging	520 E BROAD ST	Bethlehem (C)	Adult Day Care	TBD	TBD	TBD
Atria Bethlehem	1745 W MACADA RD	Bethlehem (C)	Adult Day Care	TBD	TBD	TBD
Salisbury Behavioral Health	65 E ELIZABETH AVE	Bethlehem (C)	Adult Day Care	TBD	TBD	TBD
Moravian Village	561 E MARKET ST	Bethlehem (C)	Adult Day Care	TBD	TBD	TBD
Murray H. Goodman Stadium	150 Goodman Drive	Bethlehem (C)	Arenas (Stadiums)	TBD	TBD	TBD
Stabler Arena	124 Goodman Drive	Bethlehem (C)	Arenas (Stadiums)	TBD	TBD	TBD
Leeman-Turner Arena at Grace Hall	641 TAYLOR ST	Bethlehem (C)	Arenas (Stadiums)	TBD	TBD	TBD
Abbe Hall LLC	113 W 4TH ST	Bethlehem (C)	Assisted Living	TBD	TBD	TBD
Bethlehem Manor	1838 CENTER ST	Bethlehem (C)	Assisted Living	TBD	TBD	TBD
Holy Ghost Cemetery	924 SIOUX ST	Bethlehem (C)	Cemeteries	TBD	TBD	TBD
Memorial Park Cemetery	1851 NAZARETH PIKE	Bethlehem (C)	Cemeteries	TBD	TBD	TBD
Union Cemetery	254 E CHURCH ST	Bethlehem (C)	Cemeteries	TBD	TBD	TBD
St. Thomas UCC Cemetery	902 E MACADA RD	Bethlehem (C)	Cemeteries	TBD	TBD	TBD
Bethlehem Memorial Park Cemetery	1851 LINDEN ST	Bethlehem (C)	Cemeteries	TBD	TBD	TBD
Holy Saviour Cemetery	857 E LANGHORNE AVE	Bethlehem (C)	Cemeteries	TBD	TBD	TBD
Fairview Cemetery	1501 N NEW ST	Bethlehem (C)	Cemeteries	TBD	TBD	TBD
Christ Lutheran Church of Lower Saucon	1804 EASTON RD	Bethlehem (C)	Cemeteries	TBD	TBD	TBD
Nisky Hill Cemetery	254 E CHURCH ST	Bethlehem (C)	Cemeteries	TBD	TBD	TBD
Lehigh Valley Child Care Campus Center	410 E 5TH ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Kindercare Campus	621 E BROAD ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Stefko Child Care Center	2017 STEFKO BLVD	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Happy Faces Day Care	418 EDWARD ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Giggles Kid's Club	1580 6TH ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Gaidula's Family Child Care	1930 3RD ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Spring Garden Child Care	901 NORTH BLVD	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
First Presbyterian Church	2344 CENTER ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
William Penn Child Care	1002 MAIN ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Lehigh University Child Care	5 DUH DR #21	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Lincoln Child Day Care	1260 GRESHAM ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Millie's Creative Child Care	518 BROADWAY	Bethlehem (C)	Child Day Care	TBD	TBD	TBD



SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
Lehigh Valley Child Care at Fowler Center	938 MAIN ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Donegan Childcare	1210 E 4TH ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Head Start of the LV - St. Peter's	474 VINE ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Blake Messman's Daycare	2027 MONTGOMERY ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Bethlehem YMCA Child Care	430 E BROAD ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Spark Child Care	3144 LINDEN ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Thomas Jefferson Child Care	404 E NORTH ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Head Start of the Lehigh Valley - Unitarian	424 CENTER ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Head Start of the Lehigh Valley - Salem	134 E BROAD ST	Bethlehem (C)	Child Day Care	TBD	TBD	TBD
Sands Casino Resort	77 Sands Boulevard	Bethlehem (C)	Convention Centers	TBD	TBD	TBD
Northampton County - Bechtel Building	520 E BROAD ST	Bethlehem (C)	County Buildings	TBD	TBD	TBD
United States SS Administration	555 MAIN ST	Bethlehem (C)	Federal Buildings	TBD	TBD	TBD
United States Congressman Office	701 W BROAD ST	Bethlehem (C)	Federal Buildings	TBD	TBD	TBD
United States Internal Revenue Service	3 W BROAD ST	Bethlehem (C)	Federal Buildings	TBD	TBD	TBD
Connell Funeral Home, Inc.	245 E BROAD ST	Bethlehem (C)	Funeral Homes	TBD	TBD	TBD
Snyder-Hinkle Lunsford Funeral Home	527 CENTER ST	Bethlehem (C)	Funeral Homes	TBD	TBD	TBD
Cantelmi Funeral Home P.C.	1311 BROADWAY	Bethlehem (C)	Funeral Homes	TBD	TBD	TBD
John Herron Funeral Home	458 CENTER ST	Bethlehem (C)	Funeral Homes	TBD	TBD	TBD
Long Funeral Home	500 LINDEN ST	Bethlehem (C)	Funeral Homes	TBD	TBD	TBD
Pearson Funeral Home, Inc.	1901 LINDEN ST	Bethlehem (C)	Funeral Homes	TBD	TBD	TBD
Sands Casino	77 Sands Boulevard	Bethlehem (C)	Gambling (Casinos)	TBD	TBD	TBD
Valley Eye Surgical Center	1685 VALLEY CENTER PKY	Bethlehem (C)	Health Practitioner (Physician, Dentist)	TBD	TBD	TBD
American Heart Association	212 E BROAD ST	Bethlehem (C)	Healthcare Educational	TBD	TBD	TBD
ARC of the Greater Lehigh Valley	2200 AVE A	Bethlehem (C)	Healthcare Educational	TBD	TBD	TBD
Lehigh Valley Industrial Park Inc.	1720 Spillman Drive	Bethlehem (C)	Industrial Assets	TBD	TBD	TBD
District Court 03-1-04	2980 LINDEN ST	Bethlehem (C)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
District Court 03-2-01	402 E BROAD ST	Bethlehem (C)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
District Court 03-2-10	202 W 4TH ST	Bethlehem (C)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
District Court 03-2-11	1214 STEFKO BLVD	Bethlehem (C)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
Bethlehem Area Public Library	400 WEBSTER ST	Bethlehem (C)	Libraries	TBD	TBD	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
Bethlehem Area Public Library	11 W CHURCH ST	Bethlehem (C)	Libraries	TBD	TBD	TBD
Hotel Bethlehem	437 MAIN ST	Bethlehem (C)	Lodging (Hotels)	TBD	TBD	TBD
Holiday Inn Express Hotel & Suites	2201 CHERRY LN	Bethlehem (C)	Lodging (Hotels)	TBD	TBD	TBD
Comfort Suites	120 W 3RD ST	Bethlehem (C)	Lodging (Hotels)	TBD	TBD	TBD
Homewood Suites By Hilton	2031 AVE C	Bethlehem (C)	Lodging (Hotels)	TBD	TBD	TBD
Sun Inn Preservation Association	556 MAIN ST	Bethlehem (C)	Medical Supplies, Devices, and Equipment	TBD	TBD	TBD
Northampton Community College	3835 GREEN POND RD	Bethlehem (C)	Morgues	TBD	TBD	TBD
Historic Bethlehem Partnership	66 W CHURCH ST	Bethlehem (C)	Museums	TBD	TBD	TBD
National Museum of Industrial History	530 E 3RD ST	Bethlehem (C)	Museums	TBD	TBD	TBD
Historic Bethlehem Partnership	427 N NEW ST	Bethlehem (C)	Museums	TBD	TBD	TBD
Historic Bethlehem Partnership	459 OLD YORK RD	Bethlehem (C)	Museums	TBD	TBD	TBD
Zoellner Arts Center - Lehigh University	420 E PACKER AVE	Bethlehem (C)	Performing Arts (Theaters)	TBD	TBD	TBD
Morning Call	151 MAIN ST	Bethlehem (C)	Print Media	TBD	TBD	TBD
Bethlehem Press	308 E 3RD ST	Bethlehem (C)	Print Media	TBD	TBD	TBD
City of Bethlehem Health Bureau	10 E CHURCH ST	Bethlehem (C)	Public Health	TBD	TBD	TBD
Wesley United Methodist Church	2540 CENTER ST	Bethlehem (C)	Religious (Churches, Temples)	TBD	TBD	TBD
Trinity Episcopal Church	44 E MARKET ST	Bethlehem (C)	Religious (Churches, Temples)	TBD	TBD	TBD
Notre Dame of Bethlehem	1861 CATASAUQUA RD	Bethlehem (C)	Religious (Churches, Temples)	TBD	TBD	TBD
First Presbyterian Church	2344 CENTER ST	Bethlehem (C)	Religious (Churches, Temples)	TBD	TBD	TBD
Fritz Memorial United Methodist Church	303 W PACKER AVE	Bethlehem (C)	Religious (Churches, Temples)	TBD	TBD	TBD
Ben Franklin Technology Center	125 GOODMAN DR	Bethlehem (C)	Research and Development	TBD	TBD	TBD
USGS Monocacy Creek Gauge at Bethlehem, PA	TBD	Bethlehem (C)	Sensor and Monitoring Systems (GPS)	TBD	TBD	TBD
USGS Lehigh River Gauge at Bethlehem, PA	TBD	Bethlehem (C)	Sensor and Monitoring Systems (GPS)	TBD	TBD	TBD
135th State Legislative District	104 E BROAD ST	Bethlehem (C)	State Buildings	TBD	TBD	TBD
18th State Senatorial District	559 MAIN ST	Bethlehem (C)	State Buildings	TBD	TBD	TBD
133rd State Legislative District	7 W 4TH ST	Bethlehem (C)	State Buildings	TBD	TBD	TBD



SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
United States Post Office	131 W 4TH ST	Bethlehem (C)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
United States Post Office	535 WOOD ST	Bethlehem (C)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Bethlehem Township	4225 EASTON AVE	Bethlehem (T)	Govt bldg	TBD	TBD	TBD
Country Meadows	4011 GREEN POND RD	Bethlehem (T)	Adult Day Care	TBD	TBD	TBD
Cummings Veterinary Hospital, LLC	CHURCH RD	Bethlehem (T)	Animal Care	TBD	TBD	TBD
Animal Therapy Center	3247 WIMMER RD	Bethlehem (T)	Animal Care	TBD	TBD	TBD
Caring Connection	3550 FREEMANSBURG AVE	Bethlehem (T)	Assisted Living	TBD	TBD	TBD
Northampton Memorial Shrine Inc.	3051 GREEN POND RD	Bethlehem (T)	Cemeteries	TBD	TBD	TBD
St. John's Lutheran of Farmersville	8065 WILLIAM PENN HWY	Bethlehem (T)	Cemeteries	TBD	TBD	TBD
Precious Ones Day Care	3049 FAIRVIEW ST	Bethlehem (T)	Child Day Care	TBD	TBD	TBD
Farmersville Child Care	7036 WILLIAM PENN HWY	Bethlehem (T)	Child Day Care	TBD	TBD	TBD
Lehigh Valley Child Care Stone's Crossing	4007 WILLIAM PENN HWY, BUILDING 401	Bethlehem (T)	Child Day Care	TBD	TBD	TBD
Cambridge Schools	2201 Emrick Boulevard	Bethlehem (T)	Child Day Care	TBD	TBD	TBD
Chapel Family Child Care	3315 VALLEY VIEW RD	Bethlehem (T)	Child Day Care	TBD	TBD	TBD
Miller Heights Child Care	3605 ALLEN ST	Bethlehem (T)	Child Day Care	TBD	TBD	TBD
Bethlehem Township Coolidge Building	2740 5TH ST	Bethlehem (T)	Community Organization Facilities	TBD	TBD	TBD
Bethlehem Township Community Center	2900 FARMERSVILLE RD	Bethlehem (T)	Community Organization Facilities	TBD	TBD	TBD
Federal Express - Freight	360 STOKE PARK RD	Bethlehem (T)	Courier Centers	TBD	TBD	TBD
United Parcel Service	342 STOKE PARK RD	Bethlehem (T)	Courier Centers	TBD	TBD	TBD
Northampton Country Club	5049 WILLIAM PENN HWY	Bethlehem (T)	Golf Courses	TBD	TBD	TBD
Green Pond Country Club	3604 FARMERSVILLE RD	Bethlehem (T)	Golf Courses	TBD	TBD	TBD
Comfort Inn	3191 HIGHFIELD DR	Bethlehem (T)	Lodging (Hotels)	TBD	TBD	TBD
Courtyard by Marriott - Bethlehem	2220 Emrick Boulevard	Bethlehem (T)	Lodging (Hotels)	TBD	TBD	TBD
Marriott Courtyard Bethlehem	2220 Emrick Boulevard	Bethlehem (T)	Lodging (Hotels)	TBD	TBD	TBD
United States Post Office	3232 EASTON AVE	Bethlehem (T)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Lehigh River Boat Access Ramp	Chain Dam Road	Bethlehem (T)	Waterways	TBD	TBD	TBD
Bushkill Township	1114 BUSHKILL CENTER RD	Bushkill (T)	Govt bldg	TBD	TBD	TBD
Holy Cross Day Care Center	696 JOHNSON RD	Bushkill (T)	Child Day Care	TBD	TBD	TBD



SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
Little Buddies Childcare and Preschool	1068 BUSHKILL CENTER RD	Bushkill (T)	Child Day Care	TBD	TBD	TBD
Sullivan Trail Golf Course	6227 SULLIVAN TRL	Bushkill (T)	Golf Courses	TBD	TBD	TBD
Jacobsburg Historical Society	402 HENRY RD	Bushkill (T)	Museums	TBD	TBD	TBD
Jacobsburg EE Center Bureau State Parks	835 JACOBSBURG RD	Bushkill (T)	State Buildings	TBD	TBD	TBD
Chapman Borough	1400 MAIN ST	Chapman (B)	Govt bldg	TBD	TBD	TBD
East Allen Township	5344 NOR BATH BLVD	East Allen (T)	Govt bldg	TBD	TBD	TBD
St. Peter's UCC Cemetery	8143 VALLEY VIEW RD	East Allen (T)	Cemeteries	TBD	TBD	TBD
138th State Legislative District	5330 Nor-Bath Boulevard	East Allen (T)	State Buildings	TBD	TBD	TBD
16th State Senatorial District	5330 Nor-Bath Boulevard	East Allen (T)	State Buildings	TBD	TBD	TBD
East Bangor Borough	204 BRAY ST	East Bangor (B)	Govt bldg	TBD	TBD	TBD
NH Cty Courthouse & Gov Center	3 WELLER PL	Easton (C)	Govt bldg	TBD	TBD	TBD
Easton City	1 S 3RD ST	Easton (C)	Govt bldg	TBD	TBD	TBD
Salisbury Behavioral Health	1028 BUTLER ST	Easton (C)	Adult Day Care	TBD	TBD	TBD
Fisher Stadium	McCartney and High Streets	Easton (C)	Arenas (Stadiums)	TBD	TBD	TBD
Shiloh Manor Inc.	223 THOMAS BRIGHT AVE	Easton (C)	Assisted Living	TBD	TBD	TBD
Easton - Phillipsburg Free Bridge	Administration Building	Easton (C)	Bridges	TBD	TBD	TBD
Easton - Phillipsburg Toll Bridge	Administration Building	Easton (C)	Bridges	TBD	TBD	TBD
Easton Cemetery Company	401 N 7TH ST	Easton (C)	Cemeteries	TBD	TBD	TBD
Dutchman Cemetery	2200 NORTHAMPTON ST	Easton (C)	Cemeteries	TBD	TBD	TBD
Hays Cemetery	704 PACKER ST	Easton (C)	Cemeteries	TBD	TBD	TBD
Easton Heights Cemetery Company	410 N 10TH ST	Easton (C)	Cemeteries	TBD	TBD	TBD
Olivet Wee Care Daycare and Nursery	1151 NORTHAMPTON ST	Easton (C)	Child Day Care	TBD	TBD	TBD
Family YMCA of Easton	283 W SAINT JOSEPH ST	Easton (C)	Child Day Care	TBD	TBD	TBD
Family YMCA of Easton	1225 W LAFAYETTE ST	Easton (C)	Child Day Care	TBD	TBD	TBD
Lehigh Valley Child Care Kids Kamp	Pierce and Hamilton Streets	Easton (C)	Child Day Care	TBD	TBD	TBD
Lehigh Valley Child Care March School	429 REEDER ST	Easton (C)	Child Day Care	TBD	TBD	TBD
Creative Learning Center	4 CROWN DR	Easton (C)	Child Day Care	TBD	TBD	TBD
Angel's Daycare Center	45 N 9TH ST	Easton (C)	Child Day Care	TBD	TBD	TBD
Trinity Child Care	1235 JACKSON ST	Easton (C)	Child Day Care	TBD	TBD	TBD
ACJC Day Care Center	675 NORTHAMPTON ST	Easton (C)	Child Day Care	TBD	TBD	TBD
Pride and Joy Educational Day Care	425 IRON ST	Easton (C)	Child Day Care	TBD	TBD	TBD
Spring Garden Children's Center	401 W BERWICK ST, SUITE 103	Easton (C)	Child Day Care	TBD	TBD	TBD



SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
Third Street Alliance for Women & Children	41 N 3RD ST	Easton (C)	Child Day Care	TBD	TBD	TBD
Lafayette Early Learning Center	328 MCCARTNEY ST	Easton (C)	Child Day Care	TBD	TBD	TBD
All My Children Daycare	1201 BUTLER ST	Easton (C)	Child Day Care	TBD	TBD	TBD
Head Start of the LV - Easton Paul's	610 W BERWICK ST	Easton (C)	Child Day Care	TBD	TBD	TBD
Head Start of the LV - Our Lady of Mercy	283 W SAINT JOSEPH ST	Easton (C)	Child Day Care	TBD	TBD	TBD
Head Start of the LV - Northampton Street	673 NORTHAMPTON ST	Easton (C)	Child Day Care	TBD	TBD	TBD
Northampton County - Governor Wolf Bldg	32 N 2ND ST	Easton (C)	County Buildings	TBD	TBD	TBD
Northampton County - Archives Building	684 WASHINGTON ST	Easton (C)	County Buildings	TBD	TBD	TBD
Northampton County Prison - Work Release	135 S UNION ST	Easton (C)	County Buildings	TBD	TBD	TBD
Northampton County Juvenile Detention	650 FERRY ST	Easton (C)	County Buildings	TBD	TBD	TBD
NORTHAMPTON CTY CORONER OFFICE	669 WASHINGTON ST	Easton (C)	CTY	TBD	TBD	TBD
NORTHAMPTON CTY DOMESTIC RELATIONS	669 WASHINGTON ST	Easton (C)	CTY	TBD	TBD	TBD
United States SS Administration	134 S 4TH ST	Easton (C)	Federal Buildings	TBD	TBD	TBD
United States National Park Service	1 S 3RD ST	Easton (C)	Federal Buildings	TBD	TBD	TBD
Morello Funeral Home	3720 NICHOLAS ST	Easton (C)	Funeral Homes	TBD	TBD	TBD
Ashton Funeral Home, Inc.	1337 NORTHAMPTON ST	Easton (C)	Funeral Homes	TBD	TBD	TBD
Northampton County Courthouse	669 WASHINGTON ST	Easton (C)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
District Court 03-2-06	210 Line Street	Easton (C)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
District Court 03-2-05	6 S 3RD ST	Easton (C)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
Easton Area Public Library	515 CHURCH ST	Easton (C)	Libraries	TBD	TBD	TBD
Quality Inn	185 S 3RD ST	Easton (C)	Lodging (Hotels)	TBD	TBD	TBD
Lou Reda Productions	230 FERRY ST	Easton (C)	Motion Picture and Sound	TBD	TBD	TBD
National Canal Museum	30 CENTRE SQ	Easton (C)	Museums	TBD	TBD	TBD
Hugh Moore Park & Museum	30 CENTRE SQ	Easton (C)	Museums	TBD	TBD	TBD
NC Historical & Genealogical Society	342 NORTHAMPTON ST	Easton (C)	Museums	TBD	TBD	TBD
Bachmann Publick House	169 NORTHAMPTON ST	Easton (C)	Museums	TBD	TBD	TBD
DAR Parsons Taylor House	361 FERRY ST	Easton (C)	Museums	TBD	TBD	TBD
Binney & Smith Crayola Crayon Tours	30 CENTRE SQ	Easton (C)	Museums	TBD	TBD	TBD
State Theatre Center for the Arts	453 NORTHAMPTON ST	Easton (C)	Performing Arts (Theaters)	TBD	TBD	TBD
Easton Irregular	30 S SITGREAVES ST	Easton (C)	Print Media	TBD	TBD	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
Express Times	30 N 4TH ST	Easton (C)	Print Media	TBD	TBD	TBD
NORTHAMPTON COUNTY PRISON	666 WALNUT ST	Easton (C)	PRISON	TBD	TBD	TBD
Northampton County Prison	666 WALNUT ST	Easton (C)	Prisons	TBD	TBD	TBD
Pennsylvania Department of Health	1600 NORTHAMPTON ST	Easton (C)	Public Health	TBD	TBD	TBD
Christ Lutheran Church	1110 FERRY ST	Easton (C)	Religious (Churches, Temples)	TBD	TBD	TBD
Trinity Episcopal Church	234 SPRING GARDEN ST	Easton (C)	Religious (Churches, Temples)	TBD	TBD	TBD
First Evangelical Congregational Church	28 N 10TH ST	Easton (C)	Religious (Churches, Temples)	TBD	TBD	TBD
St. John's Evangelical Lutheran Church	330 FERRY ST	Easton (C)	Religious (Churches, Temples)	TBD	TBD	TBD
First Moravian Church	225 N 10TH ST	Easton (C)	Religious (Churches, Temples)	TBD	TBD	TBD
St. Paul Lutheran Church	610 W BERWICK ST	Easton (C)	Religious (Churches, Temples)	TBD	TBD	TBD
Olivet United Presbyterian Church	1151 NORTHAMPTON ST	Easton (C)	Religious (Churches, Temples)	TBD	TBD	TBD
St. Anthony's Youth Center	901 WASHINGTON ST	Easton (C)	Religious (Churches, Temples)	TBD	TBD	TBD
First Presbyterian Church	333 SPRING GARDEN ST	Easton (C)	Religious (Churches, Temples)	TBD	TBD	TBD
Greater Shiloh Church	403 Pastor Fred Davis Street	Easton (C)	Religious (Churches, Temples)	TBD	TBD	TBD
River of God Fellowship Church	813 REYNOLDS ST	Easton (C)	Religious (Churches, Temples)	TBD	TBD	TBD
St. Bernard's Oratory	132 S 5TH ST	Easton (C)	Religious (Churches, Temples)	TBD	TBD	TBD
USGS Lehigh River Gauge at Easton, PA	TBD	Easton (C)	Sensor and Monitoring Systems (GPS)	TBD	TBD	TBD
USGS Delaware River Gauge Phillipsburg, NJ	TBD	Easton (C)	Sensor and Monitoring Systems (GPS)	TBD	TBD	TBD
136th State Legislative District	215 NORTHAMPTON ST	Easton (C)	State Buildings	TBD	TBD	TBD
Northampton County Archives	688 Washington Street	Easton (C)	Storage and Preservation (Archive)	TBD	TBD	TBD
United States Post Office	201 FERRY ST	Easton (C)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Easton (Lehigh River) Boat Access Ramp	Larry Holmes Drive	Easton (C)	Waterways	TBD	TBD	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
Easton (Delaware River) Boat Access Ramp	164 LARRY HOLMES DR	Easton (C)	Waterways	TBD	TBD	TBD
Forks Township	1606 SULLIVAN TRL	Forks (T)	Govt bldg	TBD	TBD	TBD
Thoreau Veterinary Hospital	3300 FOX HILL RD	Forks (T)	Animal Care	TBD	TBD	TBD
Easton Animal Hospital	2015 SULLIVAN TRL	Forks (T)	Animal Care	TBD	TBD	TBD
Family YMCA of Easton	1350 SULLIVAN TRL	Forks (T)	Child Day Care	TBD	TBD	TBD
Tech Tyke Center	5335 KESSLERSVILLE RD	Forks (T)	Child Day Care	TBD	TBD	TBD
Home Sweet Home	905 MECO RD	Forks (T)	Child Day Care	TBD	TBD	TBD
Family YMCA of Easton	1700 SULLIVAN TRL	Forks (T)	Child Day Care	TBD	TBD	TBD
Lehigh Valley Child Care Great Beginnings	701-A UHLER RD	Forks (T)	Child Day Care	TBD	TBD	TBD
Goddard School	1775 SULLIVAN TRL	Forks (T)	Child Day Care	TBD	TBD	TBD
Lehigh Valley Child Care at Forks School	1709 RICHMOND RD	Forks (T)	Child Day Care	TBD	TBD	TBD
Dixie Consumer Products Plant	605 Kubler Road	Forks (T)	Commercial Facilities - Other	TBD	TBD	TBD
Forks Township Community Center	1604 SULLIVAN TRL	Forks (T)	Community Organization Facilities	TBD	TBD	TBD
Riverview Golf & Country Club	1 RIVER VIEW CIR	Forks (T)	Golf Courses	TBD	TBD	TBD
Binney & Smith	2025 EDGEWOOD AVE	Forks (T)	Museums	TBD	TBD	TBD
PA Army Natl Guard - Easton Ctr	520 UHLER RD	Forks (T)	National Guard Facilities	TBD	TBD	TBD
Faith Lutheran Church	2012 SULLIVAN TRL	Forks (T)	Religious (Churches, Temples)	TBD	TBD	TBD
Majestic Athletic, Ltd.	2320 NEWLINS MILL RD	Forks (T)	Textile Manufacturing	TBD	TBD	TBD
Freemansburg Borough	600 MONROE ST	Freemansburg (B)	Govt bldg	TBD	TBD	TBD
Freemansburg Child Care	501 MONROE ST	Freemansburg (B)	Child Day Care	TBD	TBD	TBD
Pembroke Pee Wee's Child Care	1032 PEMBROKE RD	Freemansburg (B)	Child Day Care	TBD	TBD	TBD
Glendon Borough	24 FRANKLIN ST	Glendon (B)	Govt bldg	TBD	TBD	TBD
USGS Lehigh River Gauge at Glendon, PA	TBD	Glendon (B)	Sensor and Monitoring Systems (GPS)	TBD	TBD	TBD
Hanover (N) Township	685 MAIN ST	Hanover (T)	Govt bldg	TBD	TBD	TBD
Atria Bethlehem	1745 W MACADA RD	Hanover (T)	Assisted Living	TBD	TBD	TBD
Miller Keystone Blood Center	1465 Valley Center Parkway	Hanover (T)	Blood, Organ, and Tissue	TBD	TBD	TBD
Asa Packer Child Care	1650 KENWOOD DR	Hanover (T)	Child Day Care	TBD	TBD	TBD
Hanover Child Care	3890 JACKSONVILLE RD	Hanover (T)	Child Day Care	TBD	TBD	TBD
Federal Express	126 N COMMERCE WAY	Hanover (T)	Courier Centers	TBD	TBD	TBD
Visiting Nurse Association	1510 Valley Center Parkway	Hanover (T)	Healthcare and Public Health - Other	TBD	TBD	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
Holiday Inn Express Hotels & Suites	3375 High Point Boulevard	Hanover (T)	Lodging (Hotels)	TBD	TBD	TBD
Hampton Inn & Suites	200 Gateway Drive	Hanover (T)	Lodging (Hotels)	TBD	TBD	TBD
Best Western Conference Center	300 Gateway Drive	Hanover (T)	Lodging (Hotels)	TBD	TBD	TBD
Holy Cross Evangelical Lutheran Church	2700 JACKSONVILLE RD	Hanover (T)	Religious (Churches, Temples)	TBD	TBD	TBD
Lehigh Valley Friends Meetinghouse	4116 BATH PIKE	Hanover (T)	Religious (Churches, Temples)	TBD	TBD	TBD
Triangle Tech	31 S COMMERCE WAY	Hanover (T)	Specialized Education	TBD	TBD	TBD
Department of Environmental Protection	4530 BATH PIKE	Hanover (T)	State Buildings	TBD	TBD	TBD
Division of Long Term Care - Dept Health	4500 BATH PIKE	Hanover (T)	State Buildings	TBD	TBD	TBD
Hellertown Borough	1069 MUNICIPAL RD	Hellertown (B)	Govt bldg	TBD	TBD	TBD
Hellertown Union Cemetery	89 MAIN ST	Hellertown (B)	Cemeteries	TBD	TBD	TBD
Society of Little Learners Child Care	440 FRONT ST	Hellertown (B)	Child Day Care	TBD	TBD	TBD
Saucon Valley Community Center	323 NORTHAMPTON ST	Hellertown (B)	Child Day Care	TBD	TBD	TBD
Christ Lutheran Center	69 MAIN ST	Hellertown (B)	Child Day Care	TBD	TBD	TBD
Saucon Valley Community Center	323 NORTHAMPTON ST	Hellertown (B)	Community Organization Facilities	TBD	TBD	TBD
Heintzelman Funeral Home	326 MAIN ST	Hellertown (B)	Funeral Homes	TBD	TBD	TBD
Silver Creek Country Club	700 LINDEN AVE	Hellertown (B)	Golf Courses	TBD	TBD	TBD
Hellertown Area Library	409 CONSTITUTION AVE	Hellertown (B)	Libraries	TBD	TBD	TBD
United States Post Office	660 DELAWARE AVE	Hellertown (B)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Lehigh Township	2004 Hutchinson Avenue	Lehigh (T)	Govt bldg	TBD	TBD	TBD
Liza's House Personal Care Home	1357 BLUE MOUNTAIN DR	Lehigh (T)	Adult Day Care	TBD	TBD	TBD
Blue Ridge Veterinary Clinic	1124 MYRTLE RD	Lehigh (T)	Animal Care	TBD	TBD	TBD
Cherryville Animal Hospital, P.C.	486 WILLOW RD	Lehigh (T)	Animal Care	TBD	TBD	TBD
St. Paul's UCC Indianland Cemetery	787 ALMOND RD	Lehigh (T)	Cemeteries	TBD	TBD	TBD
Teddy Bear Day Care	3623 LEHIGH DR	Lehigh (T)	Child Day Care	TBD	TBD	TBD
Sharon's Day Care	4358 3RD ST	Lehigh (T)	Child Day Care	TBD	TBD	TBD
District Court 03-3-01	4330 LEHIGH DR	Lehigh (T)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
Bethany Wesleyan Church	675 BLUE MOUNTAIN DR	Lehigh (T)	Religious (Churches, Temples)	TBD	TBD	TBD
United States Post Office	331 E BREADFRUIT DR	Lehigh (T)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD



SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
United States Post Office	680 BLUE MOUNTAIN DR	Lehigh (T)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
United States Post Office	3937 MOUNTAIN VIEW DR	Lehigh (T)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Riverton - Belvidere Bridge		Lower Mt Bethel (T)	Bridges	TBD	TBD	TBD
James Palmeri Funeral Home	6602 ALPHA AVE	Lower Mt Bethel (T)	Funeral Homes	TBD	TBD	TBD
USGS Delaware River Gauge Belvidere, NJ	TBD	Lower Mt Bethel (T)	Sensor and Monitoring Systems (GPS)	TBD	TBD	TBD
United States Post Office	6564 SOUTH DELAWARE DRIVE	Lower Mt Bethel (T)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Sandt's Eddy Boat Access Ramp	4845 S DELAWARE DR	Lower Mt Bethel (T)	Waterways	TBD	TBD	TBD
PPL Boat Access Ramp	5508 DE PUES RD	Lower Mt Bethel (T)	Waterways	TBD	TBD	TBD
PPL Public Boat Access Ramp	5632 DE PUES RD	Lower Mt Bethel (T)	Waterways	TBD	TBD	TBD
Lower Mount Bethel Township	306 BUTZTOWN RD	Lower Mt. Bethel (T)	Govt bldg	TBD	TBD	TBD
Lower Nazareth Township	3700 OLD PHILADELPHIA PIKE	Lower Nazareth (T)	Govt bldg	TBD	TBD	TBD
VCA Northside Animal Hospital	185 MIKRON RD	Lower Nazareth (T)	Animal Care	TBD	TBD	TBD
Lehigh Valley Child Care Lower Nazareth	4422 NEWBURG RD	Lower Nazareth (T)	Child Day Care	TBD	TBD	TBD
Governor Wolf	1920 BUTZTOWN RD	Lower Nazareth (T)	Child Day Care	TBD	TBD	TBD
Nazareth Area Day Care	4485 HANOVERVILLE RD	Lower Nazareth (T)	Child Day Care	TBD	TBD	TBD
District Court 03-2-03	224 NAZARETH PIKE	Lower Nazareth (T)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
Towneplace Suites By Marriott	3800 EASTON NAZARETH HWY	Lower Nazareth (T)	Lodging (Hotels)	TBD	TBD	TBD
Nazareth Speedway (Decommissioned)	Routes 191 and 248	Lower Nazareth (T)	Motor Racetracks	TBD	TBD	TBD
Lower Saucon Township	2491 COMMUNITY DR	Lower Saucon (T)	Govt bldg	TBD	TBD	TBD
Saucon Valley Animal Hospital	1979 LEITHSVILLE RD	Lower Saucon (T)	Animal Care	TBD	TBD	TBD
New Jerusalem Evangelical Lutheran Church	3233 APPLES CHURCH RD	Lower Saucon (T)	Cemeteries	TBD	TBD	TBD
Saucon Valley Com Center Fore & Aft	2085 POLK VALLEY RD	Lower Saucon (T)	Child Day Care	TBD	TBD	TBD
Woodland Hills Country Club	4166 LOWER SAUCON RD	Lower Saucon (T)	Golf Courses	TBD	TBD	TBD
District Court 03-2-04	1404 WALTER ST	Lower Saucon (T)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
Moore Township	30 BELVIDERE ST	Moore (T)	Govt bldg	TBD	TBD	TBD
Salem UCC Cemetery	2218 COMMUNITY DR	Moore (T)	Cemeteries	TBD	TBD	TBD
Covenant United Methodist Cemetery	2715 MOUNTAIN VIEW DR	Moore (T)	Cemeteries	TBD	TBD	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
Emmanuel Lutheran Church Cemetery	3175 VALLEY VIEW DR	Moore (T)	Cemeteries	TBD	TBD	TBD
Amy Pysher's Child Care Center	885 POINT PHILLIPS RD	Moore (T)	Child Day Care	TBD	TBD	TBD
Bensing Funeral Home, Inc.	2165 COMMUNITY DR	Moore (T)	Funeral Homes	TBD	TBD	TBD
Southmoore Golf Course	235 MOORESTOWN DR	Moore (T)	Golf Courses	TBD	TBD	TBD
Woodstone Country Club	3777 DOGWOOD RD	Moore (T)	Golf Courses	TBD	TBD	TBD
Whitetail Golf Club	2679 KLEIN RD	Moore (T)	Golf Courses	TBD	TBD	TBD
138th State Legislative District	354 W Moorestown Road	Moore (T)	State Buildings	TBD	TBD	TBD
Nazareth Borough	1066 4TH ST	Nazareth (B)	Govt bldg	TBD	TBD	TBD
Nazareth Veterinary Center PC	40 W PROSPECT ST	Nazareth (B)	Animal Care	TBD	TBD	TBD
St. John's Lutheran Day Care	200 S BROAD ST	Nazareth (B)	Child Day Care	TBD	TBD	TBD
Lehigh Valley Child Care Shafer School	49 S LIBERTY ST	Nazareth (B)	Child Day Care	TBD	TBD	TBD
LV Child Care Nazareth Int School	355 TATAMY RD	Nazareth (B)	Child Day Care	TBD	TBD	TBD
Northampton Country Childcare	2 BELVIDERE ST	Nazareth (B)	Child Day Care	TBD	TBD	TBD
Kids Learning Kingdom	9 WEST ST	Nazareth (B)	Child Day Care	TBD	TBD	TBD
Bartholomew-Schisler Funeral Home, Inc.	211 E CENTER ST	Nazareth (B)	Funeral Homes	TBD	TBD	TBD
Reichel Funeral Home, Inc.	220 WASHINGTON PARK	Nazareth (B)	Funeral Homes	TBD	TBD	TBD
District Court 03-2-08	111 S SPRUCE ST	Nazareth (B)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
Nazareth Memorial Library	295 E CENTER ST	Nazareth (B)	Libraries	TBD	TBD	TBD
Martin Guitar Museum	510 Sycamore Street	Nazareth (B)	Museums	TBD	TBD	TBD
Whitefield House Museum	214 E CENTER ST	Nazareth (B)	Museums	TBD	TBD	TBD
Nazareth Key	127 E HIGH ST	Nazareth (B)	Print Media	TBD	TBD	TBD
St. John's United Church of Christ	183 S BROAD ST	Nazareth (B)	Religious (Churches, Temples)	TBD	TBD	TBD
St. John's Lutheran Church	200 S BROAD ST	Nazareth (B)	Religious (Churches, Temples)	TBD	TBD	TBD
137th State Legislative District	239 S BROAD ST	Nazareth (B)	State Buildings	TBD	TBD	TBD
United States Post Office	9 N MAIN ST	Nazareth (B)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
North Catasauqua Borough	1401 LAUBACH AVE	North Catasauqua (B)	Govt bldg	TBD	TBD	TBD
Delabar Family	1143 AMERICAN ST	North Catasauqua (B)	Child Day Care	TBD	TBD	TBD
Lehigh Valley Beekeepers Association	TBD	Northampton	Agriculture and Food - Other	TBD	TBD	TBD



SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
St. Michael's Cemetery	1000 E 4TH ST	Northampton	Cemeteries	TBD	TBD	TBD
Community Services For Children		Northampton	Child Day Care	TBD	TBD	TBD
PA DOT - Stockpile Hope Road	2977 HOPE RD	Northampton	Municipal Buildings	TBD	TBD	TBD
PA DOT - Stockpile Pen Argyl	1400 DELABOLE JCT	Northampton	Municipal Buildings	TBD	TBD	TBD
PA DOT - Stockpile Danielsville	1386 BLUE MOUNTAIN DR	Northampton	Municipal Buildings	TBD	TBD	TBD
PA DOT - Stockpile Newburg	504 NAZARETH PIKE	Northampton	Municipal Buildings	TBD	TBD	TBD
PA DOT - Northampton Cty Maint District	3300 FREEMANSBURG AVE	Northampton	Municipal Buildings	TBD	TBD	TBD
National Weather Service	TBD	Northampton	Sensor and Monitoring Systems (GPS)	TBD	TBD	TBD
Northampton Borough	TBD	Northampton (B)	Govt bldg	TBD	TBD	TBD
Duck Duck Goose	1218 CANAL ST	Northampton (B)	Child Day Care	TBD	TBD	TBD
Northampton Community Center	1601 LAUBACH AVE	Northampton (B)	Community Organization Facilities	TBD	TBD	TBD
Schisler Funeral Home	2119 WASHINGTON AVE	Northampton (B)	Funeral Homes	TBD	TBD	TBD
Reichel Funeral Home, Inc.	326 E 21ST ST	Northampton (B)	Funeral Homes	TBD	TBD	TBD
District Court 03-2-07	24 W 21ST ST	Northampton (B)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
Northampton Area Public Library	1615 LAUBACH AVE	Northampton (B)	Libraries	TBD	TBD	TBD
Grace United Church of Christ	902 LINCOLN AVE	Northampton (B)	Religious (Churches, Temples)	TBD	TBD	TBD
Assumption of the Virgin Mary	1301 NEWPORT AVE	Northampton (B)	Religious (Churches, Temples)	TBD	TBD	TBD
183rd State Legislative District	2030 CENTER ST	Northampton (B)	State Buildings	TBD	TBD	TBD
United States Post Office	1701 WASHINGTON AVE	Northampton (B)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Palmer Township	11 N ROBINSON AVE	Palmer (T)	Govt bldg	TBD	TBD	TBD
Redi-Care Medical Center	25th Street Shopping Center	Palmer (T)	Ambulatory Healthcare	TBD	TBD	TBD
William Penn Animal Hospital	3611 NICHOLAS ST	Palmer (T)	Animal Care	TBD	TBD	TBD
Serenity	3606 NICHOLAS ST	Palmer (T)	Assisted Living	TBD	TBD	TBD
Dynamic Child Care	401 Village at Stone's Crossing	Palmer (T)	Child Day Care	TBD	TBD	TBD
Little People Country Club	2940 NAZARETH RD	Palmer (T)	Child Day Care	TBD	TBD	TBD
Lehigh Valley Child Care at Easton	2601 WILLIAM PENN HWY	Palmer (T)	Child Day Care	TBD	TBD	TBD
Littlest Little People Country Club	2853 NAZARETH RD	Palmer (T)	Child Day Care	TBD	TBD	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
LPCC Extended Care at Tracy School	1243 TATAMY RD	Palmer (T)	Child Day Care	TBD	TBD	TBD
Patti Stout Group Child Day Care	2663 WASHINGTON ST	Palmer (T)	Child Day Care	TBD	TBD	TBD
Palmer Moravian Day School	2901 JOHN ST	Palmer (T)	Child Day Care	TBD	TBD	TBD
Charles Chrin Community Center of Palmer Township	4100 GREEN POND RD	Palmer (T)	Community Organization Facilities	TBD	TBD	TBD
District Court 03-2-09	3 WELLER PL	Palmer (T)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
Easton Area Public Library	1 WELLER PL	Palmer (T)	Libraries	TBD	TBD	TBD
Comfort Inn	South 25th Street and Route 22	Palmer (T)	Lodging (Hotels)	TBD	TBD	TBD
Holiday Inn Express	90 KUNKLE DR	Palmer (T)	Lodging (Hotels)	TBD	TBD	TBD
Hampton Inn	3729 EASTON NAZARETH HWY	Palmer (T)	Lodging (Hotels)	TBD	TBD	TBD
New Creation United Church of Christ	1913 FREEMANSBURG AVE	Palmer (T)	Religious (Churches, Temples)	TBD	TBD	TBD
St. Paul's Third Lutheran Church	2561 NEWBURG RD	Palmer (T)	Religious (Churches, Temples)	TBD	TBD	TBD
United States Post Office	650 S GREENWOOD AVE	Palmer (T)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Pen Argyl Borough	6292 SULLIVAN TRL	Pen Argyl (B)	Govt bldg	TBD	TBD	TBD
Morning Star Manor	306 W MAIN ST	Pen Argyl (B)	Adult Day Care	TBD	TBD	TBD
AVH Veterinary Group	1027 BLUE VALLEY DR	Pen Argyl (B)	Animal Care	TBD	TBD	TBD
Kid's Campus Nursery and Day Care	202 E MAIN ST	Pen Argyl (B)	Child Day Care	TBD	TBD	TBD
Pen Argyl Community Center	E. Main and Pennsylvania Streets	Pen Argyl (B)	Community Organization Facilities	TBD	TBD	TBD
United States Post Office	7 S ROBINSON AVE	Pen Argyl (B)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Plainfield Township	206 DIVISION ST	Plainfield (T)	Govt bldg	TBD	TBD	TBD
Chandler Estate, Inc.	1569 TEELS RD	Plainfield (T)	Adult Day Care	TBD	TBD	TBD
Operation Smart Start	1100 BLUE VALLEY DR	Plainfield (T)	Child Day Care	TBD	TBD	TBD
Sawmill Golf Course	5630 SULLIVAN TRL	Plainfield (T)	Golf Courses	TBD	TBD	TBD
BELFAST PSP	622 BANGOR RD	Plainfield (T)	PSP	TBD	TBD	TBD
Portland Borough	164 GARIBALDI AVE	Portland (B)	Govt bldg	TBD	TBD	TBD
United States Post Office	403 DELAWARE AVE	Portland (B)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Roseto Borough	209 MAIN ST	Roseto (B)	Govt bldg	TBD	TBD	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
Our Lady of Mount Carmel Cemetery	560 N 6TH ST	Roseto (B)	Cemeteries	TBD	TBD	TBD
United States Post Office	123 GARIBALDI AVE	Roseto (B)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Stockertown Borough	423 BROAD ST	Stockertown (B)	Govt bldg	TBD	TBD	TBD
United States Post Office	209 MAIN ST	Stockertown (B)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Tatamy Borough	387 Ye Olde Highway	Tatamy (B)	Govt bldg	TBD	TBD	TBD
USGS Bushkill Creek Gauge Route 33	TBD	Tatamy (B)	Sensor and Monitoring Systems (GPS)	TBD	TBD	TBD
USGS Bushkill Creek Gauge SR2017 brdg	TBD	Tatamy (B)	Sensor and Monitoring Systems (GPS)	TBD	TBD	TBD
United States Post Office	423 BROAD ST	Tatamy (B)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Portland - Columbia Toll Bridge	PO Box 377	Upper Mt Bethel (T)	Bridges	TBD	TBD	TBD
Portland - Columbia Pedestrian Bridge	TBD	Upper Mt Bethel (T)	Bridges	TBD	TBD	TBD
Mount Bethel Trinity Cemetery	632 S DELAWARE DR	Upper Mt Bethel (T)	Cemeteries	TBD	TBD	TBD
Christ Evang Lutheran Church Cemetery	703 S DELAWARE DR	Upper Mt Bethel (T)	Cemeteries	TBD	TBD	TBD
Wee Love & Care Day Care	2241 RIDGE RD	Upper Mt Bethel (T)	Child Day Care	TBD	TBD	TBD
Slate Belt Child Care	1597 S DELAWARE DR	Upper Mt Bethel (T)	Child Day Care	TBD	TBD	TBD
Bangor Area School District Day Care	123 FIVE POINTS RICHMOND RD	Upper Mt Bethel (T)	Child Day Care	TBD	TBD	TBD
USGS Delaware River Gauge Tocks Island	TBD	Upper Mt Bethel (T)	Sensor and Monitoring Systems (GPS)	TBD	TBD	TBD
137th State Legislative District	5 Mt. Bethel Plaza	Upper Mt Bethel (T)	State Buildings	TBD	TBD	TBD
Driftstone Delaware Boat Access Ramp	River Road	Upper Mt Bethel (T)	Waterways	TBD	TBD	TBD
Portland Power Plant Boat Access Ramp	5046 RIVER RD	Upper Mt Bethel (T)	Waterways	TBD	TBD	TBD
Doe Hollow Boat Access Ramp	River Road	Upper Mt Bethel (T)	Waterways	TBD	TBD	TBD
Upper Mount Bethel Township	100 NEWPORT AVE	Upper Mt. Bethel (T)	Govt bldg	TBD	TBD	TBD
Gracedale Nursing Home	3630 JACKSONVILLE RD	Upper Nazareth (T)	Senior	TBD	TBD	TBD
Upper Nazareth Township	417 S LINCOLN AVE	Upper Nazareth (T)	Govt bldg	TBD	TBD	TBD
Northampton County - Graystone Bldg	14 Gracedale Avenue	Upper Nazareth (T)	County Buildings	TBD	TBD	TBD
Walnutport Borough	1021 WASHINGTON BLVD	Walnutport (B)	Govt bldg	TBD	TBD	TBD
Pond View Manor Personal Care Home	1115 MYRTLE RD	Walnutport (B)	Assisted Living	TBD	TBD	TBD
Hill Street Children's Center	417 S LINCOLN AVE	Walnutport (B)	Child Day Care	TBD	TBD	TBD
Kidz Place	322 KIDDIE LN	Walnutport (B)	Child Day Care	TBD	TBD	TBD

SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
USGS Lehigh River Gauge at Walnutport, PA	TBD	Walnutport (B)	Sensor and Monitoring Systems (GPS)	TBD	TBD	TBD
United States Post Office	301 S BEST AVE	Walnutport (B)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD
Washington (N) Township	237 7TH ST	Washington (T)	Govt bldg	TBD	TBD	TBD
Five Points Veterinary Hospital	352 FIVE POINTS RICHMOND RD	Washington (T)	Animal Care	TBD	TBD	TBD
Childhood Treasures Day Care	2254 W BANGOR RD	Washington (T)	Child Day Care	TBD	TBD	TBD
West Easton Borough	655 CIDER PRESS RD	West Easton (B)	Govt bldg	TBD	TBD	TBD
Williams Township	TBD	Williams (T)	Govt bldg	TBD	TBD	TBD
Abington Manor	215 Cedar Park Boulevard	Williams (T)	Adult Day Care	TBD	TBD	TBD
The Center for Animal Health & Welfare	1165 ISLAND PARK RD	Williams (T)	Animal Care	TBD	TBD	TBD
Interstate 78 Toll Bridge	Administration Building	Williams (T)	Bridges	TBD	TBD	TBD
St. Anthony's Church Cemetery	Cedarville Road	Williams (T)	Cemeteries	TBD	TBD	TBD
Morgan Hill Day Care	2380 MORGAN HILL RD	Williams (T)	Child Day Care	TBD	TBD	TBD
Abby Burns Daycare	350 OLD WELL RD	Williams (T)	Child Day Care	TBD	TBD	TBD
The Club at Morgan Hill	100 CLUBHOUSE DR	Williams (T)	Golf Courses	TBD	TBD	TBD
St. John's Lutheran Church	2745 MORGAN HILL RD	Williams (T)	Religious (Churches, Temples)	TBD	TBD	TBD
Christ Evangelical Congregational Church	2100 MORGAN HILL RD	Williams (T)	Religious (Churches, Temples)	TBD	TBD	TBD
USGS Delaware River Gauge Riegelsville, NJ	TBD	Williams (T)	Sensor and Monitoring Systems (GPS)	TBD	TBD	TBD
Wilson Borough	29 MECHANIC ST	Wilson (B)	Govt bldg	TBD	TBD	TBD
Lehigh Valley Child Care at Avona School	2317 FRONT ST	Wilson (B)	Child Day Care	TBD	TBD	TBD
Miss Cheri's Daycare and Preschool	2011 WASHINGTON BLVD	Wilson (B)	Child Day Care	TBD	TBD	TBD
Finegan Funeral Home	1837 WASHINGTON BLVD	Wilson (B)	Funeral Homes	TBD	TBD	TBD
Strunk Funeral Home, Inc.	2101 NORTHAMPTON ST	Wilson (B)	Funeral Homes	TBD	TBD	TBD
District Court 03-2-12	1710 BUTLER ST	Wilson (B)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
Mary Meuser Memorial Library	1800 NORTHAMPTON ST	Wilson (B)	Libraries	TBD	TBD	TBD
24th State Senatorial District	1701 WASHINGTON BLVD	Wilson (B)	State Buildings	TBD	TBD	TBD
State Health Center - Dept Health	1600 NORTHAMPTON ST	Wilson (B)	State Buildings	TBD	TBD	TBD
Wind Gap Borough	TBD	Wind Gap (B)	Govt bldg	TBD	TBD	TBD
Children's Center of Wind Gap	58 FAIRVIEW AVE	Wind Gap (B)	Child Day Care	TBD	TBD	TBD



SECTION 2: REGIONAL PROFILE

Name	Address	Municipality	Type	Replacement Value	Building Type	Backup Power
District Court 03-3-02	31 W 1ST ST	Wind Gap (B)	Judicial Buildings (Courthouses)	TBD	TBD	TBD
United States Post Office	138 N BROADWAY	Wind Gap (B)	USPS Mail Centers (Post Offices)	TBD	TBD	TBD

Source: Lehigh Valley HMP Update Critical Facility Database

B = Borough

C = City

T = Township

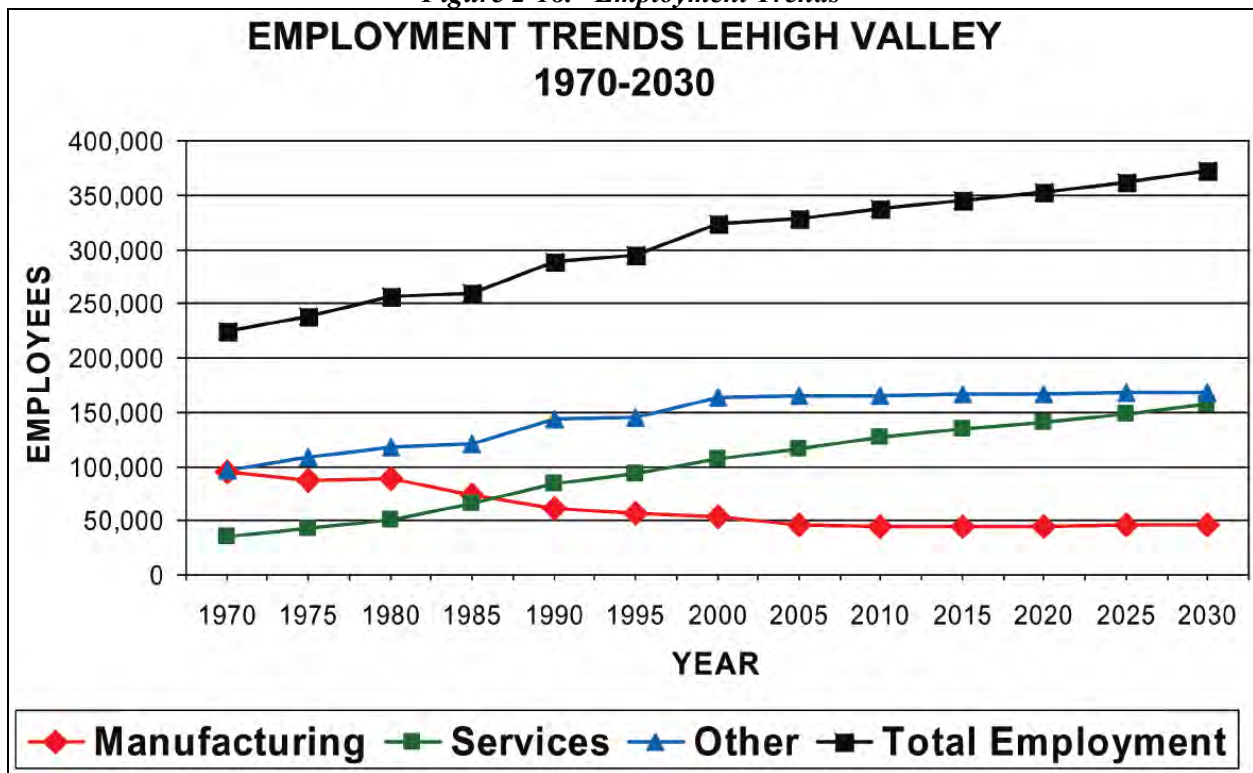
TBD = To be determined

2.9 Economic Profile

Total employment in the Lehigh Valley for 2011 was 302,400 [Lehigh Valley Profiles and Trends - 2012]. The largest non-governmental employers in the Lehigh Valley are identified in Table 2-26. The rate of unemployment in the Lehigh Valley for 2011 was 8.6%, compared to a statewide average of 7.9% and a national average of 9.0%. The median household income for 2006-2010 was \$53,541 and \$8,762 for Lehigh and Northampton Counties, respectively (LVPC, 2012).

The following information on county employment forecasts was created by the LVPC in 2006. The LVPC is currently in the process of updating these forecasts. Between 2000 and 2030, the LVPC forecasts a 15% increase in jobs in the Lehigh Valley. If trends over the last 20 years continue, most of these jobs will be in services. Manufacturing industries are likely to bottom out around current levels. Figure 2-18 illustrates these employment forecasts. The shift from manufacturing to services in the Lehigh Valley echoes national trends. The shift is occurring somewhat more rapidly in the Lehigh Valley because the area has historically had a more dominant manufacturing base than the nation. During the 1980s, 1990s and early 2000s major job losses occurred at Bethlehem Steel, Mack Truck, Agere and other manufacturing facilities. Job increases came from insurance back offices, warehousing, health care, education and personal services (LVPC, 2010).

Figure 2-18. Employment Trends



Source: LVPC, 2010

Table 2-26. Largest Employers (non-governmental)
LARGEST EMPLOYERS (NON-GOVERNMENTAL)
(Ranked by number of total employees in the Lehigh Valley)

Rank	Employer	Local Employment
1	Lehigh Valley Hospital and Health Network	9,723
2	St. Luke's Hospital and Health Network	7,222
3	Air Products and Chemicals	3,417
4	Giant Food Stores	2,339
5	PPL	2,332
6	Sodexo	2,225
7	B. Braun	1,931
8	Wegmans	1,799
9	Lehigh University	1,794
10	Wal-Mart	1,765*
11	Guardian Life Insurance Company of America	1,578
12	Northampton Community College	1,380
13	Easton Hospital	1,321
14	KidsPeace	1,250
15	Sacred Heart Healthcare System	1,230
16	Sands Casino Resort Bethlehem	1,216
17	Wells Fargo	1,213
18	Good Shepherd Rehabilitation Network	1,203
19	The Hartford Financial Services Group	1,200
20	Crayola	1,165
21	HCR Manorcare	1,150
22	Mack Trucks	1,150
23	Weis Markets	1,145
24	Lehigh Carbon Community College	1,142
25	Walgreens	1,128

*Estimate

Source: LVPC, 2011

Mineral operations are present in the Lehigh Valley. The most important mineral resource in the region is limestone. Large quantities of limestone for producing cement exist in a strip several miles wide

extending from Riverton in Lower Mount Bethel Township in Northampton County to Fogelsville in Upper Macungie Township in Lehigh County. Although the local cement industry has been in decline for decades, there is one plant in Lehigh County and four plants in Northampton County that still produce cement from local limestone deposits. Several active slate operations are also in existence. As of early 2001, there were 52 permitted mining operations in the region.

SECTION 3: PLANNING PROCESS

3.1 Introduction

This section includes a description of the planning process used to update the 2006 plan, including how it was prepared, who was involved in the process, how the public and stakeholders were involved, and how this plan coordinates and integrates with other related risk management mechanisms in the Lehigh Valley.

To ensure that the plan update met the requirements of the Disaster Mitigation Act of 2000 (DMA 2000), as well as the interests and needs within the Lehigh Valley, the plan update process and plan documentation was developed to achieve the following goals:

- Lehigh and Northampton counties, and all of the municipalities in the Lehigh Valley, have elected to actively participate in the planning process, as identified in Table 3-1.

Table 3-1. Jurisdictions Participating in the 2012 Update

Participating Jurisdictions			
LEHIGH COUNTY			
Alburtis Borough	Allentown, City of	Bethlehem, City of (LC)(NC)	Catasauqua Borough
Coopersburg Borough	Coplay Borough	Emmaus Borough	Fountain Hill Borough
Hanover Township (LC)	Heidelberg Township	Lower Macungie Township	Lower Milford Township
Lowhill Township	Lynn Township	Macungie Borough	North Whitehall Township
Salisbury Township	Slatington Borough	South Whitehall Township	Upper Macungie Township
Upper Milford Township	Upper Saucon Township	Washington Township (LC)	Weisenberg Township
Whitehall Township			
NORTHAMPTON COUNTY			
Allen Township	Bangor Borough	Bath Borough	Bethlehem Township
Bushkill Township	Chapman Borough	East Allen Township	East Bangor Borough
Easton, City of	Forks Township	Freemansburg Borough	Glendon Borough
Hanover Township (NC)	Hellertown Borough	Lehigh Township	Lower Mt. Bethel Township
Lower Nazareth Township	Lower Saucon Township	Moore Township	Nazareth Borough
North Catasauqua Borough	Northampton Borough	Palmer Township	Pen Argyl Borough
Plainfield Township	Portland Borough	Roseto Borough	Stockertown Borough
Tatamy Borough	Upper Mt. Bethel Township	Upper Nazareth Township	Walnutport Borough
Washington Township (NC)	West Easton Borough	Williams Township	Wilson Borough
Wind Gap Borough			

LC = Lehigh County; NC = Northampton County

- In addition to considering all natural hazards facing the Lehigh Valley, thereby satisfying the natural hazards mitigation planning requirements specified in DMA 2000, the plan update process has considered man-made and technological hazards believed to pose significant risk to the Lehigh Valley, and expand further upon the natural hazards in the 2006 plan.

- The plan update has been developed following the process outlined by DMA 2000, FEMA regulations, and FEMA and PEMA guidance. Following this process has ensured that all the requirements are met, and supports plan review.

The plan update was written using the best available information obtained from a wide variety of sources. Throughout plan development, a concerted effort was made to gather information from participating county and municipal agencies and staff as well as stakeholders, federal and state agencies, and the residents within the Lehigh Valley. The Steering Committee solicited information from local agencies and individuals with specific knowledge of certain natural and non-natural hazards and past historical events, as well as considering planning and zoning codes, ordinances, and other recent planning decisions. The hazard mitigation strategies identified in this plan update have been developed through an extensive planning process involving county and local agencies, municipal officials and staff, and planning area residents.

This section of the plan update describes the mitigation planning process, including (1) Organization of Planning Process; (2) Plan Update Activity; (3) Stakeholder Outreach and Involvement; (4) Public Outreach and Participation; and (5) Integration/Coordination with Existing Plans and Programs.

3.2 Organization of Planning Process

The following section describes how the many parties involved in this plan update process were organized, and describes their involvement and input to the plan update.

The 2006 plan was prepared by the Lehigh Valley Planning Commission (LVPC), Lehigh County Emergency Management Agency (LCEMA) and Northampton County Emergency Management Services (NCEMS), with participation of all jurisdictions in the Lehigh Valley. Implementation of the 2006 plan was supported by these agencies, who further prepared the “Lehigh Valley Hazard Mitigation Plan - Annual Report 2008” documenting progress since the adoption of the 2006 plan.

LCEMA and NCEMS have served as the management team to implement and manage the overall plan update process. In November of 2008, Lehigh and Northampton counties were awarded a FEMA legislative Pre-Disaster Mitigation (PDM) planning grant as part of the 2008 Hazard Mitigation Assistance (HMA) program grant cycle.

Through an open bid process, Lehigh and Northampton counties selected a contract planning consultant (Tetra Tech, Inc. – Morris Plains, New Jersey) to support the plan update process. Specifically, the planning consultant was tasked with:

- Assisting with the organization of a Steering Committee and municipal planning partnership
- Assisting with the development and implementation of a public and stakeholder outreach program
- Data collection, and review and incorporation of existing plans and documents
- Facilitation of meetings (municipal planning partnership, Steering Committee, stakeholder, public and other)
- Reviewing and updating the hazards of concern
- Updating the profiling and risk assessment for the hazards of concern, including expanded consideration of non-natural hazards
- Assistance with the update of mitigation planning goals and objectives
- Review and evaluation of progress on the county and local mitigation strategies identified in the 2006 plan
- Assistance with the screening of mitigation actions and the identification of appropriate actions

- Assistance with the prioritization of mitigation actions
- Authoring of the draft and final plan documents

To facilitate the plan update process, LCEMA and NCEMS, with support from the contract planning consultant, established a Steering Committee to provide guidance and direction to the plan update effort, and to ensure the resulting document will be embraced both politically and by the constituency within the Lehigh Valley. The Steering Committee provided guidance and leadership, oversight of the planning process, and acted as the point of contact for all municipal planning partners and the various stakeholder and interest groups in the Lehigh Valley. Specifically, the Steering Committee was charged with the following responsibilities:

- Review the original plan and identify what is needed and desired in the plan update;
- Establish a timeline for the plan update process;
- Ensure that the plan update meets the requirements of prevailing Federal regulations and Federal and State guidance;
- Solicit and document the participation of all municipalities in the plan update process;
- Organize and oversee the public and stakeholder involvement process;
- Provide input to update the hazards of concern identified in the 2006 plan;
- Assist in gathering information for inclusion in the plan update, including the use of previously developed reports and data;
- Review and approve the data and information used within the plan update;
- Assist with review of the mitigation planning goals and objectives;
- Review and update the County-level mitigation strategy;
- Review and approve sections of the plan update;
- Adopt and maintain the plan update.

Table 3-2 shows the membership of the Steering Committee at the time of this plan update’s publication.

Table 3-2. Lehigh Valley Hazard Mitigation Plan Update Steering Committee Membership

Name	Title	Department / Agency
Angel Gillette, CEM	Manager, Hazard Mitigation and Disaster Recovery	Northampton County Emergency Management Services
Robert Mateff, ENP	Director/Coordinator	Northampton County Emergency Management Services
William Hillanbrand, MA	Emergency Management Planning Manager	Northampton County Emergency Management Services
Nick Tylenda	Deputy Director	Northampton County Emergency Management Services
Todd Weaver, ENP	Deputy Director for Systems Management	Northampton County Emergency Management Services
Tanya Hook	County Mitigation Lead – Community Outreach Coordinator	Lehigh County Emergency Management Agency
Thomas Nervine	Director	Lehigh County Emergency Management Agency
Nicole Burton	Administrative Assistant	Lehigh County Emergency Management Agency

Name	Title	Department / Agency
David Fenton	Operations and Training Coordinator	Lehigh County Emergency Management Agency
Geoffrey Reese, PE	Assistant Director	Lehigh Valley Planning Commission
Susan Rockwell	Senior Environmental Planner	Lehigh Valley Planning Commission

One of the first actions of the Steering Committee was to invite all municipalities in the Lehigh Valley to participate in the plan update process, and to formalize and document their intent to participate. In August 2011, all municipalities within the Lehigh Valley were notified of the pending planning process and invited to formally participate. Municipalities were asked to formally notify Lehigh County Emergency Management Agency and Northampton County Emergency Management Services of their intent to participate via a Letter of Intent, a sample of which is included in Appendix D, and to identify a primary and secondary planning point of contact to serve as their municipal representatives throughout the planning process.

Each municipality received a copy of the “Planning Partner Expectations” which outlined the responsibilities of all plan participants. All participating jurisdictions were charged with the following responsibilities:

- Identifying municipal representatives to serve as the planning points of contacts (POCs), responsible for representing the community and assuring that participation expectations are met;
- Providing representation at regular planning group meetings and workshops;
- Providing data and information as requested;
- Assisting with the identification of stakeholders within the community that should be informed and potentially involved with the planning process;
- Facilitating public outreach efforts with citizens and local stakeholders within their community;
- Assisting with the identification of past, ongoing and appropriate future mitigation strategies and activities;
- Reviewing and commenting on plan documents, specifically the draft plans prior to submission to PEMA and FEMA;
- Adopting the plan update by resolution of the governing body after FEMA conditional approval.

It is noted that the municipal Letter of Intent to Participate in the 2012 plan update includes language authorizing the Steering Committee to “guide and direct this planning process, perform certain parts of the planning process, and prepare certain parts of the plan document” on their behalf. As such, this planning effort was organized generally according to the “Combination Model” identified in FEMA 386-8.

The Letter of Intent to Participate identifies the municipal planning partner expectations as those activities comprising overall participation by jurisdictions throughout the planning process. It is not meant, however, to serve as an explicit determinant of jurisdictional participation. It is recognized that the jurisdictions in the Lehigh Valley have differing levels of capabilities and resources available to apply to the planning process, and further have differing exposure and vulnerability to the natural and non-natural hazard risks being considered in this plan update. It was the Steering Committee’s intent to encourage participation by all inclusive jurisdictions, and to accommodate their specific needs and limitations while still meeting the intents and purposes of plan participation, the regulations and prevailing guidance. Such

accommodations have included the establishment of a Steering Committee and engaging a contract consultant to assume certain elements of the planning process on behalf of the jurisdictions, providing multiple sessions of municipal meetings, and providing additional and alternative mechanisms to meet the intent of participating in the planning process.

Ultimately, jurisdictional participation is evidenced by a completed annex (chapter) of the plan update wherein the jurisdiction has identified their planning POCs, evaluated their risk to the hazards of concern, identified their capabilities to effect mitigation in their community, and identified and prioritized an appropriate suite of mitigation initiatives, actions, and projects to mitigate their hazard risk; and eventually by the adoption of the plan update via resolution.

As all municipalities were encouraged to promote broad participation from the various departments and representatives within their community, we herein refer to the municipalities along with their planning POCs and others within their community that participated in the overall process as the “municipal planning partnership”, and the universe of county and local participants as the “planning partnership”.

The municipal planning POCs designated by the jurisdictions as of the date of the plan update are provided in each municipality’s annex in Section 9.

3.3 Plan Update Activity

During the course of the plan update, the Steering Committee and municipal planning partnership worked together through a variety of methods and venues to address the various elements of the plan update process, as summarized in Table 3-3, and further documented in the meeting agendas and minutes in Appendix C.

Municipalities, through their POCs and other municipal representatives, stakeholders and residents, actively participated through a program of meetings, forums, workshops, and other data and information collection and input mechanisms. Municipal level planning activities included a series of project meetings offered at multiple times and locations to accommodate the varying schedules of plan participants, augmented with direct local assistance through onsite meetings and phone and email support. Through these activities, municipalities were able to gather and share information, identify specific hazard areas and vulnerabilities, develop and update their local assets including critical facilities, identify their local capabilities to mitigate hazard risk, identify progress on their 2006 local mitigation strategies, and update their local strategies with new projects and initiatives addressing their local risks and vulnerabilities.

Table 3-3 presents a summary of project activities implemented, and milestones met, during the planning process for this update.

Table 3-3. Summary of Project Activity and Milestones

Date	Description of Activity	Participants
August 2008	Annual Plan Review and Report: Prepared a plan progress report, documenting progress to date on the 2006 plan.	Lehigh and Northampton counties; LVPC; all municipalities that participated in the 2006 plan.
July 7, 2011	Project Management /Steering Committee Meeting: Discuss project scope of work; assignment of responsibilities and schedule; establish program for inviting, promoting and documenting municipal participation; discuss Steering Committee membership including	Angel Gillette, Bob Mateff – NCEMS; Tanya Hook, Tom Nervine – LCEMA; Jonathan Raser, Cynthia Bianco, Alison Miskiman - Tetra Tech

SECTION 3: PLANNING PROCESS

Date	Description of Activity	Participants
	stakeholder involvement; review data collection and risk assessment progress; discuss review of 2006 plan, crosswalk and 2010 state plan, and establish plan update requirements; discuss public and stakeholder outreach strategy; discuss progress reporting and the tracking of “in kind” service.	
August 4, 2011	Project and Grant Meeting: Meeting with PEMA and FEMA Region III staff to discuss project execution, and project and grant administration.	Angel Gillette, Bob Mateff – NCEMS; Tanya Hook, Tom Nervine, Nicole Burton – LCEMA; Tess Grubb, Crystal Newman, Matt McCullogh – FEMA Region III; Jonathan Raser - Tetra Tech
September 2011	NCEMS develops and launches project Hazard Mitigation Planning website, including Citizens Hazard Preparedness / Public Awareness questionnaire.	NCEMS; public and stakeholders
October 26, 2011	Meeting with LVPC: Review and compile available data, reports and documents, including GIS data, model ordinances, and Act 167 Stormwater Management Plans.	Michael Kaiser, Geoffrey Reese, Susan Rockwell – LVPC; Jonathan Raser – Tetra Tech
October 2011	LVPC includes article on plan update process with links to public website and citizen survey in the 4Q11 edition of their newsletter.	LVPC; public and stakeholders
October 2011	Planning partnership provided tri-fold brochure for local public distribution, explaining the HMP program, how to provide input to the process, and local contact information.	Planning partnership, public
November 17, 2011 (2 identical sessions, afternoon and evening)	Municipal “Kick Off” Meeting – Northampton County: Provided overview of planning process, plan participant expectations, review of hazards and hazards of concern identification exercise, discussion of data needs, and discussion of public and stakeholder outreach efforts. Each municipality was provided survey forms for completion (Contact and Municipal Information, Evaluation of Identified Hazards, Capability Assessment).	Representatives from Northampton County municipalities (see Sign-In Sheets, Appendix C); Tetra Tech
November 29, 2011 (2 identical sessions, afternoon and evening)	Municipal “Kick Off” Meeting – Lehigh County: Provided overview of planning process, plan participant expectations, review of hazards and hazards of concern identification exercise, discussion of data needs, and discussion of public and stakeholder outreach efforts. Each municipality was provided survey forms for completion (Contact and Municipal Information, Evaluation of Identified Hazards, Capability Assessment).	Representatives from Lehigh County municipalities (see Sign-In Sheet, Appendix C); Tetra Tech
December 13, 2011	Northampton County Council of Governments and Municipalities – Joint Meeting: Project presentation by Angel Gillette explaining the status of the project and encouraging broad local participation.	Northampton County Council of Governments and municipal representatives (see Appendix E)
December 19, 2011	Steering Committee Meeting: Review overall project progress and discuss schedule; review progress on data collection and critical facility inventory; review status of regional profile; review	Angel Gillette, Bob Mateff – NCEMS; Jim Lakey – Northampton County GIS; Tanya Hook, David Fenton, Tom Nervine – LCEMA; Geoff Reese - LVPC; Jonathan

SECTION 3: PLANNING PROCESS

Date	Description of Activity	Participants
	updated hazards of concern, profiling and risk assessment progress; review municipal participation; discuss ongoing public and stakeholder outreach.	Raser - Tetra Tech
January 17, 2012	Municipal Project Meeting - Northampton County: Provided an overview of planning process and progress to date; reviewed selection of hazards and hazards of concern; discussed data needs and progress on local data collection; discussed progress on public and stakeholder outreach efforts. Each municipality was provided survey forms for completion (Contact and Municipal Information, Evaluation of Identified Hazards, Capability Assessment).	Representatives from Northampton County municipalities (see Sign-In Sheets, Appendix C); Angel Gillette – NCEMS; Cynthia Bianco - Tetra Tech
January 24, 2012	Municipal Project Meeting – Lehigh County: Provided an overview of planning process and progress to date; reviewed selection of hazards and hazards of concern; discussed data needs and progress on local data collection; discussed progress on public and stakeholder outreach efforts. Each municipality was provided survey forms for completion (Contact and Municipal Information, Evaluation of Identified Hazards, Capability Assessment).	Representatives from Lehigh County municipalities (see Sign-In Sheets, Appendix C); Tanya Hook, David Fenton – LCEMA; Jonathan Raser - Tetra Tech
March 26, 2012	Stakeholder Outreach Workshop, Northampton County: Conducted workshop with county and regional stakeholders to identify regional hazard vulnerabilities and capabilities, and screen a broad range of mitigation alternatives for use by the planning partnership.	Brian Harris, Tom Barnowski – Bushkill Township; Dave Malloy – PADEP; Gregory Long – Moravian College; Bob Mateff – NCEMS; Cordelia Miller – ARC; May Ellen Keegan – Monroe County EMA; Barry Downes, Diane Coffin, Kathleen McVeigh– Pennsylvania Power and Light; Marvin Gruber – NC Facilities; Mark Nalesnik – Carbon County EMA; Mark Stein – Bethlehem Area SD; Ken Johnson – Bethlehem Township VFC; Gary Falasen – Lehigh University; Kristen Wenrich – Bethlehem Health Bureau; Alice Rehrig – Lehigh Township; John Bast – City of Easton; Jeff Troxell – Lafayette College; Angel Gillette, William Hillanbrand, Nick Tylenda – NCEMS; Jonathan Raser, Kris Mattson -Tetra Tech
March 27, 2012	Stakeholder Outreach Workshop, Lehigh County: Conducted workshop with county and regional stakeholders to identify regional hazard vulnerabilities and capabilities, and screen a broad range of mitigation alternatives for use by the planning partnership.	William Bellas – PennDOT; Joel Calario – Allentown EMS; Ben Galiardo – Lower Macungie; John Dondero – Lower Milford Police Department; Mark Lapos – Parkland SD; Michael Nonemacher – Emmaus Ambulance Corp.; Judy Borger – Carbon County EMA; Vincent D’Angelo - PA State Police; Glenn Solt – LC General Services; Mark Rosania – Pinebrook Family Services; Barry Rodenbough – Allentown SD; Cordelia Miller - LV Red Cross; Larry Wiersch – Cetronia Ambulance; Kevin Gram – LC Authority; Grant Grimm - Upper Macungie Township; John Kalynych – LC EMA; Christopher Greb – Macungie Ambulance; MaryEllen Shiels – Allentown



SECTION 3: PLANNING PROCESS

Date	Description of Activity	Participants
		Health Bureau; Tanya Hook, David Fenton, Tom Nervine, Valerie Brooks – LC EMA; Jonathan Raser, Kris Mattson -Tetra Tech
April 2, 2012	Public Meeting – Northampton County: Public presentation describing the planning process; presenting information on the hazard profiling and risk assessment; and soliciting public input to the planning process.	Angel Gillette – NCEMS; Jonathan Raser, Kris Mattson -Tetra Tech
April 4, 2012	Public Meeting – Lehigh County: Public presentation describing the planning process; presenting information on the hazard profiling and risk assessment; and soliciting public input to the planning process.	Tanya Hook, David Fenton – LCEMA; Jonathan Raser, Kris Mattson -Tetra Tech
April 24, 2012	Planning Committee Meeting - Northampton County: Jurisdictional Annex Workshop to provide participating jurisdictions with draft templates, tools and resources to develop their chapter (jurisdictional annex) to the plan update.	Representatives from Northampton County municipalities (see Sign In sheets, Appendix C); Kelsey Walko – PEMA; Therese Grubb – FEMA Region III; Angel Gillette, Nick Tylenda – NCEMS; Jonathan Raser - Tetra Tech
April 26, 2012	Planning Committee Meeting, Lehigh County - Jurisdictional Annex Workshop to provide participating jurisdictions with templates, tools and resources to develop their chapter (jurisdictional annex) to the plan update.	Representatives from Lehigh County municipalities (see Sign In sheets, Appendix C); Tanya Hook, David Fenton, Tom Nervine - LCEMA; Jonathan Raser - Tetra Tech
May 10, 2012	Planning Committee Meeting – Lehigh and Northampton counties: Jurisdictional Annex Workshop to provide participating jurisdictions with draft templates, tools and resources to develop their chapter (jurisdictional annex) to the plan update.	Representatives from Northampton and Lehigh County municipalities (see Sign In sheets, Appendix C); Tanya Hook , Tom Nervine – LCEMA; Angel Gillette – NCEMS; Jonathan Raser, Paul Miller - Tetra Tech
May 12, 2012	PA Silver Jackets (State Hazard Mitigation Committee) Quarterly Meeting in Harrisburg, PA – Plan update project identified and discussed.	State Hazard Mitigation Committee members; Lehigh and Northampton county and Steering Committee representatives
April 2012 – March 2013	Lehigh and Northampton county and Steering Committee representatives and contract consultant work with municipalities to complete their jurisdictional annexes, including the identification and prioritization of mitigation initiatives and projects.	All participating municipalities; Lehigh and Northampton county and Steering Committee representatives; Tetra Tech
June 14, 2012	Steering Committee Meeting – Review project progress and municipal participation; review and approve plan maintenance and update procedures; discuss posting of draft plan for public and stakeholder comment; review plan completion schedule.	Thomas Nervine, Tanya Hook – LC EMA; Bob Mateff, Angel Gillette – NCEMS; Jonathan Raser – Tetra Tech
August, 2012	Project hazard mitigation planning website updated to include interim draft sections of the plan for public review and comment.	NCEMS, public and stakeholders
September 12, 2012	County Level Mitigation Strategy Meeting: Meeting to review draft updated county level mitigation strategies, review draft sections of the plan, discuss progress on municipal annexes.	Angel Gillette, William Hillanbrand, Bob Mateff – NCEMS; Tanya Hook, Tom Nervine – LCEMA; Jonathan Raser - Tetra Tech
September 2012	Updated draft plan sections posted to project HMP website. Counties and participating municipalities inform the public of the availability of the draft for	NCEMS; All participating municipalities

Date	Description of Activity	Participants
	review.	
September 28, 2012	Northampton County Association of Township Officials Annual Meeting – Plan update process and status of municipal participation presented to Northampton County Township Officials, encouraging planning support at the local government level.	Northampton County Township officials; Jonathan Raser – Tetra Tech
October 23, 2012	LVPC Environmental Committee meeting - Plan update process and status of municipal participation presented to the Environmental Committee, encouraging support for municipal participation.	LVPC Environmental Committee members; Jonathan Raser – Tetra Tech
November 29, 2012	LVPC Monthly Board meeting - Plan update process and status of municipal participation presented to the LVPC Board, encouraging support for municipal participation.	LVPC Board members; Jonathan Raser – Tetra Tech
November, 2012	Draft plan update (less jurisdictional annexes) submitted to PEMA / FEMA for preliminary review.	PEMA / FEMA Region III
March 25, 2013	Complete draft plan posted to project website and announced to public via legal notice, website announcement and media release.	Lehigh and Northampton Counties; public.
April 2013	Public, Stakeholder and Steering Committee comments and updates incorporated into final draft plan.	Steering Committee
May 1, 2013	Draft plan update (complete) submitted to PEMA / FEMA for review and approval.	Lehigh and Northampton Counties; PEMA
Upon FEMA approval	Plan adopted via resolution by all plan participants	All participating jurisdictions

EMA = Emergency Management Agency

FEMA = Federal Emergency Management Agency

GIS = Geographic Information Systems

LCEMA = Lehigh County Emergency Management Agency

LVPC = Lehigh Valley Planning Commission

NCEMS = Northampton County Emergency Management Services

PEMA = Pennsylvania Emergency Management Agency

PennDOT = Pennsylvania Department of Transportation

SD = School District

VFC = Volunteer Fire Company

3.4 Stakeholder Outreach and Involvement

Diligent efforts were made to assure broad regional, county and local representation in this planning process. To that end, a comprehensive list of stakeholders was developed with the support of the Steering Committee. Stakeholder outreach was performed early on, and continually throughout the planning process, and included the following methods of outreach and involvement:

- Critical county and regional stakeholders served on the Steering Committee (see Steering Committee membership earlier in this section).
- Key State and Federal stakeholders (including PEMA and FEMA Region III) met directly with the Steering Committee and attended certain planning meetings throughout the plan update process.
- Members of the Steering Committee and municipal planning partnership serve on and/or participate with various regional, county and local stakeholder groups (e.g. Delaware River Basin Commission, Community Emergency Response Teams (CERTs), Local Emergency Planning

Committees (LEPCs); Schools, Fire and Police Departments, Emergency Medical Services, utility authorities, and hazardous material response teams).

- The project was presented at numerous regularly scheduled stakeholder group meetings throughout the Lehigh Valley, wherein stakeholders were encouraged to provide input to the process and plan update relevant to their mission and purview.
- Mitigation survey forms (see Appendix E) were developed to elicit specific, relevant mitigation information. The surveys were distributed to the following stakeholder groups:
 - Emergency Medical Service Providers
 - Firefighters
 - Law Enforcement
 - Hospitals and Health Care Facilities
 - Schools Districts and Higher Education
 - Utilities
 - Business/Commerce
- In March 2012, a large and diverse group of stakeholders were invited to participate in a hazard mitigation workshop, held in each of the two counties (see invitation list in Appendix E). The reason for this meeting was to explain the purpose and benefits of mitigation planning, and to help identify potential mitigation strategies (initiatives, programs, projects) to be included in the plan update. The meeting was an open forum, facilitated by the contract consultant for this project, in the format of a Strengths, Weaknesses, Obstacles and Opportunities (SWOO) exercise. This interactive exercise was designed to screen a broad range of potential mitigation initiatives to address those hazards that pose the greatest risk in the Lehigh Valley, in order to identify specific mitigation initiatives at the regional, county and local level for inclusion in the plan update.

The following is a list of the various stakeholders that were invited to participate in the development of this plan update, along with a summary of how these stakeholders participated and contributed to the plan. It should be noted that this summary listing cannot possibly represent the universe of stakeholders that were aware of and/or contributed to this plan update. Outreach efforts were being made, both formally and informally, throughout the process by the many planning partners involved in the effort, and documentation of all such efforts is impossible. Rather, this summary is intended to demonstrate the scope and breadth of the stakeholder outreach efforts made during the development of this plan update.

Information and input provided by these stakeholders has been included throughout this plan update where appropriate, as identified in the references.

3.4.1 Federal, State and Regional Agencies

Federal Emergency Management Agency (FEMA) Region III: Provided planning grant funding; provided programmatic guidance and support; attended and facilitated certain project meetings; provided National Flood Insurance Program (NFIP) data for the Lehigh Valley; provided input on risk ranking (risk factor) process; reviewed plan update documents.

Pennsylvania Emergency Management Agency (PEMA): Attended and facilitated certain project meetings; provided grant administration support and guidance; provided recent FEMA planning guidance; provided programmatic, technical and administrative assistance.

Pennsylvania Department of Environmental Protection (PADEP): Invited to participate on the Steering Committee. The PADEP sanitarian supervisor attended the March 2012 stakeholder workshop and provided input on mitigation support and efforts available through PADEP.

Pennsylvania Department of Transportation (PennDOT): Attended the March 2012 stakeholder workshop and provided input on mitigation activities for state infrastructure in the Lehigh Valley.

American Red Cross of the Greater Lehigh Valley: Provided data on shelters and sheltering. Attended March 2012 stakeholder outreach workshops; discussed issues with sheltering and utility outages.

United States Army Corps of Engineers: Provided data and information on dams and levees in the Lehigh Valley.

3.4.2 Lehigh and Northampton County Government Agencies

Northampton County Emergency Management Services (NCEMS): Mitigation project management; provided grant and contract application and administrative support; provided direct representation on the Steering Committee; provided data and information on assets and vulnerabilities throughout the County; supported public and stakeholder outreach including hosting the public HMP website; identified completed and ongoing mitigation activities and updates to the county and local mitigation strategies; reviewed and provided comment on draft plan sections; and facilitated regional mitigation planning coordination.

Lehigh County Emergency Management Agency (LCEMA): Assisted NCEMS with mitigation project management; provided direct representation on the Steering Committee; provided data and information on assets and vulnerabilities throughout the County; supported public and stakeholder outreach; identified completed and ongoing mitigation activities and updates to the county and local mitigation strategies; reviewed and provided comment on draft plan sections; and facilitated regional mitigation planning coordination.

Lehigh Valley Planning Commission (LVPC): Provided representation on the Steering Committee; provided regional data and information, plans and studies; supported public and stakeholder outreach, assisted with the identification of county and local vulnerabilities; reviewed and provided comments on draft plan sections.

Lehigh County Geographic Information Systems (GIS) Department: Provided critical GIS data for Lehigh County.

Northampton County GIS Department: Provided critical GIS data for Northampton County.

Lehigh County General Services: Attended a March 2012 stakeholder outreach workshop; provided information on the capabilities and services available through general services that can support regional mitigation, emergency and risk management; and provided input on mitigation projects addressing Lehigh County-owned assets.

Northampton County Department of Community and Economic Development (NCDCED): Provided input on their capabilities to support regional mitigation and disaster recovery; provided information on growth and development in the region; identified vulnerabilities in the county; and identified specific initiatives to improve disaster response and recovery.

Northampton County Department of Public Works (NCDPW): Provided information on the capabilities and services available through the public works division that can support mitigation, emergency and risk management; provided information on potential mitigation projects addressing Northampton County-owned assets. Public Works and Emergency Management staff conducted site visits to potential mitigation project areas in April 2012. This was further supported by the County's contract engineer (Borton-Lawson), who assisted with identifying vulnerable county infrastructure and developing mitigation projects to address these vulnerabilities.

3.4.3 Surrounding Counties

All counties bordering the Lehigh Valley (including Hunterdon County, New Jersey) were invited to attend the March 2012 stakeholder outreach meetings to learn about the plan update project and provide input and coordination into the process. Invitations were sent to the County Emergency Managers. Representatives from Carbon and Monroe counties attended the stakeholder outreach workshops in March 2012, discussed hazard vulnerabilities in their county, and provided input to this plan update.

3.4.4 Fire Services

Fire Companies – Fire companies in Lehigh and Northampton counties were provided with the Fire Services mitigation survey developed for this process, and invited to attend the March 2012 stakeholder outreach workshops. The following fire companies either provided completed surveys (see Appendix E) and/or attended the March 2012 workshops:

- Bethlehem Township Volunteer Fire Department
- Catasauqua Borough Fire Department
- East Allen Township Fire Department
- Hanover Township (LC) Fire Department
- Forks Township Fire Department
- New Tripoli Fire Company

Their input, including the identification of specific hazard vulnerabilities and/or mitigation strategies, has been incorporated into this plan update as appropriate.

3.4.5 Police and Law Enforcement Services

Municipal police departments in the Lehigh Valley were provided an opportunity to provide input to the planning process through their municipal contacts, including identifying hazard vulnerabilities, and identifying potential mitigation projects and activities. Each police department was provided the Law Enforcement mitigation survey form developed for this process, and invited to attend the March 2012 stakeholder outreach workshops.

The following police departments either provided completed surveys (see Appendix E) and/or attended the March 2012 workshops:

- Coopersburg Police Department
- Hanover Township (LC) Police Department
- Lehigh Township Police Department
- Lower Milford Police Department
- Lower Saucon Police Department

- Pennsylvania State Police
- Upper Saucon Police Department

Their input, including the identification of specific hazard vulnerabilities and/or mitigation strategies, has been incorporated into this plan as appropriate.

3.4.6 School Districts and Higher Education

All Lehigh and Northampton County school districts and higher education institutions were provided the opportunity to provide input to the planning process, including being provided with the School District and Higher Education mitigation survey form, and were invited to attend the March 2012 stakeholder outreach workshops.

The following school districts and higher education institutions either provided completed surveys (see Appendix E) and/or attended the March 2012 workshops:

- Allentown School District
- Bethlehem Area School District
- Parkland School District
- Easton Area School District
- Southern Lehigh School District
- DeSales University
- Lafayette College
- Lehigh University
- Moravian College
- Northampton Community College
- Lehigh Carbon Community College

Their input, including the identification of specific hazard vulnerabilities and/or mitigation strategies, has been incorporated into this plan update as appropriate, including needs for backup power and other improvements at schools used for sheltering, and initiatives to improve emergency management preparedness coordination prior to mass-gathering events.

3.4.7 Hospitals, Health Care and Emergency Medical Services

Owners/operators of hospitals and health care facilities, and health agencies in the Lehigh Valley, were provided the Hospitals and Health Care Facilities mitigation survey developed for this process, and were invited to attend the March 2012 stakeholder outreach workshops. Emergency Medical Services (EMS) providers in the Lehigh Valley were provided the Emergency Medical Services mitigation survey developed for this process, and were invited to attend the March 2012 stakeholder outreach workshops.

The following hospitals, health care facilities, health services and EMS providers in the Lehigh Valley either provided completed surveys (see Appendix E) and/or attended the March workshops:

- City of Allentown EMS
- Cetronia Ambulance
- Emmaus Ambulance Corporation
- Macungie Ambulance
- Allentown Health Department

- Bethlehem Health Department

Their input, including the identification of specific hazard vulnerabilities and/or mitigation strategies, has been incorporated into this update as appropriate.

3.4.8 Transportation

Pennsylvania Department of Transportation (PennDOT): Attended the March 2012 stakeholder workshops and provided input on mitigation activities for state transportation infrastructure in the Lehigh Valley.

3.4.9 Utilities

Pennsylvania Power and Light (PPL): Attended the stakeholder outreach workshops in March 2012; provided data and information on PPL risk management programs; provided public outreach materials related to personal and commercial risk mitigation. Hosted a public outreach meeting where the plan update process was presented.

Outreach to utilities serving the Lehigh Valley was facilitated and supported through the distribution of the Utilities Stakeholder Survey. Specific information and input provided by these entities has been incorporated into this plan update as appropriate, including the distribution of public outreach information/materials provided by PPL through the countywide public education and outreach initiatives.

3.4.10 Business and Commerce

Outreach to business and commercial entities in the Lehigh Valley was facilitated and supported through the distribution of the Business/Commerce Stakeholder Survey, and through invitation to attend the stakeholder workshops in March 2012. Respondents to this survey include Pinebrook Family Services.

Further, several businesses in the Lehigh Valley supported the public outreach process by hosting forums where this plan update process was presented to the public (see following subsection). Specific information and input provided by these entities has been incorporated into this plan update as appropriate.

3.5 Public Outreach and Participation

In order to facilitate coordination and communication with the Steering Committee, planning partnership and citizens, numerous methods of public outreach were conducted to inform the public of the plan update and encourage participation in the planning process. The following public outreach efforts were made during the development and review of this plan update:

- Members of the Steering Committee made presentations on the project at the following meetings to explain the project and process, and to encourage full and broad municipal participation:
 - Four Seasons at Farmington Community Outreach Meeting (1/23/12 – 7pm)
 - Meeting with Lehigh County Aging and Adult Services (3/6/12 – 10am)
 - Lehigh County Bicentennial Celebration at Ag Hall (3/10/12 – 11am to 8pm)
 - Emergency Preparedness Outreach Event at Liberty Resources (Allentown, 3/29/12 – 10am)

- Emergency Preparedness Outreach Event at Lutron Electronics (Upper Saucon, 5/22/12 – 11 am)
 - Emergency Preparedness Outreach Event at Lutron Electronics (Upper Saucon, 5/22/12 – 12 pm)
 - Emergency Preparedness Outreach Event at Lutron Electronics (Upper Macungie, 6/11/12 – 10am)
 - Emergency Preparedness Outreach Event at Lutron Electronics(Upper Macungie, 6/11/12 – 4pm)
 - Emergency Preparedness Outreach Event at Lutron Electronics (Emmaus, 6/15/12 – 12 pm)
 - LC Lunch and Learn at PPL (Allentown, 9/13/12 – 12 pm)
 - LC Parkland Emergency Preparedness Day (South Whitehall, 9/15/12 – 11am)
 - LC Wells Fargo Safety Fair (Bethlehem, 9/25/12 – 11am)
 - LC Lunch and Learn at Wells Fargo (Bethlehem, 9/26/12 – 11am)
 - LC Points of Pride Parade (Allentown, 9/29/12 – 11am)
- Northampton County Emergency Management Services developed a public Hazard Mitigation Planning webpage (http://www.nc911.org/html/hazard_mitigation.html) to explain the project and elicit public participation in the process and input into the plan update. The webpage was launched in September 2011. See Appendix E for further views of the webpages and content.



**LEHIGH VALLEY
HAZARD MITIGATION PLAN
UPDATE**

*****Citizen Hazard Preparedness Survey*****

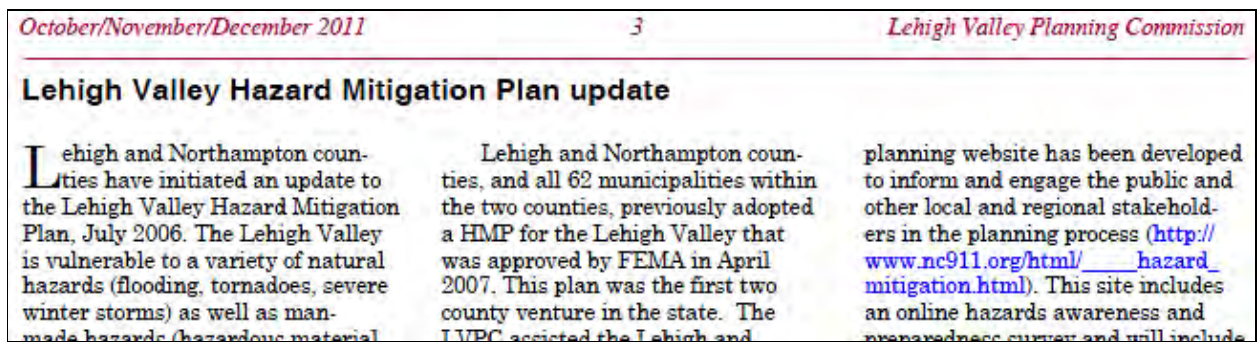
 [HMGP Application Timelines Update](#)

- [Hazard Mitigation Plan 2012 Update - Introduction](#)
- [What is Hazard Mitigation?](#)
- [How does this Plan benefit the Lehigh Valley?](#)
- [How can I get involved?](#)
- [County Contacts](#)
- [Plan Update Steering Committee](#)
- [Public Outreach Events and Activities](#)
- [2006 Hazard Mitigation Plan](#)
- [Resources and Links](#)
- [Stakeholder Forms](#)

- An on-line natural hazards preparedness citizen survey was developed to gauge household preparedness that may impact the Lehigh Valley and to assess the level of knowledge of tools and techniques to assist in reducing risk and loss from those hazards (<http://www.surveymonkey.com/s/G7PYYW7>). The questionnaire asked 23 quantifiable questions about citizen perception of risk, knowledge of mitigation, and support of community programs. The questionnaire also asked several demographic questions to help analyze trends.

The questionnaire has been available on the public website since September 2011, and further advertised in the project tri-fold brochure (see below), through email distribution lists, and local newsletters. Appendix E summarizes public input received through the website, the online survey, and other sources.

- A hazard mitigation planning tri-fold brochure (see Appendix E) was developed to inform the public of the planning process, provide local contact information, and encourage the public to review the plan and provide input. Lehigh County distributed the brochure at the various Citizen Corps, Local Emergency Planning Committee (LEPC), Local Emergency Planning Coordinators Meetings, and the various community outreach events that were conducted from March to August (see above list of events).
- The Lehigh Valley Planning Commission included an article entitled “Lehigh Valley Hazard Mitigation Plan Update” in their October/November/December 2011 newsletter. The full article is provided in Appendix E.



- A round of public meetings was offered in Northampton County and Lehigh County in April 2012 to present the results of the risk assessment, and to encourage public input to the planning process.
- The project has been presented by members of the Steering Committee at various regularly scheduled local meetings to encourage awareness of the project and elicit input to the plan update, including the following:
 - LC Citizens Corps Meeting (2/22/12 – 3 pm)
 - LC Local Emergency Management Coordinators Meeting (3/8/12 – 7 pm)
 - LC Local Emergency Management Coordinators Meeting (4/12/12 – 7 pm)
 - LC Local Emergency Planning Committee (LEPC) Meeting (6/14/12 – 10 am)
 - LC Citizen Corps Meeting (6/27/12 – 3 pm)
 - LC Council of Governments Meeting (9/11/12- 1pm)
 - NC LEPC Meeting (3/7/12 – 10 am)
 - NC LEPC Meeting (6/6/12 – 10 am)
 - NC Local Emergency Management Coordinators Meeting (6/13/12 – 7 pm)
 - NC Local Emergency Management Coordinators Meeting (8/8/12 – 7 pm)

- NC Council of Governments Meeting (6/14/12- 10 am)
 - NC Council of Governments Meeting (8/13/12- 10 am)
 - NC Council of Governments Meeting (9/11/12- 10 am)
 - NC Public Safety Briefing (6/9/11 – 7 pm)
 - NC Public Safety Briefing (4/12/12 – 7 pm)
 - NC Public Safety Briefing (6/14/12 – 7 pm)
 - NEPARTF VOAD Subcommittee Meeting (6/23/12 – 10 am)
 - Lehigh Valley Disaster Relief Task Force Meeting (8/9/12 – 10 am)
- The plan update process was discussed at the PA Silver Jackets (State Hazard Mitigation Committee) Quarterly Meeting in Harrisburg, PA on May 12, 2012.
 - Draft and final versions of the plan update have been posted to the public website (http://www.nc911.org/html/hazard_mitigation.html) for public review and comment, as they became available.
 - The complete draft plan was posted to the public website in March 2013 and advertised via legal notice, on both County emergency management homepages, and through press releases to local media.
 - The two counties and all municipalities have identified continued public outreach as a high priority mitigation initiative within their jurisdictional annexes (see Section 9).

3.6 Integration/Coordination with Existing Plans and Programs

Effective mitigation is achieved when hazard awareness and risk management approaches and strategies become an integral part of public activities and decision-making. In the Lehigh Valley there are many existing plans and programs that support hazard risk management, and thus it is critical that this hazard mitigation plan integrate and coordinate with, and complement, those mechanisms.

Section 5 “Capability Assessment” provides a summary and description of the existing plans, programs and regulatory mechanisms in the Lehigh Valley that support hazard mitigation. This section documents how these existing plans and programs have been integrated into this updated plan, and how this plan will continue to promote and effect that coordination.

The integration of existing data, plans and programs is further documented in the comprehensive “References” section of this plan update, as well as in the “Data and Methodology” sections of the hazard profiles (Section 4).

3.6.1 Emergency Management Plans and Programs

The Lehigh Valley HMP update project has been managed through the LCEMA and NCEMS, allowing broad integration of relevant emergency management data, information and programs to this update. Further, county and municipal participation in this process has included emergency managers, police, fire and other first responders, and input from members of LEPCs and Community Emergency Response Teams (CERTs).

Data and information used included disaster claims data (including public and individual assistance) and other loss information to support the updated vulnerability assessments and assist with the identification

of appropriate, cost-effective mitigation projects. Specifics about response and recovery programs and efforts in the Lehigh Valley, including the management and administration of mitigation and emergency preparedness grant programs, have led to specific county and local-level mitigation actions to improve regional emergency management coordination and build related risk management capabilities.

The two counties and municipalities in the Lehigh Valley recognize that the findings and recommendations of this plan update need to be incorporated into their emergency planning, preparedness, response and recovery programs and operations. Public education and outreach to improve personal preparedness, and promote an awareness of mitigation opportunities and personal protection through risk insurance, have been incorporated in specific county and local initiatives.

3.6.2 Comprehensive Planning and Land Use Regulation

Available comprehensive/master and relevant land use planning and regulation documents were reviewed during this plan update process, including:

- Comprehensive Plan, The Lehigh Valley...2030, April 2005, Update June 2010
- Lehigh Valley 2010 Comprehensive Economic Development Strategy
- Lehigh Valley Surface Transportation Plan, 2011-2030, October 2010
- Lehigh Valley Greenways Plan, A Regional Greenways Plan for Lehigh and Northampton Counties, 2007
- Lehigh Valley Profiles and Trends, June 2011
- Floodplain Guide/Model Regulations, October 2007
- Riparian and Wetland Buffers Guide/Model Regulations, January 2011
- Conservation Subdivisions Guide/Model Regulations, November 2010
- Steep Slope Guide/Model Regulations, November 2008
- Woodlands Guide/Model Regulations, March 2009
- Subdivision and Building Activity Report, March 2011
- Lehigh and Northampton Counties, Housing in the Lehigh Valley, July 2009

Information from these plans was incorporated into the regional profile (Section 2), hazard profiles (Section 4), and into the asset inventory (population/demographics, general building stock, critical facilities) used to develop the updated vulnerability assessments (Section 4).

Recommendations within these plans have been considered in developing and updating the county and municipal-level mitigation strategies. The availability of model ordinances, developed by the LVPC to address the specific risks and regulatory frameworks of the Lehigh Valley, was presented to the planning partnership during the planning process, discussed at the Jurisdictional Annex Workshops, and included in mitigation strategy identification/development resources provided to the plan participants.

It was the intention that through this planning process, municipalities shall incorporate the findings and recommendations of this plan update into future local planning efforts, and into the overall execution of their land-use planning process (e.g. site plan review, permitting, code enforcement). Known or anticipated future development in the Lehigh Valley was identified at the local level, including the identification of known hazard risks and risk zones, within the jurisdictional annexes (Section 9).

3.6.3 Act 167 Stormwater Management Plans

The LVPC provided Act 167 Stormwater Management Plans for the entire Lehigh Valley. Information that was incorporated into this plan update includes general watershed information, identification of

floodprone areas and known restrictions, and potential mitigation projects. At the Jurisdictional Annex Workshops, all municipalities were provided excerpts (hard copy and on CD) of the salient portions of the Act 167 Stormwater Management Plans for their watershed for review and use as they were developing their jurisdictional annexes.

In 2007, the LVPC secured a 5-year bi-county contract from PADEP to update existing Act 167 plans. The LVPC began work under the contract, however due to lack of funding, PADEP terminated all Act 167 contracts in 2010. LVPC work on these plan updates is deferred until funding is restored.

3.6.4 National Flood Insurance Program (NFIP) and the Community Rating System (CRS)

Currently all municipalities in the Lehigh Valley participate in the NFIP, with no municipalities having outstanding sanctions or suspensions. All municipalities have adopted a Flood Damage Prevention Ordinance which is administered locally by their Floodplain Administrator, as identified in the “Regulatory” and “Administrative and Technical” section of the Capability Assessment in each municipality’s annex (Section 9). All floodplain managers were informed of the planning process, and were tasked with reviewing the plan documents and providing direct input to the plan update.

At the time this plan update was written, the Lehigh County FEMA Digitized Flood Insurance Rate Maps (DFIRM) dated July 2004 and the Northampton County preliminary DFIRMs dated 2011 were used to evaluate exposure and determine potential future losses. The Northampton County 2011 DFIRMs, although considered preliminary, are the best available data and were used for this plan update.

FEMA Region III provided NFIP policy, claims and repetitive loss data for the entire Lehigh Valley. This data was incorporated in the flood hazard profiling and risk assessment (Section 4), as well as into the municipal annexes in Section 9. All municipalities were encouraged to include mitigation initiatives that specify continued and enhanced participation in the NFIP, and address their flood vulnerable structures and infrastructure, including Repetitive Loss (RL) and Severe Repetitive Loss (SRL) properties.

Both counties and all municipalities have identified public outreach initiatives that include increasing public awareness of and participation in the NFIP. Further, both counties have identified that they will be hosting a hazard insurance forum with major regional insurers to better understand hazard insurance issues (requirements, availability, limitations, costs, etc.) and thus be better able to inform the public.

As updated NFIP mapping is prepared for Lehigh and Northampton counties, communities will need to adopt this mapping, update their NFIP Flood Damage Prevention Ordinances, and assist their residents with issues such as Letters of Map Amendment (LOMAs). FEMA Region III and the State NFIP Coordinator’s Office provide support for these efforts, in addition to the LVPC who prepared a model Floodplain Ordinance for use by Lehigh Valley communities.

Currently within the Lehigh Valley only Hanover Township in Northampton County participates in the CRS program, with a current rating of 9 (5% discount on flood insurance premiums). Northampton County Emergency Management Services sponsored a CRS workshop in May 2012 to inform the communities of the program and encourage participation. Increased participation in the Lehigh Valley will continue to be supported by both Counties as identified in their updated mitigation strategies. Further, certain communities in the Lehigh Valley have identified in their updated mitigation strategies that they plan to apply to the CRS program.

3.6.5 FEMA Unified Hazard Mitigation Assistance (HMA)

By virtue of having a current, FEMA-approved HMP, the two counties and all communities in the Lehigh Valley are eligible to apply for and receive mitigation grant funding for eligible, cost-effective mitigation projects under the Unified HMA grant programs, including:

- Hazard Mitigation Grant Program (HMGP)
- Pre-Disaster Mitigation (PDM)
- Flood Mitigation Assistance (FMA)
- Repetitive Flood Claims (RFC)
- Severe Repetitive Loss (SRL)

Throughout this plan update process, participating municipalities were provided information, including FEMA brochures and publications, to inform them of these grant programs. The counties and all municipalities were asked to identify any projects that were funded under these programs, as identified in their jurisdictional annexes (Section 9). As an example, Lower Macungie Township in Lehigh County received SRL funding to address two SRL properties, and has applied for HMGP funding to address three additional flood vulnerable residential properties.

During this update process, the 2012 Unified HMA national program was offered in the Commonwealth, in addition to several HMGP opportunities in the wake of declared disasters in the Commonwealth. In particular, HMGP opportunities following Hurricane Irene (DR-4025) and Tropical Storm Lee (DR-4030) made available significant levels of HMGP funding in the Commonwealth.

As the counties and municipalities updated their mitigation strategies, potential mitigation grant eligible projects have been indicated as such when identifying the potential funding source. LCEMA and NCEMS will continue to inform their inclusive municipalities as mitigation grant opportunities are announced by PEMA, and provide assistance as feasible and appropriate with the grant application process.

3.6.6 Capital Improvement Planning

Both counties and many of the municipalities in the Lehigh Valley have capital improvements plans, identifying specific capital projects to be funded and completed according to a defined schedule. Some of these projects involve improvements to facilities and infrastructure that provide hazard mitigation benefits. As such, during this update process, the counties and municipalities have been encouraged to consider the mitigation benefits associated with their known or anticipated capital projects as a way to help prioritize their execution and to develop awareness that mitigation grants may be available to help fund such projects.

3.6.7 Housing and Urban Development (HUD) and Community Development Block Grant (CDBG) Funding

Opportunities for the application of HUD and CDBG funding to support certain types of mitigation activities in the Lehigh Valley, as identified in the 2012-2017 Northampton County Consolidated Plan, were reviewed as part of this plan update process.

4.1 METHODOLOGY AND TOOLS

This section describes the methodology and tools used to support the risk assessment process.

Methodology

The risk assessment process used for this Plan is consistent with the process and steps presented in FEMA 386-2, State and Local Mitigation Planning How-to-Guide, Understanding Your Risks – Identifying Hazards and Estimating Losses (FEMA, 2001). This process identifies and profiles the hazards of concern and assesses the vulnerability of assets (population, structures, critical facilities and the economy) at risk in the community. A risk assessment provides a foundation for the community’s decision makers to evaluate mitigation measures that can help reduce the impacts of a hazard when one occurs (Section 5.4 of this plan).

Step 1: The first step of the risk assessment process is to identify the hazards of concern. FEMA’s current regulations only require an evaluation of natural hazards. Natural hazards are natural events that threaten lives, property, and many other assets. Often, natural hazards can be predicted, where they tend to occur repeatedly in the same geographical locations because they are related to weather patterns or physical characteristics of an area.

Step 2: The next step of the risk assessment is to prepare a profile for each hazard of concern. These profiles assist communities in evaluating and comparing the hazards that can impact their area. Each type of hazard has unique characteristics that vary from event to event. That is, the impacts associated with a specific hazard can vary depending on the magnitude and location of each event (a hazard event is a specific, uninterrupted occurrence of a particular type of hazard). Further, the probability of occurrence of a hazard in a given location impacts the priority assigned to that hazard. Finally, each hazard will impact different communities in different ways, based on geography, local development, population distribution, age of buildings, and mitigation measures already implemented.

Steps 3 and 4: To understand risk, a community must evaluate what assets it possesses and which assets are exposed or vulnerable to the identified hazards of concern. Hazard profile information combined with data regarding population, demographics, general building stock, and critical facilities at risk, located in Section 4, prepares the community to develop risk scenarios and estimate potential damages and losses for each hazard.

Tools

To address the requirements of DMA 2000 and better understand potential vulnerability and losses associated with hazards of concern, the Lehigh Valley used standardized tools, combined with local, state, and federal data and expertise to conduct the risk assessment. Our standardized tools used to support the risk assessment are described below.

Hazards U.S. – Multi-Hazard (HAZUS-MH)

In 1997, FEMA developed a standardized model for estimating losses caused by earthquakes, known as Hazards U.S. or HAZUS. HAZUS was developed in response to the need for more effective national-, state-, and community-level planning and the need to identify areas that face the highest risk and potential for loss. HAZUS was expanded into a multi-hazard methodology, HAZUS-MH with new models for estimating potential losses from wind (hurricanes) and flood (riverine and coastal) hazards. HAZUS-MH is a Geographic Information System (GIS)-based software tool that applies engineering and scientific risk calculations that have been developed by hazard and information technology experts to provide defensible

damage and loss estimates. These methodologies are accepted by FEMA and provide a consistent framework for assessing risk across a variety of hazards. The GIS framework also supports the evaluation of hazards and assessment of inventory and loss estimates for these hazards.

HAZUS-MH uses GIS technology to produce detailed maps and analytical reports that estimate a community's direct physical damage to building stock, critical facilities, transportation systems and utility systems. To generate this information, HAZUS-MH uses default HAZUS-MH provided data for inventory, vulnerability, and hazards; this default data can be supplemented with local data to provide a more refined analysis. Damage reports can include induced damage (inundation, fire, threats posed by hazardous materials and debris) and direct economic and social losses (casualties, shelter requirements, and economic impact) depending on the hazard and available local data. HAZUS-MH's open data architecture can be used to manage community GIS data in a central location. The use of this software also promotes consistency of data output now and in the future and standardization of data collection and storage. The guidance *Using HAZUS-MH for Risk Assessment: How-to Guide (FEMA 433)* was used to support the application of HAZUS-MH for this risk assessment and plan. More information on HAZUS-MH is available at <http://www.fema.gov/plan/prevent/hazus/index.shtm>.

In general, probabilistic analyses were performed to develop estimates of long-term average losses (annualized losses) for the earthquake and wind hazards, as well as an expected/estimated distribution of losses (mean return period losses) for the earthquake, flood and wind hazards. The probabilistic hazard generates estimates of damage and loss for specified return periods. For annualized losses, HAZUS-MH 2.1 calculates the maximum potential annual dollar loss resulting from various return periods averaged on a "per year" basis. It is the summation of all HAZUS-supplied return periods (e.g., 10, 50, 100, 200, 500) multiplied by the return period probability (as a weighted calculation). In summary, the estimated cost of a hazard (earthquake and wind) each year is calculated.

Custom methodologies in HAZUS-MH 2.1 were used to assess potential exposure and losses associated with hazards of concern for the Lehigh Valley:

- **Inventory:** The default demographic data in HAZUS-MH 2.1, based on the 2000 U.S. Census, was used for analysis. However, the 2010 U.S. Census data was used to estimate hazard exposure at the municipal level.

The default building inventory in HAZUS-MH 2.1 was updated and replaced at the Census-block level with a custom building inventory developed for the Lehigh Valley. The custom building inventory was developed using detailed structure-specific assessor data, as well as parcel and structure location information. Structural and content replacement cost values were calculated for each building utilizing available assessor data and RSMeans 2011 values. An updated critical facility inventory was also developed and incorporated into HAZUS-MH replacing the default essential facility (police, fire, schools, etc.) and utility inventories.

The occupancy classes available in HAZUS-MH 2.1 were condensed into the following categories (residential, commercial, industrial, agricultural, religious, government, and educational) to facilitate the analysis and the presentation of results. Residential loss estimates address both multi-family and single-family dwellings.

The critical facility inventory (essential facilities, utilities, transportation features and user-defined facilities) was updated for the earthquake, flood and wind hazard models. This comprehensive inventory was developed by gathering input from numerous sources including Lehigh County GIS, Northampton County GIS, Northampton County's 911 database, participating municipalities and input from the Steering Committee.

The ‘user-defined facilities’ category includes all assets that the Lehigh Valley plan participants deemed critical to include in the inventory and that do not fit within a pre-defined HAZUS-MH facility category. These facilities include shelters, senior care facilities and municipal-owned buildings.

- **Earthquake:** HAZUS-MH 2.1 was used to evaluate the Lehigh Valley’s risk to the seismic hazard. A probabilistic assessment was performed to analyze the earthquake hazard losses (annualized losses and 100-, 500- and 2,500-year mean return period [MRP] losses). The probabilistic method uses information from historic earthquakes and inferred faults, locations and magnitudes, and computes the probable ground shaking levels that may be experienced during a recurrence period by Census tract.

The National Earthquake Hazard Reduction Program (NEHRP) developed five soil classifications that impact the severity of an earthquake. The soil classification system ranges from A to E, where A represents hard rock that reduces ground motions from an earthquake and E represents soft soils that amplify and magnify ground shaking and increase building damage and losses. NEHRP soil classifications were not available for the Lehigh Valley at the time of this analysis. Soils were classified as NEHRP soil type D across the Lehigh Valley as a conservative approach to this risk assessment. Groundwater was set as at a depth of five-feet (default setting). Damages and loss due to liquefaction, landslide or surface fault rupture were not included in this analysis.

Default demographic and the updated general building stock and critical facility inventory data in HAZUS-MH 2.1 were used for the earthquake analysis.

- **Flood:** The 1% and 0.2% chance flood events were examined to evaluate the Lehigh Valley’s risk and vulnerability to the riverine flood hazard. These flood events are generally those considered by planners and evaluated under federal programs such as the NFIP.

A Level 2 HAZUS-MH riverine flood analysis was performed. The Lehigh County FEMA Digital Flood Insurance Rate Maps (DFIRMs) dated July 2004 and the Northampton County preliminary DFIRMs dated 2011 were used to evaluate exposure and determine potential future losses. Please note the Northampton County 2011 DFIRMs, although considered preliminary are the best available data and used for this plan.

A 10-foot depth grid was developed for the 1% flood event for the Lehigh Valley. Using Geographic Information System (GIS) tools and the best available data including the DFIRM database for both Counties and the 2008 3.2-foot Light Detection and Ranging (LiDAR) Bare Earth Digital Elevation Model (DEM) available from Pennsylvania Spatial Data Access – the Pennsylvania Geospatial Data Clearinghouse, a flood depth grid was generated and integrated into the HAZUS-MH riverine flood model.

To estimate exposure to the 1% and 0.2% flood events, the DFIRM flood boundaries, updated building and facility inventories and 2010 U.S. Census population data were used. The HAZUS-MH 2.1 riverine flood model was run to estimate potential losses for the Lehigh Valley for the 1% flood event. HAZUS-MH 2.1 calculated the estimated potential losses to the population (default 2000 U.S. Census data) and potential damages to the updated general building stock and critical facility inventories based on the depth grid generated and the default HAZUS damage functions in the flood model.

- Hurricane/Wind: A HAZUS-MH 2.1 probabilistic analysis was performed to analyze the wind hazard losses for the Lehigh Valley. The probabilistic hurricane hazard activates a database of thousands of potential storms that have tracks and intensities reflecting the full spectrum of Atlantic hurricanes observed since 1886 and identifies those with tracks associated with the Planning Area. HAZUS-MH contains data on historic hurricane events and wind speeds. It also includes surface roughness and vegetation (tree coverage) maps for the area. Surface roughness and vegetation data support the modeling of wind force across various types of land surfaces. Annualized losses and the 100- and 500-year MRPs were examined for the wind/severe storm hazard. Default demographic and updated building and critical facility inventories in HAZUS-MH 2.1 were used for the analysis.
- Other Hazards: GIS tools including HAZUS-MH were used to evaluate other hazards (i.e., wildfire, landslide, etc.), as feasible. For many of the hazards evaluated in this risk assessment, historic data are not adequate to model future losses at this time. However, HAZUS-MH can map hazard areas and calculate exposures if geographic information on the locations of the hazards and inventory data are available. For some of the other hazards of concern, areas and inventory susceptible to specific hazards were mapped and exposure was evaluated to help guide mitigation efforts discussed in Section 5.4. For other hazards, a qualitative analysis was conducted using the best available data and professional judgment.

For this risk assessment, the loss estimates, exposure assessments, and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their affects on the built environment. Uncertainties also result from the following:

- 1) Approximations and simplifications necessary to conduct such a study
- 2) Incomplete or dated inventory, demographic, or economic parameter data
- 3) The unique nature, geographic extent, and severity of each hazard
- 4) Mitigation measures already employed by the participating municipalities and the amount of advance notice residents have to prepare for a specific hazard event

These factors can result in a range of uncertainty in loss estimates, possibly by a factor of two or more. Therefore, potential exposure and loss estimates are approximate. These results do not predict precise results and should be used to understand relative risk. Over the long term, the Lehigh Valley will collect additional data to assist in developing refined estimates of vulnerabilities to natural and non-natural hazards.

4.2 Hazard Identification

In identifying those hazards that pose significant risk to the Lehigh Valley, the planning committee that prepared the 2006 Lehigh Valley HMP reviewed information and historical records from a wide range of sources and selected the following natural hazards for consideration and profiling in the original plan (the original “hazards of concern”):

- Floods
- Winter Storms
- Tornados
- Sinkholes
- Droughts
- Wildfires
- Earthquakes

The 2006 plan further acknowledged that the Commonwealth of Pennsylvania 2010 Standard All-Hazard Mitigation Plan (State HMP) identified other hazards that have an impact in the state, including landslides, lightning, wind, hail, temperature extremes and radon. These hazards were considered to be of a lower priority due to their infrequency of occurrence, or lack of data on occurrences or damages, relative to the original plan’s selected hazards of concern, and noted that these hazards may be studied in greater detail in subsequent plan updates. Further, non-natural hazards were not considered in the 2006 plan

As part of the plan update process, the Steering Committee reviewed the hazards of concern detailed in the 2006 plan as well as those identified in the State HMP, and considered the history of events in the Lehigh Valley that have occurred historically as well as since completion of the 2006 plan. This review of historical events included an evaluation of all Emergency and Disaster Declarations in the Commonwealth, with a focus on those in which Lehigh and/or Northampton counties were designated for Federal assistance.

Further, all jurisdictions participating in the plan update process were provided a “Hazard Identification/Evaluation of Risk” worksheet to help identify those hazards, natural and non-natural, that each community believed posed significant risk to the Lehigh Valley, including any that may not have been considered in either the 2006 plan or the State HMP. Completed worksheets submitted by the municipalities may be found in Appendix D.

Based on all available information and input from the municipalities, the Steering Committee selected the following natural and non-natural hazards for consideration in this plan update:

Natural Hazards

- Drought
- Earthquake
- Extreme Temperatures
- Flood (including riverine, ice-jam, flash and urban stormwater flooding)
- Hailstorm
- Landslide
- Lightning Strike
- Radon Exposure

- Subsidence/Sinkholes
- Wildfire
- Wind (incl. tornado)
- Winter Storm (incl. heavy snow, blizzard and ice storms)

Non-Natural Hazards

- Building Collapse
- Dam Failure
- Environmental Hazards (incl. Explosions)
- Fire (Urban, Structural)
- Levee Failure
- Mass Gathering and Civil Disturbance
- Nuclear Incidents
- Terrorism
- Transportation Accidents
- Utility Outage/Interruption

These hazards have been profiled individually in Section 4.3 of this plan update.

4.3.1 Drought

A drought can be defined by rainfall amounts, vegetation conditions, agricultural productivity, soil moisture, reservoir levels and stream flow. Simply put, a drought is a significant deficit in moisture availability due to lower than normal rainfall. As rainfall provides the basis for both ground and surface water resources in the Commonwealth, the earliest indicator of a potential drought is precipitation deficits.

Pennsylvania is a member of interstate compact commissions that include the Delaware River Basin (DRB) of which the Lehigh Valley is a part. These commissions have regulatory authority over the waters of the basin. While basin commissions have authority to declare drought emergencies, they rely on respective member states to implement and enforce any actions they may dictate during a drought emergency. The Delaware River Basin Commission (DRBC) monitors the combined storage at three large water supply reservoirs (Pepacton, Neversink and Cannonsville) in the New York City Delaware reservoir system to identify drought conditions. Pennsylvania Department of Environmental Protection (PADEP) coordinates closely with the basin commission in all its drought management activities. The basin commission's primary role is one of ensuring effective coordination among member states (LVHMP, 2006).

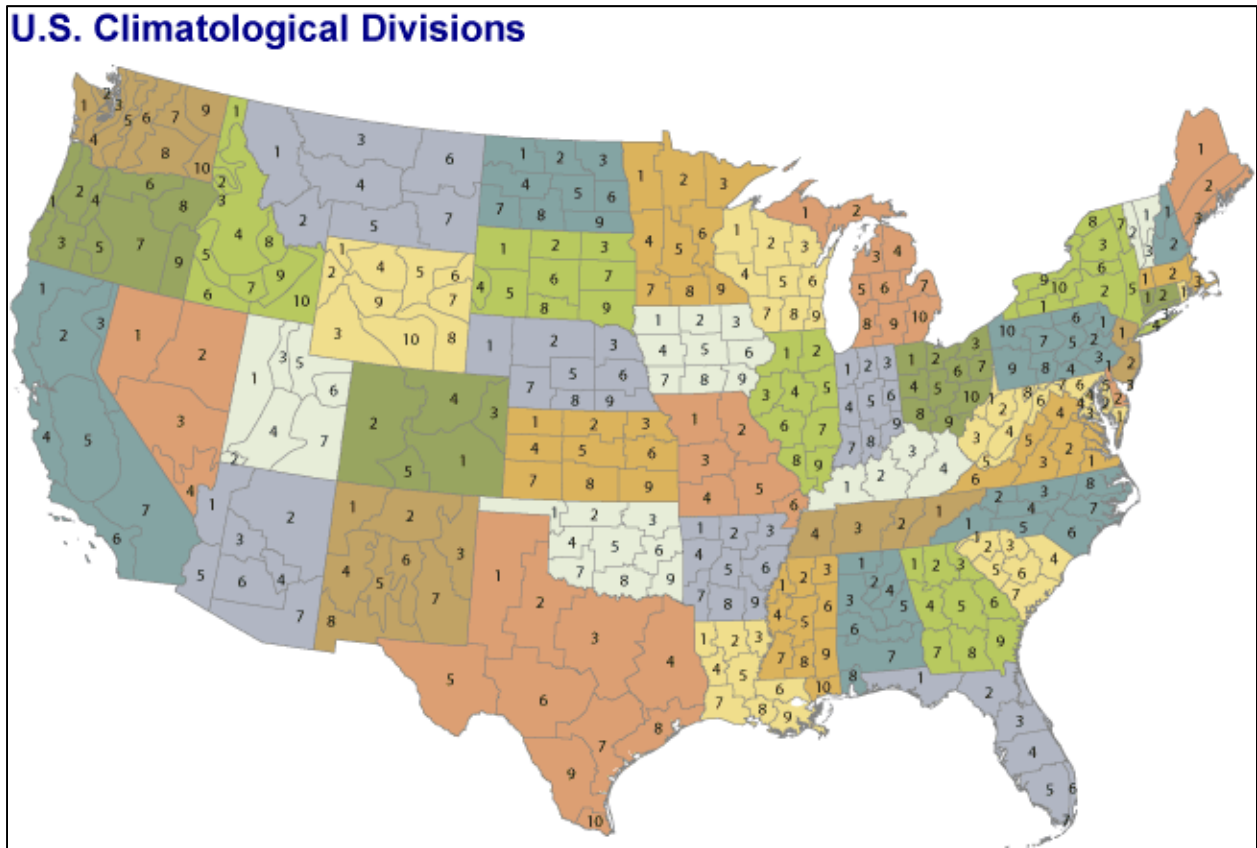
4.3.1.1 Location and Extent

Droughts are regional in nature and may affect the entire Lehigh Valley, as opposed to individual municipalities within the counties. In general, areas along waterways will show drought conditions later than those areas away from waterways.

Climate divisions are regions within a state that are climatically homogenous. The National Oceanic and Atmospheric Administration (NOAA) has divided the U.S. into 359 climate divisions. The boundaries of these divisions typically coincide with the county boundaries, except in the western U.S., where they are based largely on drainage basins (Energy Information Administration, 2005).

According to NOAA, Pennsylvania is made up of 10 climate divisions: Pocono Mountains, East Central Mountains, Southeastern Piedmont, Lower Susquehanna, Middle Susquehanna, Upper Susquehanna, Central Mountains, South Central Mountains, Southwest Plateau, and Northwest Plateau Climate Division (NOAA, Date Unknown). Figure 4.3.1-1 shows the climate divisions throughout the U.S. and Figure 4.3.1-2 shows more specifically the climate divisions of Pennsylvania. The Lehigh Valley is located in the East Central Mountains climate division.

Figure 4.3.1-1. Climate Divisions in the U.S.

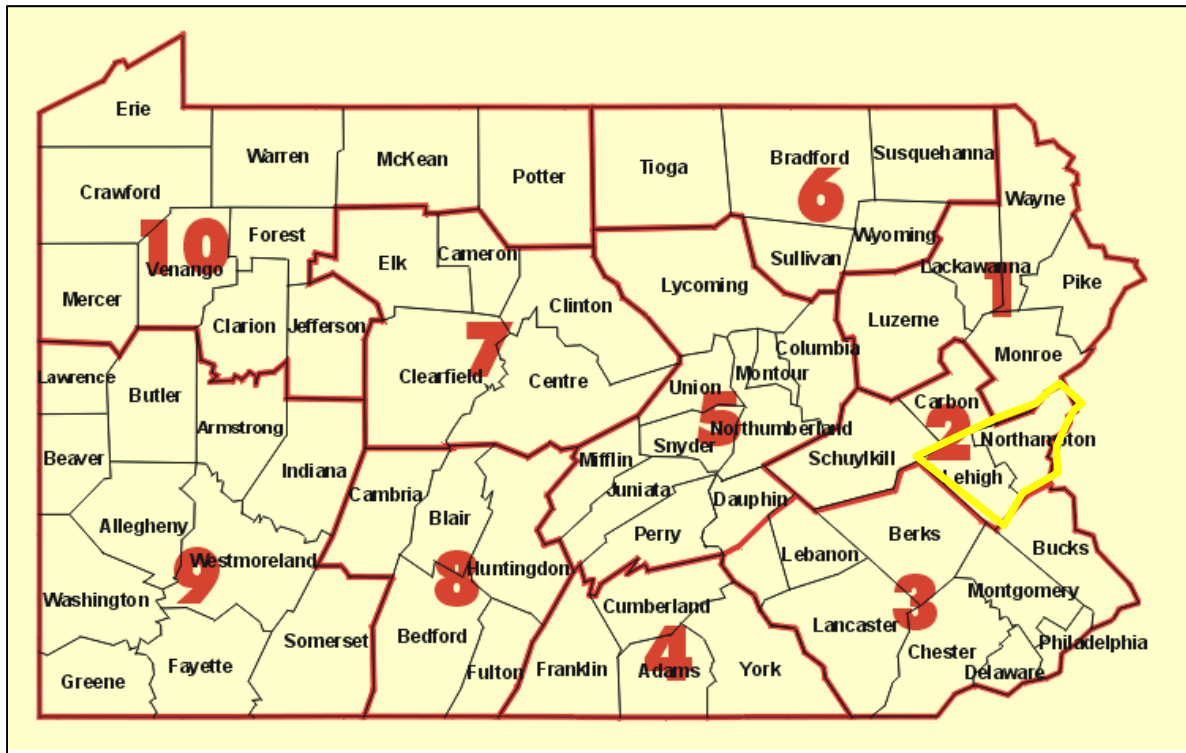


Source: NOAA, 2012

Note (1): The climate division names vary from state to state. The climate divisions for Pennsylvania are:

- 1 = Pocono Mountains; 2 = East Central Mountains; 3 = Southeastern Piedmont; 4 = Lower Susquehanna; 5 = Middle Susquehanna; 6 = Upper Susquehanna; 7 = Central Mountains; 8 = South Central Mountains; 9 = Southwest Plateau; 10 = Northwest Plateau

Figure 4.3.1-2. Climate Divisions of Pennsylvania



Source: NOAA NWS Climate Prediction Center, 2005

Note: Highlight added.

The climate divisions for Pennsylvania are:

1 = Pocono Mountains; 2 = East Central Mountains; 3 = Southeastern Piedmont; 4 = Lower Susquehanna; 5 = Middle Susquehanna; 6 = Upper Susquehanna; 7 = Central Mountains; 8 = South Central Mountains; 9 = Southwest Plateau; 10 = Northwest Plateau

4.3.1.2 Range of Magnitude

Droughts can have varying effects depending on their severity, timing, duration and location. Some droughts may have their greatest impact on agriculture, while others may impact water supply or recreation. When droughts occur, they can have significant adverse effects on the following:

- Public water supplies for human consumption
- Rural water supplies for livestock consumption and agricultural operations
- Water quality
- Natural soil water or irrigation water for agriculture
- Water for forests and for fighting forest fires
- Water for navigation and recreation

As described in the Commonwealth of Pennsylvania 2010 Standard Hazard Mitigation Plan (PA HMP), PADEP and Pennsylvania Emergency Management Agency (PEMA) manage water supply droughts in Pennsylvania using four drought phase conditions. These drought phase conditions are defined in the PA HMP as follows:

- Drought Watch: A period to alert government agencies, public water suppliers, water users, and the public regarding the potential for future drought-related problems. The focus is on increased

monitoring, awareness, and preparation for response if conditions worsen. A request for voluntary water conservation is made. The objective of voluntary water conservation measures during a drought watch is to reduce water use by five-percent in the affected areas. Because of varying conditions, individual water suppliers or municipalities may ask for more stringent conservation actions.

- Drought Warning: This phase involves a coordinated response to imminent drought conditions and potential water supply shortages through concerted voluntary conservation measures to avoid or reduce shortages, relieve stressed sources, develop new sources, and if possible forestall the need to impose mandatory water use restrictions. The objective of voluntary water conservation measures during a drought warning is to reduce overall water use by 10 to 15 percent in the affected areas. Because of varying conditions, individual water suppliers or municipalities may ask for more stringent conservation actions.
- Drought Emergency: This stage is a phase of concerted management operations to marshal all available resources to respond to actual emergency conditions, to avoid depletion of water sources, to ensure at least minimum water supplies to protect public health and safety, to support essential and high-priority water uses, and to avoid unnecessary economic dislocations. It is possible during this phase to impose mandatory restrictions on nonessential water uses as provided for in 4 Pa. Code Chapter 119, if deemed necessary and if ordered by the governor. The objective of water use restrictions (mandatory or voluntary) and other conservation measures during this phase is to reduce consumptive water use in the affected areas by 15 percent, and to reduce total use to the extent necessary to preserve public water system supplies, to avoid or mitigate local or area shortages, and to ensure equitable sharing of limited supplies.
- Local Water Rationing: Although not a drought phase, local municipalities may, with the approval of the Pennsylvania Emergency Management Council, implement local water rationing to share a rapidly dwindling or severely depleted water supply in designated water supply service areas. These individual water rationing plans, authorized through provisions of 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, 2010).

Pennsylvania uses five parameters to assess drought conditions: precipitation deficits, stream flows, reservoir storage levels, groundwater levels, and a measure of soil moisture. These are described in detail below.

Precipitation Deficits: As rainfall provides the basis for both ground and surface water resources, precipitation deficits are the earliest indicators of a potential drought. The National Weather Service (NWS) records “normal” monthly precipitation data for each county in Pennsylvania. These figures are generated from long-term monthly and decennial averages of precipitation, updated at the end of each decade based upon the most recent 30 years. Monthly totals that are less than the normal values represent precipitation deficits, which are then converted to percentages of the normal values. Table 4.3.1-1 lists the drought conditions, as defined in the PA HMP and noted above, that are indicated by various precipitation deficit percentages (PEMA, 2010).

Table 4.3.1-1. Precipitation Deficit Drought Indicators for Pennsylvania

Duration of Deficit Accumulation (months)	Drought Watch (deficit as percent of normal precipitation)	Drought Warnings (deficit as percent of normal precipitation)	Drought Emergency (deficit as percent of normal precipitation)
3	25	35	45
4	20	30	40
5	20	30	40
6	20	30	40
7	18.5	28.5	38.5
8	17.5	27.5	37.5
9	16.5	26.5	36.5
10	15	25	35
11	15	25	35
12	15	25	35

Source: PEMA, 2010

Table 4.3.1-2 shows the precipitation normal, from 1971 to 2000, for the City of Allentown. These numbers are available through the National Climatic Data Center (NCDC), which compiles monthly and annual total precipitation (inches) normals data retrieved from both National Weather Service Cooperative Network (COOP) and Principal Observation (First-Order) locations throughout the U.S. While historical records show COOP stations in both the cities of Allentown and Bethlehem, the NCDC report only provides data for the former station (NC State University, 2012).

Table 4.3.1-2. Monthly and Annual Precipitation Normal (total in inches) from 1971 to 2000 at Allentown

Station Name	January	February	March	April	May	June	July	August	September	October	November	December	ANNUAL
Allentown	3.5	2.75	3.56	3.49	4.47	3.99	4.27	4.35	4.37	3.33	3.7	3.39	45.17

Source: NOAA, 2002

Stream Flows: Stream flows, which typically lag up to two months behind precipitation normals in signaling a drought, offer the second earliest indication of drought conditions. PADEP uses 73 U.S. Geological Survey (USGS)-maintained stream gauges throughout the State as its drought monitoring network, computing 30-day average stream flow values for each of the stream gages based on the entire period of record for each gage. For example, the Lehigh River gage in the City of Bethlehem has more than 100 years of record from which the long-term 30-day average, or normal, flows are now determined. Drought status is determined from stream flows based on exceedances, rather than percentages. The various stages of drought watch, warning and emergency conditions are indicated by the 75-, 90-, and 95-percent exceedance 30-day average flows, respectively (PEMA, 2010). Detailed methodology for these data collections is provided in the PA HMP.

Reservoir Storage Levels: Water level storage in three New York City reservoirs in the Upper Delaware River Basin and several other large public water supply reservoirs is another indicator used by PADEP for

drought monitoring. PADEP considers the percentage of storage drawdown for various reservoirs to determine drought stages, based on the length of refill period and total quantity of storage.

Groundwater Levels: Groundwater level can be an indicator of a developing drought, though low readings may lag up to three months behind drought-indicative precipitation readings. This is due to the nearly 80 trillion gallons of groundwater stored throughout the Commonwealth, which disguises precipitation deficits for many months before experiencing significant and noticeable effects of the lack of groundwater recharge (PEMA, 2010).

The USGS also maintains groundwater monitoring wells in each county throughout the Commonwealth. Groundwater measurements taken from these wells at exceedances of 75, 90 and 95 percent are used to indicate drought watch, warning and emergency statuses, respectively. Amongst the USGS well network, the 30-day average depth to groundwater readings are analyzed in relation to long-term 30-day averages based on the period of record for each county well (USGS, 2010).

Soil Moisture: NOAA’s Palmer Drought Severity Index (PDSI) provides soil moisture information for evaluating the scope, severity, and frequency of prolonged periods of abnormally dry or wet weather. The tool is frequently used to indicate the availability of irrigation water supplies, reservoir levels, range conditions, amount of stock water, and forest fire potential. The PDSI is a notably ineffective tool for short-term drought monitoring forecasts; however it is the most effective for determining long-term droughts, and as such is most frequently used to delineate disaster areas (NWS CPC, 2005).

Table 4.3.1-3 lists the Palmer Classifications. Zero is used to reflect normal status, and droughts are indicated by negative numbers. For example, 0 is no drought, -2 is moderate drought, and -4 is extreme drought. Positive numbers represent excess precipitation (NOAA, Date Unknown).

Table 4.3.1-3. Palmer Drought Severity Index (PDSI) Classifications

Severity Category	PDSI Value	Drought Status
Extremely wet	4.0 or more	None
Very wet	3.0 to 3.99	None
Moderately wet	2.0 to 2.99	None
Slightly wet	1.0 to 1.99	None
Incipient wet spell	0.5 to 0.99	None
Near normal	0.49 to -0.49	None
Incipient dry spell	-0.5 to -0.99	None
Mild drought	-1.0 to -1.99	None
Moderate drought	-2.0 to -2.99	Watch
Severe drought	-3.0 to -3.99	Warning
Extreme drought	-4.0 or less	Emergency

Source: Hayes, 2006; PEMA, 2010

Water supply availability and management is discussed in the 2009 Pennsylvania State Water Plan, a joint effort by the Statewide Water Resources Committee and PADEP. In 2009, the PADEP Secretary approved an updated State Water Plan to guide the management of the State’s water resources over a 15-year planning horizon. As a functional planning tool for all Pennsylvania municipalities, counties, and regional planning partnerships, the State Water Plan profiles drought and resource constraints and encourages the implementation of new technology and use policies to facilitate reduced water uses and resource demands at critical peak times. The plan provides inventories of water availability, as well as an assessment of current and future water use demands and trends. It also offers strategies for improving the

management of water resources and waterway corridors which aim to reduce damages from extreme drought and flooding conditions (PADEP, 2009).

4.3.1.3 Past Occurrence

Many sources provided historical information regarding previous occurrences and losses associated with drought events throughout Pennsylvania and more specifically the Lehigh Valley. With so many sources reviewed for the purpose of this Plan, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this Plan.

According to NOAA's NCDC storm events database, the Lehigh Valley experienced 42 drought events between April 30, 1950 and November 30, 2011. This total also includes damages in other counties. According to the Hazard Research Lab at the University of South Carolina's Spatial Hazard Events and Losses Database for the U.S. (SHELDUS), between 1960 and 2010, eight drought events occurred within the Lehigh Valley. These numbers may vary from the NCDC accounts due to the database identifying the location of the hazard event in various forms or throughout multiple counties or regions.

Since 1930, the Commonwealth of Pennsylvania experienced ten significant droughts. Since 1955, the Commonwealth experienced 12 drought events that resulted in a governor's proclamation or a Federal Emergency Management Agency (FEMA) declared disaster or emergency. The Lehigh Valley was included in five of these events. In addition to these events, the PADEP indicated that the Lehigh Valley has experienced nine drought watch declarations, 11 drought warning declarations, and five drought emergency declarations between the years of 1980 and 2009 (PEMA, 2010).

Between 1954 and 2011, FEMA declared that Pennsylvania experienced one drought-related disaster (DR) or emergency (EM) classified as one or a combination of the following disaster types: drought or water shortage. Generally, these disasters cover a wide region of the Commonwealth; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations. Of those events, the FEMA, PEMA and other sources indicate that Northampton County has been declared as a disaster area as a result of a 1964-1966 drought-related event (FEMA, 2011).

Based on all sources researched, known drought events between 1895 and 2011 that have affected the Lehigh Valley are identified in Table 4.3.1-4. Not all sources have been identified or researched; therefore, Table 4.3.1-4 may not include all events that have occurred throughout the region.

Table 4.3.1-4. Past Occurrences of Drought Events from 1895 to 2011

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
November 1895 – January 1896	Drought	N/A	N/A	Lowest PDSI of -3.97	NRCC
November 1900 – February 1901	Drought	N/A	N/A	Lowest PDSI of -4.06	NRCC
September 1909 – January 1910	Drought	N/A	N/A	Lowest PDSI of -4.43	NRCC
July – August 1910	Drought	N/A	N/A	Lowest PDSI of -3.27	NRCC
October 1910 – March 1911	Drought	N/A	N/A	Lowest PDSI of -4.08	NRCC
May – July 1911	Drought	N/A	N/A	Lowest PDSI of -3.76	NRCC
October – December 1914	Drought	N/A	N/A	Lowest PDSI of -3.82	NRCC
November – December 1922	Drought	N/A	N/A	Lowest PDSI of -3.90	NRCC
May – December 1923	Drought	N/A	N/A	Lowest PDSI of -4.29	NRCC
August 1930 – July 1931	Drought	N/A	N/A	Lowest PDSI of -4.95	NRCC
September 1931 – February 1932	Drought	N/A	N/A	Lowest PDSI of -4.40	NRCC
April – September 1932	Drought	N/A	N/A	Lowest PDSI of -4.24	NRCC
November 1939 – January 1940	Drought	N/A	N/A	Lowest PDSI of -3.90	NRCC

SECTION 4.3.1: RISK ASSESSMENT – DROUGHT

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
September 1941 – February 1942	Drought	N/A	N/A	Lowest PDSI of -4.16	NRCC
September – November 1957	Drought	N/A	N/A	Lowest PDSI of -3.07	NRCC
August 1964 – January 1966	Drought, Water Shortage	DR-206	Northampton	In August, the Delaware River Basin was included in a FEMA disaster declaration. Lowest PDSI of -4.95	NRCC, PEMA, FEMA
June – November 1966	Drought	N/A	N/A	Lowest PDSI of -4.21	NRCC
January – February 1967	Drought	N/A	N/A	Lowest PDSI of -3.40	NRCC
August 1980 – January 1981	Drought	N/A	N/A	The Lehigh Valley was under a declared drought emergency in November. Lowest PDSI of -5.07	NRCC, PADEP, PEMA
March – July 1985	Drought	N/A	N/A	The Lehigh Valley was under a declared drought emergency between April and July. Lowest PDSI of -4.30	NRCC, PADEP, PEMA
August 1991 – February 1992	Drought	N/A	N/A	Lowest PDSI of -3.53	NRCC
September – November 1995	Drought	N/A	N/A	The Lehigh Valley was under a drought warning in early September and November. A drought emergency was declared for the Lehigh Valley in mid-September. Preliminary crop losses caused by the drought were \$300 million statewide and \$26,799 in the Lehigh Valley. No data on water supply problems/shortages for the Lehigh Valley was available.	PADEP, PEMA
December 1998 – July 1999	Drought	N/A	N/A	The Lehigh Valley was under a drought warning. The DRBC also declared a drought warning for the entire basin. The 0.62-inches of precipitation in December at the Lehigh Valley International Airport was the second driest December on record. In March 1999, the drought warning was downgraded to a drought watch due to a trend of above normal precipitation. By June, the state declared a drought warning again in 47 counties including all of eastern Pennsylvania due to unseasonably dry weather. Groundwater levels were extremely low in several counties in the lower part of the basin. The drought intensified in July and was the driest July on record at the Lehigh Valley International Airport. Open fires were banned in Northampton	PADEP



SECTION 4.3.1: RISK ASSESSMENT – DROUGHT

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				County. The Jordan Creek in South Whitehall Township stopped flowing.	
July – August 1999	Drought	N/A	N/A	<p>The Lehigh Valley was under a drought emergency in July. It was estimated that the corn crop loss in the state could reach \$100 million. In the Lehigh Valley, alfalfa cutting was expected to be one quarter of normal, the soybean crop one third of normal and the corn crop one half of normal. Low water levels made it difficult or impossible to use waterways for fishing and boating. Fish were dying due to low stream flows. By August, many farms in the Lehigh Valley and Berks County reported corn losses around 9%. The continued lack of rain resulted in wells going dry. Hardest hit were wells in Berks, Carbon and Montgomery counties. Lowest PDSI of -3.54.</p> <p>The drought emergency was lifted on September 30, 1999 after Hurricane Floyd. Agricultural losses throughout the state were estimated at about \$700 million. Crop loss figures in the Lehigh Valley were \$214,388 for 1998 and \$2.2 million for 1999, totaling over \$2.4 million for the two years. No data on water supply problems/shortages for the Lehigh Valley was available.</p>	NRCC
December 18, 2001 - November 25, 2002	Drought	N/A	N/A	<p>In November 2001, a drought warning was issued for eastern Pennsylvania due to unseasonably dry weather. Due to low groundwater levels caused by the drought, a well in East Allen Township ran dry, cutting off water service to 73 area homes. Water was trucked in to restore water service between August and November.</p> <p>From February to September, the Lehigh Valley was under a drought emergency. Groundwater levels were continuing to decline with streamflow levels reaching record low levels in some cases. Private wells were running dry in some areas including Chester and Montgomery Counties. Shallow wells were also going dry in Bucks and Carbon Counties. In August 2002, water once again had to be trucked in to serve customers at the East Allen Gardens subdivision in East Allen Township.</p> <p>It was estimated the drought cost farmers approximately \$300 million across the state. Crop losses due to drought in the Lehigh Valley for 2002 were \$4.2 million. No additional water supply problems/shortages for the Lehigh Valley were reported.</p>	DIR, PA DEP, PEMA, PA HMP



SECTION 4.3.1: RISK ASSESSMENT – DROUGHT

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
June – November 2005	Drought	N/A	N/A	<p>A drought warning was put into effect September 12 by the Sellersville Borough Council; non-essential water use was prohibited. The warning was directed at the 1,800 water users because water levels at all three municipal wells were falling, with one well approximately 40 feet below normal. The Borough water treatment plant, which treats reservoir water, was closed for renovations. The reservoir had also fallen below normal levels and was about three-quarters empty. The reservoir normally holds about 14 million gallons, but was down to four or five million gallons.</p> <p>The Pennsylvania governor asked for \$128 million in subsidence for farmers who lost a majority of their soybean, corn, hay, and alfalfa crops in 2005. After being declared a drought disaster, farmers were eligible for low interest loans from the USDA. The counties eligible for assistance were Armstrong, Bedford, Bradford, Centre, Clearfield, Clinton, Elk, Erie, Fayette, Fulton, Greene, Jefferson, Lackawanna, Lehigh, Luzerne, McKean, Pike, Potter, Sullivan, Susquehanna, Tioga, Washington, and Wayne.</p>	DIR
June 2007 – January 2008	Drought	N/A	N/A	<p>As a result of a dry summer, the Lehigh Valley remained under a declared drought watch as of January 1, 2008. Surface and groundwater conditions had improved during the last quarter of 2007 and the trend continued during the first few weeks of 2008. In response to the improvement, PADEP lifted drought watch declarations in the Lehigh Valley, along with 9 other Delaware River Basin counties on January 11, 2008.</p>	DRBC
April – November 2010	Drought	N/A	N/A	<p>The hot, dry summer and decreasing water supplies led Pennsylvania environmental authorities to issue a drought warning for 24 counties and asked residents to reduce their water use by 10 to 15 percent. The counties in the warning were Allegheny, Beaver, Bedford, Berks, Bucks, Carbon, Fayette, Franklin, Fulton, Greene, Huntingdon, Lackawanna, Lawrence, Lehigh, Luzerne, Mercer, Monroe, Montgomery, Northampton, Philadelphia, Pike, Schuylkill, Somerset, and Washington.</p> <p>Sixteen counties in Pennsylvania were declared to be natural disaster areas by the USDA due to an ongoing drought that started on May 25. The counties affected by the declaration included Bucks, Franklin, Monroe, Schuylkill, Carbon, Fulton, Montgomery, Snyder, Chester, Lehigh, Northampton, Union,</p>	DIR, PADEP

SECTION 4.3.1: RISK ASSESSMENT – DROUGHT

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				<p>Dauphin, Luzerne, Northumberland and York Counties. This declaration permitted impacted farmers, ranchers, and other agricultural producers to apply for low-interest emergency loans from the Farm Service Agency.</p> <p>In Northampton County, there was no significant rainfall since June 11th. Lawns were very brown and dry, small stream flow was reduced. Corn crops were dying.</p>	

Sources: NRCC, 2012; DIR, 2012; DRBC, 2008; PEMA, 2010; PADEP, 2012.

Notes:

DIR: National Drought Mitigation Center Drought Impact Reporter

DRBC: Delaware River Basin Commission

NRCC: Northeast Regional Climate Center

PA HMP: Pennsylvania 2010 Standard All Hazard Mitigation Plan

PADEP: Pennsylvania Department of Environmental Protection

PEMA: Pennsylvania Emergency Management Agency

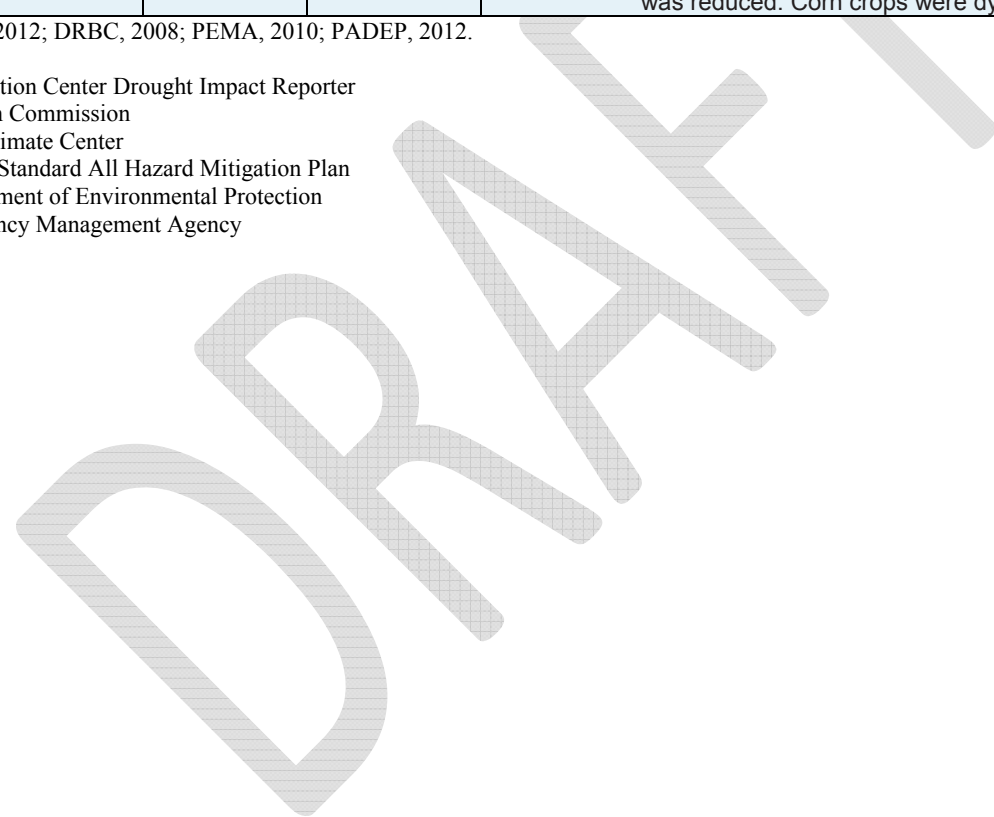


Table 4.3.1-5 displays the crop loss insurance payments on claims from the Lehigh Valley due to drought events since 1948.

Table 4.3.1-5. Crop Loss Insurance Claims Due to Drought

Crop Year	Total Claims	Crop Year	Total Claims
1948 - 1988	\$346,721	2000	\$3,466
1989	\$0	2001	\$440,747
1990	\$0	2002	\$4,223,046
1991	\$69,113	2003	\$0
1992	\$0	2004	\$0
1993	\$36,390	2005	\$848,019
1994	\$0	2006	\$152,694
1995	\$26,799	2007	\$237,300
1996	\$0	2008	\$456,108
1997	\$8,755	2009	\$0
1998	\$214,388	2010	\$1,077,812
1999	\$2,230,116	2011	\$8,264

Source: USDA, 2012

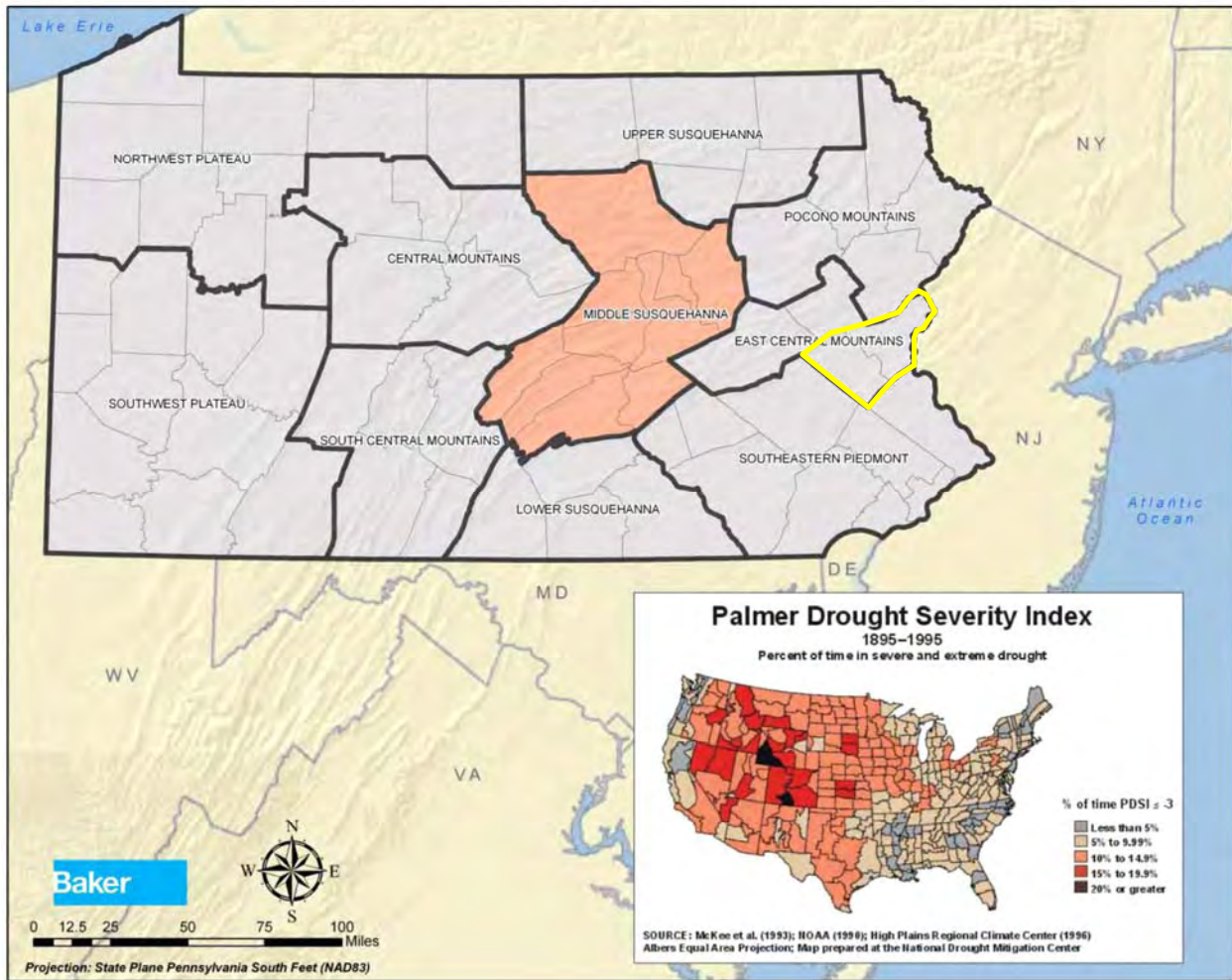
4.3.1.4 Future Occurrence

The frequency of droughts is difficult to forecast. It appears that the occurrences of drought are cyclical in nature and thus will occur in the future. The 2002 Lehigh Valley Planning Commission (LVPC) Water Supply Assessment Report indicates that water supply sources at the basin level should meet the needs of existing and future users through 2030 during a 25-year drought; however, more localized problems may occur as with the East Allen Township shortages reported during 2001 and 2002. Further details on the LVPC preliminary assessment are discussed in the ‘Vulnerability Assessment’ later in this Risk Assessment.

Based on national annual data from 1895 to 1995, the Lehigh Valley was in severe or extreme drought conditions approximately 5 to 9.9% of the time (refer to Figure 4.3.1-3). Based on national annual data from 1895 to 2011, the East Central Mountains (climate division 2), in which the Lehigh Valley is located, had an average PDSI of -.25. This climate division has been in severe or extreme drought during approximately 11 percent of the 117 years on record.

The future occurrence of drought events is considered *likely* as defined by the Risk Factor Methodology probability criteria (refer to Section 4.4).

Figure 4.3.1-3. Palmer Drought Severity Index for Pennsylvania (1895 to 1995)



Source: PEMA, 2010 (highlight added)

4.3.1.5 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed and vulnerable in the identified hazard area. For the drought hazard, all of the Lehigh Valley has been identified as the hazard area. Therefore, all assets (population, structures, critical facilities and lifelines), as described in the Regional Profile (Section 2), are vulnerable to a drought. The following text evaluates and estimates the potential impact of the drought hazard on the Lehigh Valley including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety, (2) general building stock, (3) critical facilities, (4) economy, (5) environment and (6) future growth and development
- Effect of climate change on vulnerability
- Further data collections that will assist understanding this hazard over time

4.3.1.5.1 Overview of Vulnerability

All of the Lehigh Valley is vulnerable to drought. Assets at particular risk would include any open land or structures located along the wildland/urban interface (WUI) that could become vulnerable to the wildfire hazard due to extended periods of low rain and high heat, usually associated with a drought. In addition, water supply resources could be impacted by extended periods of low rain. Finally, vulnerable populations could be particularly susceptible to the drought hazard and cascading impacts due to age, health conditions, and limited ability to mobilize to shelter, cooling and medical resources.

4.3.1.5.2 Data and Methodology

At the time of this Plan, insufficient data was available to model the long-term potential impacts of a drought on the Lehigh Valley. Over time, additional data will be collected to allow better analysis for this hazard. Available information and a preliminary assessment are provided below.

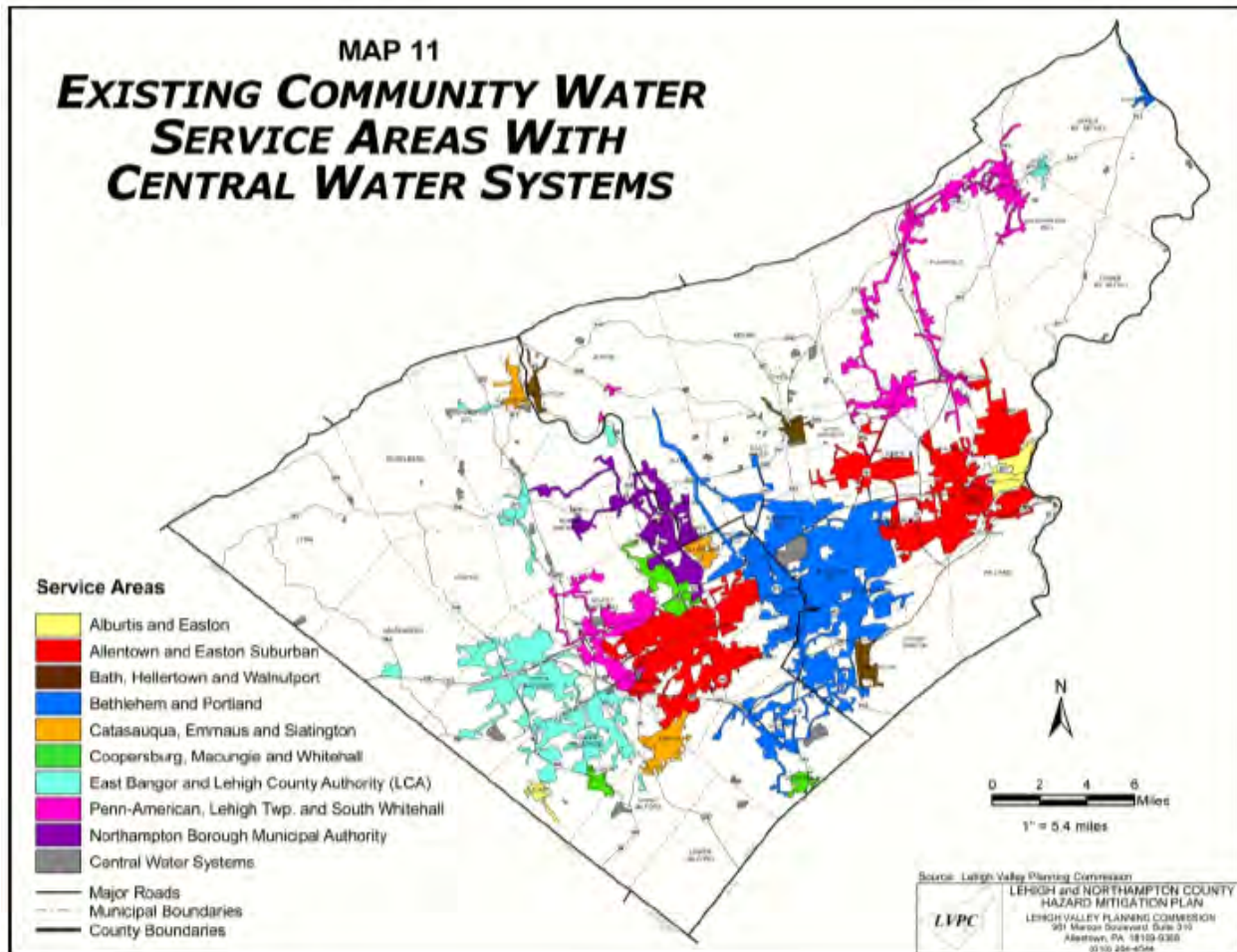
4.3.1.5.3 Impact on Life, Health and Safety

Drought conditions can cause a shortage of water for human consumption and reduce local firefighting capabilities. The drought hazard is a concern because private water supply sources in the Lehigh Valley come from local groundwater sources.

In 2002, the LVPC completed a preliminary assessment report of the Lehigh Valley's water resources. The purpose of the assessment was to identify current and future well water users of all types through 2030 and groundwater availability during normal and drought conditions. Types of users include community and central water systems, as shown on Figure 4.3.1-4 below, and users with their own individual well such as commercial agriculture production operations, golf courses, residential, commercial/industrial and water bottling operations. For the study, the LVPC defined 22 groundwater basins based on surface water divides and geology. From published data, groundwater recharge rates for the different geologic units in the Lehigh Valley were selected. In addition to average year recharge conditions, two drought conditions were included: 10-year and 25-year droughts. The study also included a standard condition used by the DRBC in the special groundwater protected areas in southeastern Pennsylvania that identifies when a basin has become potentially stressed.

For the study, groundwater recharge was compared with the estimated amount of well withdrawals now and in the future under average year and drought conditions. From the available data, it was found that well water demand should not exceed groundwater supply during normal and drought conditions through 2030 on a basin level. It should be noted that one of the main findings of the assessment was the lack of up-to-date, reliable data on water usage and groundwater recharge from PADEP, DRBC and USGS.

Figure 4.3.1-4. Existing Community Water Service Areas with Central Water Systems



Source: LVHMP, 2006

Social impacts of a drought include mental and physical stress, public safety (increased threat from forest/grass fires), health, conflicts between water users, reduced quality of life, and inequities in the distribution of impacts and disaster relief. The infirm, young, and elderly are particularly susceptible to drought and extreme temperatures, sometimes associated with drought conditions, due to their age, health conditions and limited ability to mobilize to shelters, cooling and medical resources. Impacts on the economy and environment may have social implications as well (NYS DPC, 2011). For the purposes of this Plan, the entire population in the Lehigh Valley is vulnerable to drought events.

4.3.1.5.4 Impact on General Building Stock and Critical Facilities

No structures are anticipated to be directly affected by a drought, and all are expected to be operational during a drought event. However, droughts contribute to conditions conducive to wildfires. Risk to life and property is greatest in those areas where forested areas adjoin urbanized areas (high density residential, commercial and industrial), also known as the WUI. Therefore, all assets in and adjacent to the WUI zone, including population, structures, critical facilities, lifelines, and businesses are considered vulnerable to wildfire. Please refer to Section 4.3.10 regarding the wildfire hazard in the Lehigh Valley.

4.3.1.5.5 Impact on the Economy

A prolonged drought can have serious direct and indirect economic impacts on a community or across the Lehigh Valley. A summary of impacts on the economy is presented in Table 4.3.1-6.

Table 4.3.1-6. Impacts on the Economy

Losses to Agricultural Producers	Losses to Livestock Producers	Loss from Timber Production
Annual and perennial crop losses	Reduced productivity of rangeland	Wildland fires
Damage to crop quality	Reduced milk production	Tree disease
Income loss for farmers due to reduced crop yields	Forced reduction of foundation stock	Insect infestation
Reduced productivity of cropland (wind erosion, long-term loss of organic matter, etc.)	High cost/unavailability of water for livestock	Impaired productivity of forest land
Insect infestation	Cost of new or supplemental water resource development (wells, dams, pipelines)	Direct loss of trees, especially young ones
Plant disease	High cost/unavailability of feed for livestock	Transportation Industry
Wildlife damage to crops	Increased feed transportation costs	Loss from impaired navigability of streams, rivers, and canals
Increased irrigation costs	High livestock mortality rates	Decline in food production/disrupted food supply
Cost of new or supplemental water resource development (wells, dams, pipelines)	Disruption of reproduction cycles (delayed breeding, more miscarriages)	Increase in food prices
Loss from Fishery Production	Decreased stock weights	Increased importation of food (higher costs)
Damage to fish habitat	Increased predation	Water Suppliers
Loss of fish and other aquatic organisms due to decreased flows	Grass fires	Revenue shortfalls and/or windfall profits
Loss to Recreation and Tourism Industry	Energy-related Effects	Cost of water transport or transfer
Loss to manufacturers and sellers of recreational equipment	Increased energy demand and reduced supply because of drought-related power curtailments	Cost of new or supplemental water resource development
Losses related to curtailed activities: hunting and fishing, bird watching, boating, etc.	Costs to energy industry and consumers associated with substituting more expensive fuels (oil) for hydroelectric power	

Source: NYSDPC, 2011

Loss estimation stems from lost agricultural revenues statewide. Table 4.3.1-7 below enumerates each county’s farmland acreage exposure to the drought hazard as well as the annual market value of all agricultural products sold, as documented in the 2007 USDA Census of Agriculture. Lehigh County is threatened with higher agricultural losses than Northampton County. If a drought were to eliminate the entire Lehigh Valley’s agricultural yield, total losses may exceed \$100 million which would be devastating to the local economy (PEMA, 2010).

Table 4.3.1-7. Estimated County Losses Relating to Agricultural Production

County	Farmland Acreage Exposed	Market Value Of All Agricultural Products
Lehigh	84,643	\$72,059,000
Northampton	68,252	\$31,762,000

Source: PEMA, 2010

4.3.1.5.6 Impact on the Environment

As summarized in the PA HMP, environmental impacts of drought include:

- Hydrologic effects – lower water levels in reservoirs, lakes and ponds; reduced streamflow; loss of wetlands; estuarine impacts; groundwater depletion and land subsidence; effects on water quality such as increases in salt concentration and water temperature;
- Damage to animal species – lack of feed and drinking water; disease; loss of biodiversity; migration or concentration; and reduction and degradation of fish and wildlife habitat;
- Damage to plant communities – loss of biodiversity; loss of trees from urban landscapes and wooded conservation areas;
- Increased number and severity of fires;
- Reduced soil quality;
- Air quality effects – dust and pollutants; and
- Loss of quality in landscape through loss in plants and plant diversity (PEMA, 2010).

4.3.1.5.7 Future Growth and Development

Development trends indicate that farmland is being converted to housing, commercial and industrial uses at a rate of 3.5 square miles per year in the Lehigh Valley. Farmland is under intense development pressure that is expected to continue through 2030. With the continuing loss of farmland, the impacts of drought on agriculture will likely decrease. There are no potential losses likely for existing and future structures associated with drought conditions.

Areas targeted for potential future growth and development in the next five (5) to ten (10) years have been identified across the Lehigh Valley at the municipal level. Refer to the jurisdictional annexes in Volume II of this HMP. Table B.1 in each jurisdictional annex lists the location of the potential new development and its exposure (if any) to known hazard zones. It is anticipated that any new development and new residents will be exposed to the drought hazard.

4.3.1.5.8 Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as droughts. While predicting changes of drought events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2006).

Pennsylvania’s Department of Environmental Protection was directed by the Climate Change Act (Act 70 of 2008) to initiate a study of the potential impacts of global climate change on the Commonwealth. The June 2009 Pennsylvania Climate Impact Assessment’s main findings indicate it is very likely that

Pennsylvania will experience increased temperatures in the 21st century. Increases in temperature will likely lead to increased evapotranspiration and thus an increase in soil-moisture-related droughts throughout late spring and early fall. Pennsylvania's precipitation climate is projected to become more extreme in the future, with longer dry periods and greater intensity of precipitation. Most models indicate the maximum number of consecutive dry days in a year, a drought indicator, is projected to increase (Shortle et. al, 2009).

Future improvements in modeling smaller scale climatic processes can be expected and will lead to improved understanding of how the changing climate will alter temperature, precipitation, storm frequency, and intensity in Pennsylvania and thus provide better indication for future drought events (Shortle et. al, 2009).

4.3.1.5.9 Additional Data and Next Steps

For future plan updates, localized concerns and impacts will be collected and analyzed.

4.3.2 Earthquake

This section provides a profile and vulnerability assessment for the earthquake hazard. According to the Pennsylvania Bureau of Topographic and Geologic Survey, the State is relatively free of earthquake activity compared to other states; however, earthquakes do occur. Pennsylvania has experienced fewer and milder earthquake events than most other eastern states (LVHMP, 2006).

An earthquake is the sudden movement of the Earth’s surface caused by the release of stress accumulated within or along the edge of the Earth’s tectonic plates, a volcanic eruption, or by a manmade explosion (Federal Emergency Management Agency [FEMA], 2010). Most earthquakes occur at the boundaries where the Earth’s tectonic plates meet (faults); however, less than 10 percent of earthquakes occur within plate interiors. The Lehigh Valley is in an area where plate interior-related earthquakes occur.

The U.S. Geological Survey (USGS) Earthquake Hazards Program defines an earthquake hazard as anything associated with an earthquake that may affect resident’s normal activities.

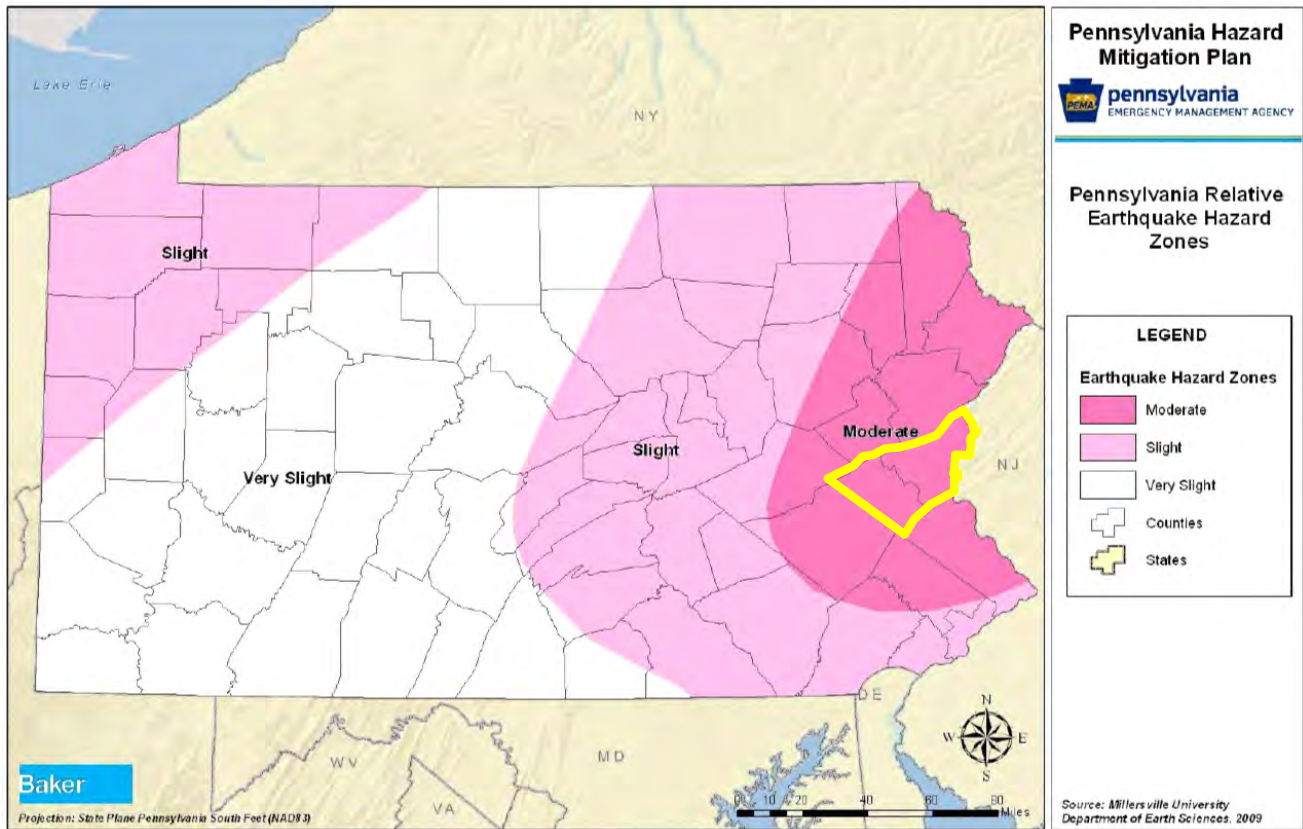
4.3.2.1 Location and Extent

The location of an earthquake is commonly described by its focal depth and the geographic position of its epicenter. The focal depth of an earthquake is the depth from the Earth’s surface to the region where an earthquake’s energy originates (the focus or hypocenter). The epicenter of an earthquake is the point on the Earth’s surface directly above the hypocenter. Earthquakes usually occur without warning and their effects can impact areas at great distance from the epicenter.

According to the Pennsylvania Bureau of Topographic and Geologic Survey, when events occur in Pennsylvania, their impact area is very small (less than 100 kilometers in diameter). The most seismically active region in the state is in southeastern Pennsylvania in the area of Lancaster County (PEMA, 2010). Areas of Pennsylvania, including the Lehigh Valley, may be subject to the effects of earthquakes with epicenters outside the state.

Pennsylvania has three earthquake hazard area zones (very slight, slight and moderate) as shown in Figure 4.3.2-1 (PEMA, 2010). The Lehigh Valley falls into the “moderate” zone, along with other municipalities and counties located within 17.5 miles from a historical epicenter. In this zone, minor earthquake damage is expected.

Figure 4.3.2-1: Pennsylvania Earthquake Hazard Zones



Source: PEMA, 2010

Note: The yellow highlight illustrates the location of the Lehigh Valley.

4.3.2.2 Range of Magnitude

Earthquake magnitude is often measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake. Table 4.3.2-1 summarizes the Richter Scale magnitudes and corresponding earthquake effects. Based on historical events, earthquakes in Pennsylvania do not exceed magnitudes greater than 6.0, however, the possibility of higher magnitude earthquakes cannot be ruled out. The worst-case earthquake in the Lehigh Valley would likely result in trees swaying, objects falling off walls, cracked walls and falling plaster.

Table 4.3.2-1: Richter Scale Magnitudes

Richter Magnitude	Earthquake Effects
2.5 or less	Usually not felt, but can be recorded by seismograph
2.5 to 5.4	Often felt, but only causes minor damage
5.5 to 6.0	Slight damage to buildings and other structures
6.1 to 6.9	May cause a lot of damage in very populated areas
7.0 to 7.9	Major earthquake; serious damage
8.0 or greater	Great earthquake; can totally destroy communities near the epicenter

Source: USGS, 2006

The impact an earthquake event has on an area is typically measured in terms of earthquake intensity. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale based on direct and indirect measurements of seismic effects. A detailed description of the MMI Scale is shown in Table 4.3.2-2. The earthquakes that occur in Pennsylvania originate deep within the earth’s crust, not on an active fault. No injury or severe damage from earthquake events has been reported in the Lehigh Valley.

Table 4.3.2-2: Modified Mercalli Intensity Scale with Associated Impacts

Scale	Intensity	Description Of Effects	Corresponding 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

Source: PEMA, 2012

Environmental impacts of earthquakes can be numerous, widespread, and devastating, particularly if indirect impacts are taken into account. Some examples are shown below but are unlikely to occur in the Lehigh Valley:

- Induced tsunamis and flooding or landslides and avalanches
- Poor water quality
- Damage to vegetation
- Breakage in sewage or toxic material containments
- Secondary impacts including: train derailments and spillage of hazardous materials and utility interruption

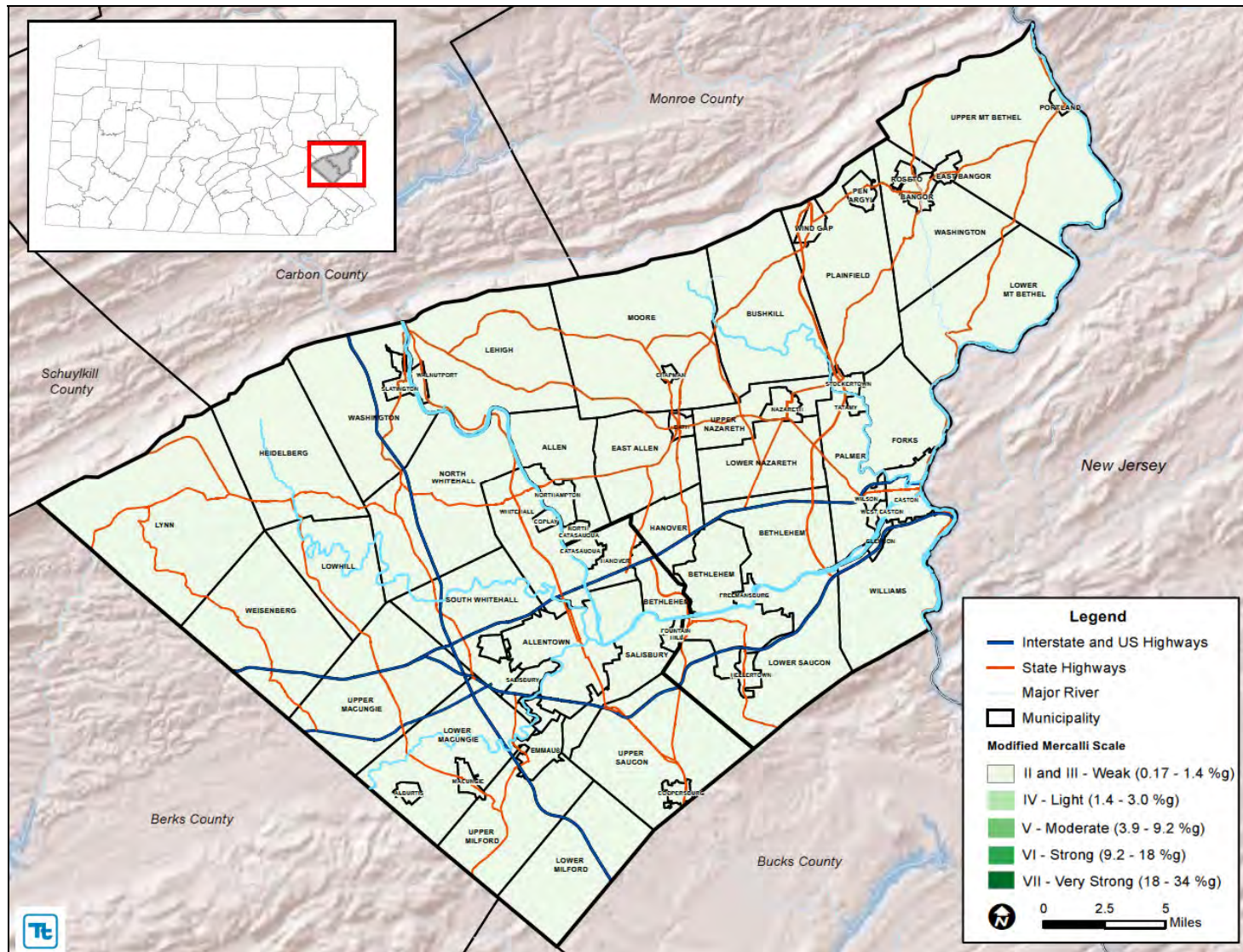
Seismic hazards are often expressed in terms of Peak Ground Acceleration (PGA) and Spectral Acceleration (SA). USGS defines PGA and SA as the following: ‘PGA is what is experienced by a particle on the ground. Spectral Acceleration (SA) is approximately what is experienced by a building, as modeled by a particle mass on a massless vertical rod having the same natural period of vibration as the building’ (USGS, Date Unknown). Both PGA and SA can be measured in g (the acceleration due to gravity) or expressed as a percent acceleration force of gravity (%g). PGA and SA hazard maps provide insight into location specific vulnerabilities (NYSDPC, 2011).

PGA is a common earthquake measurement that shows three things: the geographic area affected, the probability of an earthquake of each given level of severity, and the strength of ground movement (severity) expressed in terms of percent of acceleration force of gravity (%g). In other words, PGA expresses the severity of an earthquake and is a measure of how hard the earth shakes (or accelerates) in a given geographic area (NYSDPC, 2011).

National maps of earthquake shaking hazards have been produced since 1948. They provide information essential to creating and updating the seismic design requirements for building codes, insurance rate structures, earthquake loss studies, retrofit priorities and land use planning used in the U.S. Scientists frequently revise these maps to reflect new information and knowledge. Buildings, bridges, highways and utilities built to meet modern seismic design requirements are typically able to withstand earthquakes better, with less damages and disruption. After thorough review of the studies, professional organizations of engineers update the seismic-risk maps and seismic design requirements contained in building codes (Brown et al., 2001).

A probabilistic assessment was conducted for the 100-, 500- and 2,500-year mean return periods (MRP) through a Level 1 analysis in HAZUS-MH version 2.1 to analyze the earthquake hazard for the Lehigh Valley. The HAZUS analysis evaluates the statistical likelihood that a specific event will occur and what consequences will occur. A 100-year MRP event is an earthquake with a 1% chance that the mapped ground motion levels (PGA) will be exceeded in any given year. For a 500-year MRP, there is a 0.2% chance the mapped PGA will be exceeded in any given year. For a 2,500-year MRP, there is a 0.04% chance the mapped PGA will be exceeded in any given year. Figures 4.3.2-2 through 4.3.2-4 illustrate the geographic distribution of PGA (%g) across the Lehigh Valley for the 100-, 500- and 2,500-year MRP events. A discussion of the estimated potential losses estimated by HAZUS-MH for each MRP and the associated PGA is discussed in the ‘Vulnerability Assessment’ subsection below.

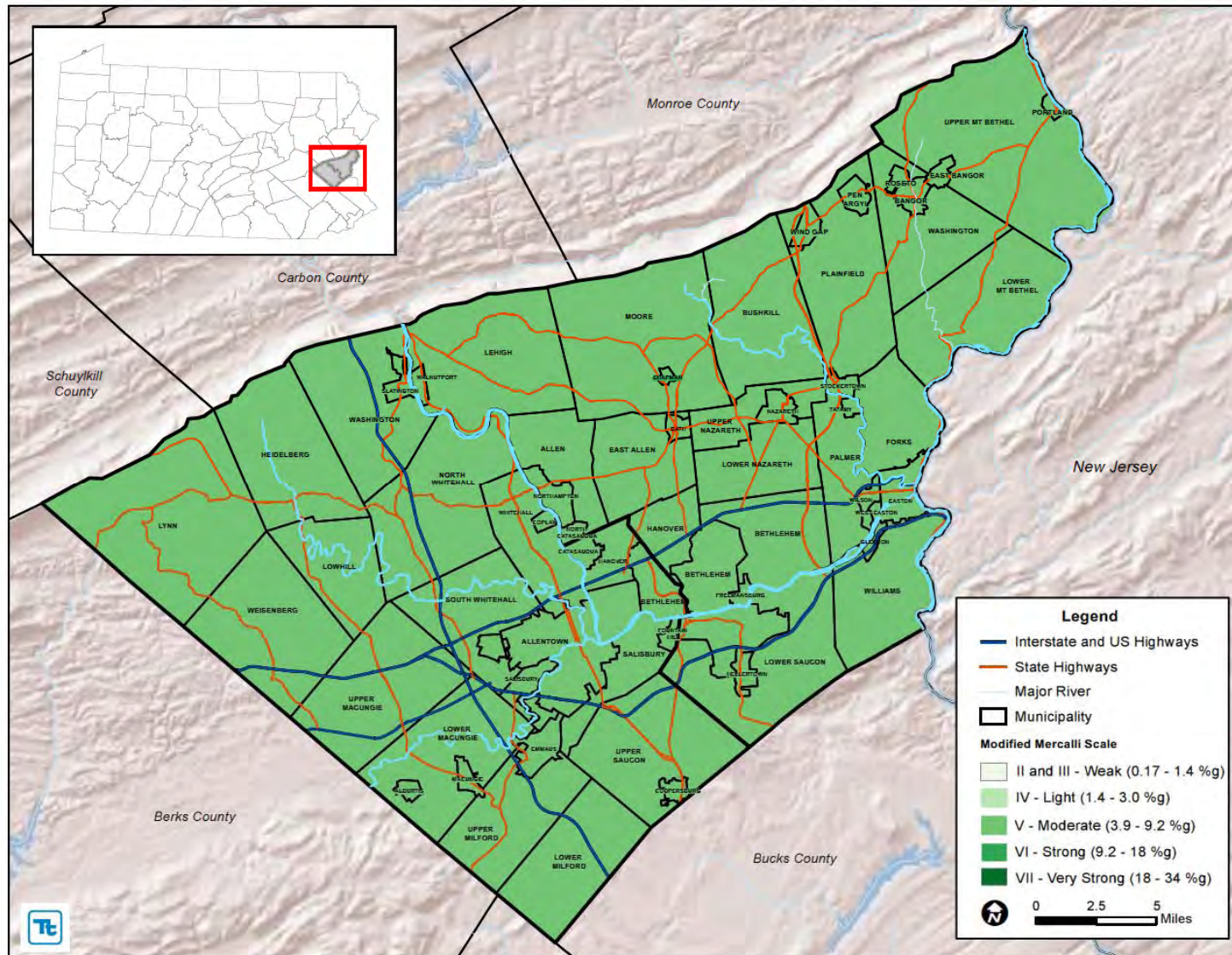
Figure 4.3.2-2. Peak Ground Acceleration Modified Mercalli Scale in the Lehigh Valley for a 100-Year MRP Earthquake Event



Source: HAZUS-MH 2.1

Note: The peak ground acceleration for the 100-year MRP is 1.12 – 1.18 %g.

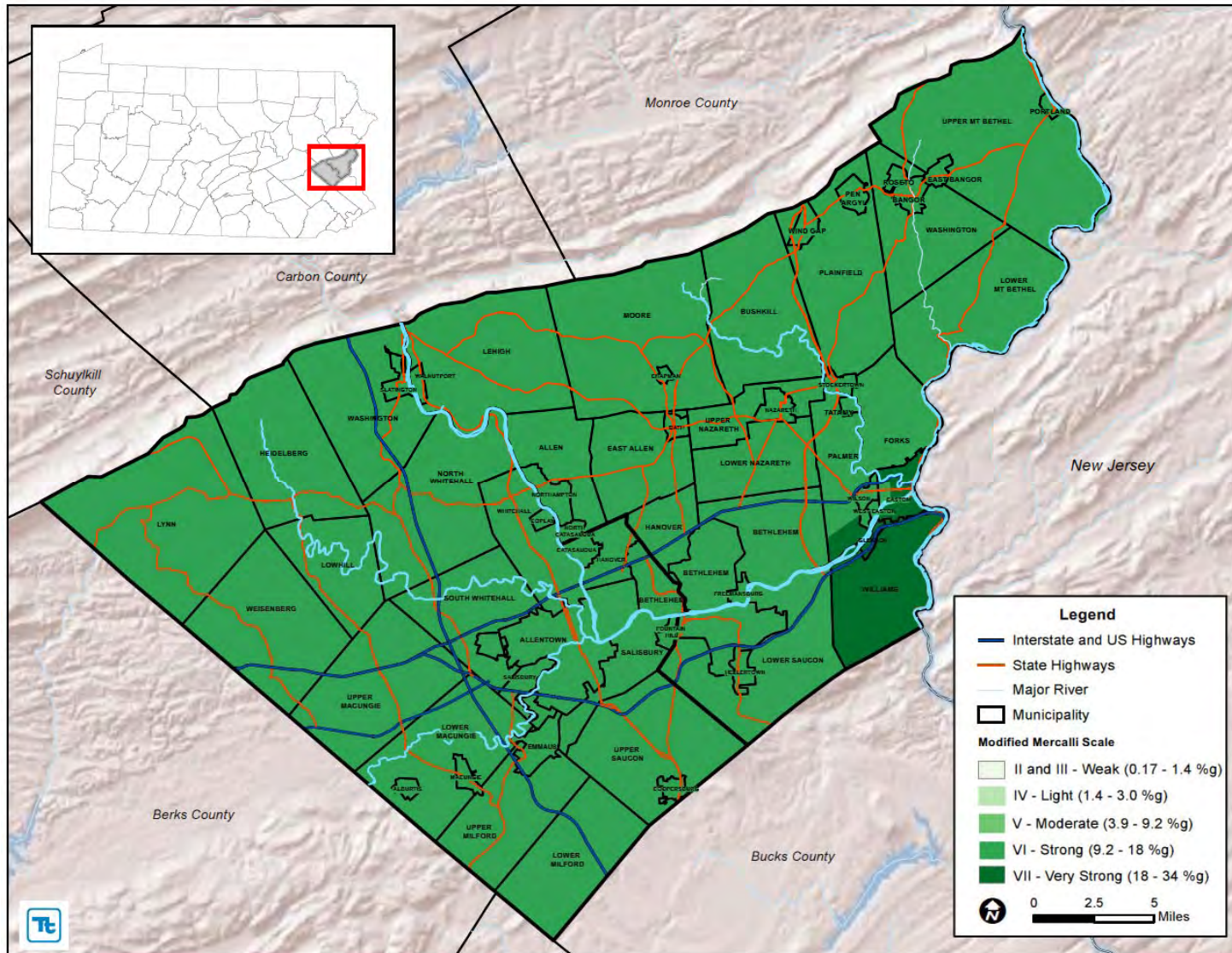
Figure 4.3.2-3. Peak Ground Acceleration Modified Mercalli Scale in the Lehigh Valley for a 500-Year MRP Earthquake Event



Source: HAZUS-MH 2.1

Note: The peak ground acceleration for the 500-year MRP is 4.64 to 5.44%g.

Figure 4.3.2-4. Peak Ground Acceleration Modified Mercalli Scale in the Lehigh Valley for a 2,500-Year MRP Earthquake Event



Source: HAZUS 2.1

Note: The peak ground acceleration for the 2,500-year MRP is 15.68 to 18.06 %g.

4.3.2.3 Past Occurrence

The historical record for earthquakes goes back approximately 200 years. In Pennsylvania, about 35 earthquakes have caused light damage since the Colonial period. Nearly half of these events had out-of-state epicenters (PEMA, 2010).

Data from the Pennsylvania Department of Conservation and Natural Resources shows five recorded earthquakes occurred in the Lehigh Valley between the dates of 1724, to July 31, 2003, all with epicenters located in the City of Allentown area (see Table 4.3.2-3). Note that the magnitude of the earthquakes varies from 2.4 to 4.3 on the Richter Scale, suggesting relatively minor events (PA DCNR, 2004).

Earthquakes whose epicenters fall outside of Pennsylvania can also impact the Lehigh Valley. Historically, large earthquakes in eastern North America have historically occurred in three regions: 1) Mississippi Valley near the Town of New Madrid, Missouri; 2) St. Lawrence Valley region of Quebec Canada; and 3) Charleston, South Carolina. In February 1925, one of the region's largest earthquakes on record occurred with its epicenter in a region of Quebec with a magnitude near 7. If a similar magnitude earthquake were to occur in the western part of the Quebec region, some moderate damage might be expected in one or more counties of Pennsylvania's northern tier. In Charleston, South Carolina, an earthquake with an estimated magnitude of about 7.5 occurred on August 31, 1886. The earthquake was felt in most of Pennsylvania, however, it is expected that a recurrence would pose little hazard to Pennsylvania (LVHMP, 2006)

Other earthquakes have occurred in east coast areas including eastern Massachusetts, southeastern New York and northern New Jersey. Moderate earthquakes were experienced in southeastern New York and northern New Jersey and were felt in eastern Pennsylvania. If an earthquake of magnitude 6 or greater were to occur in this area, damage would likely result in easternmost counties of Pennsylvania, including the Lehigh Valley (LVHMP, 2006).

Based on all sources researched, known earthquake events that have affected the Lehigh Valley and its municipalities are identified in Table 4.3.2-3. Please note, not all sources have been identified or researched. Therefore, Table 4.3.2-3 may not include all events that have occurred throughout the Lehigh Valley.

Table 4.3.2-3: Earthquake Events between 1871 and 2012 in the Lehigh Valley

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
October 9, 1871	Earthquake	N/A	N/A	Epicenter near Wilmington, Delaware with a maximum intensity of VII. This was felt in the Lehigh Valley. Chimneys were thrown down in Oxford and doors and windows rattled in Philadelphia.	PA Bureau of Topographic and Geologic Survey
May 31, 1884	Earthquake 2.9	N/A	N/A	Epicenter near the City of Allentown. Maximum intensity of V. In Allentown, dishes were thrown from tables.	USGS
August 10, 1884	Earthquake	N/A	N/A	Centered in northeast New Jersey near New York City. This earthquake caused chimneys to fall and glassware and other small objects to fall. Chimney damage was reported in the Cities of Allentown and Easton. Waves on the Delaware River were also reported.	USGS
August 31, 1886	Earthquake 7.5	N/A	N/A	Epicenter near Charleston, South Carolina. Most of Pennsylvania felt the earthquake.	PA Bureau of Topographic and Geologic Survey
May 31, 1908	Earthquake 3.1	N/A	N/A	Epicenter near the City of Allentown. Maximum intensity of VI. In Allentown, the shock shook down chimneys.	USGS
February 1925	Earthquake 7.0	N/A	N/A	Epicenter in the region of Quebec. No reference and/or no damage reported.	PA Bureau of Topographic and Geologic Survey
June 22, 1928	Earthquake 2.4	N/A	N/A	Epicenter near the City of Allentown. Maximum intensity of III. No reference and/or no damage reported.	PA Bureau of Topographic and Geologic Survey
August 23, 1938	Earthquake	N/A	N/A	Epicenter near Ocean County, New Jersey. This was one of the strongest shocks in the Northeast. It was the principal shock of a dozen tremors that were felt in the region. In Philadelphia, there were reports of broken windows.	USGS
November 23, 1951	Earthquake 3.3	N/A	N/A	Epicenter near the City of Allentown. Maximum intensity of IV. No reference and/or no damage reported.	PA Bureau of Topographic and Geologic Survey
January 7, 1954	Earthquake	N/A	N/A	The area around Sinking Spring, west of Reading, experienced minor damage from this earthquake. Plaster fell from walls, dishes and bottles came off shelves, and furniture was moved. There was some minor damage to brick and frame buildings. The tremor was felt in western Berks County and eastern Lancaster County.	USGS
September 14, 1961	Earthquake 4.3	N/A	N/A	Epicenter near the City of Allentown. Maximum intensity of V. The earthquake shook buildings over a broad area. There was	USGS

SECTION 4.3.2: RISK ASSESSMENT – EARTHQUAKE

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts	Source(s)
				only one report of damage of loose bricks that fell from a chimney in Allentown. Other areas that were effected included Bethlehem, Catasauqua, Coplay, Egypt, Fountain Hill, Freemansburg, and Hellertown.	
December 27, 1961	Earthquake	N/A	N/A	An earthquake struck near the northeast portion and suburbs of Philadelphia. Buildings shook, dishes rattled and other objects were disturbed. Several New Jersey communities along the Delaware River experienced similar effects.	USGS
February 28, 1973	Earthquake	N/A	N/A	Epicenter near Wilmington, Delaware with a maximum intensity of V. This event extended towards the northeast along the Delaware River. No damage was reported in the Lehigh Valley.	PA Bureau of Topographic and Geologic Survey
October 5, 2008	Earthquake 2.0	N/A	N/A	No reference and/or no damage reported.	USGS
October 19, 2005	Earthquake 2.1	N/A	N/A	No reference and/or no damage reported.	USGS
January 16, 1994	Earthquake 4.0	N/A	N/A	Epicenter near Berks County, Pennsylvania. No reference and/or no damage reported.	PA Bureau of Topographic and Geologic Survey
December 27, 2008	Earthquake 3.4	N/A	N/A	Epicenter near Manheim, Pennsylvania. The Boroughs of Catasauqua and Emmaus reported having felt the earthquake.	USGS
December 31, 2008	Earthquake 2.1	N/A	N/A	No reference and/or no damage reported.	USGS
April 4, 2009	Earthquake 2.4-2.9	N/A	N/A	No reference and/or no damage reported.	USGS
October 25, 2009	Earthquake 2.6-2.8	N/A	N/A	No reference and/or no damage reported.	USGS
June 3, 2010	Earthquake 2.9	N/A	N/A	Epicenter near Dillsburg, Pennsylvania. No reference and/or no damage reported.	USGS
August 23, 2011	Earthquake 5.8	N/A	N/A	An earthquake occurred in Louisa County, Virginia with damage reported as far away as Brooklyn, New York. It was felt as far north as Quebec and as far west as Illinois. Minor damage was reported in southeastern Pennsylvania. No injuries or significant damage was reported in the Lehigh Valley.	USGS

Note: N/A = Not Applicable



4.3.2.4 Future Occurrence

The Pennsylvania Bureau of Topographic and Geologic Survey indicates that an earthquake is a relatively low-level hazard in Pennsylvania based on a probabilistic analysis considering the threat from earthquakes both outside and inside Pennsylvania (LVHMP, 2006). An earthquake's severity can be expressed by considering the rate in change of motion of the earth's surface during a seismic event as a percent of the normal rate of acceleration due to gravity (g), which is called the Peak Horizontal Ground Acceleration (PHGA). In general, ground acceleration must exceed 15 percent of g for significant damage to occur, although soil conditions at local sites are extremely important in controlling how much damage will occur as a consequence of a given amount of ground acceleration. According to PEMA, the highest seismic hazard in the state exists in southeastern Pennsylvania, where PHGA values range from 10-14 percent and there is a 90-percent probability that maximum horizontal acceleration in rock of 10-percent of gravity will not be exceeded in a 50- year period (PEMA, 2010).

Based on available historical data, the future occurrence of earthquake events can be considered *unlikely* as defined by the Risk Factor Methodology probability criteria (refer to Section 4.4).

4.3.2.5 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the earthquake hazard, all of the Lehigh Valley is exposed. Therefore, all assets (population, structures, critical facilities and lifelines), as described in Section 2, are exposed and vulnerable to direct and indirect impacts of earthquakes. The following section includes an evaluation and estimation of the potential impact of the earthquake hazard on the Lehigh Valley including the following:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety, (2) general building stock, (3) critical facilities, (4) economy, (5) environment and (6) future growth and development
- Effect of climate change on vulnerability
- Further data collections that will assist understanding this hazard over time

4.3.2.5.1 Overview of Vulnerability

Earthquakes usually occur without warning and can impact areas a great distance from their point of origin. The extent of damage depends on the density of population and building and infrastructure construction in the area shaken by the quake. Some areas may be more vulnerable than others based on soil type, the age of the buildings and building codes in place. Compounding the potential for damage – historically, Building Officials Code Administration (BOCA) used in the Northeast was developed to address local concerns including heavy snow loads and wind; seismic requirements for design criteria are not as stringent compared to the west coast's reliance on the more seismically-focused Uniform Building Code. As such, a smaller earthquake in the Northeast can cause more structural damage than if it occurred out west.

In summary, the entire population and general building stock inventory of the Lehigh Valley are at risk of being damaged or experiencing losses due to impacts of an earthquake. The impacts on population, existing structures, critical facilities and the economy within the Lehigh Valley are presented below for

three probabilistic earthquake events, the 100-year, 500- and 2,500-year MRPs, in addition to annualized losses; following a summary of the data and methodology used.

4.3.2.5.2 Data and Methodology

A probabilistic assessment was conducted for the Lehigh Valley for the 100-, 500- and 2,500-year MRPs through a Level 2 analysis in HAZUS-MH 2.1 to analyze the earthquake hazard and provide a range of loss estimates. The probabilistic method uses information from historic earthquakes and inferred faults, locations and magnitudes, and computes the probable ground shaking levels that may be experienced during a recurrence period by Census Tract. Please note, in some cases there is more than one municipality per Census Tract and the results are reported as such in the tables below.

Ground shaking is the primary cause of earthquake damage to man-made structures and soft soils amplify ground shaking. One contributor to the site amplification is the velocity at which the rock or soil transmits shear waves (S-waves). The National Earthquake Hazard Reduction Program (NEHRP) developed five soil classifications defined by their shear-wave velocity that impact the severity of an earthquake. The soil classification system ranges from A to E, where A represents hard rock that reduces ground motions from an earthquake and E represents soft soils that amplify and magnify ground shaking and increase building damage and losses. NEHRP soil classifications were not available for the Lehigh Valley at the time of this analysis. Soils were classified as NEHRP soil type D across the Lehigh Valley as a conservative approach to this risk assessment. Groundwater was set at a depth of five-feet (default setting). Damages and loss due to liquefaction, landslide or surface fault rupture were not included in this analysis. The default assumption is a magnitude 7 earthquake for all return periods.

In addition to the probabilistic scenarios mentioned, an annualized loss run was conducted in HAZUS 2.1 to estimate the annualized general building stock dollar losses for the Lehigh Valley. The annualized loss methodology combines the estimated losses associated with ground shaking for eight return periods: 100, 250, 500, 750, 1000, 1500, 2000, 2500-year, which are based on values from the USGS seismic probabilistic curves. Annualized losses are useful for mitigation planning because they provide a baseline upon which to 1) compare the risk of one hazard across multiple jurisdictions and 2) compare the degree of risk of all hazards for each participating jurisdiction.

As noted in the HAZUS-MH Earthquake User Manual ‘Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS Earthquake Model, possibly at best a factor of two or more.’ However, HAZUS’ potential loss estimates are acceptable for the purposes of this HMP.

4.3.2.5.3 Impact on Life, Health and Safety

The entire population of the Lehigh Valley (647,232 people – 2010 Census) is potentially exposed to direct and indirect impacts from earthquakes. The degree of exposure is dependent on many factors, including the age and construction type of buildings and the soil type buildings are constructed on. The impact of earthquakes on life, health and safety is dependent upon the severity of the event. Risk to public safety and loss of life from an earthquake in the Lehigh Valley is minimal with higher risks occurring in buildings as a result of damage to the structure, or people walking below building ornamentation and chimneys that may be shaken loose and fall as a result of the quake. Business interruption may prevent people from working, road closures could isolate populations and loss of

SECTION 4.3.2: RISK ASSESSMENT – EARTHQUAKE

functions of utilities could impact populations that may not have suffered direct damage from the event itself.

Populations considered most vulnerable include the elderly (persons over the age of 65) and individuals living below the Census poverty threshold. These socially vulnerable populations are most susceptible, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing.

Residents may be displaced or require temporary to long-term sheltering due to the event. The number of people requiring shelter is generally less than the number displaced as some displaced persons use hotels or stay with family or friends following a disaster event. Tables 4.3.2-4 and 4.3.2-5 summarize the population HAZUS-MH 2.1 estimates will be displaced or will require short-term sheltering as a result of the 100-, 500- and 2,500-year MRP earthquake events.

Table 4.3.2-4. Summary of Estimated Sheltering Needs for the Lehigh Valley

Scenario	Displaced Households	People Requiring Short-Term Shelter
100-Year Earthquake	0	0
500-Year Earthquake	83	56
2,500-Year Earthquake	1,323	874

Source: HAZUS-MH 2.1

Table 4.3.2-5. Estimated Sheltering Needs by Municipality for the Lehigh Valley

Municipality	500-Year		2,500-Year	
	Number of Displaced Households	People Requiring Short-Term Shelter	Number of Displaced Households	People Requiring Short-Term Shelter
Lehigh County				
Alburtis Borough, Lower Macungie Township	0	0	5	3
Allentown, City of	23	17	343	262
Bethlehem, City of	4	2	63	37
Catasauqua Borough	1	1	17	10
Coopersburg Borough	0	0	7	4
Coplay Borough	0	0	7	4
Emmaus Borough	2	1	32	17
Fountain Hill Borough	1	1	14	9
Hanover Township	0	0	7	4
Heidelberg Township, Lynn Township	0	0	8	5
Lower Macungie Township	2	1	28	14
Lower Milford Township	0	0	4	2
Lowhill Township, Weisenberg Township	0	0	6	3
Macungie Borough	1	0	11	5
North Whitehall Township	1	1	19	11
Salisbury Township	1	1	21	12

SECTION 4.3.2: RISK ASSESSMENT – EARTHQUAKE

Municipality	500-Year		2,500-Year	
	Number of Displaced Households	People Requiring Short-Term Shelter	Number of Displaced Households	People Requiring Short-Term Shelter
Slatington Borough	1	1	11	7
South Whitehall Township	2	1	29	17
Upper Macungie Township	1	1	21	12
Upper Milford Township	1	0	12	6
Upper Saucon Township	1	0	12	7
Washington Township	0	0	7	4
Whitehall Township	5	3	71	40
Lehigh County (est. total)	48	32	755	496
Northampton County				
Allen Township	0	0	3	2
Bangor Borough, Roseto Borough	1	1	19	13
Bath Borough	0	0	7	5
Bethlehem Township	2	1	34	19
Bethlehem, City of	9	8	146	118
Bushkill Township	0	0	6	4
East Allen Township	0	0	5	3
East Bangor Borough	0	0	2	1
Easton, City of	6	4	86	65
Forks Township	1	0	11	6
Freemansburg Borough	0	0	3	2
Hanover Township	1	1	18	9
Hellertown Borough	1	0	15	8
Lehigh Township	1	0	10	6
Lower Mt Bethel Township	0	0	5	3
Lower Nazareth Township	0	0	6	4
Lower Saucon Township	1	0	15	8
Moore Township	1	0	10	6
Nazareth Borough	1	1	20	12
North Catasauqua Borough	0	0	5	3
Northampton Borough	1	1	20	11
Palmer Township	2	1	30	16
Pen Argyl Borough	1	0	8	5
Plainfield Township	1	0	9	5
Portland Borough, Upper Mt Bethel Township	1	0	12	7
Stockertown Borough	0	0	3	2
Upper Nazareth Township	0	0	5	3
Walnutport Borough	0	0	3	2



SECTION 4.3.2: RISK ASSESSMENT – EARTHQUAKE

Municipality	500-Year		2,500-Year	
	Number of Displaced Households	People Requiring Short-Term Shelter	Number of Displaced Households	People Requiring Short-Term Shelter
Washington Township	0	0	7	4
Williams Township	0	0	7	4
Wilson Borough	1	1	22	13
Wilson Borough, West Easton Borough	0	0	5	3
Wind Gap Borough	1	0	10	6
Northampton County (est. total)	35	24	568	378

Source: HAZUS-MH 2.1

Notes: The HAZUS-MH earthquake model results are reported by Census Tract. In some cases, there is more than one municipality per Census Tract.

Est. = Estimated.

According to the 1999-2003 New York City Area Consortium for Earthquake Loss Mitigation (NYSCEM) Summary Report (*Earthquake Risks and Mitigation in the New York / New Jersey / Connecticut Region*), there is a strong correlation between structural building damage and the number of injuries and casualties from an earthquake event. HAZUS-MH 2.1 estimates the number of people that may potentially be injured and/or killed by an earthquake depending upon the time of day the event occurs. These estimates are provided for three times of day (2:00 am, 2:00 pm and 5:00 pm), representing the periods of the day that different sectors of the community are at their peak. The 2:00 am estimate considers the residential occupancy at its maximum, the 2:00 pm estimate considers the educational, commercial and industrial sector at their maximum and the 5:00 pm estimate represents peak commuter time.

No injuries or casualties are estimated for the 100-year event. Tables 4.3.2-6 and 4.3.2-7 summarize the injuries and casualties estimated for the 500-year and 2,500-year MRP earthquake events.

Table 4.3.2-6. Estimated Number of Injuries and Casualties from the 500-Year MRP Earthquake Event for the Lehigh Valley

Level of Severity	Time of Day		
	2:00 AM	2:00 PM	5:00 PM
Injuries	53	32	34
Hospitalization	8	4	5
Casualties	1	1	1

Source: HAZUS-MH 2.1

Table 4.3.2-7. Estimated Number of Injuries and Casualties from the 2,500-Year MRP Earthquake Event for the Lehigh Valley

Level of Severity	Time of Day		
	2:00 AM	2:00 PM	5:00 PM
Injuries	532	408	400
Hospitalization	111	81	83
Casualties	23	15	16

Source: HAZUS-MH 2.1

Earthquakes can cause secondary hazard events such as fires. No fires are anticipated as a result of the 100-, 500- and 2,500-year events.

4.3.2.5.4 Impact on General Building Stock

After considering the population exposed to the earthquake hazard, the value of general building stock exposed to and damaged by 100-, 500- and 2,500-year MRP earthquake events was evaluated. In addition, annualized losses were calculated using HAZUS 2.1. The entire study area’s general building stock is considered at risk and exposed to this hazard. The HAZUS 2.1 model estimates the value of the exposed building stock and the loss (in terms of damage to the exposed stock). Refer to Section 2 for general building stock data replacement value statistics (structure and contents).

Using HAZUS 2.1, a probabilistic model was run for the purposes of this Plan to estimate annualized dollar losses for the Lehigh Valley. Please note that annualized loss does not predict what losses will occur in any particular year. The estimated annualized losses are approximately \$2,421,986 per year for the Lehigh Valley (Table 4.3.2-8).

Table 4.3.2-8. Summary of Estimated Annualized Earthquake General Building Stock Losses for the Lehigh Valley

Municipality	Total (Buildings + Contents)	Buildings (Structural and Non-Structural)	Contents
Lehigh County			
Alburtis Borough, Lower Macungie Township	\$29,018	\$22,838	\$6,180
Allentown, City of	\$370,812	\$292,380	\$78,432
Bethlehem, City of	\$86,983	\$67,757	\$19,226
Catasauqua Borough	\$15,941	\$12,816	\$3,125
Coopersburg Borough	\$7,930	\$6,340	\$1,590
Coplay Borough	\$6,648	\$5,442	\$1,206
Emmaus Borough	\$35,941	\$28,549	\$7,392
Fountain Hill Borough	\$20,439	\$15,585	\$4,854
Hanover Township	\$45,424	\$34,906	\$10,518
Heidelberg Township, Lynn Township	\$17,434	\$14,328	\$3,106
Lower Macungie Township	\$76,263	\$61,969	\$14,294
Lower Milford Township	\$8,978	\$7,380	\$1,598
Lowhill Township, Weisenberg Township	\$26,408	\$21,466	\$4,942
Macungie Borough	\$8,872	\$7,120	\$1,752
North Whitehall Township	\$46,948	\$37,795	\$9,153
Salisbury Township	\$65,099	\$50,362	\$14,737
Slatington Borough	\$11,515	\$9,329	\$2,186
South Whitehall Township	\$91,987	\$73,691	\$18,296
Upper Macungie Township	\$197,373	\$155,683	\$41,690
Upper Milford Township	\$20,818	\$16,996	\$3,822

SECTION 4.3.2: RISK ASSESSMENT – EARTHQUAKE

Municipality	Total (Buildings + Contents)	Buildings (Structural and Non-Structural)	Contents
Upper Saucon Township	\$57,507	\$46,099	\$11,408
Washington Township	\$13,611	\$11,215	\$2,396
Whitehall Township	\$94,862	\$75,952	\$18,910
Lehigh County (est. total)	\$1,356,807	\$1,075,997	\$280,810
Northampton County			
Allen Township	\$11,908	\$9,713	\$2,195
Bangor Borough, Roseto Borough	\$21,886	\$17,270	\$4,616
Bath Borough	\$8,353	\$6,684	\$1,669
Bethlehem Township	\$105,661	\$81,391	\$24,270
Bethlehem, City of	\$185,483	\$145,115	\$40,368
Bushkill Township	\$20,973	\$17,111	\$3,862
East Allen Township	\$20,012	\$16,428	\$3,584
East Bangor Borough	\$19,179	\$14,615	\$4,564
Easton, City of	\$2,015	\$1,656	\$359
Forks Township	\$95,655	\$75,233	\$20,422
Freemansburg Borough	\$58,197	\$45,136	\$13,061
Hanover Township	\$6,858	\$5,495	\$1,363
Hellertown Borough	\$23,275	\$18,507	\$4,768
Lehigh Township	\$62,225	\$48,371	\$13,854
Lower Mt Bethel Township	\$16,466	\$13,197	\$3,269
Lower Nazareth Township	\$23,725	\$19,452	\$4,273
Lower Saucon Township	\$9,236	\$7,390	\$1,846
Moore Township	\$42,962	\$33,655	\$9,307
Nazareth Borough	\$34,407	\$27,963	\$6,444
North Catasauqua Borough	\$24,583	\$19,242	\$5,341
Northampton Borough	\$6,564	\$5,281	\$1,283
Palmer Township	\$30,276	\$24,100	\$6,176
Pen Argyl Borough	\$76,614	\$60,142	\$16,472
Plainfield Township	\$12,033	\$9,494	\$2,539
Portland Borough, Upper Mt Bethel Township	\$19,151	\$15,237	\$3,914
Stockertown Borough	\$26,638	\$20,852	\$5,786
Upper Nazareth Township	\$9,615	\$7,303	\$2,312
Walnutport Borough	\$18,261	\$14,539	\$3,722
Washington Township	\$8,237	\$6,268	\$1,969
Williams Township	\$15,729	\$12,549	\$3,180



SECTION 4.3.2: RISK ASSESSMENT – EARTHQUAKE

Municipality	Total (Buildings + Contents)	Buildings (Structural and Non-Structural)	Contents
Wilson Borough	\$29,145	\$22,466	\$6,679
Wilson Borough, West Easton Borough	\$10,271	\$7,972	\$2,299
Wind Gap Borough	\$9,592	\$7,553	\$2,039
Northampton County (est. total)	\$1,065,179	\$837,375	\$227,804

Source: HAZUS-MH 2.1

Notes: The HAZUS-MH earthquake model results are reported by Census Tract. In some cases, there is more than one municipality per Census Tract.

Est. = Estimated

According to the NYCEM, where earthquake risks and mitigation were evaluated in the New York, New Jersey and Connecticut region, most damage and loss caused by an earthquake is directly or indirectly the result of ground shaking (NYCEM, 2003). NYCEM indicates there is a strong correlation between PGA and the damage a building might experience. The HAZUS-MH 2.1 model is based on the best available earthquake science and aligns with these statements. HAZUS-MH 2.1 methodology and model were used to analyze the earthquake hazard for the general building stock for Lehigh Valley. See Figures 4.3.2-2 through 4.3.2-4 earlier in this profile that illustrate the geographic distribution of PGA (%g) across the Lehigh Valley for 100-, 500- and 2,500-year MRP events.

According to NYCEM, a building’s construction determines how well it can withstand the force of an earthquake. The NYCEM report indicates that un-reinforced masonry buildings are most at risk during an earthquake because the walls are prone to collapse outward, whereas steel and wood buildings absorb more of the earthquake’s energy. Additional attributes that contribute to a building’s capability to withstand an earthquake’s force include its age, number of stories and quality of construction. HAZUS-MH considers building construction and the age of buildings as part of the analysis. Because the default general building stock was used for this HAZUS-MH analysis, the default building ages and building types already incorporated into the inventory were used.

Potential building damage was evaluated by HAZUS-MH 2.1 across the following damage categories (none, slight, moderate, extensive and complete). Table 4.3.2-9 provides definitions of these five categories of damage for a light wood-framed building; definitions for other building types are included in HAZUS-MH technical manual documentation. General building stock damage for these damage categories by occupancy class and building type across the Lehigh Valley is summarized for the 100-, 500- and 2,500-year events in Tables 4.3.2-10 through 4.3.2-13.

Table 4.3.2-9. Example of Structural Damage State Definitions for a Light Wood-Framed Building

Damage Category	Description
Slight	Small plaster or gypsum-board cracks at corners of door and window openings and wall-ceiling intersections; small cracks in masonry chimneys and masonry veneer.
Moderate	Large plaster or gypsum-board cracks at corners of door and window openings; small diagonal cracks across shear wall panels exhibited by small cracks in stucco and gypsum wall panels; large cracks in brick chimneys; toppling of tall masonry chimneys.
Extensive	Large diagonal cracks across shear wall panels or large cracks at plywood joints; permanent lateral movement of floors and roof; toppling of most brick chimneys; cracks in foundations; splitting of wood sill plates and/or slippage of structure over foundations; partial collapse of room-over-garage or other soft-story configurations.
Complete	Structure may have large permanent lateral displacement, may collapse, or be in imminent danger of collapse due to cripple wall failure or the failure of the lateral load resisting system; some structures may slip and fall off the foundations; large foundation cracks.

Source: HAZUS-MH Technical Manual

SECTION 4.3.2: RISK ASSESSMENT – EARTHQUAKE

Table 4.3.2-10. Estimated Number of Buildings Damaged by General Occupancy for 100-year, 500-year and 2,500-year MRP Earthquake Events

Category	Average Damage State														
	100-Year MRP					500-Year MRP					2,500-Year MRP				
	None	Slight	Moderate	Extensive	Complete	None	Slight	Moderate	Extensive	Complete	None	Slight	Moderate	Extensive	Complete
Residential	209,073	0	0	0	0	200,469	6,262	2,008	304	30	159,019	32,626	13,680	3,168	580
Commercial	11,122	0	0	0	0	10,535	424	143	18	1	7,014	2,122	1,566	375	45
Industrial	1,392	0	0	0	0	1,320	52	18	2	0	862	255	216	55	6
Education, Government, Religious and Agricultural	1,639	0	0	0	0	1,555	59	21	3	1	1,086	290	207	50	6

Source: HAZUS-MH 2.1

Table 4.3.2-11. Estimated Number of Buildings Damaged by Building Type for 100-year, 500-year and 2,500-year MRP Earthquake Events

Category	Average Damage State														
	100-Year MRP					500-Year MRP					2,500-Year MRP				
	None	Slight	Moderate	Extensive	Complete	None	Slight	Moderate	Extensive	Complete	None	Slight	Moderate	Extensive	Complete
Wood	139,325	0	0	0	0	137,250	1,899	162	14	0	115,744	19,209	4,064	293	15
Steel	6,902	0	0	0	0	6,604	223	69	6	0	4,262	1,252	1,109	251	28
Concrete	1,383	0	0	0	0	1,326	44	12	1	0	1,094	339	350	90	7
Reinforced Masonry	2,434	0	0	0	0	2,310	77	41	6	0	1,385	237	240	75	1
Un-Reinforced Masonry	72,404	0	0	0	0	65,687	4,500	1,885	301	31	45,139	14,079	9,750	2,898	583
Manufactured Housing	780	0	0	0	0	702	56	21	1	0	357	179	201	40	3

Source: HAZUS-MH 2.1



SECTION 4.3.2: RISK ASSESSMENT – EARTHQUAKE

HAZUS-MH 2.1 estimates \$0 in building damage to the Lehigh Valley’s general building stock as a result of a 100-year MRP event.

Tables 4.3.2-12 and 4.3.2-13 summarize the potential damage estimated for the 500- and 2,500-year MRP earthquake events for each participating municipality by Census Tract. Damage loss estimates include structural and non-structural damage to the building and loss of contents.

Table 4.3.2-12. Estimated Potential General Building Stock Loss (Structure and Contents) for the 500-Year MRP Earthquake Event

Municipality	Total Loss (All Occupancies)	Percentage of Total Building Value	Residential	Commercial	Industrial
Lehigh County					
Alburtis Borough, Lower Macungie Township	\$1,673,633	0.1	\$799,362	\$558,508	\$531,915
Allentown, City of	\$21,719,863	0.1	\$10,742,670	\$6,901,999	\$5,894,643
Bethlehem, City of	\$4,968,965	0.1	\$2,296,248	\$2,117,462	\$1,718,115
Catasauqua Borough	\$975,394	0.1	\$645,139	\$127,037	\$120,266
Coopersburg Borough	\$474,981	0.1	\$288,012	\$129,879	\$106,615
Coplay Borough	\$435,211	0.1	\$339,134	\$66,202	\$54,960
Emmaus Borough	\$2,124,268	0.1	\$1,226,090	\$482,628	\$426,994
Fountain Hill Borough	\$1,127,444	0.1	\$493,430	\$567,012	\$417,062
Hanover Township	\$2,279,560	0.1	\$284,836	\$1,478,557	\$1,308,485
Heidelberg Township, Lynn Township	\$1,162,756	0.1	\$850,980	\$148,572	\$121,001
Lower Macungie Township	\$4,952,077	0.1	\$3,773,836	\$755,901	\$618,019
Lower Milford Township	\$620,615	0.1	\$552,189	\$38,001	\$29,953
Lowhill Township, Weisenberg Township	\$1,590,731	0.1	\$960,239	\$527,056	\$436,200
Macungie Borough	\$545,513	0.1	\$388,055	\$85,156	\$81,722
North Whitehall Township	\$3,010,225	0.1	\$1,993,034	\$589,454	\$475,459
Salisbury Township	\$3,697,572	0.1	\$1,787,960	\$1,584,901	\$1,201,824
Slatington Borough	\$727,022	0.1	\$447,626	\$119,827	\$101,931
South Whitehall Township	\$5,079,506	0.1	\$3,237,193	\$1,594,252	\$1,283,472
Upper Macungie Township	\$10,693,397	0.1	\$2,807,124	\$6,840,384	\$5,803,264
Upper Milford Township	\$1,345,311	0.1	\$1,093,849	\$177,440	\$147,238
Upper Saucon Township	\$3,585,578	0.1	\$2,298,021	\$748,104	\$604,955
Washington Township	\$906,781	0.1	\$692,659	\$160,245	\$131,400
Whitehall Township	\$5,596,503	0.1	\$3,081,265	\$1,875,543	\$1,562,897
Lehigh County (est. total)	\$79,292,904	0.1	\$41,078,949	\$27,674,121	\$23,178,387

SECTION 4.3.2: RISK ASSESSMENT – EARTHQUAKE

Municipality	Total Loss (All Occupancies)	Percentage of Total Building Value	Residential	Commercial	Industrial
Northampton County					
Allen Township	\$801,123	0.1	\$619,494	\$74,422	\$67,666
Bangor Borough, Roseto Borough	\$1,347,462	0.1	\$724,138	\$329,033	\$310,340
Bath Borough	\$510,553	0.1	\$279,310	\$114,953	\$101,946
Bethlehem Township	\$6,325,775	0.1	\$3,303,949	\$1,025,787	\$1,285,675
Bethlehem, City of	\$10,694,524	0.1	\$5,157,404	\$2,571,506	\$2,377,894
Bushkill Township	\$1,448,103	0.1	\$1,157,396	\$148,519	\$123,450
East Allen Township	\$1,136,737	0.1	\$1,122,955	\$102,085	\$96,030
East Bangor Borough	\$136,872	0.1	\$560,952	\$196,682	\$267,457
Easton, City of	\$5,685,553	0.1	\$110,041	\$15,287	\$13,086
Forks Township	\$3,696,848	0.1	\$2,585,234	\$1,776,222	\$1,510,870
Freemansburg Borough	\$420,602	0.1	\$2,265,192	\$387,007	\$577,513
Hanover Township	\$3,668,993	0.1	\$260,635	\$71,923	\$64,068
Hellertown Borough	\$995,291	0.1	\$1,086,399	\$145,150	\$169,840
Lehigh Township	\$1,591,023	0.1	\$1,790,047	\$1,214,667	\$1,149,587
Lower Mt Bethel Township	\$607,481	0.1	\$643,321	\$244,695	\$212,207
Lower Nazareth Township	\$2,388,227	0.1	\$1,231,372	\$178,386	\$163,010
Lower Saucon Township	\$2,284,264	0.1	\$413,904	\$133,835	\$118,623
Moore Township	\$1,377,345	0.1	\$907,332	\$1,085,736	\$970,662
Nazareth Borough	\$1,381,478	0.1	\$1,848,720	\$299,146	\$248,612
North Catasauqua Borough	\$410,900	0.1	\$637,842	\$424,970	\$404,245
Northampton Borough	\$1,845,958	0.1	\$279,201	\$89,086	\$77,991
Palmer Township	\$4,723,621	0.1	\$1,103,123	\$323,338	\$318,717
Pen Argyl Borough	\$734,913	0.1	\$2,905,411	\$837,830	\$889,700
Plainfield Township	\$1,234,674	0.1	\$401,857	\$145,411	\$150,819
Portland Borough, Upper Mt Bethel Township	\$1,719,293	0.1	\$790,990	\$214,346	\$210,982
Stockertown Borough	\$561,079	0.1	\$1,011,818	\$319,174	\$356,083
Upper Nazareth Township	\$1,142,786	0.1	\$233,208	\$141,477	\$161,599
Walnutport Borough	\$472,945	0.1	\$748,182	\$90,739	\$119,611
Washington Township	\$1,023,895	0.1	\$208,082	\$79,451	\$112,676
Williams Township	\$1,491,689	0.1	\$681,460	\$210,056	\$193,036
Wilson Borough	\$1,637,306	0.1	\$650,314	\$676,435	\$552,433



SECTION 4.3.2: RISK ASSESSMENT – EARTHQUAKE

Municipality	Total Loss (All Occupancies)	Percentage of Total Building Value	Residential	Commercial	Industrial
Wilson Borough, West Easton Borough	\$592,521	0.1	\$252,080	\$109,219	\$110,691
Wind Gap Borough	\$557,047	0.1	\$269,382	\$178,440	\$168,427
Northampton County (est. total)	\$64,646,879	0.1	\$36,240,744	\$13,955,011	\$13,655,544

Source: HAZUS-MH 2.1

Note: The HAZUS-MH earthquake model results are reported by Census Tract. In some cases, there is more than one municipality per Census Tract.

Table 4.3.2-13. Estimated Potential General Building Stock Loss (Structure and Contents) for the 2,500-Year MRP Earthquake Event

Municipality	Total Loss (All Occupancies)	Percentage of Total Building Value	Residential	Commercial	Industrial
Lehigh County					
Alburtis Borough, Lower Macungie Township	\$26,073,454	1.6	\$10,841,849	\$9,427,947	\$5,229,858
Allentown, City of	\$339,727,876	1.6	\$154,337,267	\$116,623,775	\$29,947,653
Bethlehem, City of	\$77,781,292	1.6	\$32,879,284	\$35,442,167	\$5,664,282
Catasauqua Borough	\$14,683,796	1.6	\$9,128,316	\$2,129,280	\$1,159,730
Coopersburg Borough	\$7,287,848	1.7	\$4,133,367	\$2,192,928	\$280,456
Coplay Borough	\$6,230,766	1.5	\$4,623,864	\$1,112,852	\$155,939
Emmaus Borough	\$33,098,661	1.6	\$17,579,367	\$8,302,874	\$2,844,346
Fountain Hill Borough	\$18,023,467	1.6	\$6,961,053	\$9,954,627	\$246,382
Hanover Township	\$38,564,910	1.7	\$4,346,740	\$24,879,587	\$7,565,882
Heidelberg Township, Lynn Township	\$16,244,218	1.4	\$11,117,267	\$2,482,589	\$38,346
Lower Macungie Township	\$71,631,356	1.6	\$51,606,358	\$12,904,139	\$1,706,024
Lower Milford Township	\$8,715,197	1.6	\$7,577,498	\$639,708	\$0
Lowhill Township, Weisenberg Township	\$23,816,050	1.5	\$13,089,603	\$8,935,507	\$492,858
Macungie Borough	\$8,330,981	1.6	\$5,590,024	\$1,456,681	\$907,484
North Whitehall Township	\$42,669,840	1.5	\$26,190,009	\$9,581,523	\$273,874
Salisbury Township	\$58,485,961	1.6	\$24,797,425	\$28,235,897	\$1,150,156
Slatington Borough	\$10,399,727	1.4	\$5,959,979	\$1,932,012	\$342,414
South Whitehall Township	\$77,405,927	1.6	\$45,522,605	\$27,121,687	\$1,581,403
Upper Macungie Township	\$168,915,042	1.7	\$38,237,737	\$111,890,155	\$17,475,703
Upper Milford Township	\$19,904,895	1.6	\$15,518,640	\$3,093,342	\$374,627
Upper Saucon Township	\$52,599,071	1.7	\$31,280,982	\$12,427,883	\$880,207



SECTION 4.3.2: RISK ASSESSMENT – EARTHQUAKE

Municipality	Total Loss (All Occupancies)	Percentage of Total Building Value	Percentage of Total Building Value		
			Residential	Commercial	Industrial
Washington Township	\$12,590,211	1.4	\$9,052,404	\$2,652,249	\$149,794
Whitehall Township	\$85,453,447	1.6	\$43,444,289	\$31,240,323	\$4,815,033
Lehigh County (est. total)	\$1,218,633,992	1.6	\$573,815,926	\$464,659,731	\$83,282,451
Northampton County					
Allen Township	\$11,119,904	1.5	\$8,109,001	\$1,226,849	\$444,366
Bangor Borough, Roseto Borough	\$19,486,265	1.6	\$9,495,144	\$5,208,708	\$2,628,416
Bath Borough	\$7,400,490	1.6	\$3,702,282	\$1,830,921	\$544,718
Bethlehem Township	\$94,588,860	1.6	\$43,829,714	\$16,779,657	\$26,077,448
Bethlehem, City of	\$166,016,861	1.7	\$72,368,759	\$43,228,095	\$18,517,515
Bushkill Township	\$19,450,942	1.5	\$14,801,715	\$2,406,265	\$488,452
East Allen Township	\$17,131,560	1.6	\$14,448,710	\$1,647,652	\$804,380
East Bangor Borough	\$1,855,726	1.6	\$7,327,564	\$3,169,744	\$6,157,871
Easton, City of	\$85,017,557	1.8	\$1,431,521	\$237,595	\$46,368
Forks Township	\$52,869,226	1.7	\$35,464,382	\$28,281,778	\$5,577,828
Freemansburg Borough	\$6,254,817	1.7	\$29,159,965	\$6,134,891	\$14,497,581
Hanover Township	\$55,976,895	1.6	\$3,612,193	\$1,182,020	\$381,581
Hellertown Borough	\$15,124,332	1.7	\$14,596,887	\$2,427,983	\$3,083,194
Lehigh Township	\$21,915,756	1.5	\$24,285,403	\$19,941,580	\$10,520,399
Lower Mt Bethel Township	\$8,492,941	1.7	\$9,092,788	\$4,161,973	\$1,025,027
Lower Nazareth Township	\$37,290,630	1.7	\$16,013,856	\$2,902,521	\$1,126,693
Lower Saucon Township	\$32,622,599	1.7	\$5,378,584	\$2,108,288	\$675,694
Moore Township	\$18,593,529	1.5	\$12,111,479	\$18,122,907	\$5,820,378
Nazareth Borough	\$21,755,207	1.7	\$25,244,821	\$5,026,665	\$699,199
North Catasauqua Borough	\$6,071,810	1.6	\$9,052,916	\$7,136,614	\$3,753,337
Northampton Borough	\$27,358,119	1.5	\$3,819,147	\$1,512,236	\$403,328
Palmer Township	\$69,597,030	1.7	\$14,781,795	\$5,427,605	\$3,498,819
Pen Argyl Borough	\$10,664,406	1.6	\$38,922,679	\$13,777,316	\$12,686,081
Plainfield Township	\$17,305,887	1.6	\$5,279,032	\$2,317,482	\$1,881,740
Portland Borough, Upper Mt Bethel Township	\$23,925,551	1.6	\$10,159,672	\$3,404,595	\$2,216,474
Stockertown Borough	\$8,528,599	1.7	\$12,721,213	\$4,875,613	\$5,322,195
Upper Nazareth Township	\$16,461,042	1.6	\$3,067,985	\$2,262,120	\$2,680,861
Walnutport Borough	\$7,255,593	1.4	\$9,944,461	\$1,461,081	\$2,623,975
Washington Township	\$14,246,696	1.6	\$2,708,258	\$1,289,509	\$2,811,317



SECTION 4.3.2: RISK ASSESSMENT – EARTHQUAKE

Municipality	Total Loss (All Occupancies)	Percentage of Total Building Value	Occupancy Class		
			Residential	Commercial	Industrial
Williams Township	\$21,597,531	1.7	\$8,727,765	\$3,338,928	\$1,505,840
Wilson Borough	\$25,470,056	1.7	\$8,947,774	\$11,290,383	\$2,201,051
Wilson Borough, West Easton Borough	\$9,057,562	1.7	\$3,431,668	\$1,794,228	\$1,355,097
Wind Gap Borough	\$8,409,240	1.6	\$3,655,554	\$2,899,591	\$1,442,510
Northampton County (est. total)	\$958,913,216	1.6	\$485,694,685	\$228,813,391	\$143,499,729

Source: HAZUS-MH 2.1

Notes: Total is sum of damages for all occupancy classes (residential, commercial, industrial, agricultural, educational, religious and government).

The HAZUS-MH earthquake model results are reported by Census Tract. In some cases, there is more than one municipality per Census Tract and results are reported as such.

Est. = estimated

It is estimated that there would be \$79 Million in building damages for Lehigh County and \$64 Million in building damages for Northampton County during a 500-year earthquake event. This includes structural damage, non-structural damage and loss of contents, representing 0.1-percent of the total replacement value for general building stock in each County. For a 2,500-year MRP earthquake event, the estimated total building damage is \$1.2 Billion for Lehigh County (or 1.6% of the total general building stock replacement value) and nearly \$959 Million for Northampton County (or 1.6% of the total). Residential and commercial buildings account for most of the damage for earthquake events. This is likely because they comprise the majority of the building inventory.

As stated earlier, NEHRP soil classifications were not available for the Lehigh Valley at the time of this analysis. In general, softer soils follow riverine reaches and valleys. Lacking appropriately classified soil layers (NEHRP and those susceptible to liquefaction), it is currently feasible, or necessary for this planning process, to conduct additional earthquake vulnerability assessment modeling, other than use NEHRP Class ‘E’ soil type (soft soils) across the Lehigh Valley to provide the least conservative loss estimation results. A second 2,500-year probabilistic earthquake was run in HAZUS-MH, and the NEHRP soil classification was changed from ‘D’ to ‘E’ across the entire Lehigh Valley. The building and content damages to all buildings in the Lehigh Valley increased by 2.5 times when compared to damages using soil type ‘D’. It is clear that soil types impact the potential loss estimates in HAZUS-MH.

In general soft soils are also more susceptible to liquefaction, a secondary effect of an earthquake where soils lose their shear strength and flow or behave as liquid, thereby damaging structures that derive their support from the soil. In HAZUS-MH, damages and loss due to liquefaction, landslide or surface fault rupture were not included in this analysis. As summarized in the HAZUS-MH Earthquake Technical Manual, Youd and Perkins (1978) relative susceptibility ratings indicate that ‘recently deposited relatively unconsolidated soils such as Holocene-age river channel, flood plain, and delta deposits and uncompacted artificial fills located below the groundwater table have high to very high liquefaction susceptibility. Sands and silty sands are particularly susceptible to liquefaction. Silts and gravels also are susceptible to liquefaction, and some sensitive clays have exhibited liquefaction-type strength losses (Updike, et. al., 1988).’

In summary, areas with ‘softer’ soils in the Lehigh Valley will be more susceptible to ground shaking and liquefaction and will experience greater building damages. As NEHRP soil and landslide susceptibility maps are developed, they can be incorporated into HAZUS-MH to perform a user-supplied data defined analysis for the earthquake hazard. Refer to the subsection ‘Additional Data and Next Steps’ below.

4.3.2.5.5 Impact on Critical Facilities

After considering the general building stock exposed to, and damaged by, 100-, 500- and 2,500-year MRP earthquake events, critical facilities were evaluated. All critical facilities (essential facilities, transportation systems, lifeline utility systems, high-potential loss facilities and user-defined facilities) in the Lehigh Valley are considered exposed and vulnerable to the earthquake hazard. Refer to subsection ‘Critical Facilities’ in Section 2 (Regional Profile) of this plan for a complete inventory of critical facilities. However, the degree of exposure is dependent on many factors, including the age and construction type of buildings and the soil type buildings are constructed on.

HAZUS-MH 2.1 estimates the probability that critical facilities may sustain damage as a result of 100-, 500- and 2,500-year MRP earthquake events. Additionally, HAZUS-MH estimates percent functionality for each facility days after the event. For the 100-Year MRP event, HAZUS-MH 2.1 emergency facilities (police, fire, EMS and medical facilities), schools and specific facilities identified by the plan participants as critical (i.e., user-defined facilities such as shelters, municipal buildings) will be 100% functional on day one of the event. Therefore, the impact to critical facilities is not significant for the 100-year event and is not discussed further.

Appendix G, Tables G-1 and G-2, list the probability of critical facilities sustaining the damage category as defined by the column heading and percent functionality after the event for the 500-year and 2,500-year MRP earthquake events.

4.3.2.5.6 Impact on Economy

Earthquakes also have impacts on the economy, including: loss of business function, damage to inventory, relocation costs, wage loss and rental loss due to the repair/replacement of buildings. A Level 2 HAZUS-MH analysis estimates the total economic loss associated with each earthquake scenario, which includes building- and lifeline-related losses (transportation and utility losses) based on the available inventory (facility [or GIS point] data only). Direct building losses are the estimated costs to repair or replace the damage caused to the building. This is reported in the “Impact on General Building Stock” section discussed earlier. Lifeline-related losses include the direct repair cost to transportation and utility systems and are reported in terms of the probability of reaching or exceeding a specified level of damage when subjected to a given level of ground motion. Additionally, economic loss includes business interruption losses associated with the inability to operate a business due to the damage sustained during the earthquake as well as temporary living expenses for those displaced. These losses are discussed below.

For the 500-year event, HAZUS-MH estimates 25% of the estimated losses were related to the business interruption of the region. For the 2,500-year event, HAZUS-MH estimates 25% of the estimated losses were related to the business interruption of the region. The Lehigh Valley will incur approximately \$578 Million in income losses, mainly to the residential and commercial occupancy classes associated with wages, loss of income, rental and relocation.

For the 100-year MRP, in terms of utilities, HAZUS-MH estimates 100% functionality on day one of the event. Damage results are not considered to be significant as a result of a 100-year event; therefore, utility loss estimates are not discussed further in this assessment for this HMP.

Appendix G, Tables G-3 and G-4, summarize the HAZUS-MH 2.1 estimated probability of damage that each utility may sustain (as defined by the column heading) and estimated loss of use in days as result of a

SECTION 4.3.2: RISK ASSESSMENT – EARTHQUAKE

500-year and 2,500-year MRP earthquake event, respectively. Damage categories are related to the damage ratio (defined as ratio of repair to replacement cost) for evaluation of direct economic loss. Refer to the HAZUS-MH Earthquake Technical Manual for a description of the damage categories for each utility feature.

In terms of transportation, roadway segments and railroad tracks may experience damage due to ground failure. Damage estimates to these components were not calculated by HAZUS. It is assumed that regional transportation and distribution of materials may be interrupted as a result of an earthquake event. Losses to the community that result from damages to lifelines can be much greater than the cost of repair.

HAZUS-MH 2.1 estimates \$10,000 in highway bridge loss as a result of a 500-year MRP event. HAZUS-MH 2.1 estimates \$1 Million in highway bridge loss as a result of a 2,500-year event.

HAZUS-MH 2.1 also estimates the volume of debris that may be generated as a result of an earthquake event to enable the Lehigh Valley to prepare and rapidly and efficiently manage debris removal and disposal. Debris estimates are divided into two categories: (1) reinforced concrete and steel that require special equipment to break it up before it can be transported, and (2) brick, wood and other debris that can be loaded directly onto trucks with bulldozers (HAZUS-MH Earthquake User’s Manual).

For the 100-year MRP event, HAZUS-MH estimates no debris will be generated. For the 500-year MRP event, HAZUS-MH estimates 118,278 tons of debris will be generated and for the 2,500-year MRP event, HAZUS-MH estimates greater than 1 Million tons of debris will be generated. Table 4.3.2-14 summarizes the estimated debris by the 500- and 2,500-year MRP earthquake events by municipality.

Table 4.3.2-14. Estimated Debris Generated by the 500- and 2,500-year MRP Earthquake Events

Municipality	500-Year		2,500-Year	
	Brick/Wood (tons)	Concrete/Steel (tons)	Brick/Wood (tons)	Concrete/Steel (tons)
Lehigh County				
Alburtis Borough, Lower Macungie Township	1,163	410	8,127	6,935
Allentown, City of	12,919	4,371	89,579	72,544
Bethlehem, City of	2,724	918	18,754	15,056
Catasauqua Borough	674	183	4,597	2,747
Coopersburg Borough	302	88	2,094	1,383
Coplay Borough	333	80	2,224	1,086
Emmaus Borough	1,399	405	9,694	6,365
Fountain Hill Borough	557	202	3,891	3,495
Hanover Township	998	556	7,608	10,983
Heidelberg Township, Lynn Township	918	209	5,906	2,698
Lower Macungie Township	3,761	871	25,206	11,731
Lower Milford Township	510	104	3,382	1,248
Lowhill Township, Weisenberg Township	1,185	330	8,119	5,161
Macungie Borough	378	106	2,577	1,599
North Whitehall Township	2,138	545	13,994	7,527

SECTION 4.3.2: RISK ASSESSMENT – EARTHQUAKE

Municipality	500-Year		2,500-Year	
	Brick/Wood (tons)	Concrete/Steel (tons)	Brick/Wood (tons)	Concrete/Steel (tons)
Salisbury Township	2,083	659	14,430	10,857
Slatington Borough	498	138	3,211	1,946
South Whitehall Township	3,241	921	22,061	14,121
Upper Macungie Township	6,093	2,573	43,967	46,794
Upper Milford Township	1,057	241	7,176	3,228
Upper Saucon Township	2,431	637	16,376	9,303
Washington Township	728	169	4,739	2,246
Whitehall Township	3,498	1,070	24,153	17,315
Lehigh County (est. total)	49,588	15,787	341,864	256,369
Northampton County				
Allen Township	633	144	4,125	1,837
Bangor Borough, Roseto Borough	845	255	5,618	4,017
Bath Borough	322	96	2,144	1,471
Bethlehem Township	3,757	1,142	25,658	18,717
Bethlehem, City of	6,203	2,012	43,503	34,214
Bushkill Township	1,126	250	7,198	3,043
East Allen Township	701	227	4,773	3,730
East Bangor Borough	103	24	672	316
Easton, City of	3,187	1,059	21,729	17,404
Forks Township	2,449	703	16,090	10,569
Freemansburg Borough	274	74	1,865	1,115
Hanover Township	2,163	673	14,711	10,726
Hellertown Borough	656	184	4,530	2,890
Lehigh Township	1,225	288	8,080	3,818
Lower Mt Bethel Township	425	108	2,750	1,448
Lower Nazareth Township	1,426	511	10,170	9,193
Lower Saucon Township	1,754	391	11,673	5,114
Moore Township	1,102	246	7,086	3,035
Nazareth Borough	776	266	5,416	4,593
North Catasauqua Borough	300	77	2,026	1,120
Northampton Borough	1,235	350	8,287	5,350
Palmer Township	3,129	873	21,068	13,513
Pen Argyl Borough	460	144	3,038	2,281
Plainfield Township	841	227	5,516	3,328

SECTION 4.3.2: RISK ASSESSMENT – EARTHQUAKE

Municipality	500-Year		2,500-Year	
	Brick/Wood (tons)	Concrete/Steel (tons)	Brick/Wood (tons)	Concrete/Steel (tons)
Portland Borough, Upper Mt Bethel Township	1,111	325	7,239	4,796
Stockertown Borough	318	109	2,190	1,855
Upper Nazareth Township	773	208	5,116	3,052
Walnutport Borough	278	102	1,897	1,713
Washington Township	713	185	4,632	2,634
Williams Township	1,083	271	7,244	3,916
Wilson Borough	861	300	6,028	5,225
Wilson Borough, West Easton Borough	325	105	2,242	1,766
Wind Gap Borough	318	108	2,187	1,834
Northampton County (est. total)	40,869	12,034	276,499	189,635

Source: HAZUS-MH 2.1

Note: est. = Estimated

4.3.2.5.7 Impact on the Environment

Earthquakes can lead to numerous, widespread, and devastating environmental impacts. These impacts may include but are not limited to:

- Induced flooding or landslides
- Poor water quality
- Damage to vegetation
- Breakage in sewage or toxic material containments

Secondary impacts can include train derailments and spillage of hazardous materials and utility interruption.

4.3.2.5.8 Future Growth and Development

Areas targeted for potential future growth and development in the next five (5) to ten (10) years have been identified across the Lehigh Valley at the municipal level. Refer to the jurisdictional annexes in Volume II of this HMP. Table B.1 in each jurisdictional annex lists the location of the potential new development and its exposure (if any) to known hazard zones. It is anticipated that new development in the Lehigh Valley will be exposed to such risks.

4.3.2.5.9 Effect of Climate Change on Vulnerability

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity according to research into prehistoric earthquakes and volcanic activity. NASA and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes (NASA, 2004).

Secondary impacts of earthquakes could be magnified by climate change. Increased saturation of soils by more frequent and/or intense storms could increase the risk for liquefaction. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts.

4.3.2.5.10 Additional Data and Next Steps

A HAZUS-MH earthquake analysis was conducted for the Lehigh Valley using the updated building and critical facility inventories which included user-defined data. Additional data needed to further refine the Lehigh Valley's vulnerability assessment include: (1) updated demographic data and (2) NEHRP soil classifications and soil liquefaction data. Additionally, un-reinforced masonry critical facilities and privately-owned buildings (i.e., residences) can be identified using local knowledge and/or pictometry/orthophotos. These buildings may not withstand earthquakes of certain magnitudes and plans to provide emergency response/recovery efforts for these properties can be set in place.

4.3.3 Extreme Temperature

This section provides a profile and vulnerability assessment for the extreme temperature hazard, including extreme heat and extreme cold. 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. What constitutes an extreme cold temperature event varies across different regions of the United States, but in the Lehigh Valley and other areas accustomed to winter weather, below zero temperatures may be considered as extreme cold (NOAA, 1998). Mainly, cold temperatures may be classified as extreme when they drop well below what is considered normal for an area during the winter months, and often when they are accompanied by winter storm events. Combined with increases in wind speed, such cold temperatures in Pennsylvania (including the Lehigh Valley) can be life threatening to those exposed for extended periods of time.

4.3.3.1 Location and Extent

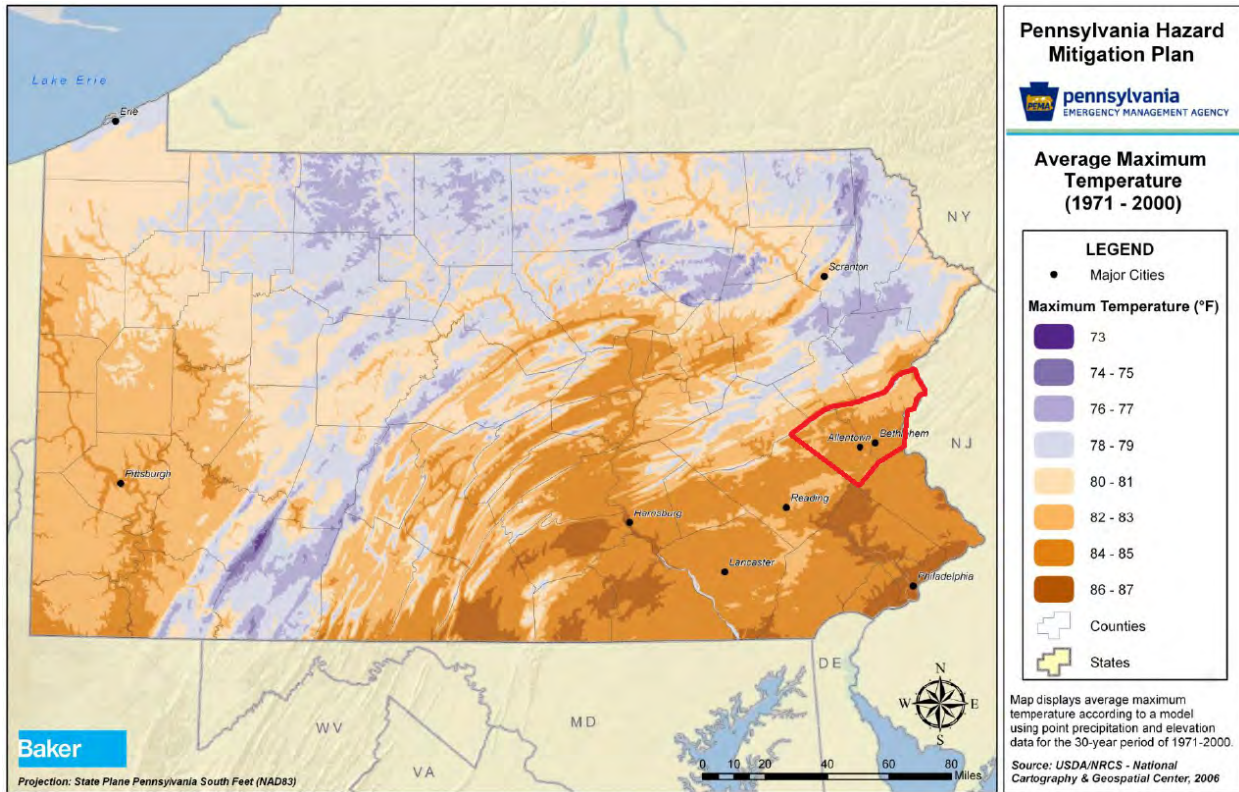
The Lehigh Valley can experience many different temperature extremes in the summer and winter seasons. Areas most susceptible to extreme heat include urban environments, which tend to retain the heat well into the night, leaving little opportunity for dwellings to cool.

The Lehigh Valley falls within the Piedmont Plateau geographic area, which experiences long and at times uncomfortably hot summers. Records from across the Piedmont Plateau are generally representative of conditions in the Lehigh Valley, and show daily temperatures reaching 90°F or above on the average of 25 days during the summer season; however, readings of 100°F or above are comparatively rare. From about July 1 to the middle of September this geographic area occasionally experiences uncomfortably warm periods, four to five days per week in length, during which light wind movement and high relative humidity make conditions oppressive. In general, the winters are comparatively mild, with an average of less than 100 days with minimum temperatures below the freezing point. The freeze-free season averages 170 to 200 days (NCDC, Date Unknown).

Figure 4.3.3-1 and Figure 4.3.3-2 show mean maximum and minimum temperatures throughout Pennsylvania by county. During July, the warmest month, high temperatures in the Lehigh Valley normally range from the low-80s in the northern areas to the mid-80s / upper-70s in the central and southern areas. Minimum temperatures in the Lehigh Valley range from the upper-60s in the southeast to the lower-50s in the north-central mountains. During the colder months, most of the Lehigh Valley experiences low temperature averages ranging from 16°F to 17°F in the north to as high as 21°F in urban areas.

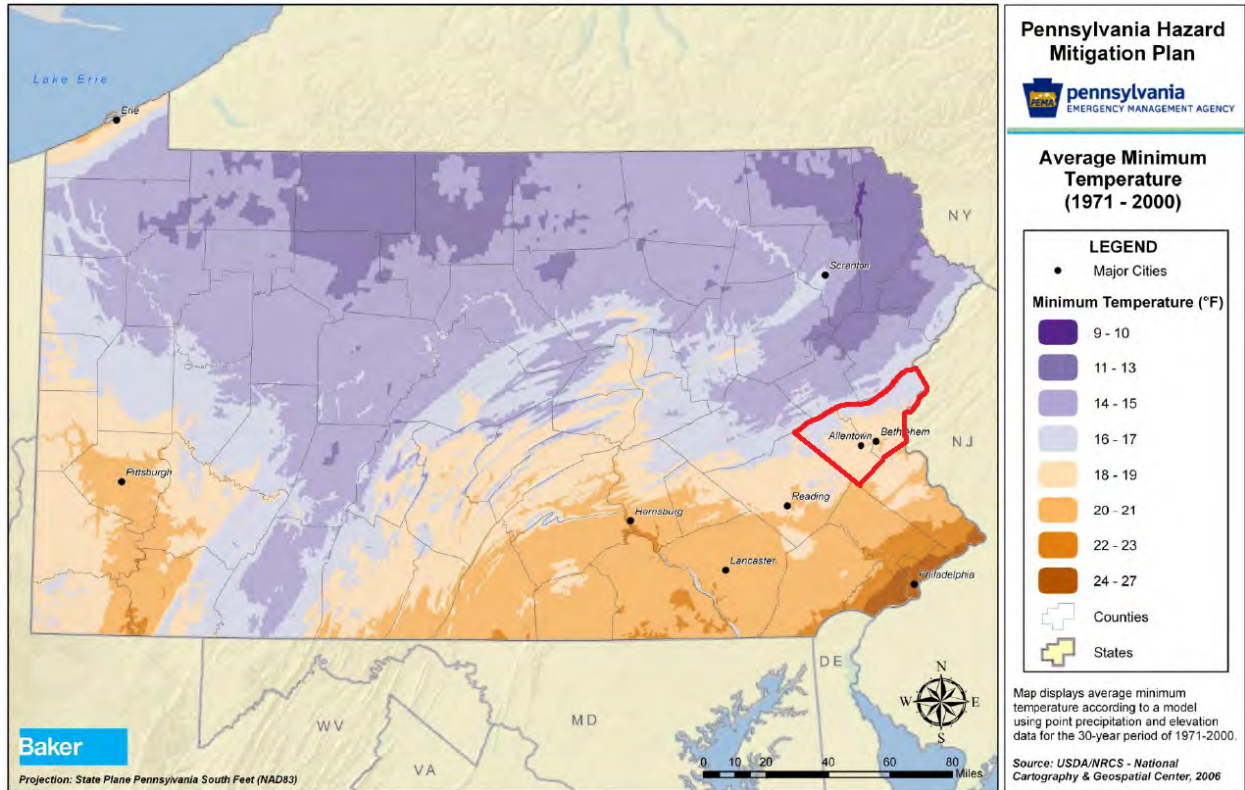
SECTION 4.3.3: RISK ASSESSMENT – EXTREME TEMPERATURE

Figure 4.3.3-1. Average Maximum Temperature throughout Pennsylvania (1971 and 2000)



Source: PEMA, 2010
 Note: Highlight added.

Figure 4.3.3-2. Average Minimum Temperature throughout Pennsylvania (1971 to 2000)



Source: PEMA, 2010
 Note: Highlight added.

4.3.3.2 Range of Magnitude

Exposure to heat can cause health problems indirectly, such as through the increased workload on the heart. This can be especially dangerous to individuals with preexisting medical conditions, typically the elderly. Extremely high temperatures cause heat stress which can be divided into four categories (see Table 4.3.3-1). Each category is defined by apparent temperature which is associated with a heat index value that captures the combined effects of dry air temperature and relative humidity on humans and animals. Major human risks for these temperatures include heat cramps, heat syncope, heat exhaustion, heatstroke, and death. Note that while the temperatures in Table 4.3.3-1 serve as a guide for various danger categories, the impacts of high temperatures will vary from person to person based on individual age, health, and other factors.

SECTION 4.3.3: RISK ASSESSMENT – EXTREME TEMPERATURE

Table 4.3.3-1. Four Categories of Heat Stress

Danger Category	Heat Disorders	Apparent Temperature (°F)
I (Caution)	Fatigue possible with prolonged exposure and physical activity.	80 to 90
II (Extreme Caution)	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and physical activity.	90 to 105
III (Danger)	Sunstroke, heat cramps, or heat exhaustion likely; heat stroke possible with prolonged exposure and physical activity.	105 to 130
IV (Extreme Danger)	Heatstroke or sunstroke imminent.	>130

Source: PEMA, 2010

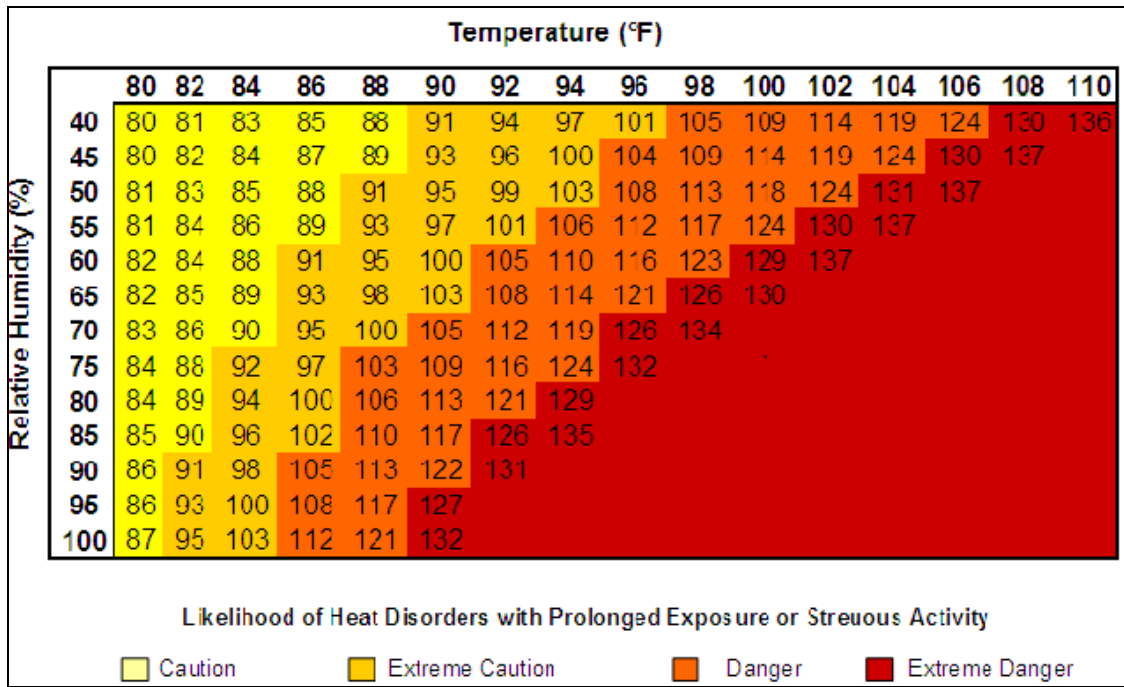
Temperature advisories, watches and warnings are issued by the National Weather Service (NWS) relating the above impacts to the range of temperatures typically experienced in Pennsylvania. Exact thresholds vary across the Commonwealth, but in the Lehigh Valley Heat Advisories are issued when the heat index will be equal to or greater than 100°F, but less than 105°F. Excessive Heat Warnings are issued when heat indices will attain or exceed 105°F. Excessive Heat Watches are issued when there is a possibility that excessive heat warning criteria may be experienced within 12 to 48 hours (NOAA NWS, 2010).

Cold weather has a number of effects, most dramatically on the general population’s mortality rate. The average mortality on a winter's day is about 15 percent higher than on a summer's day. Cold weather is directly responsible for deaths through such things as hypothermia, influenza, and pneumonia. It is also an indirect factor in a number of ways, such as death and injury from falls, accidents, carbon monoxide poisoning, and house fires, all of which are partially attributable to cold temperatures. Wind chill temperatures are often used in place of raw temperature values due to the effect that wind can have in drawing heat from the body under cold temperatures. These values represent what temperatures actually feel like to humans and animals under cold, windy conditions. Similarly to high temperatures, the effect of cold temperatures will vary by individual. In Pennsylvania (including in the Lehigh Valley), Wind Chill Warnings are issued when wind chills drop to -25°F or lower. Wind Chill Advisories are issued in the Lehigh Valley when wind chill values drop to -15°F to -24°F (NOAA NWS, 2010).

Figure 4.3.3-3 shows the effects of humidity on extreme heat events. Figure 4.3.3-4 shows the effects of wind speed on extreme cold events. These compounding factors can increase the risk experienced by vulnerable populations and the general public.

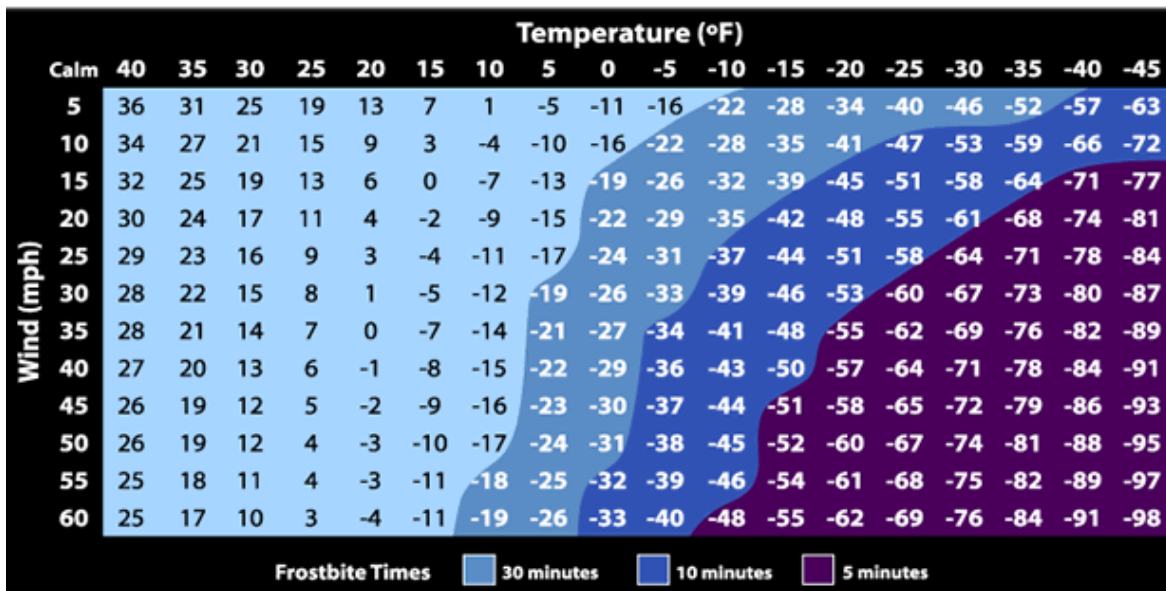
SECTION 4.3.3: RISK ASSESSMENT – EXTREME TEMPERATURE

Figure 4.3.3-3. Extreme Heat and Heat Index



Source: NOAA NWS, 2012

Figure 4.3.3-4. Extreme Cold and Wind Chill



Source: NOAA NWS, 2012

The following impacts can be observed following an extreme temperature event:

Health Impacts – The health impacts of extreme cold are greater in terms of mortality in humans, but often after more prolonged exposure versus a cold snap. Extreme heat waves, however, can prove more deadly over a shorter duration. At greatest risk of death in heat waves are the urban-dwelling elderly without access to an air-conditioned environment for at least part of the day.

Transportation – Cold weather can impact automotive engines, possibly stranding motorists, and stress metal bridge structures. Highways and railroad tracks can become distorted in high heat. Disruptions to the transportation network and accidents due to extreme temperatures represent an additional risk.

Agriculture – Absolute temperature and duration of extreme cold can have devastating effects on trees and winter crops. Livestock is especially vulnerable to heat, and crop yields can be impacted by heat waves that occur during key development stages.

Energy – Energy consumption rises significantly during extreme cold weather. Residents are placed in extreme danger when any fuel shortages or utility failures prevent the heating of a dwelling. Extreme heat can also result in utility interruptions, and sagging transmission lines due to the heat can lead to shorting out.

The range of these impacts, especially health effects, can be mitigated through improved forecasts, warnings, community preparedness, and appropriate community-based response.

The Lehigh Valley's worst-case extreme heat scenario would be an excessive heat spell occurring during a summer holiday weekend, such as Independence Day weekend. Summer holiday weekends bring people out of their air-conditioned work environments and into the outdoors, often despite dangerous heat and humidity. This took place in July 1999. High temperatures reached the 90s for the first time on July 3rd, but sweltering humidity and record breaking maximum temperatures of approximately 100°F occurred from Independence Day through July 6th. The combination of the temperature and humidity produced heat indices of around 110°F during the afternoon of each day. Record high temperatures of 100°F were reported on July 5th at the Lehigh Valley International Airport and in the City of Easton. Two heat-related deaths were reported in the Lehigh Valley; although there were 74 heat-related deaths and over 100 reported heat related injuries across the 10 Pennsylvania counties impacted.

The Lehigh Valley's worst-case extreme cold temperature scenario would involve below zero temperatures and chilling winds accompanied by snow and/or ice accumulation and power failure. The Lehigh Valley's worst-case extreme cold temperature scenario took place in January 2003 when temperatures were between 8 and -11°F. There were four deaths related to this event.

4.3.3.3 Past Occurrence

The Lehigh Valley has been subject to more than 50 extreme temperature events over the last 18 years, as shown in Table 4.3.3-2. Please note that extreme temperature data is regional and the temperatures, deaths, injuries, and damage described were not necessarily in the Lehigh Valley.

SECTION 4.3.3: RISK ASSESSMENT – EXTREME TEMPERATURE

Table 4.3.3-2. Extreme Temperature Events

Date	Type	Actual Temperature (not including Wind Chill/Heat Index)	Deaths	Injuries
6/13/1994	Heat Waves	95 to 100	5	0
2/6/1995	Extreme Cold	9 to -8	1	0
7/13/1995	Heat Wave	Unknown	4	0
8/16/1995	Heat Wave	93	0	0
8/31/1995	Heat Wave	93 to 98	6	0
12/9/1995	Unseasonably Cold	-10 to -20	2	0
2/4/1996	Extreme Cold	-6 to -12	0	0
5/19/1996	Excessive Heat	92 to 98	1	4
1/17/1997	Extreme Cold	-7 to 8	3	0
7/12/1997	Excessive Heat	94 to 100	24	60
7/21/1998	Hot Weather	93 to 95	0	0
9/27/1998	Unseasonably Hot	88 to 93	0	0
6/7/1999	Unseasonably Hot	91 to 98	0	0
7/4/1999	Excessive Heat	92 to 104	74	135
7/16/1999	Excessive Heat	93 to 100	0	0
7/23/1999	Excessive Heat	96 to 102	4	0
8/1/1999	Excessive Heat	96 to 102	5	0
5/2/2001	Unseasonably Hot	87 to 92	0	0
8/6/2001	Excessive Heat	98 to 104	22	0
7/1/2002	Excessive Heat	94 to 102	15	0
7/15/2002	Excessive Heat	94 to 98	2	0
7/28/2002	Excessive Heat	93 to 101	3	0
8/1/2002	Excessive Heat	91 to 102	9	0
8/11/2002	Excessive Heat	97 to 100	8	0
1/14/2003	Extreme Cold/wind Chill	-11 to 8	4	0
1/9/2004	Extreme Cold/wind Chill	-10 to 4	2	0
1/15/2004	Extreme Cold/wind Chill	-32 to -14	1	0
12/20/2004	Extreme Cold/wind Chill	-5 to 10	0	0
1/18/2005	Extreme Cold/wind Chill	-20 to 10	2	1
1/23/2005	Extreme Cold/wind Chill	-5 to 5	1	0
1/28/2005	Extreme Cold/wind Chill	-6 to 6	0	0
7/25/2005	Excessive Heat	93 to 98	7	0
8/2/2005	Excessive Heat	93 to 98	5	0
8/11/2005	Excessive Heat	94 to 98	2	0
12/14/2005	Cold/wind Chill	-4 to -2	0	0
8/1/2006	Excessive Heat	90 to 98	24	40
1/26/2007	Extreme Cold/wind Chill	-7 to 10	0	0
2/6/2007	Extreme Cold/wind Chill	-9 to 10	0	0
2/16/2007	Cold/wind Chill	-3 to 11	0	0
2/19/2007	Cold/wind Chill	1 to 11	0	0

SECTION 4.3.3: RISK ASSESSMENT – EXTREME TEMPERATURE

Date	Type	Actual Temperature (not including Wind Chill/Heat Index)	Deaths	Injuries
3/6/2007	Cold/wind Chill	-10 to 17	0	0
6/26/2007	Excessive Heat	92 to 95	0	0
7/9/2007	Excessive Heat	92 to 98	0	0
8/8/2007	Excessive Heat	94 to 97	0	0
8/25/2007	Excessive Heat	92 to 96	0	0
6/7/2008	Excessive Heat	89 to 99	0	5
7/16/2008	Excessive Heat	94 to 98	0	0
7/29/2008	Heat	87	0	1
1/16/2009	Cold/wind Chill	-14 to 14	0	0
4/26/2009	Heat	90 to 93	0	0
7/5/2010	Excessive Heat	94 to 104	0	0
6/8/2011	Excessive Heat	94 to 99	0	0
7/21/2011	Excessive Heat	94 to 106	0	0
Total			236	246

Source: NCDC, 2010

4.3.3.4 Future Occurrence

Due to its location and geography, the Lehigh Valley is more likely to encounter excessive heat than extreme cold weather. Topography and vegetation can impact temperature differentials across the Lehigh Valley.

The Commonwealth of Pennsylvania 2010 Standard All-Hazard Mitigation Plan provides information on the probability of extreme maximum and minimum temperatures using data from 30 recording stations throughout the State. These stations produce location-specific data, which is more precise than the broader geographic area averages referenced under the “Location and Extent” section of this chapter. According to this data, high temperatures of 90°F or above occur on the average of 10 to 20 days per year in the Lehigh Valley; with the fewest events occurring in the northeast areas of Northampton County, and the greatest frequency occurring in the south and southwest portions of both counties. There are, on average, three days per year where temperatures in the Lehigh Valley reach or exceed 95°F. For temperatures greater than 100°F, the number of years between occurrences ranges between 10 and 50. Extreme cold temperatures less than 0°F occur on the average of four days annually with the greatest number of occurrences in the northeast areas of Northampton County, and the fewest days occurring in the southwest portions of Lehigh County. For temperatures lower than -10°F, the number of years between occurrences ranges between 20 and 30, and the number of years between occurrences for temperatures lower than -20°F ranges between 50 and 70.

The future occurrence of extreme temperatures can be considered *likely* as defined by the Risk Factor Methodology probability criteria (refer to Section 4.4).

4.3.3.5 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. Most extreme temperature events involve a large region; therefore, the entire Lehigh Valley has been identified as the hazard area. The following text evaluates and estimates the potential impact of extreme temperature events on the Lehigh Valley including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety, (2) general building stock, (3) critical facilities, (4) economy, and (5) future growth and development
- Effect of climate change on vulnerability
- Further data collections that will assist understanding of this hazard over time

4.3.3.5.1 Overview of Vulnerability

Extreme temperatures generally occur for a short period of time but can cause a range of impacts, particularly to vulnerable populations that may not have access to adequate cooling or heating. This natural hazard can also cause impacts to agriculture (crops and animals), infrastructure (e.g., through pipe bursts associated with freezing, power failure) and the economy.

4.3.3.5.2 Data and Methodology

At the time of this Plan, insufficient data is available to model the long-term potential impacts of extreme temperature on the Lehigh Valley. Over time, additional data will be collected to allow better analysis for this hazard. Available information and a preliminary assessment are provided below.

4.3.3.5.3 Impact on Life, Health and Safety

For the purposes of this Plan, the entire population in the Lehigh Valley is vulnerable to extreme temperature events. Extreme temperature events have potential health impacts including injury and death.

According to the Centers for Disease Control and Prevention, populations most at risk to extreme cold and heat events include the following: 1) the elderly, who are less able to withstand temperature extremes due to their age, health conditions and limited mobility to access shelters; 2) infants and children up to four years of age; 3) individuals who are physically ill (e.g., heart disease or high blood pressure), 4) low-income persons that cannot afford proper heating and cooling; and 5) the general public who may overexert during work or exercise during extreme heat events or experience hypothermia during extreme cold events.

Meteorologists can accurately forecast extreme heat event development and the severity of the associated conditions with several days lead time. These forecasts provide an opportunity for public health and other officials to notify vulnerable populations, implement short-term emergency response actions and focus on surveillance and relief efforts on those at greatest risk. Adhering to extreme temperature warnings can significantly reduce the risk of temperature-related deaths.

Refer to Section 2 which summarizes population in the Lehigh Valley over the age of 65, and population with an annual income below the poverty threshold.

4.3.3.5.4 Impact on General Building Stock

All of the building stock in the Lehigh Valley is exposed to the extreme temperature hazard. Refer to Section 2 which summarizes the building inventory in the Lehigh Valley. Extreme heat generally does not impact buildings. Losses may be associated with the overheating of HVAC systems. Extreme cold temperature events can damage buildings through freezing/bursting pipes and freeze/thaw cycles. Additionally, manufactured homes (mobile homes) and antiquated or poorly constructed facilities may have inadequate capabilities to withstand extreme temperatures.

4.3.3.5.5 Impact on Critical Facilities

All critical facilities in the Lehigh Valley are exposed to the extreme temperature hazard. Impacts to critical facilities are the same as described for general building stock (above). Additionally, it is essential that critical facilities remain operational during natural hazard events. Extreme heat events can sometimes cause short periods of utility failure commonly referred to as “brown-outs”, due to increased usage from air conditioners, appliances, etc. Similarly, heavy snowfall and ice storms, associated with extreme cold temperature events, can cause power interruption as well. Backup power is recommended for critical facilities and infrastructure.

4.3.3.5.6 Impact on the Economy

Extreme temperature events also have impacts on the economy, including loss of business function and damage/loss of inventory. Business-owners may be faced with increased financial burdens due to unexpected repairs caused to the building (e.g., pipes bursting), higher than normal utility bills or business interruption due to power failure (i.e., loss of electricity, telecommunications).

The agricultural industry is most at risk in terms of economic impact and damage due to extreme temperature events. Extreme heat events can result in drought and dry conditions and directly impact livestock and crop production.

4.3.3.5.7 Future Growth and Development

Development trends indicate that farmland is being converted to housing, commercial and industrial uses at a rate of 3.5 square miles per year in the Lehigh Valley. Farmland is under intense development pressure that is expected to continue through 2030. With the continuing loss of farmland, the impacts of extreme temperature on agriculture will likely decrease.

Areas targeted for potential future growth and development in the next five (5) years have been identified across the Lehigh Valley at the municipal level. Refer to the jurisdictional annexes in Volume II of this Plan. Table B.1 in each jurisdictional annex lists the location of the potential new development and its exposure (if any) to known hazard zones. It is anticipated that any new development and new residents will be exposed to the extreme temperature hazard.

4.3.3.5.8 Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as extreme temperature events. While predicting changes of extreme temperature events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2006).

Pennsylvania’s Department of Environmental Protection was directed by the Climate Change Act (Act 70 of 2008) to initiate a study of the potential impacts of global climate change on the Commonwealth. The June 2009 PA Climate Impact Assessment’s main findings indicate it is very likely that Pennsylvania will experience increased temperatures in the 21st century. Higher summer temperatures will result in higher ozone concentrations in urban areas which can negatively impact vulnerable population’s respiratory health. Increased winter temperatures will mean fewer cold-related deaths (Shortle et. al, 2009).

With one to three-degree increases in temperature, Pennsylvania farmers' yield of hay, corn and soybeans may increase while yields of cool-temperature adapted fruits such as apples and potatoes may decrease. However, changes in these crop yields will greatly depend on the exact temperature change. Dairy producers may experience the greatest challenges because they rely on their own-crop production, their animals may experience heat stress, and productivity may be impacted (Shortle et. al, 2009). It is clear that temperature changes will impact the agricultural industry, which is a large part of the Lehigh Valley's economy.

4.3.3.5.9 Additional Data and Next Steps

For future plan updates, the Lehigh Valley can track data on extreme temperature events, obtain additional County- and jurisdiction-specific information on past and future events, particularly in terms of any injuries, deaths, shelter needs, pipe freeze, agricultural losses and other impacts. This will help to identify any concerns or trends for which mitigation measures should be developed or refined. In time, quantitative modeling of estimated extreme heat/cold events may be feasible as data is gathered and improved.

4.3.4 Flood

This section provides a profile and vulnerability assessment for the flood hazard. Floods are one of the most common natural hazards in the U.S. and are the most prevalent type of natural disaster occurring in Pennsylvania. Pennsylvania has more miles of streams than any other state and leads the U.S. in flood-related losses. Over 94-percent of the State’s municipalities have been designated as flood-prone areas. Both seasonal and flash floods have been the cause of millions of dollars in annual property damages, loss of lives, and disruption of economic Activities (PEMA, 2010).

The FEMA definition for flooding is “a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from the overflow of inland or tidal waters or the rapid accumulation of runoff of surface waters from any source” (FEMA, Date Unknown).

Most floods fall into three categories: riverine, coastal and shallow (FEMA, 2005). Other types of floods may include ice-jam floods, alluvial fan floods, dam failure floods, and floods associated with local drainage or high groundwater (as indicated in the previous flood definition). For the purpose of this HMP and as deemed appropriate by the Steering Committee, riverine, flash, ice jam, dam failure and stormwater flooding are the main flood types of concern for the Lehigh Valley. These types of floods are further discussed below.

Riverine Floods – Riverine floods are the most common flood type and occur along a channel. Channels are defined features on the ground that carry water through and out of a watershed. They may be called rivers, creeks, streams or ditches. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas. These floods usually occur after heavy rains, heavy thunderstorms, or snowmelt, and can be slow or fast-rising, and generally develop over a period of hours to days (FEMA, Date Unknown; The Illinois Association for Floodplain and Stormwater Management, 2006).

Flash Floods – According to the National Weather Service (NWS), flash floods are a rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within six hours of the causative event (e.g., intense rainfall, dam failure, ice jam) (NWS, 2009).

Flash floods can occur very quickly and with very little warning. This type of flood can be deadly because it produces rapid rises in water levels and has devastating flow velocities. Urban areas are more susceptible to flash floods because a high percentage of the surface area is impervious (LVHMP, 2006).

However, the Actual time threshold may vary in different parts of the country. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters (NWS, 2005). Flash floods often have a dangerous wall of roaring water that carries rocks, mud, and other debris and can sweep away most things in its path. They usually result from intense storms dropping large amounts of rain within a brief period with little or no warning; can reach their peak in only a few minutes. They normally occur in the summer during the thunderstorm season. The most severe flooding conditions usually occur when direct rainfall is augmented by snowmelt. If the soil is saturated or frozen, stream flow may increase due to the inability of the soil to absorb additional precipitation (FEMA, Date Unknown).

Ice Jam Floods - An ice jam is an accumulation of ice that Acts as a natural dam and restricts flow of a body of water. Ice jams occur when warm temperatures and heavy rains cause rapid snow melt. The

melting snow, combined with the heavy rain, causes frozen rivers to swell. The rising water breaks the ice layers into large chunks, which float downstream and often pile up near narrow passages and obstructions (bridges and dams). Ice jams may build up to a thickness great enough to raise the water level and cause flooding (NESEC, Date Unknown; U.S. Army Corps of Engineers [USACE], 2002).

There are two different types of ice jams: freeze-up and breakup. Freeze-up jams occur in the early to mid-winter when floating ice may slow or stop due to a change in water slope as it reaches an obstruction to movement. Breakup jams occur during periods of thaw, generally in late winter and early spring. The ice cover breakup is usually associated with a rapid increase in runoff and corresponding river discharge due to a heavy rainfall, snowmelt or warmer temperatures (USACE, 2002).

Dam Failure Floods – A dam is an artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage or control of water (FEMA, 2010). Dams are man-made structures built across a stream or river that impound water and reduce the flow downstream (FEMA, 2003). They are built for the purpose of power production, agriculture, water supply, recreation, and flood protection. Dam failure is any malfunction or abnormality outside of the design that adversely affect a dam's primary function of impounding water (FEMA, 2004). Dams can fail for one or a combination of the following reasons:

- Overtopping caused by floods that exceed the capacity of the dam (inadequate spillway capacity);
- Prolonged periods of rainfall and flooding;
- Deliberate Acts of sabotage (terrorism);
- Structural failure of materials used in dam construction;
- Movement and/or failure of the foundation supporting the dam;
- Settlement and cracking of concrete or embankment dams;
- Piping and internal erosion of soil in embankment dams;
- Inadequate or negligent operation, maintenance and upkeep;
- Failure of upstream dams on the same waterway; or
- Earthquake (liquefaction / landslides) (FEMA, 2009).

Flooding can occur when a dam fails or breaks, producing effects similar to flash floods. Areas that are most susceptible to the effects of floods are low-lying areas that are near water or downstream from a dam (FEMA, 2006).

Flooding due to dam failure is addressed in Section 4.3.14 of this plan.

4.3.4.1 Location and Extent

Flooding in Pennsylvania is typically associated with abnormally high and intense rainfall amounts. It can also be caused by sudden snowmelt, landslides, or dam failures. In Pennsylvania, flooding usually occurs in the summer; however, flooding has occurred during the winter months as well (LVHMP, 2006).

Floodplains are found in lowlands, adjacent to rivers, streams, creeks, lakes, or other bodies of water that become inundated during a flood. The size of a floodplain is described by the recurrence interval of a given flood. A 100-year floodplain is associated with a flood that has a 1-percent chance of occurring in a given year, and is smaller than the floodplain associated with a flood that has a 0.2-percent annual chance of occurring (500-year) (PEMA, 2010).

Flooding is the most significant natural hazard in the Lehigh Valley. Two major rivers, the Lehigh and Delaware, are located within the Lehigh Valley, along with the tributaries of these two rivers. The Lehigh River essentially splits the Lehigh Valley in half and it is a tributary to the Delaware River. The

Delaware River flows along the eastern portion of Northampton County and eventually flows into the Atlantic Ocean. In Lehigh and Northampton Counties, all municipalities have areas prone to flooding along streams and rivers (LVHMP, 2006).

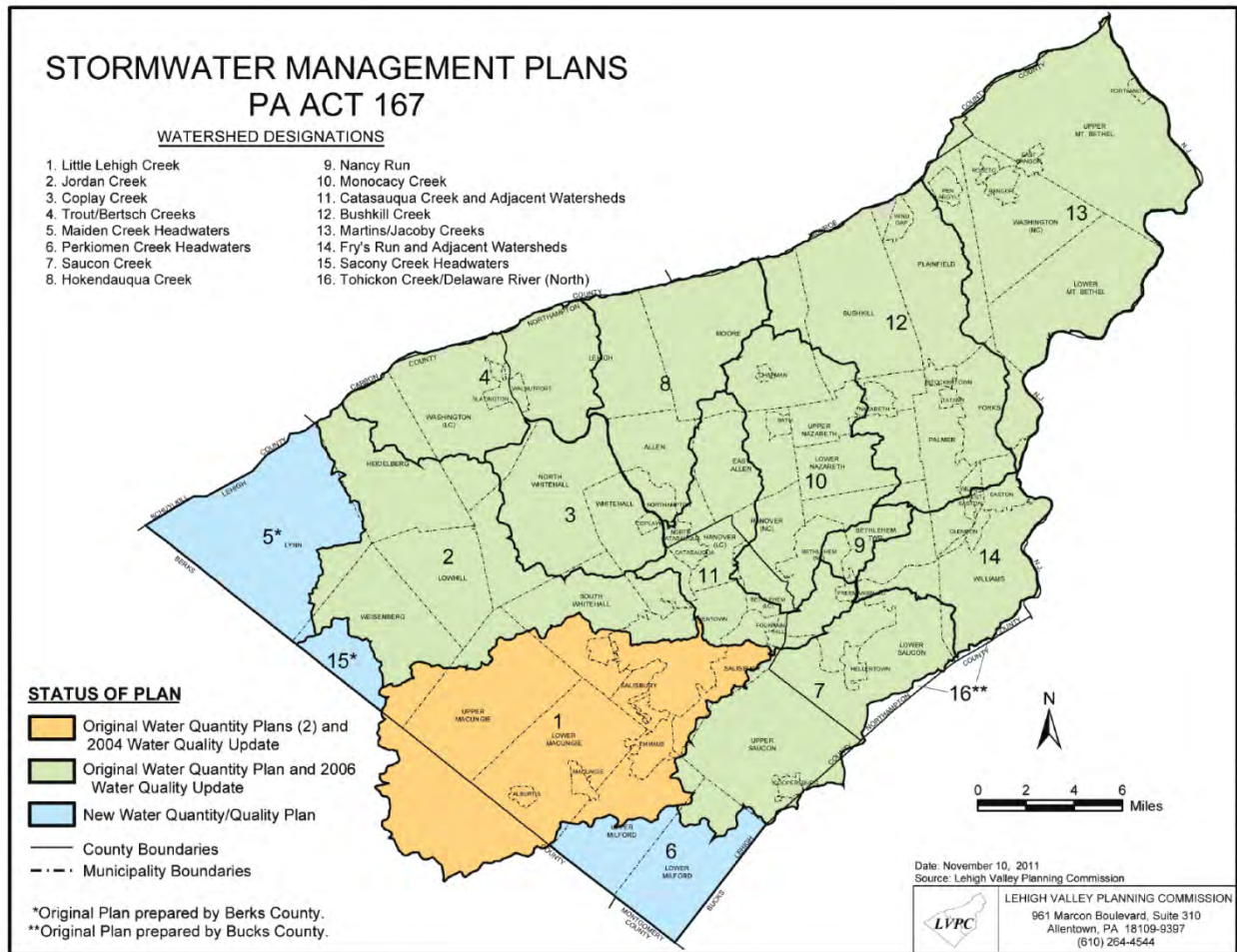
Both Lehigh and Northampton Counties are located within the Delaware River Basin. The Basin has a total area of 13,539 square miles, with 6,466 square miles in Pennsylvania. It is the third largest watershed in the State (Allegheny College, Date Unknown).

Two major rivers flow through the region: the Lehigh River and Delaware River. In Pennsylvania, the Delaware River has a total length of 326 miles. Numerous other streams flow through the region. They include the Coplay, Jordan and Little Lehigh creeks in the west, the Saucon Creek in the south and the Monocacy, Bushkill and Martins creeks in the north, all of which drain into the Lehigh or Delaware rivers (LVHMP, 2006).

The Lehigh River flows through Lehigh Gap at the northern boundary of Lehigh and Northampton Counties southbound to Allentown where it makes an abrupt turn eastward. From Allentown the Lehigh River flows eastward to its confluence with the Delaware River at Easton. Major tributary streams flowing into the Lehigh River are Little Lehigh Creek, Hokendauqua Creek, Monocacy Creek and Saucon Creek. Bushkill Creek and Martins Creek flow directly into the Delaware.

Per the 1978 Pennsylvania Stormwater Management Act (Act 167), counties are required to prepare stormwater management plans on a watershed-by-watershed basis that provide for the improved management of the stormwater impacts associated with the development of land. Within Lehigh and Northampton Counties, the state has designated 16 Act 167 study areas, as identified on Figure 4.3.4-1. Table 4.3.4-1 summarizes the municipalities each stormwater management plan covers. Please refer to these plans for additional details on the flooding related to stormwater drainage problems in each of these watersheds.

Figure 4.3.4-1: Stormwater Management Plans



Source: LVPC, 2011

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Table 4.3.4-1: Stormwater Management Plans for the Lehigh Valley

ID	Title	Lehigh County	Northampton County
167-001	Bushkill Creek Watershed- Act 167-Storm Water Management Plan, May 1992		Bethlehem Township Bushkill Township City of Easton Forks Township Lower Nazareth Township Moore Township Nazareth Borough Palmer Township Plainfield Township Stockertown Borough Tatamy Borough Upper Nazareth Township Wilson Borough Wind Gap Borough
167-016	Catasauqua Creek Watershed and Lehigh River Sub-Basin 4- Act 167-Storm Water Management Plan, February 1997	City of Allentown Catasauqua Borough Fountain Hill Borough Hanover Township Salisbury Township Whitehall Township	Allen Township City of Bethlehem East Allen Township Freemansburg Borough Hanover Township Lower Saucon Township Moore Township Northampton Borough North Catasauqua Borough
167-003	Coplay Creek Watershed and Lehigh River Sub-Basin 2- Act 167-Storm Water Management Plan, November 1994	Coplay Borough North Whitehall Township South Whitehall Township Washington Township Whitehall Township	
167-002	Delaware River Sub-Basin 2 and Lehigh River Sub-Basin 5 (Fry's Run Study Area)- Act 167-Storm Water Management Plan, February 1999		Bethlehem Township City of Easton Glendon Borough Lower Saucon Township Palmer Township West Easton Borough Williams Township Wilson Borough
167-004	Hokendauqua Creek Watershed and Lehigh River Sub-Basin 3- Act 167-Storm Water Management Plan, September 1997		Allen Township East Allen Township Lehigh Township Moore Township Northampton Borough North Catasauqua Borough
167-005	Jordan Creek Watershed- Act 167-Storm Water Management Plan, May 1992	City of Allentown Heidelberg Township Lowhill Township Lynn Township North Whitehall Township South Whitehall Township Upper Macungie Township Washington Township Weisenberg Township Whitehall Township	

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

ID	Title	Lehigh County	Northampton County
167-007	Little Lehigh Creek Watershed-Act 167-Storm Water Management Plan Update, June 1999	Alburtis Borough City of Allentown Emmaus Borough Lower Macungie Township Macungie Borough Salisbury Township South Whitehall Township Upper Macungie Township Upper Milford Township Weisenberg Township	
167-008	Maiden Creek Headwaters- Act 167-Storm Water Management Plan, April 2010	Heidelberg Township Lynn Township Weisenberg Township	
167-009	Martins/Jacoby Creeks Watershed and Delaware Sub-Basin 1 Act 167-Storm Water Management Plan, February 1996		Bangor Borough East Bangor Borough City of Easton Forks Township Lower Mount Bethel Township Pen Argyl Borough Plainfield Township Portland Borough Roseto Borough Upper Mount Bethel Township
167-010	Monocacy Creek Act 167 Stormwater Management Plan, March 1989	Hanover Township	Bath Borough City of Bethlehem Bethlehem Township Bushkill Township Chapman Borough East Allen Township Hanover Township Lower Nazareth Township Moore Township Nazareth Borough Upper Nazareth Township
167-011	Nancy Run Watershed- Act 167-Storm Water Management Plan, March 1989		City of Bethlehem Bethlehem Township Freemansburg Borough
167-012	Perkiomen Creek Headwaters- Act 167-Storm Water Management Plan, Act 167-Storm Water Management Plan, October 2009	Lower Macungie Township Lower Milford Township Upper Milford Township Upper Saucon Township	
167-013	Sacony Creek Headwaters- Act 167-Storm Water Management Plan, Stormwater Management Plan, April 2010	Weisenberg Township	
167-014	Saucon Creek Act 167 Stormwater Management Plan, April, 1991	Coopersburg Borough Lower Milford Township Salisbury Township Upper Milford Township Upper Saucon Township	City of Bethlehem Hellertown Borough Lower Saucon Township Williams Township
167-015	Trout/Bertsch Creeks and Lehigh River Sub-Basin- Act 167-Storm Water Management Plan, April 1995	Heidelberg Township Slatington Borough Washington Township	Lehigh Township Walnutport Borough

Source: LVPC, Various Dates



Flood Protection Measures

The U.S. Army Corps of Engineers (USACE) constructed and operates four flood-control reservoirs in the Delaware River Basin. Reservoirs are located on tributaries in Wayne County, Pennsylvania. The Francis E. Walter Dam is on the Lehigh River in Carbon and Luzerne Counties, Pennsylvania, approximately 77 miles above the confluence with the Delaware River. Beltzville Reservoir is located on Pohopoco Creek, approximately four miles upstream from the confluence of the Lehigh River in Carbon County, Pennsylvania. These two reservoirs are used for low-flow augmentation and recreation, in addition to flood control. The State maintains Nockamixon State Park on Tohikon Creek for flood control, recreation and future water supply. In addition, several local flood protection projects have been constructed along the Lehigh River in the City of Bethlehem (FEMA, 2011).

In Lehigh County, levees provide several communities with some degree of protection against flooding. Levees are located in the Cities of Allentown and Bethlehem and in the Township of Salisbury. Two USACE dams currently operate in Lehigh County. The Francis E. Walter Dam and Beltzville Lake are designed for low-flow augmentation, recreation and flood control. They reduce flood stages on the Lehigh River; thereby, decreasing the backwater effect on the Little Lehigh Creek. In addition to the two flood control dams, several local flood protection projects have been constructed along the Lehigh River. In the City of Allentown, there is a 750-foot low levee along the right bank of the River, a concrete floodwall extends 204 feet upstream of the Old Hamilton Street bridge, a short levee spanning 69 feet between the abutment of the Old and New Hamilton Street bridges, a levee extending 1,125 feet connecting with Kline's Island Levee, and a training dike approximately 1,300 feet long that was constructed around a sharp bend to reduce backwater stages in the Little Lehigh Creek. A straightened and deepened main channel, extending 8,280 feet, is another local flood control project within the City. In Salisbury Township, a dike was built along the south side of the Lehigh River to protect the floodplain in the loop of the River (FEMA, 2004).

FEMA Regulatory Flood Zones

According to FEMA, flood hazard areas are defined as areas that are shown to be inundated by a flood of a given magnitude on a map. These areas are determined using statistical analyses of records of riverflow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses. Flood hazard areas are delineated on FEMA's Flood Insurance Rate Maps (FIRM), which are official maps of a community on which the Federal Insurance and Mitigation Administration has delineated both the Special Flood Hazard Areas (SFHA) and the risk premium zones applicable to the community. These maps identify the SFHAs; the location of a specific property in relation to the SFHA; the base (1% or 100-year) flood elevation (BFE) at a specific site; the magnitude of flood a flood hazard in a specific area; the undeveloped coastal barriers where flood insurance is not available and locates regulatory floodways and floodplain boundaries (100-year and 500-year floodplain boundaries) (FEMA, 2003; FEMA, 2004; FEMA, 2006; FEMA, 2008).

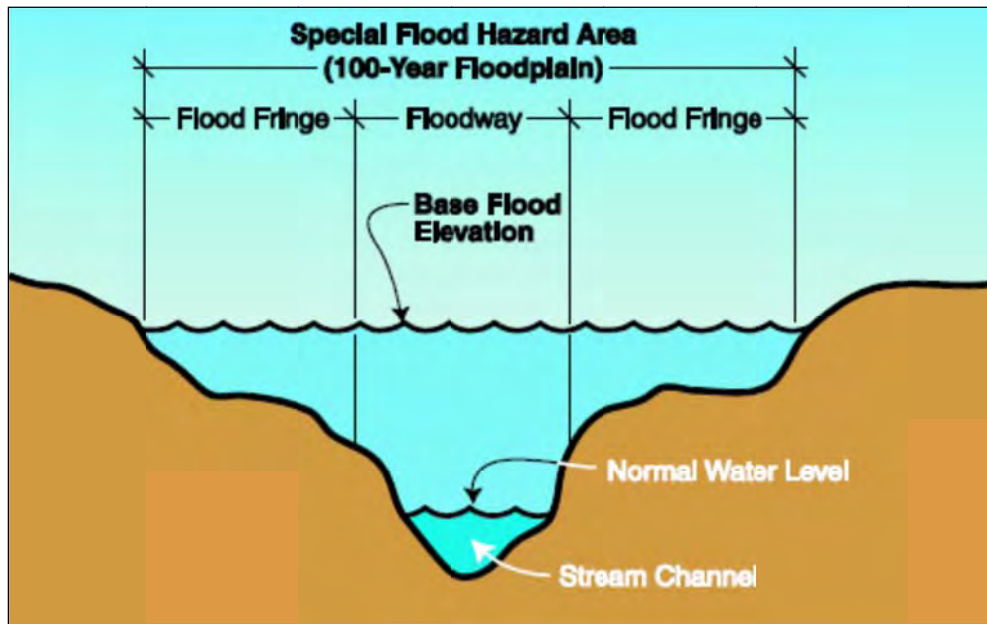
The land area covered by the floodwaters of the base flood is the SFHA on a FIRM. It is the area where the National Flood Insurance Programs (NFIP) floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies. This regulatory boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities since many communities have maps showing the extent of the base flood and likely depths that will be experienced.

The base flood is often referred to as the "100-year" flood designation. As defined by NFIP, the BFE on a FIRM is the elevation of a base flood event, or a flood which has a one-percent chance of occurring in any given year. The BFE describes the exact elevation of the water that will result from a given discharge level, which is one of the most important factors used in estimating the potential damage to occur in a given area. A structure located within a 100-year floodplain has a 26-percent chance of suffering flood

damage during the term of a 30-year mortgage. The 100-year flood is a regulatory standard used by federal agencies and most states, to administer floodplain management programs. The 100-year flood is used by the NFIP as the basis for insurance requirements nationwide. FIRMs also depict 500-year flood designations, which is a boundary of the flood that has a 0.2-percent chance of being equaled or exceeded in any given year (FEMA, 2003; FEMA, 2006).

Figure 4.3.4-2 depicts the special flood hazard area, the base flood elevation, the flood fringe, and the floodway areas of a floodplain.

Figure 4.3.4-2: Floodplain Illustration

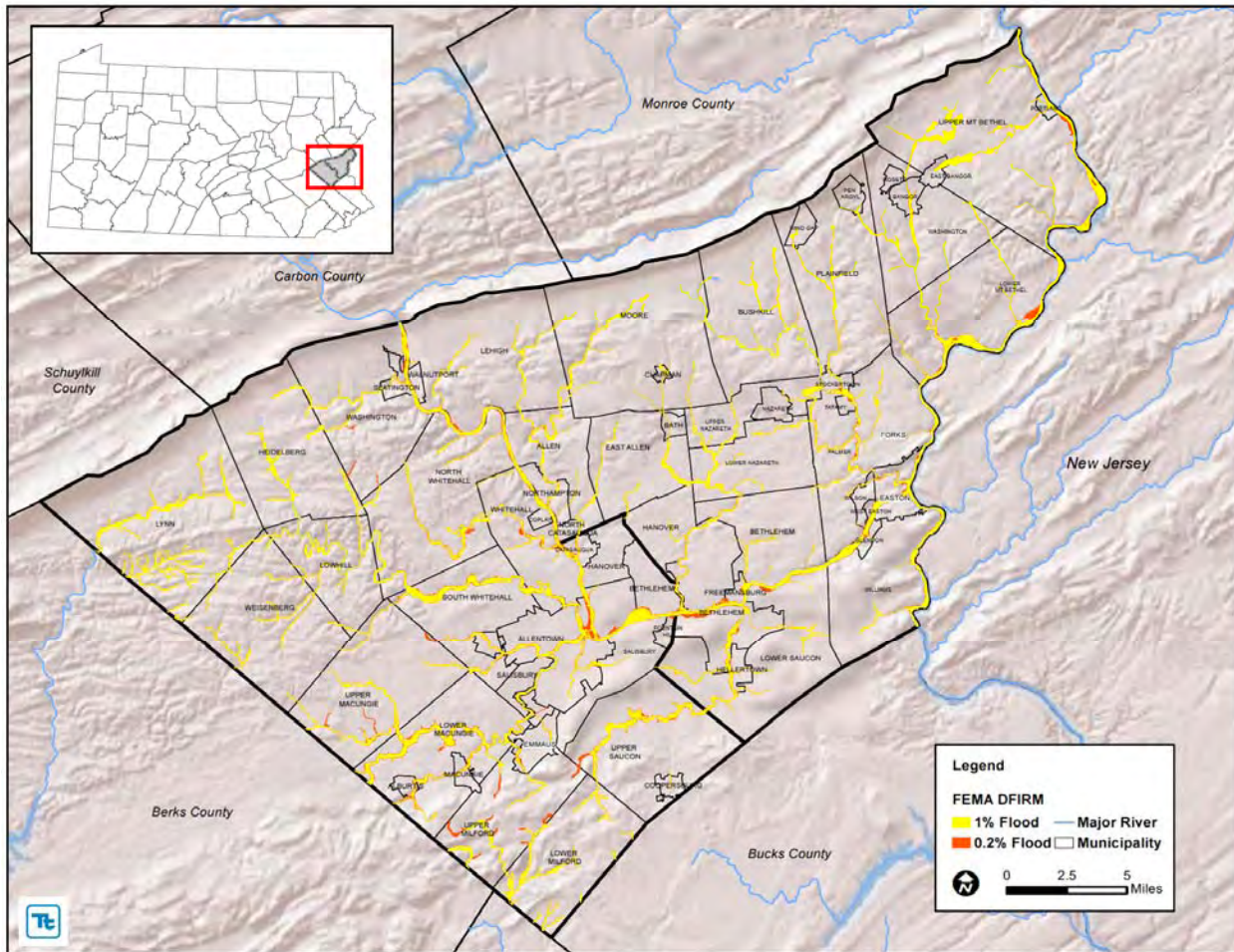


Source: PEMA, 2010

The Special Flood Hazard Area (SFHA) serves as the primary regulatory boundary used by FEMA and Pennsylvania. Digitized FIRMs (DFIRMs), FIRMs and other flood hazard information can be used to identify the expected spatial extent of flooding from a one-percent and 0.2-percent annual chance event.

At the time this plan was written, the 2004 Lehigh County DFIRMs and the 2011 Northampton County preliminary DFIRMs are considered the best available and used for the risk analysis. Figure 4.3.4-3 illustrates the NFIP flood zones in Lehigh Valley. Individual municipal maps showing the NFIP flood zones may be found in the municipal annexes in Volume II of this plan.

Figure 4.3.4-3. NFIP Floodplains in the Lehigh Valley



Source: FEMA, 2004; FEMA 2011

Note: Please note the Northampton County preliminary DFIRMs were used to generate this figure and are not considered regulatory at the time this plan was written.

FEMA DFIRMs were overlaid upon Lehigh Valley to summarize the flood mapping and hazard areas in Lehigh and Northampton Counties. Refer to Table 4.3.4-2 below.

Table 4.3.4-2. Area Located in the 1% and 0.2% FEMA DFIRM Flood Boundaries

Municipality	Total Area (sq. mi.)	1% Flood Hazard Area		0.2% Flood Hazard Area	
		Area Exposed (sq. mi.)	% of Total	Area Exposed (sq. mi.)	% of Total
Lehigh County					
Alburtis Borough	0.71	0.044	6.2	0.075	10.6
Allentown, City of	18.02	1.77	9.8	2.36	13.1
Bethlehem, City of	4.4	0.00012	0	0.000119	0.0
Catasauqua Borough	1.3	0.18	13.8	0.26	20.0
Coopersburg Borough	0.94	0.021	2.2	0.02	2.1
Coplay Borough	0.63	0.025	4	0.027	4.3

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Municipality	Total Area (sq. mi.)	1% Flood Hazard Area		0.2% Flood Hazard Area	
		Area Exposed (sq. mi.)	% of Total	Area Exposed (sq. mi.)	% of Total
Emmaus Borough	2.9	0.12	4.1	0.17	5.9
Fountain Hill Borough	0.76	0.02	2.6	0.045	5.9
Hanover Township	4.3	0.093	2.2	0.11	2.6
Heidelberg Township	24.7	1.06	4.3	1.06	4.3
Lower Macungie Township	22.5	1.9	8.4	2.46	10.9
Lower Milford Township	19.7	1.25	6.3	1.25	6.3
Lowhill Township	14.1	1	7.1	1	7.1
Lynn Township	41.7	2.58	6.2	2.58	6.2
Macungie Borough	0.99	0.04	4	0.069	7.0
North Whitehall Township	28.5	1.5	5.3	1.78	6.2
Salisbury Township	11.3	0.55	4.9	0.59	5.2
Slatington Borough	1.4	0.15	10.7	0.21	15.0
South Whitehall Township	17.2	1.38	8	1.64	9.5
Upper Macungie Township	26.2	0.94	3.6	1.16	4.4
Upper Milford Township	18.0	0.81	4.5	1.26	7.0
Upper Saucon Township	24.7	1.13	4.6	1.41	5.7
Washington Township	23.7	0.59	2.5	0.69	2.9
Weisenberg Township	26.8	0.85	3.2	0.85	3.2
Whitehall Township	12.8	0.91	7.1	1.18	9.2
Lehigh County (est. total)	348.3	18.9	5.4	22.3	6.4
Northampton County					
Allen Township	11.3	0.8	7.1	0.85	7.5
Bangor Borough	1.5	0.12	8.0	0.15	10.0
Bath Borough	0.9	0.02	2.2	0.023	2.6
Bethlehem Township	14.7	0.66	4.5	0.69	4.7
Bethlehem, City of	15.0	1.00	6.7	1.39	9.3
Bushkill Township	25.7	0.99	3.9	0.99	3.9
Chapman Borough	0.4	0.06	15.0	0.06	15.0
East Allen Township	14.6	0.54	3.7	0.54	3.7
East Bangor Borough	0.9	0.10	11.1	0.10	11.1
Easton, City of	4.4	0.96	21.8	1.12	25.5
Forks Township	12.3	0.57	4.6	0.65	5.3
Freemansburg Borough	0.8	0.14	17.5	0.19	23.8
Glendon Borough	0.8	0.14	17.5	0.17	21.3
Hanover Township	6.6	0.16	2.4	0.17	2.6
Hellertown Borough	1.3	0.13	10.0	0.16	12.3
Lehigh Township	29.8	1.1	3.7	1.21	4.1
Lower Mt. Bethel Township	24.6	1.9	7.7	2.16	8.8
Lower Nazareth Township	13.6	0.74	5.4	0.74	5.4
Lower Saucon Township	24.5	0.84	3.4	0.97	4.0

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Municipality	Total Area (sq. mi.)	1% Flood Hazard Area		0.2% Flood Hazard Area	
		Area Exposed (sq. mi.)	% of Total	Area Exposed (sq. mi.)	% of Total
Moore Township	37.7	0.90	2.4	0.91	2.4
Nazareth Borough	1.7	0.0099	0.6	0.0099	0.6
North Catasauqua Borough	0.8	0.067	8.4	0.082	10.3
Northampton Borough	2.6	0.35	13.5	0.40	15.4
Palmer Township	10.4	0.54	5.2	0.66	6.3
Pen Argyl Borough	1.4	0.030	2.1	0.030	2.1
Plainfield Township	24.5	0.65	2.7	0.67	2.7
Portland Borough	0.6	0.12	20.0	0.14	23.3
Roseto Borough	0.6	0.00028	0.0	0.00028	0.0
Stockertown Borough	1.0	0.14	14.0	0.17	17.0
Tatamy Borough	0.6	0.050	8.3	0.082	13.7
Upper Mt. Bethel Township	44.0	2.89	6.6	3.13	7.1
Upper Nazareth Township	7.5	0.52	6.9	0.52	6.9
Walnutport Borough	0.8	0.09	11.3	0.11	13.8
Washington Township	18.0	0.61	3.4	0.61	3.4
West Easton Borough	0.3	0.083	27.7	0.095	31.7
Williams Township	18.6	0.87	4.7	0.95	5.1
Wilson Borough	1.2	0.045	3.8	0.052	4.3
Wind Gap Borough	1.4	0.054	3.9	0.056	4.0
Northampton County (est. total)	377.2	19.00	5.0	21.01	5.6

Source: FEMA, 2004; FEMA 2011

Notes: This analysis was conducted using the DFIRMs available for Lehigh Valley (2004 for Lehigh County and preliminary 2011 for Northampton County). est. = Estimated. sq. mi. = Square miles. % = Percent.

While the FIRMs provide a creditable source to document extent and location of the flood hazard, there are limitations to the accuracy of the data reflected on these maps. As such, it is noted that FIRMs are based upon the existing hydrology conditions at the time of the maps preparation. FIRMs are not set up to account for the possible changes in hydrology that can occur over time.

Flood Insurance Study

In addition to FIRM and DFIRMs, FEMA also provides Flood Insurance Studies (FIS) for entire counties and individual jurisdictions. These studies aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. They are narrative reports of countywide flood hazards, including descriptions of the flood areas studied and the engineered methods used, principal flood problems, flood protection measures and graphic profiles of the flood sources (FEMA, Date Unknown). A countywide FIS for Lehigh and Northampton Counties has been completed although the FIS for Northampton County is a preliminary document. The principal flood problems within each of the Counties, as stated in their FISs, are further discussed below.

Lehigh County

Flooding in Lehigh County occurs during all seasons. Flood conditions may be aggravated by the rapid melting of an existing snow pack or by reduction in infiltration losses due to frozen ground. Flooding in

the County typically occurs along the Lehigh River (FEMA, 2004). The FIS noted the following areas of concern for flooding.

- **Catasauqua Borough** – Within the Borough, CONRAIL lies between the Lehigh River and Canal and Catasauqua Creek. At this point, both the canal and railroad cross the Creek. At this location, the Borough has experienced flooding. Flooding has also occurred in the vicinity of Race Street over Catasauqua Creek (FEMA, 2004).
- **Salisbury Township** – Trout Creek No. 1 is subject to wide variation in flow with flood flows being caused by the rapid runoff from surrounding mountain slopes. In this area, flood-related damage has been limited to occasional residential damage (FEMA, 2004).
- **South Whitehall Township** – Jordan Creek flows across the Township within a narrow channel with well-defined banks and wide floodplain areas. Numerous floods have occurred along the Creek. Cedar Creek and Little Cedar Creek have also had flood occurrences in the past. Some of the flooding is caused by the inadequate capacity of drainage culverts and bridges to carry the flood flows (FEMA, 2004).

Northampton County

Flooding in Northampton County occurs during all seasons. Flood conditions may be aggravated by the rapid melting of an existing snow pack or by reduction in infiltration losses due to frozen ground (FEMA, 2011). No specific areas of concern or flood locations were noted in the FIS.

Ice Jam Hazard Areas

Ice jams are common in the Northeast U.S. and the State of Pennsylvania is not an exception. The Ice Jam Database, maintained by the Ice Engineering Group at the USACE Cold Regions Research and Engineering Laboratory (CRREL), currently consists of over 18,000 records from across the U.S. According to the USACE-CRREL, the Lehigh Valley experienced 17 historic ice jam events between 1780 and 2012 (Ice Engineering Research Group, Date Unknown). Historical events are further mentioned in the “Past Occurrence” section of this hazard profile.

4.3.4.2 Range of Magnitude

Both localized and widespread floods are considered hazards when people and property are affected. Injuries and deaths can occur when people are swept away by flood currents or bacteria and disease are spread by moving or stagnant floodwaters. Most property damage results from inundation by sediment-filled water. A large amount of rainfall over a short period of time can result in flash floods. Small amounts of rain can cause flooding in areas where there is frozen soil or saturated soils from a previous event or if the rain is concentrated in areas of impervious surfaces (PEMA, 2010).

Several factors determine the severity of floods, including intensity and duration, topography, ground cover and rate of snowmelt. Water runoff is greater in areas with steep slopes and little or no vegetative ground cover. Many areas in Pennsylvania have relatively steep slopes which promotes quick surface water runoff. Most storms track from west to east; however, some originate in the Great Lakes or the Atlantic Ocean (PEMA, 2010).

Rainfall in Pennsylvania is about average for the eastern U.S. When classified, the amount of precipitation can be divided into six categories. The six categories are as follows:

- Very light rain – precipitation rate of <0.01 inches per hour
- Light rain – precipitation rate between 0.01 inches and 0.04 inches per hour
- Moderate rain – precipitation rate between 0.04 inches and 0.16 inches per hour

- Heavy rain – precipitation rate between 0.16 inches and 0.63 inches per hour
- Very heavy rain – precipitation rate between 0.63 inches and two inches per hour
- Extreme rain – precipitation rate greater than two inches per hour (PEMA, 2010)

The severity of a flood depends not only on the amount of water that accumulates in a period of time, but also on the land's ability to manage this water. One element is the size of rivers and streams in an area; but an equally important factor is the land's absorbency. When it rains, soil acts as a sponge. When the land is saturated or frozen, infiltration into the ground slows and any more water that accumulates must flow as runoff (Harris, 2001).

Riverine and Flash Floods

In the case of riverine or flash flooding, once a river reaches flood stage, the flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category has a definition based on property damage and public threat:

- Minor Flooding - minimal or no property damage, but possibly some public threat or inconvenience.
- Moderate Flooding - some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- Major Flooding - extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations (NWS, 2008).

4.3.4.3 Past Occurrence

Many sources provided historical information regarding previous occurrences and losses associated with flooding events throughout the State of Pennsylvania and the Lehigh Valley. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

According to NOAA's NCDC storm events database, the Lehigh Valley experienced 129 flood events between April 30, 1950 and November 30, 2011. Total property damages, as a result of these flood events, were estimated at \$156.97 million. Total crop damages, as a result of these flood events, were estimated at \$2 million. This total also includes damages to other counties. According to the Hazard Research Lab at the University of South Carolina's Spatial Hazard Events and Losses Database for the U.S. (SHELDUS), between 1960 and 2010, 50 flood events occurred within the Lehigh Valley. The database indicated that flood events and losses specifically associated with Lehigh and Northampton Counties and its municipalities totaled over \$105.8 million in property damage and over \$13.5 million in crop damage. However, these numbers may vary due to the database identifying the location of the hazard event in various forms or throughout multiple counties or regions.

Between 1954 and 2012, the State of Pennsylvania experienced 32 FEMA-declared flood-related disasters (DR) or emergencies (EM) classified as one or a combination of the following disaster types: severe storms, mudslides, flash flooding, tropical storm, tropical depression, high winds, and rains. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations (FEMA, 2011).

Based on all sources researched, known flooding events that have affected the Lehigh Valley and its municipalities are identified in Table 4.3.4-3. With flood documentation for the State of Pennsylvania

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

being so extensive, not all sources have been identified or researched. Therefore, Table 4.3.4-3 may not include all events that have occurred throughout the Lehigh Valley.

Table 4.3.4-3. Flooding Events between 1950 and 2012 in the Lehigh Valley

Dates of Event	Event Type	FEMA Declaration Number	Counties Designated?	Losses / ImpActs	Source(s)
August 19-20, 1955	Floods, Rains (Hurricane Diane)	DR-40	Yes	This flood was a result of two tropical storms (Connie and Diane) passing over the Delaware Basin within one week of each other. Tropical Storm Diane brought heavy rainfall that resulted in high surface runoff and severe flooding in Lehigh Valley. The elevation of the estimated 100-year flood at the Walnutport gaging station on the Lehigh River is 364.5 feet. The elevation of a high water mark experienced during the 1955 flood at Walnutport was 367.95 feet.	FEMA, PEMA
August 1967	Flash Flood	N/A	N/A	Northampton County	PEMA
January 1969	Flood	N/A	N/A	Lehigh County	PEMA
June 21-23, 1972	Flood (Tropical Storm Agnes)	DR-340	Yes	Tropical Storm Agnes brought heavy rain to the Lehigh Valley. Rainfall totals were around four inches. Roads were closed and people were evacuated. The central portion of the State was the hardest hit. Lehigh Valley had over \$14 M in property damage and \$1.4 M in crop damages.	FEMA, PEMA, SHELDUS
July 17, 1973	Severe Storms and Flooding	DR-400	Northampton	No reference and/or no damage reported	FEMA, PEMA
September 23-26, 1975	Flood (Tropical Storm Eloise)	DR-485	No	Over \$1.5 M in property damage.	FEMA, PEMA
September 1987	Flood	N/A	N/A	Lehigh and Northampton	PEMA
September 1989	Flood	N/A	N/A	Lehigh and Northampton	PEMA
January 19-21, 1996	Flooding	DR-1093	Yes	The combination of snowmelt, unseasonably warm temperatures and additional two inches of rain, caused flash flooding of almost every small stream and significant roadway flooding in the area. Major flooding also occurred along the larger streams and rivers in Pennsylvania. In Lehigh County, firefighters in the City of Allentown responded to 123 calls for flooded basements, the most in 22 years. Adams Island in Allentown was evacuated due to Lehigh River flooding. In South Whitehall Township, the heavy rain caused a snow slide that damaged two homes and caused one injury. The	FEMA, PEMA, NOAA-NCDC

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Dates of Event	Event Type	FEMA Declaration Number	Counties Designated?	Losses / ImpActs	Source(s)
				<p>Lehigh River at Walnutport crested 4.3 feet above flood stage. In the City of Bethlehem, the river 0.9 feet above flood stage.</p> <p>Northampton County experienced both small stream and large river flooding. Route 611 was closed due to flooding, river debris and erosion. Most of the significant flooding occurred along the Lehigh and Delaware Rivers. In the Township of Upper Mount Bethel, 12 homes were damaged and hundreds of people were evacuated. In the Township of Forks, 50 homes were damaged and about 50 people were evacuated. In the City of Easton, flooding was severe at the confluence of the Delaware and Lehigh Rivers. Evacuations were ordered. All downtown streets and parks were flooded. In the Township of Williams, 13 homes suffered flood damage.</p> <p>Lehigh Valley had approximately \$42.3 M in property damages.</p>	
September 16, 1999	Flooding (Hurricane Floyd)	DR-1294	No	Hurricane Floyd struck the eastern portion of Pennsylvania, bringing heavy rain and damaging winds. The hurricane caused widespread flash flooding as storm totals averaged around six to eight inches. All counties were included in the Pennsylvania Governor's Proclamation	FEMA, PEMA
August 11, 2001	Flash Flood	N/A	N/A	Slow moving thunderstorms with heavy downpours caused flash flooding in the Townships of Salisbury and Upper Saucon. Businesses along Main Street flooded. Rainfall totals were between six and eight inches. Lehigh County had approximately \$10 M in property damage.	NOAA-NCDC
September 15, 2003	Flood (Remnants of Tropical Storm Henri)	N/A	N/A	<p>In Lehigh County, the heaviest rain fell across the Townships of Upper and Lower Milford and the Boroughs of Slatington and Washington. Rainfall totals in Lehigh County ranged between two and six inches.</p> <p>Heavy rain fell across portions of Northampton County, with the heaviest rain in the Township of Lower Saucon and the Borough of Hellertown. Rainfall totals ranged between two and four inches.</p>	LV HMP
September 18-19, 2004	Tropical Depression Ivan	DR-1557	Yes	Remnants of Tropical Storm Ivan caused widespread heavy rain. Storm totals averaged around five inches and caused widespread poor drainage, creek and river flooding throughout Lehigh Valley. In Lehigh County, the hardest hit municipalities in the County included the City of Allentown and the Townships of Lower Macungie and Macungie. It was estimated that 85	FEMA, PEMA, NOAA-NCDC, NWS, LV HMP



SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Dates of Event	Event Type	FEMA Declaration Number	Counties Designated?	Losses / ImpActs	Source(s)
				<p>homes, 31 businesses and 5 public buildings and structures were damaged. Damage along the Nancy Run, Monocacy, Bushkill, Saucon and Schoeneck Creeks was the result of flash flooding, and damage along Jacoby Creek resulted when an old earthen dam at Lake POCO failed and caused increased damage in the Borough of Portland, which was already flooded by the Delaware River. The Little Lehigh Creek within the Lehigh Parkway crested at 4.49 feet above flood stage. The Little Lehigh Creek at 10th Street in Allentown crested at 2.05 feet above flood stage.</p> <p>In Northampton County, nearly every town reported flood damages. Approximately 865 homes, businesses and structures were damaged, including several roads and bridges. The Lehigh River at Walnutport crested at 4.32 feet above flood stage. The Lehigh River in Bethlehem crested at 2.79 feet above flood stage. In Glendon the Lehigh River crested at 0.82 feet above flood stage. The Monocacy Creek at Bethlehem crested at 5.17 feet above flood stage. The Delaware River at Easton crested at 11.45 feet above flood stage.</p> <p>Total damages for the Counties were approximately \$6 M.</p>	
April 2-3, 2005	Severe Storms and Flooding	DR-1587	Northampton	<p>Heavy rain fell across Lehigh and Northampton Counties. In Lehigh County, the heavy rain caused poor drainage flooding and flooding along the Lehigh River. Storm totals ranged between three and four inches in the area. In the City of Allentown, flooding closed two roads. In the City of Bethlehem, the Industrial Quarter along the Monocacy Creek was flooding.</p> <p>In Northampton County, the municipalities along the Delaware River experienced the worst damage. Downtown areas of the City of Easton, Portland Borough and the Townships of Upper and Lower Mount Bethel were the hardest hit. Approximately 500 people were evacuated. About 700 homes and businesses were damaged, 32 homes were destroyed and 160 suffered major damage. Two small bridges were destroyed and 16 others were damaged. About 100 roads were damaged. Four sewage pumping stations in the City of Easton were heavily damaged. In Portland, the downtown area was seriously flooded as the Jacoby Creek also flooded. Water reached up to seven feet in some stores. In Upper Mount Bethel, 200 people were evacuated. In Forks Township, 23 homes suffered major</p>	FEMA, PEMA, NOAA-NCDC, NWS, LV HMP



SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Dates of Event	Event Type	FEMA Declaration Number	Counties Designated?	Losses / ImpActs	Source(s)
				<p>damage as the Bushkill Creek also flooded. In Williams Township, about 70 homes were heavily damaged. The heavy rain also caused the Monocacy Creek to flood in downtown Bethlehem. The Delaware River at Easton crested at an estimated 36.5 feet on April 4th. The Monocacy Creek in Bethlehem crested at 0.94 feet above flood stage. The Lehigh River in Walnutport crested at 2.49 feet above flood stage. The Lehigh River at Glendon crested at 1.81 feet above flood stage. The Lehigh River at Bethlehem was briefly above its 16-foot flood stage at 16.06 feet.</p> <p>Rainfall totals for Lehigh Valley ranged from 3.5 inches in Germansville (Lehigh) to 4.3 inches in the Township of Forks (Northampton).</p>	
October 8, 2005	Flash Flood	N/A	N/A	<p>The remnants of Tropical Storm Tammy produced heavy rain across the Lehigh Valley. Storm totals averaged around 10 inches, causing widespread poor drainage flooding and flooding along the smaller creeks. The worst flooding was reported along the Little Lehigh Creek in Lehigh County and the Bushkill Creek in the Townships of Palmer and Forks in Northampton County. In the City of Allentown, the Little Lehigh Creek divided the City in half. Three County roads were closed due to flooding. Many of the municipalities within Lehigh County experienced flooding along the creeks and roadways. The County had approximately \$100 K in property damage.</p>	NOAA-NCDC
June 27-30, 2006	Severe Storms, Flooding and Mudslides	DR-1649	Northampton	<p>Several days of heavy rain throughout the Delaware River Basin caused flash flooding of smaller streams and along the Lehigh River. Storm totals in Lehigh County ranged between five and nine inches. In Eastern Pennsylvania, over 5,000 homes, apartments and businesses were damaged. In Lehigh County, about 300 homes and businesses were affected by the flooding. In the City of Allentown, residents from Adam’s Island were evacuated. Homes were damaged in the Boroughs of Catasauqua, Coopersburg and Emmaus, and the Townships of Heidelberg, Lynn, Slatington, South Whitehall, and Upper Saucon. The County had approximately \$1 M in property damage and \$1 M in crop damage. In Northampton County, approximately 400 homes and businesses were affected by the flooding. Eleven homes were destroyed in the Townships of Upper Mount Bethel, Lower Mount Bethel, and Williams and in the Borough of West Easton. The worst damage was in the City</p>	FEMA, PEMA, NOAA-NCDC



SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Dates of Event	Event Type	FEMA Declaration Number	Counties Designated?	Losses / ImpActs	Source(s)
				of Easton, the Borough of Portland, and the Townships of Upper and Lower Mount Bethel. More than 20 bridges and roads were closed. The County had approximately \$10 M in property damages and \$1 M in crop damages.	
July 4, 2007	Flash Flooding	N/A	N/A	Heavy rain caused roadway flooding and small stream flooding in southern portions of Northampton County. The City of Bethlehem and the Township of Lower Saucon were hit the hardest. In the City of Bethlehem, flooding along the Monocacy Creek inundated historic buildings. Total damages in the County were approximately \$500 K.	NOAA-NCDC
August 12-13, 2009	Storms and Flooding	N/A	N/A	Showers and thunderstorms produced heavy rain which resulted in flooding. In Lehigh County, heavy rain caused roadway flooding and flooding of smaller streams in the northern portion of the County and near the Townships of Whitehall, North Whitehall, and Heidelberg. Rainfall totals in the County were approximately six inches.	PEMA, NOAA-NCDC
July 10, 2010	Flash Flood	N/A	N/A	Heavy rain caused flash flooding along Monocacy Creek. The Creek flooded four structures near the intersection of Main and West Church Streets. There was about five feet of water in these structures. The County had approximately \$200 K in property damage.	NOAA-NCDC
March 10-12, 2011	Flood	N/A	N/A	Heavy rain fell across eastern Pennsylvania, bringing between 1.5 to 5 inches of rain. This caused widespread river, stream and poor drainage flooding. The Delaware, Lehigh and Schuylkill Rivers experienced flooding. The worst flooding was seen in Northampton and Bucks County. In Northampton County, flooding caused considerable damage along the towpaths of both the Lehigh and Delaware River canals. Many people were evacuated; roads were closed. The County had approximately \$1.8 M in property damage.	NOAA-NCDC
August 13-14, 2011	Flash Flood	N/A	N/A	A series of thunderstorms brought heavy rain to the Lehigh Valley. This rain caused flash flooding and flooding of streams and creeks. In Northampton County, flash flooding along the Monocacy Creek caused evacuations in the City of Bethlehem. The County had approximately \$100 K in property damage.	NOAA-NCDC
August 27-28, 2011	Flood (Hurricane Irene)	DR-4025	Yes	Hurricane Irene produced heavy rains, flooding, tropical storm force wind gusts and moderate tidal flooding along the Delaware River. Approximately 700,000 people were without power in eastern Pennsylvania. The Little Lehigh Creek at Little Lehigh Park near the City of Allentown had moderate flooding. Preliminary damages in the State were around \$6 M.	FEMA, NOAA-NCDC



SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Dates of Event	Event Type	FEMA Declaration Number	Counties Designated?	Losses / ImpActs	Source(s)
September 5-8, 2011	Flood (Tropical Storm Lee)	DR-4030	Northampton	<p>Remnants of Tropical Storm Lee produced several days of heavy rain across eastern Pennsylvania. Rainfall totals ranged from four to nine inches, with six to 12 in Berks County. The heavy rain caused widespread poor drainage flooding, as well as moderate flooding along the Delaware and Schuylkill River Basins, with minor to moderate flooding along the Lehigh River Basin. The Upper Schuylkill, Lehigh, and Delaware River Basins crests were the highest since June 2006. Some of the smaller streams in southeastern Pennsylvania reached major flooding levels. Total damages for the State were estimated at \$500 M.</p> <p>In eastern Pennsylvania, there were 22 homes and businesses that were destroyed, 201 that suffered major damage, 672 that had minor damage, and 1,217 that were affected.</p> <p>In the Lehigh Valley, the heavy rain caused poor drainage flooding and flash flooding of smaller streams in the Townships of Lower Milford and Upper Saucon. The Lehigh River at Walnutport was briefly above flood stage. The Little Lehigh at Little Lehigh Park in Allentown was above its six foot flood stage. Rainfall totals in the Lehigh Valley ranged from 6.02 inches in Schnecksville to 7.07 inches at the Lehigh Valley Airport.</p>	FEMA, NOAA-NCDC

Note: Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of increased U.S. Inflation Rates.

- | | | | |
|------|-------------------------------------|---------|-------------------------------------------------------|
| DR | Federal Disaster Declaration | N/A | Not applicable |
| EM | Federal Emergency Declaration | NCDC | National Climate Data Center |
| FEMA | Federal Emergency Management Agency | NOAA | National Oceanic Atmospheric Administration |
| HMP | Hazard Mitigation Plan | NWS | National Weather Service |
| K | Thousand (\$) | PEMA | Pennsylvania Emergency Management Agency |
| LV | Lehigh Valley | SHELDUS | Spatial Hazard Events and Losses Database for the U.S |
| M | Million (\$) | | |



Figure 4.3.4-1: Historic Ice Jams in the Lehigh Valley

As of the date of this Plan, the figure for ice jams in the Lehigh Valley is unavailable.

Source: CRREL Database

Based on review of the CRREL database, Table 4.3.4-4 lists the ice jam events that have occurred in the Lehigh Valley between 1780 and 2012. Information regarding losses associated with these reported ice jams was limited.

Table 4.3.4-4. Ice Jam Events in the Lehigh Valley between 1780 and 2012

Municipality	River	Jam Date	Water Year	Gage Number
Salisbury Township	Big Piney Run	2/27/1936	1936	3078500
Salisbury Township	Big Piney Run	1/3/1939	1939	3078500
Salisbury Township	Big Piney Run	3/9/1942	1942	3078500
Salisbury Township	Big Piney Run	1/28/1944	1944	3078500
Salisbury Township	Big Piney Run	2/22/1944	1944	3078500
Salisbury Township	Big Piney Run	2/22/1944	1944	3078500
Salisbury Township	Big Piney Run	3/14/1947	1947	3078500
Salisbury Township	Big Piney Run	2/14/1948	1948	3078500
City of Allentown	Jordan Creek	2/20/1948	1948	1452000
Salisbury Township	Big Piney Run	12/22/1951	1952	3078500
Salisbury Township	Big Piney Run	12/22/1951	1952	3078500
Salisbury Township	Big Piney Run	1/21/1959	1959	3078500
Salisbury Township	Big Piney Run	3/28/1960	1960	3078500
Salisbury Township	Big Piney Run	2/19/1961	1961	3078500
Salisbury Township	Big Piney Run	2/7/1965	1965	3078500
Salisbury Township	Big Piney Run	2/11/1966	1966	3078500
Bushkill Township	Delaware River	2/5/1970	1970	?

Source: CRREL, 2012

Note: Although many events were reported for Lehigh Valley, information pertaining to every event was not easily ascertainable; therefore this table may not represent all ice jams in the Counties.

National Flood Insurance Program

According to FEMA's 2002 *National Flood Insurance Program (NFIP): Program Description*, the U.S. Congress established the NFIP with the passage of the National Flood Insurance Act of 1968. The NFIP is a Federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. The NFIP collects and stores a vast quantity of information on insured structures, including the number and location of flood insurance policies, number of claims per insured property, dollar value of each claim and aggregate value of claims, repetitive flood loss properties, etc.

NFIP data presents a strong indication of the location of flood events among other indicators (NYSDPC, 2008).

Participation in the NFIP is based on an agreement between communities and the Federal Government. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction and substantial improvements in floodplains, the Federal Government will make flood insurance available within the community as a financial protection against flood losses. This insurance is designed to provide an insurance alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods (FEMA, 2002).

There are three components to the NFIP: flood insurance, floodplain management and flood hazard mapping. Nearly 20,000 communities across the U.S. and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary. Flood damage is reduced by nearly \$1 billion each year through communities implementing sound floodplain management requirements and property owners purchasing flood insurance. Additionally, buildings constructed in compliance with NFIP building standards suffer approximately 80-percent less damages annually than those not built in compliance (FEMA, 2008).

4.3.4.4 Future Occurrence

Given the history of flood events that have impacted the Lehigh Valley, it is apparent that future flooding of varying degrees will occur. The fact that the elements required for flooding exist and that major flooding has occurred throughout the Counties in the past suggests that many people and properties are at risk from the flood hazard in the future.

As defined by FEMA, geographic areas within the 100-year floodplain in the Lehigh Valley are estimated to have a one-percent chance of flooding in any given year. A structure located within a 100-year floodplain has a 26-percent chance of suffering flood damage during the term of a 30-year mortgage. Geographic areas in the Lehigh Valley located within the 500-year flood boundary are estimated to have a 0.2-percent chance of being flooded in any given year (FEMA, 2003; FEMA, 2006). As noted, Figure 4.3.4-3 illustrates the FEMA DFIRM 100-year and 500-year flood zones for Lehigh Valley.

In Section 4.4, the identified hazards of concern for the Lehigh Valley were ranked for relative risk. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records, NFIP data and information, and reference to the Pennsylvania State Hazard Mitigation Plan, the probability of occurrence for flood events in the Lehigh Valley is considered *‘highly likely’* (100% annual probability). Please refer to Section 4.4 for further information on PEMA’s risk factor methodology.

It is estimated that the Lehigh Valley will continue to experience flooding annually. Some of the flooding events may induce secondary hazards such as: water quality and supply concerns, infrastructure damage, deterioration and failure, utility failures, power outages, transportation delays/accidents/inconveniences, and public health and safety concerns.

4.3.4.5 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the flood hazard, areas identified as hazard areas include the 1% and 0.2% flood zones. The following text evaluates and estimates the potential impact of flooding in the Lehigh Valley including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety, (2) general building stock, (3) critical facilities and infrastructure, (4) economy, (5) environment and (6) future growth and development
- Effect of climate change on vulnerability
- Further data collections that will assist understanding of this hazard over time

4.3.4.5.1 Overview of Vulnerability

All types of flooding can cause widespread damage throughout rural and urban areas, including but not limited to: water-related damage to the interior and exterior of buildings; destruction of electrical and other expensive and difficult-to-replace equipment; injury and loss of life; proliferation of disease vectors; disruption of utilities, including water, sewer, electricity, communications networks and facilities; loss of agricultural crops and livestock; placement of stress on emergency response and healthcare facilities and personnel; loss of productivity; and displacement of persons from homes and places of employment (Foster, Date Unknown).

The flood hazard is a major concern for the Lehigh Valley. To assess vulnerability, potential losses were calculated for the Lehigh Valley for riverine flooding for 1% (100-year) and 0.2% (500-year) annual chance flood events. The flood hazard exposure and loss estimate analysis is presented below.

4.3.4.5.2 Data and Methodology

The 1% and 0.2% chance flood events were examined to evaluate the Lehigh Valley's risk and vulnerability to the flood hazard. These flood events are generally those considered by planners and evaluated under federal programs such as the NFIP.

A Level 2 HAZUS-MH riverine flood analysis was performed. The default building inventory in HAZUS-MH was updated and replaced at the Census-block level with a custom building inventory developed for both Counties. The updated building inventory was built using detailed structure-specific assessor data, as well as parcel and structure location information. An updated critical facility inventory was also developed and incorporated into HAZUS-MH replacing the default essential facility (police, fire, schools, etc.) and utility inventories.

The Lehigh County FEMA DFIRMs dated July 2004 and the Northampton County preliminary DFIRMs dated 2011 were used to evaluate exposure and determine potential future losses. Please note the Northampton County 2011 DFIRMs, although considered preliminary are the best available data and used for this plan.

A 10-foot depth grid was developed for the 1% flood event for Lehigh and Northampton Counties. Using Geographic Information System (GIS) tools and the best available data including the DFIRM database for both Counties and the 2008 3.2-foot Light Detection and Ranging (LiDAR) Bare Earth Digital Elevation Model (DEM) available from Pennsylvania Spatial Data Access – the Pennsylvania Geospatial Data Clearinghouse, a flood depth grid was generated and integrated into the HAZUS-MH riverine flood model.

To estimate exposure to the 1% and 0.2% flood events, the DFIRM flood boundaries, updated building and facility inventories and 2010 U.S. Census population data were used. The HAZUS-MH 2.1 riverine flood model was run to estimate potential losses for the Lehigh Valley for the 1% flood event. HAZUS-MH 2.1 calculated the estimated potential losses to the population (default 2000 U.S. Census data) and

potential damages to the updated general building stock and critical facility inventories based on the depth grid generated and the default HAZUS damage functions in the flood model.

4.3.4.5.3 Impact on Life, Health and Safety

The impact of flooding on life, health and safety is dependent upon several factors including the severity of the event and whether or not adequate warning time is provided to residents. Exposure represents the population living in or near floodplain areas that could be impacted should a flood event occur. Additionally, exposure should not be limited to only those who reside in a defined hazard zone, but everyone who may be affected by the effects of a hazard event (e.g., people are at risk while traveling in flooded areas, or their access to emergency services is compromised during an event). The degree of that impact will vary and is not strictly measurable.

To estimate the population exposed to the 1% and 0.2% flood events, the FEMA DFIRM floodplain boundaries (Lehigh County 2004 DFIRMs and Northampton County 2011 preliminary DFIRMs) were used to estimate the number of structures within the floodplains, which were then factored by the average number of persons per household in the Lehigh Valley. While this assumes that all structures in the floodplain are residential and single-household, it provides a reasonable estimate of population directly exposed to the flood risk. According to this methodology, Table 4.3.4-5 lists the estimated population located within the 1% and 0.2% flood zones by municipality for both Lehigh and Northampton Counties.

Table 4.3.4-5. Estimated Lehigh Valley Population Vulnerable to the 1% and 0.2% Flood Hazard

Municipality	Population in 1% Flood Boundary (SFHA)	Percent Population	Population in 0.2% Flood Boundary	Percent Population
Lehigh County				
Alburtis Borough	5	0.2	86	3.7
Allentown, City of	798	0.7	1267	1.1
Bethlehem, City of	58	0.3	173	0.9
Catasauqua Borough	183	2.8	378	5.9
Coopersburg Borough	5	0.2	5	0.2
Coplay Borough	0	0.0	0	0.0
Emmaus Borough	107	1.0	137	1.2
Fountain Hill Borough	0	0.0	3	0.1
Hanover Township	0	0.0	3	0.2
Heidelberg Township	142	4.2	145	4.2
Lower Macungie Township	500	1.6	1161	3.8
Lower Milford Township	104	2.8	104	2.8
Lowhill Township	25	1.2	25	1.2
Lynn Township	196	4.6	196	4.6
Macungie Borough	10	0.3	23	0.7
North Whitehall Township	137	0.9	155	1.0
Salisbury Township	102	0.8	124	0.9

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Municipality	Population in 1% Flood Boundary (SFHA)	Percent Population	Population in 0.2% Flood Boundary	Percent Population
Slatington Borough	15	0.4	66	1.6
South Whitehall Township	193	1.0	414	2.2
Upper Macungie Township	165	0.8	297	1.5
Upper Milford Township	168	2.3	229	3.1
Upper Saucon Township	56	0.4	91	0.6
Washington Township	89	1.3	94	1.4
Weisenberg Township	64	1.3	64	1.3
Whitehall Township	216	0.8	584	2.2
Lehigh County (est. total)	3338	1.0	5824	1.7
Northampton County				
Allen Township	61	1.4	71	1.7
Bangor Borough	457	8.7	599	11.4
Bath Borough	23	0.8	23	0.8
Bethlehem Township	254	1.1	272	1.1
Bethlehem, City of	208	0.4	411	0.7
Bushkill Township	61	0.7	61	0.7
Chapman Borough	5	2.6	5	2.6
East Allen Township	74	1.5	74	1.5
East Bangor Borough	0	0.0	0	0.0
Easton, City of	340	1.3	665	2.5
Forks Township	147	1.0	178	1.2
Freemansburg Borough	193	7.3	277	10.5
Glendon Borough	5	1.2	13	2.9
Hanover Township	18	0.2	20	0.2
Hellertown Borough	79	1.3	104	1.8
Lehigh Township	119	1.1	165	1.6
Lower Mt. Bethel Township	429	13.8	538	17.4
Lower Nazareth Township	94	1.7	94	1.7
Lower Saucon Township	150	1.4	198	1.8
Moore Township	124	1.4	127	1.4
Nazareth Borough	18	0.3	18	0.3
North Catasauqua Borough	0	0.0	0	0.0
Northampton Borough	394	4.0	554	5.6
Palmer Township	198	1.0	226	1.1

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Municipality	Population in 1% Flood Boundary (SFHA)	Percent Population	Population in 0.2% Flood Boundary	Percent Population
Pen Argyl Borough	0	0.0	0	0.0
Plainfield Township	66	1.1	66	1.1
Portland Borough	69	13.2	81	15.7
Roseto Borough	0	0.0	0	0.0
Stockertown Borough	10	1.1	13	1.4
Tatamy Borough	10	0.8	23	1.9
Upper Mt. Bethel Township	401	6.0	554	8.3
Upper Nazareth Township	30	0.5	30	0.5
Walnutport Borough	36	1.7	46	2.2
Washington Township	147	2.9	147	2.9
West Easton Borough	36	2.8	53	4.2
Williams Township	178	3.0	259	4.4
Wilson Borough	8	0.1	8	0.1
Wind Gap Borough	23	0.8	23	0.8
Northampton County (est. total)	4465	1.5	5997	2.0

Source: Census, 2010; FEMA, 2004; FEMA, 2011

Notes: est. = Estimated; SFHA = Special Flood Hazard Area (1% chance flood)

Of the population exposed, the most vulnerable include the economically disadvantaged and the population over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact to their family. The population over the age of 65 is also more vulnerable because they are more likely to seek or need medical attention which may not be available due to isolation during a flood event and they may have more difficulty evacuating.

Using 2000 U.S. Census data, HAZUS-MH 2.1 estimates the potential sheltering needs as a result of a 1% flood event. For the 1% flood event, HAZUS-MH 2.1 estimates 7,281 people will be displaced and 4,033 people will seek short-term sheltering, representing 2.3% and 1.3% of the Lehigh County population, respectively. For the 1% flood event in Northampton County, HAZUS-MH 2.1 estimates 7,100 people will be displaced and 3,677 people will seek short-term sheltering, representing 2.7% and 1.4% of the County population, respectively. These statistics, by municipality, are presented in Table 4.3.4-6.

The total number of injuries and casualties resulting from flooding is generally limited based on advance weather forecasting, blockades and warnings. Therefore, injuries and deaths generally are not anticipated if proper warning and precautions are in place. Ongoing mitigation efforts should help to avoid the most likely cause of injury, which results from persons trying to cross flooded roadways or channels during a flood.

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Table 4.3.4-6: Estimated Lehigh Valley Population Displaced or Seeking Short-Term Shelter from the 1% Chance Flood Event

Municipality	Displaced Persons	Percent Displaced	Persons Seeking Short-Term Sheltering	Percent Seeking Shelter
Lehigh County				
Alburtis Borough	35	1.6	9	0.4
Allentown, City of	1,751	1.6	1,236	1.2
Bethlehem, City of	259	1.4	233	1.2
Catasauqua Borough	328	5.0	195	3.0
Coopersburg Borough	64	2.5	9	0.3
Coplay Borough	15	0.4	4	0.1
Emmaus Borough	200	1.8	49	0.4
Fountain Hill Borough	4	0.1	0	0.0
Hanover Township	7	0.4	0	0.0
Heidelberg Township	124	3.8	8	0.2
Lower Macungie Township	929	4.8	548	2.8
Lower Milford Township	191	5.3	32	0.9
Lowhill Township	71	3.7	5	0.3
Lynn Township	298	7.7	46	1.2
Macungie Borough	73	2.4	65	2.1
North Whitehall Township	284	1.9	56	0.4
Salisbury Township	214	1.6	88	0.7
Slatington Borough	105	2.4	46	1.0
South Whitehall Township	529	2.9	377	2.1
Upper Macungie Township	234	1.7	82	0.6
Upper Milford Township	277	4.0	87	1.2
Upper Saucon Township	174	1.5	47	0.4
Washington Township	113	1.7	16	0.2
Weisenberg Township	25	0.6	0	0.0
Whitehall Township	977	3.9	795	3.2
Lehigh County (est. total)	7,281	2.3	4,033	1.3
Northampton County				
Allen Township	120	4.5	21	0.8
Bangor Borough	619	11.6	493	9.3
Bath Borough	160	6.0	114	4.3
Bethlehem Township	459	2.2	285	1.3
Bethlehem, City of	455	0.9	274	0.5
Bushkill Township	181	2.6	22	0.3
Chapman Borough	10	4.7	1	0.5
East Allen Township	149	3.0	30	0.6
East Bangor Borough	19	1.9	3	0.3
Easton, City of	477	1.8	262	1.0
Forks Township	158	1.9	53	0.6

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Municipality	Displaced Persons	Percent Displaced	Persons Seeking Short-Term Sheltering	Percent Seeking Shelter
Freemansburg Borough	232	12.5	80	4.3
Glendon Borough	3	0.8	0	0.0
Hanover Township	237	2.5	191	2.0
Hellertown Borough	155	2.8	96	1.7
Lehigh Township	214	2.2	21	0.2
Lower Mt. Bethel Township	259	8.0	62	1.9
Lower Nazareth Township	284	5.4	149	2.8
Lower Saucon Township	316	3.2	117	1.2
Moore Township	282	3.2	122	1.4
Nazareth Borough	18	0.3	1	0.0
North Catasauqua Borough	31	1.1	4	0.1
Northampton Borough	534	5.7	380	4.1
Palmer Township	411	2.4	229	1.4
Pen Argyl Borough	9	0.3	1	0.0
Plainfield Township	71	1.2	4	0.1
Portland Borough	79	13.6	50	8.6
Roseto Borough	1	0.1	0	0.0
Stockertown Borough	73	10.6	47	6.8
Tatamy Borough	54	5.8	49	5.3
Upper Mt. Bethel Township	363	6.0	137	2.3
Upper Nazareth Township	179	3.9	105	2.3
Walnutport Borough	28	1.4	10	0.5
Washington Township	147	3.6	43	1.1
West Easton Borough	77	6.6	61	5.2
Williams Township	116	2.6	54	1.2
Wilson Borough	1	0.0	0	0.0
Wind Gap Borough	119	4.2	106	3.7
Northampton County (est. total)	7,100	2.7	3,677	1.4

Source: HAZUS-MH 2.1

Note: The percent of the population displaced and seeking shelter was calculated using the 2000 U.S. Census data for the Lehigh Valley. est. = Estimated

4.3.4.5.4 Impact on General Building Stock

After considering the population exposed and vulnerable to the flood hazard, the built environment was evaluated. Exposure in the flood zone includes those buildings located in the flood zone. Potential damage is the modeled loss that could occur to the exposed inventory, including structural and content value.

The total land area located in the 1% and 0.2% flood zones was calculated for each municipality, as presented in Table 4.3.4-7 below. To provide a general estimate of number of structures, parcels, and structural/content replacement value exposure, the FEMA DFIRM flood boundaries (1% and 0.2% flood zones) were overlaid upon Lehigh and Northampton Counties' parcel and the updated building stock inventory point shapefiles. The parcels that intersect the 1% and/or 0.2% flood zones were totaled for

each municipality. The total number of buildings with their centroid located in the 1% and 0.2% flood boundaries was also determined and their estimated building stock replacement value (structure and contents) is listed for each municipality in Table 4.3.4-8.

The depth grid developed for the 1% flood event for Lehigh and Northampton Counties was integrated into the HAZUS-MH riverine flood model. The model was then run to estimate the potential general building stock losses for the 1% flood event. The potential estimated losses are summarized by municipality in Table 4.3.4-8.

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Table 4.3.4-7. Estimated Number of Parcels Located in the 1% and 0.2% FEMA DFIRM Flood Boundaries

Municipality	Total Number of Parcels	1% Flood Hazard Area		0.2% Flood Hazard Area	
		Number of Parcels	% of Total	Number of Parcels	% of Total
Lehigh County					
Alburtis Borough	922	22	2.4	45	4.9
Allentown, City of	33,998	714	2.1	984	2.9
Bethlehem, City of	6,208	2	0.0	2	0.0
Catasauqua Borough	2,379	165	6.9	241	10.1
Coopersburg Borough	890	61	6.9	61	6.9
Coplay Borough	1,375	4	0.3	5	0.4
Emmaus Borough	4,213	117	2.8	143	3.4
Fountain Hill Borough	1,626	0	0.0	1	0.1
Hanover Township	593	15	2.5	18	3.0
Heidelberg Township	1,708	223	13.1	224	13.1
Lower Macungie Township	10,426	644	6.2	889	8.5
Lower Milford Township	1,764	241	13.7	242	13.7
Lowhill Township	1,070	171	16.0	171	16.0
Lynn Township	2,401	402	16.7	402	16.7
Macungie Borough	874	10	1.1	19	2.2
North Whitehall Township	6,121	338	5.5	356	5.8
Salisbury Township	5,679	151	2.7	167	2.9
Slatington Borough	1,631	63	3.9	101	6.2
South Whitehall Township	7,929	275	3.5	357	4.5
Upper Macungie Township	7,207	311	4.3	425	5.9
Upper Milford Township	3,358	248	7.4	336	10.0
Upper Saucon Township	5,856	126	2.2	166	2.8
Washington Township	3,202	224	7.0	247	7.7
Weisenberg Township	2,408	214	8.9	214	8.9
Whitehall Township	9,080	329	3.6	527	5.8

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Municipality	Total Number of Parcels	1% Flood Hazard Area		0.2% Flood Hazard Area	
		Number of Parcels	% of Total	Number of Parcels	% of Total
Lehigh County (est. total)	122,980	5,070	4.1	6,343	5.2
Northampton County					
Allen Township	2,411	140	5.8	142	5.9
Bangor Borough	2,039	321	15.7	386	18.9
Bath Borough	1,013	94	9.3	94	9.3
Bethlehem Township	9,409	374	4.0	388	4.1
Bethlehem, City of	16,915	432	2.6	600	3.5
Bushkill Township	3,678	216	5.9	216	5.9
Chapman Borough	111	20	18.0	20	18.0
East Allen Township	1,984	180	9.1	180	9.1
East Bangor Borough	455	5	1.1	5	1.1
Easton, City of	8,503	396	4.7	581	6.8
Forks Township	6,699	349	5.2	407	6.1
Freemansburg Borough	1,041	135	13.0	176	16.9
Glendon Borough	209	16	7.7	19	9.1
Hanover Township	4,450	66	1.5	68	1.5
Hellertown Borough	2,420	85	3.5	106	4.4
Lehigh Township	4,844	299	6.2	300	6.2
Lower Mt. Bethel Township	1,762	483	27.4	514	29.2
Lower Nazareth Township	2,612	256	9.8	256	9.8
Lower Saucon Township	5,078	263	5.2	301	5.9
Moore Township	4,139	285	6.9	288	7.0
Nazareth Borough	2,019	29	1.4	29	1.4
North Catasauqua Borough	1,148	11	1.0	23	2.0
Northampton Borough	4,028	330	8.2	419	10.4
Palmer Township	8,924	313	3.5	353	4.0
Pen Argyl Borough	1,436	7	0.5	7	0.5
Plainfield Township	2,998	177	5.9	181	6.0



SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Municipality	Total Number of Parcels	1% Flood Hazard Area		0.2% Flood Hazard Area	
		Number of Parcels	% of Total	Number of Parcels	% of Total
Portland Borough	283	69	24.4	74	26.1
Roseto Borough	757	4	0.5	4	0.5
Stockertown Borough	384	62	16.1	66	17.2
Tatamy Borough	447	20	4.5	34	7.6
Upper Mt. Bethel Township	3,590	596	16.6	638	17.8
Upper Nazareth Township	2,316	105	4.5	105	4.5
Walnutport Borough	922	24	2.6	37	4.0
Washington Township	2,530	232	9.2	232	9.2
West Easton Borough	544	33	6.1	43	7.9
Williams Township	3,148	257	8.2	288	9.1
Wilson Borough	2,923	17	0.6	18	0.6
Wind Gap Borough	1,004	32	3.2	33	3.3
Northampton County (est. total)	119,227	6,733	5.6	7,631	6.4

Source: FEMA, 2004; FEMA 2011

Notes: This analysis was conducted using the DFIRMs available for the Lehigh Valley (2004 for Lehigh County and preliminary 2011 for Northampton County).
est. = Estimated.

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Table 4.3.4-8. Estimated Building Exposure and Potential Losses to the 1% and 0.2% Flood Events

Municipality	Total Number of Buildings	Total RV	1% Event						0.2% Event			
			Exposed				Estimated Potential Loss		Exposed			
			Number of Buildings	% of Total	RV	% of Total	RV	% of Total	Number of Buildings	% of Total	RV	% of Total
Lehigh County												
Alburtis Borough	884	\$280,994,000	2	0.2	\$447,803	0.1	\$0 *	0.0*	34	3.8	\$8,894,616	3.2
Allentown, City of	33,947	\$20,982,347,000	314	0.9	\$459,623,347	2.2	\$87,951,767	0.4	499	1.5	\$815,926,964	3.9
Bethlehem, City of	6,437	\$4,769,721,000	23	0.4	\$16,497,498	0.3	\$3,823,292	0.1	68	1.1	\$40,715,000	0.9
Catasauqua Borough	2,258	\$934,748,000	72	3.2	\$64,751,762	6.9	\$13,572,704	1.5	149	6.6	\$94,462,469	10.1
Coopersburg Borough	867	\$421,475,000	2	0.2	\$543,570	0.1	\$9,956	0.0	2	0.2	\$543,570	0.1
Coplay Borough	1,316	\$406,752,000	0	0	\$0	0	\$0	0.0	0	0	\$0	0
Emmaus Borough	4,166	\$2,088,277,000	42	1	\$22,204,207	1.1	\$1,298,745	0.1	54	1.3	\$27,932,348	1.3
Fountain Hill Borough	1,554	\$1,101,911,000	0	0	\$0	0	\$0	0.0	1	0.1	\$42,929,696	3.9
Hanover Township	616	\$2,254,652,000	0	0	\$0	0	\$0	0.0	1	0.2	\$270,043	0
Heidelberg Township	1,261	\$550,037,000	56	4.4	\$21,668,702	3.9	\$472,220	0.1	57	4.5	\$21,940,023	4
Lower Macungie Township	11,371	\$5,924,050,000	197	1.7	\$98,878,159	1.7	\$12,059,304	0.2	457	4	\$237,785,998	4
Lower Milford Township	1,433	\$534,598,000	41	2.9	\$15,193,448	2.8	\$801,315	0.1	41	2.9	\$15,193,448	2.8
Lowhill Township	864	\$371,530,000	10	1.2	\$3,995,586	1.1	\$640,899	0.2	10	1.2	\$3,995,586	1.1
Lynn Township	1,670	\$612,033,000	77	4.6	\$28,251,857	4.6	\$5,626,176	0.9	77	4.6	\$28,251,857	4.6
Macungie Borough	1,809	\$533,007,000	4	0.2	\$5,252,628	1	\$55,203	0.0	9	0.5	\$11,553,563	2.2
North Whitehall Township	5,485	\$2,850,746,000	54	1	\$37,602,959	1.3	\$1,872,214	0.1	61	1.1	\$39,218,883	1.4
Salisbury Township	5,299	\$3,606,044,000	40	0.8	\$115,464,662	3.2	\$14,244,095	0.4	49	0.9	\$163,967,438	4.5
Slatington Borough	1,484	\$715,470,000	6	0.4	\$2,631,933	0.4	\$486,482	0.1	26	1.8	\$12,432,388	1.7
South Whitehall Township	7,891	\$4,885,829,000	76	1	\$32,881,268	0.7	\$1,153,788	0.02	163	2.1	\$66,423,903	1.4
Upper Macungie Township	6,903	\$10,206,499,000	65	0.9	\$34,502,731	0.3	\$1,175,439	0.01	117	1.7	\$52,076,836	0.5
Upper Milford Township	3,010	\$1,178,767,000	66	2.2	\$33,941,755	2.9	\$1,629,335	0.1	90	3	\$44,870,707	3.8
Upper Saucon Township	5,301	\$3,171,479,000	22	0.4	\$119,843,915	3.8	\$845,309	0.0	36	0.7	\$125,154,286	3.9



SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Municipality	Total Number of Buildings	Total RV	1% Event						0.2% Event			
			Exposed				Estimated Potential Loss		Exposed			
			Number of Buildings	% of Total	RV	% of Total	RV	% of Total	Number of Buildings	% of Total	RV	% of Total
Washington Township	2,516	\$893,760,000	35	1.4	\$13,078,422	1.5	\$487,129	0.1	37	1.5	\$13,859,185	1.6
Weisenberg Township	1,878	\$1,189,552,000	25	1.3	\$6,450,939	0.5	\$297,330	0.02	25	1.3	\$6,450,939	0.5
Whitehall Township	8,974	\$5,424,311,000	85	0.9	\$55,257,330	1	\$3,547,116	0.1	230	2.6	\$214,334,925	4
Lehigh County (est. total)	119,194	\$75,888,589,000	1,314	1.10	\$1,188,964,481	1.57	\$152,049,818	0.20	2,293	1.92	\$2,089,184,671	2.75
Northampton County												
Allen Township	2,043	\$712,840,000	24	1.2	\$41,046,480	5.7	\$10,313,020	1.4	28	1.4	\$42,501,553	5.9
Bangor Borough	1,849	\$926,661,000	180	9.7	\$240,768,217	25.9	\$83,770,170	9.0	236	12.8	\$297,389,629	32
Bath Borough	939	\$471,748,000	9	1	\$8,352,303	1.8	\$244,958	0.1	9	1	\$8,352,303	1.8
Bethlehem Township	8,683	\$5,752,889,000	100	1.2	\$70,803,684	1.2	\$13,134,031	0.2	107	1.2	\$82,662,097	1.4
Bethlehem, City of	15,889	\$9,934,952,000	82	0.5	\$226,971,075	2.3	\$30,527,071	0.3	162	1	\$616,001,097	6.2
Bushkill Township	3,001	\$1,289,529,000	24	0.8	\$9,073,207	0.7	\$2,519,746	0.2	24	0.8	\$9,073,207	0.7
Chapman Borough	86	\$32,434,000	2	2.3	\$609,672	1.9	\$0	0.0	2	2.3	\$609,672	1.9
East Allen Township	1,730	\$1,104,833,000	29	1.7	\$14,773,261	1.3	\$1,085,392	0.1	29	1.7	\$14,773,261	1.3
East Bangor Borough	375	\$118,151,000	0	0	\$0	0	\$0	0.0	0	0	\$0	0
Easton, City of	7,643	\$4,848,037,000	134	1.8	\$347,201,853	7.2	\$111,092,616	2.3	262	3.4	\$598,150,980	12.3
Forks Township	5,661	\$3,177,595,000	58	1	\$25,067,233	0.8	\$7,168,387	0.2	70	1.2	\$28,307,911	0.9
Freemansburg Borough	931	\$361,483,000	76	8.2	\$35,689,588	9.9	\$7,737,003	2.1	109	11.7	\$64,272,950	17.8
Glendon Borough	167	\$89,841,000	2	1.2	\$7,579,362	8.3	\$0 *	0.0*	5	3	\$11,134,727	12.2
Hanover Township	4,288	\$3,484,970,000	7	0.2	\$8,898,211	0.3	\$1,348,806	0.04	8	0.2	\$9,304,871	0.3
Hellertown Borough	2,314	\$888,848,000	31	1.3	\$29,582,113	3.3	\$2,774,447	0.3	41	1.8	\$40,360,406	4.5
Lehigh Township	3,863	\$1,487,389,000	47	1.2	\$23,437,269	1.6	\$2,764,042	0.2	65	1.7	\$30,844,951	2.1
Lower Mt. Bethel Township	1,237	\$502,664,000	169	13.7	\$65,573,683	12.8	\$19,317,630	3.8	212	17.1	\$85,022,698	16.6
Lower Nazareth Township	2,274	\$2,194,429,000	37	1.6	\$20,809,242	0.9	\$1,153,330	0.1	37	1.6	\$20,809,242	0.9
Lower Saucon Township	4,331	\$1,968,200,000	59	1.4	\$42,011,502	2.1	\$9,223,565	0.5	78	1.8	\$52,369,178	2.6



SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Municipality	Total Number of Buildings	Total RV	1% Event						0.2% Event			
			Exposed				Estimated Potential Loss		Exposed			
			Number of Buildings	% of Total	RV	% of Total	RV	% of Total	Number of Buildings	% of Total	RV	% of Total
Moore Township	3,289	\$1,223,870,000	49	1.5	\$20,188,049	1.6	\$3,567,907	0.3	50	1.5	\$20,599,178	1.7
Nazareth Borough	1,876	\$1,312,606,000	7	0.4	\$2,583,924	0.2	\$89,607	0.007	7	0.4	\$2,583,924	0.2
North Catasauqua Borough	1,089	\$386,289,000	0	0	\$0	0	\$0	0.0	0	0	\$0	0
Northampton Borough	3,757	\$1,843,226,000	155	4.1	\$68,488,687	3.7	\$12,791,593	0.7	218	5.8	\$118,078,813	6.4
Palmer Township	8,073	\$4,169,701,000	78	1	\$54,256,641	1.3	\$9,310,796	0.2	89	1.1	\$89,388,973	2.1
Pen Argyl Borough	1,306	\$651,065,000	0	0	\$0	0	\$0	0.0	0	0	\$0	0
Plainfield Township	2,412	\$1,086,698,000	26	1.1	\$11,914,046	1.1	\$1,401,605	0.1	26	1.1	\$11,914,046	1.1
Portland Borough	222	\$162,069,000	27	12.2	\$41,162,613	25.4	\$13,702,107	8.5	32	14.4	\$48,090,975	29.7
Roseto Borough	612	\$276,318,000	0	0	\$0	0	\$0	0.0	0	0	\$0	0
Stockertown Borough	335	\$298,470,000	4	1.2	\$4,601,284	1.5	\$17,592	0.0	5	1.5	\$4,691,374	1.6
Tatamy Borough	417	\$216,261,000	4	1	\$58,261,178	26.9	\$6,405,961	3.0	9	2.2	\$73,217,968	33.9
Upper Mt. Bethel Township	2,542	\$1,311,378,000	158	6.2	\$56,932,675	4.3	\$16,922,758	1.3	218	8.6	\$71,425,841	5.4
Upper Nazareth Township	1,973	\$1,071,480,000	12	0.6	\$8,707,011	0.8	\$185,290	0.0	12	0.6	\$8,707,011	0.8
Walnutport Borough	825	\$506,739,000	14	1.7	\$2,379,216	0.5	\$505,590	0.1	18	2.2	\$3,115,770	0.6
Washington Township	1,927	\$875,751,000	58	3	\$28,625,717	3.2	\$6,133,702	0.7	58	3	\$28,625,717	3.2
West Easton Borough	475	\$267,628,000	14	2.9	\$70,706,197	26.4	\$17,350,937	6.5	21	4.4	\$75,387,427	28.1
Williams Township	2,629	\$1,200,406,000	70	2.7	\$46,419,802	3.8	\$21,516,886	1.8	102	3.9	\$57,626,700	4.8
Wilson Borough	2,803	\$1,731,473,000	3	0.1	\$6,946,734	0.4	\$13,200	0.0	3	0.1	\$6,946,734	0.4
Wind Gap Borough	869	\$532,380,000	9	1	\$11,808,483	2.2	\$103,354	0.0	9	1	\$11,808,483	2.2
Northampton County (est. total)	104,735	\$58,471,301,000	1,758	1.7	\$1,712,230,210	2.9	\$414,193,098	0.7	2,361	2.3	\$2,644,149,665	4.5

Source: Lehigh County GIS; Northampton County GIS; HAZUS-MH 2.1

Notes: This analysis was conducted using the DFIRMs available for the Lehigh Valley (2004 for Lehigh County and preliminary 2011 for Northampton County) and the point shapefiles generated for the HAZUS-MH general building stock update using the structure, parcel and assessor’s data available from both Counties. est. = Estimated.

Values represent replacement values (RV) for building structure and contents.

* Although buildings are located within the special flood hazard boundary, HAZUS did not estimate potential damages. This may be because even though these structures are located within the boundary of the flood depth grid, the depth of flooding does not amount to any damages to the structure or contents according to the depth damage function used in HAZUS.



In addition to total building stock modeling, individual data available on flood policies, claims, Repetitive Loss (RL) and Severe Repetitive Loss (SRL) properties were analyzed. FEMA Region 3 provided a list of residential properties with NFIP policies, past claims and multiple claims (including RL\SRL). According to the metadata provided: “The NFIP Repetitive Loss File contains losses reported from individuals who have flood insurance through the Federal Government. A property is considered a repetitive loss property when there are two or more losses reported which were paid more than \$1,000 for each loss. The two losses must be within 10 years of each other and be at least 10 days apart. Only losses from (*sic* since) 1/1/1978 that are closed are considered.”

SRL properties were then examined in the Lehigh Valley. According to section 1361A of the National Flood Insurance Act, as amended (NFIA), 42 U.S.C. 4102a, an SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- Has at least four NFIP claim payments (including building and contents) over \$5,000 each, and the cumulative amount of such claims payments exceeds \$20,000; or
- For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.
- For both of the above, at least two of the referenced claims must have occurred within any 10-year period, and must be greater than 10 days apart.

Table 4.3.4-9 and Figure 4.3.4-5 summarize the NFIP policies, claims and repetitive loss data and statistics for the Lehigh Valley. According to FEMA, there are 50 RL and 11 SRL properties in Lehigh County; and 185 RL and 35 SRL properties in Northampton County. Of the 11 SRL properties in Lehigh County, three (3) are classified as residential structures and eight (8) are non-residential structures. Of the 35 SRL properties in Northampton County, 27 are classified as residential, two (2) are classified as two-to-four family, five (5) are classified as non-residential and one (1) is classified as ‘other’ (FEMA Region 2, 2011). This information is current as of February 29, 2012.

The location of the properties with policies, claims and repetitive and severe repetitive flooding were geocoded by FEMA with the understanding that there are varying tolerances between how closely the longitude and latitude coordinates correspond to the location of the property address, or that the indication of some locations are more accurate than others.

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Table 4.3.4-9. NFIP Policies, Claims and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in 100-year Boundary (3)	# Policies in 500-Boundary (3)	# Policies Outside the 500-year Flood Hazard (3)
Lehigh County								
Alburtis Borough	1	1	\$0	0	0	0	0	1
Allentown, City of	171	387	\$3,675,590	15	6	107	120	51
Bethlehem, City of	94	171	\$2,780,150	12	4	0	0	94
Catasauqua Borough	34	11	\$204,371	2	1	27	29	5
Coopersburg Borough	3	5	\$16,414	0	0	2	2	1
Coplay Borough	2	0	\$0	0	0	0	0	2
Emmaus Borough	25	11	\$65,317	0	0	11	11	14
Fountain Hill Borough	1	1	\$3,161	0	0	0	0	1
Hanover Township	0	0	\$0	0	0	0	0	0
Heidelberg Township	20	7	\$18,032	1	0	13	13	7
Lower Macungie Township	157	123	\$1,713,140	12	0	94	110	47
Lower Milford Township	7	2	\$0	0	0	3	3	4
Lowhill Township	6	2	\$17,108	0	0	2	2	4
Lynn Township	27	1	\$6,862	0	0	14	14	13
Macungie Borough	13	42	\$300,452	3	0	2	4	9
North Whitehall Township	28	11	\$85,149	0	0	5	6	22
Salisbury Township	13	6	\$15,872	0	0	4	4	9
Slatington Borough	2	3	\$7,525	0	0	0	0	2
South Whitehall Township	63	55	\$346,928	1	0	33	45	18
Upper Macungie Township	34	12	\$34,248	0	0	5	12	22
Upper Milford Township	30	12	\$192,595	2	0	19	21	9
Upper Saucon Township	28	16	\$76,845	0	0	5	8	20
Washington Township	10	1	\$23,080	0	0	4	4	6
Weisenberg Township	10	0	\$0	0	0	8	8	2



SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in 100-year Boundary (3)	# Policies in 500-Boundary (3)	# Policies Outside the 500-year Flood Hazard (3)
Whitehall Township	56	51	\$213,272	2	0	25	30	26
Lehigh County	835	931	\$9,796,111	50	11	383	446	389
Northampton County								
Allen Township	10	3	\$18,209	1	0	1	2	8
Bangor Borough	71	53	\$1,446,296	8	1	55	58	13
Bath Borough	8	6	\$50,861	0	0	0	0	8
Bethlehem Township	63	40	\$2,022,525	5	0	12	12	51
Bethlehem, City of*	0	0	\$1,783,018	0	0	0	0	0
Bushkill Township	15	13	\$170,522	0	0	4	4	11
Chapman Borough	2	0	\$0	0	0	1	1	1
East Allen Township	8	8	\$54,947	0	0	1	1	7
East Bangor Borough	0	0	\$0	0	0	0	0	0
Easton, City of	110	273	\$11,262,520	37	4	79	87	23
Forks Township	86	166	\$5,578,611	37	9	54	67	19
Freemansburg Borough	35	45	\$285,453	3	0	28	31	4
Glendon Borough	0	0	\$0	0	0	0	0	0
Hanover Township	8	2	\$33,455	3	1	0	0	8
Hellertown Borough	29	16	\$252,655	2	0	7	10	19
Lehigh Township	21	7	\$12,453	0	0	2	2	19
Lower Mt. Bethel Township	103	219	\$6,768,867	38	7	62	66	37
Lower Nazareth Township	15	7	\$71,178	1	0	1	1	14
Lower Saucon Township	34	25	\$354,179	2	1	5	5	29
Moore Township	19	14	\$90,856	1	0	8	8	11
Nazareth Borough	7	4	\$18,664	0	0	1	1	6
North Catasauqua Borough	0	0	\$0	0	0	0	0	0
Northampton Borough	97	28	\$372,699	3	1	82	83	14



SECTION 4.3.4: RISK ASSESSMENT – FLOOD

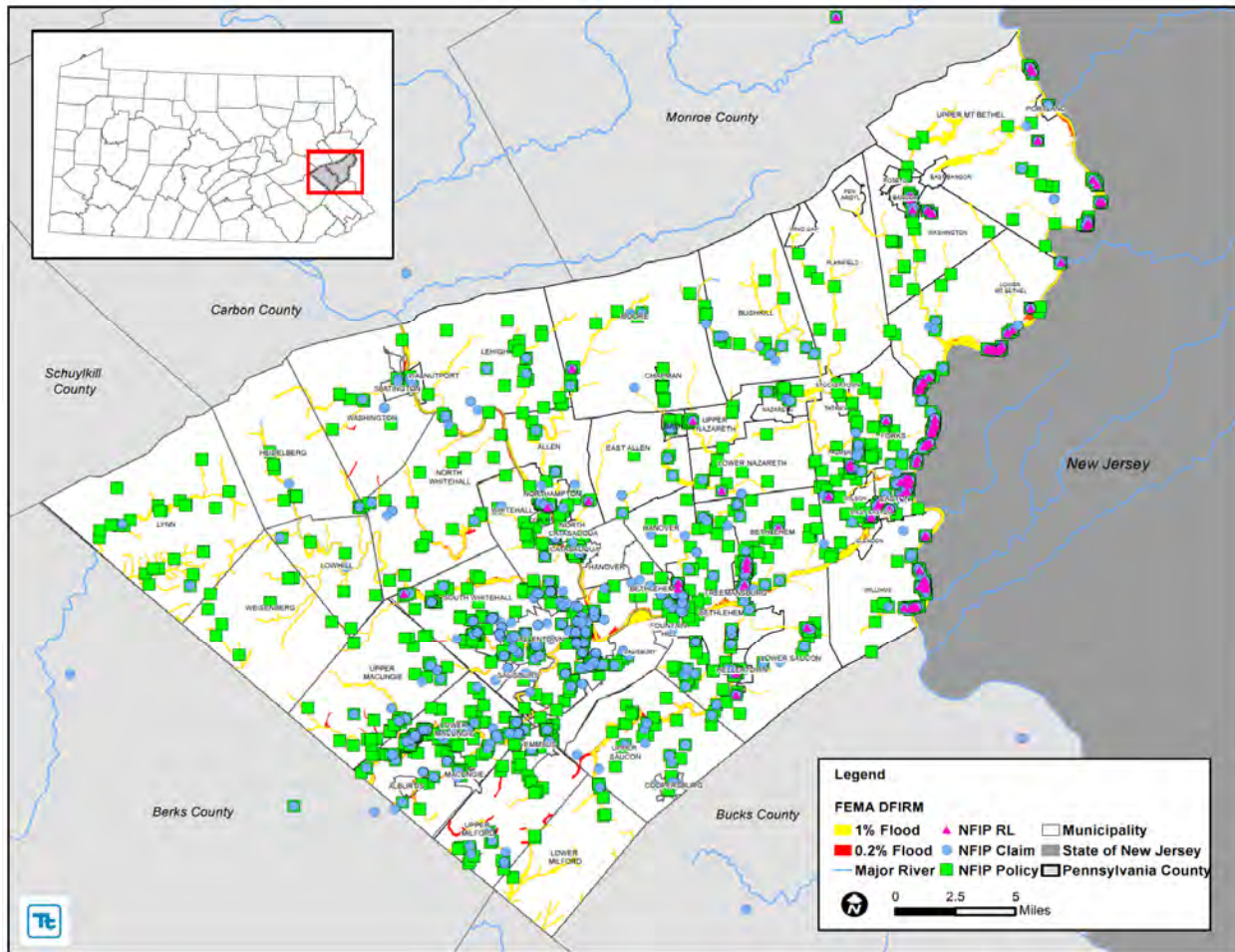
Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in 100-year Boundary (3)	# Policies in 500-Boundary (3)	# Policies Outside the 500-year Flood Hazard (3)
Palmer Township	41	24	\$1,607,949	1	0	2	2	39
Pen Argyl Borough	0	0	\$0	0	0	0	0	0
Plainfield Township	6	0	\$0	0	0	1	1	5
Portland Borough	7	15	\$2,424,858	0	0	9	9	-2
Roseto Borough	0	0	\$0	0	0	0	0	0
Stockertown Borough	4	2	\$100,772	0	0	1	1	3
Tatamy Borough	3	0	\$0	0	0	0	2	1
Upper Mt. Bethel Township	89	136	\$3,845,690	17	6	60	65	24
Upper Nazareth Township	11	3	\$53,507	1	0	1	1	10
Walnutport Borough	4	3	\$829	0	0	2	2	2
Washington Township	25	3	\$7,760	0	0	13	13	12
West Easton Borough	6	18	\$206,233	2	0	17	17	-
Williams Township	56	128	\$4,286,487	23	5	35	39	17
Wilson Borough	2	0	\$0	0	0	0	0	2
Wind Gap Borough	0	0	\$0	0	0	0	0	0
Northampton County	995	1,261	\$41,399,035	185	35	546	594	401

Source: FEMA Region 3, 2012

- (1) Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA Region 3, in April 2012 using the “Comm_Name”. These statistics are current as of February 29, 2012. Please note the total number of repetitive loss properties includes the severe repetitive loss properties.
- (2) Total building and content losses from the claims file provided by FEMA Region 3 (current as of February 29, 2012).
- (3) The policies inside and outside of the flood zones are based on the latitude and longitude provided by FEMA Region 3 in the policy file.
 * The number of policies and claims appears low for the City of Bethlehem when using the ‘Comm_Name’ column in the spreadsheets provided by FEMA. If based on location, regardless of the community name provided, there are 69 policies, 91 claims, 3 repetitive loss properties which are also severe repetitive loss properties and \$1,783,018 in total loss payments (claims) within the City limits.



Figure 4.3.4-5. NFIP Policies, Claims, Repetitive Loss and Severe Repetitive Loss Properties in the Lehigh Valley



Source: FEMA Region 3, 2012

4.3.4.5.5 Impact on Critical Facilities

In addition to considering general building stock at risk, the risk of flood to critical facilities, utilities and user-defined facilities was evaluated. HAZUS-MH was used to estimate the flood loss potential to critical facilities exposed to the flood risk. Using depth/damage function curves, HAZUS estimates the percent of damage to the building and contents of critical facilities. Table 4.3.4-10 lists the critical facilities and utilities located in the FEMA preliminary DFIRM flood zones and the percent damage HAZUS-MH 2.1 estimates to the facility as a result of the 1% event.

In cases where short-term functionality is impacted by a hazard, other facilities of neighboring municipalities may need to increase support response functions during a disaster event. Mitigation planning should consider means to reduce impacts to critical facilities and ensure sufficient emergency and school services remain when a significant event occurs.

Table 4.3.4-10. Critical Facilities Located in the DFIRM 1% and 0.2% Flood Boundaries and Estimated Potential Damage from the 1% Flood Event

Name	Municipality	Type	Exposure		Potential Loss from 1% Flood Event		
			1% Event	0.2% Event	Structure Damage (%)	Content Damages (%)	Days to 100-Percent Functional
Lehigh County							
CITY OF ALLENTOWN	Allentown (C)	User Defined (Gov)	X	X	5.7	37.0	NA
LEHIGH COUNTY HUMANE SOC	Allentown (C)	User Defined (Gov)	X	X	5.7	37.0	NA
CITY OF ALLENTOWN	Allentown (C)	User Defined (Gov)	X	X	2.0	11.7	NA
CITY OF ALLENTOWN	Allentown (C)	User Defined (Gov)	X	X	0.0	0.0	NA
CITY OF ALLENTOWN	Allentown (C)	User Defined (Gov)	X	X	0.0	0.0	NA
SALISBURY HOUSE OF NORTHEAST PA INC	Allentown (C)	User Defined (Res)	X	X	27.6	35.9	NA
COMMONWEALTH OF PA	Allentown (C)	User Defined (Gov)	X	X	37.1	100.0	NA
COMMONWEALTH OF PA	Allentown (C)	User Defined (Gov)	X	X	36.0	100.0	NA
COMMONWEALTH OF PA	Allentown (C)	User Defined (Gov)	X	X	47.4	100.0	NA
COMMONWEALTH OF PA	Allentown (C)	User Defined (Gov)	X	X	55.0	100.0	NA
COMMONWEALTH OF PA	Allentown (C)	User Defined (Gov)	X	X	47.8	100.0	NA
OCASIO RAYMOND S & BERTHA L	Allentown (C)	User Defined (Edu)	X	X	0.0	0.0	NA
U G I CORP-LEHIGH DIV	Allentown (C)	Electric Power	X	X	-	-	-
PENNA POWER & LIGHT CO	Allentown (C)	Electric Power		X	-	-	-
Union Terrace Elementary School	Allentown (C)	School		X	-	-	-
Borough of Catasauqua	Catasauqua (B)	User Defined		X	-	-	-
PENNA POWER & LIGHT CO	Catasauqua (B)	Electric Power		X	-	-	-
CITIZENS FIRE CO	Emmaus (B)	Fire	X	X	0.0	0.0	NA
BORO OF EMMAUS	Emmaus (B)	User Defined (Gov)	X	X	11.1	68.3	NA
GOLDSTEIN LEE A ET AL	Emmaus (B)	Communication	X	X	-	-	-
HANOVER TOWNSHIP	Hanover (T)	User Defined (Gov)	X	X	14.9	98.7	NA

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Name	Municipality	Type	Exposure		Potential Loss from 1% Flood Event		
			1% Event	0.2% Event	Structure Damage (%)	Content Damages (%)	Days to 100-Percent Functional
HEIDELBERG TWP	Heidelberg (T)	User Defined (Gov)	X	X	-	-	-
RITTER DEAN L & MARYBETH A	Heidelberg (T)	User Defined (Res)	X	X	-	-	-
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined (Gov)	X	X	14.1	90.6	NA
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined (Gov)	X	X	22.0	100.0	NA
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined (Gov)	X	X	15.1	100.0	NA
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined (Gov)	X	X	19.9	100.0	NA
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined (Gov)	X	X	18.5	100.0	NA
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined (Gov)	X	X	26.2	100.0	NA
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined (Gov)	X	X	9.7	64.2	NA
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined (Gov)	X	X	14.7	97.2	NA
CONTEL OF PENNSYLVANIA INC	Lower Macungie (T)	Electric Power	X	X	-	-	-
LOWER MILFORD TWP FIRE CO #1	Lower Milford (T)	Fire	X	X	1.1	1.2	NA
Lynn Township Sewer Authority	Lynn (T)	WWTF	X	X	-	-	-
NORTHAMPTON BORO MUN AUTH	North Whitehall (T)	Electric Power	X	X	-	-	-
COUNTY OF LEHIGH	Salisbury (T)	User Defined (Gov)	X	X	-	-	-
BORO OF SLATINGTON	Slatington (B)	User Defined (Gov)	X	X	9.8	19.1	NA
Slatington Airport	Slatington (B)	Airport		X	-	-	-
PFG Gas Inc	Slatington (B)	Electric		X	-	-	-
DATZYK MONTESSORI SCHOOL	South Whitehall (T)	School	X	X	-	-	-
City of Allentown (owner)	South Whitehall (T)	User Defined (Gov)		X	-	-	-
TREXLERTOWN GOOD WILL FIRE CO #1	Upper Macungie (T)	Fire	X	X	1.8	2.0	NA
COMMONWEALTH OF PA	Upper Macungie (T)	User Defined (Gov)	X	X	0.0	0.0	NA
PENNA POWER & LIGHT CO	Upper Macungie (T)	Electric Power	X	X	-	-	-
City of Allentown (owner)	Upper Macungie (T)	User Defined (Gov)		X	-	-	-



SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Name	Municipality	Type	Exposure		Potential Loss from 1% Flood Event		
			1% Event	0.2% Event	Structure Damage (%)	Content Damages (%)	Days to 100-Percent Functional
WASHINGTON TWP	Washington (T)	User Defined (Gov)	X	X	-	-	-
WHITEHALL TWP	Whitehall (T)	User Defined (Gov)	X	X	-	-	-
Coplay-Whitehall Sewer Authority	Whitehall (T)	WWTF		X	-	-	-

Name	Municipality	Type	Exposure		Potential Loss from 1% Flood Event		
			1% Event	0.2% Event	Structure Damage	Content Damages	Days to 100-Percent Functional
Northampton County							
District Court 03-3-03	Bangor (B)	User Defined	X	X	0.0	0.0	NA
Learning Locomotion	Bangor (B)	User Defined	X	X	21.8	24.5	NA
Bangor Public Library	Bangor (B)	User Defined	X	X	17.5	100.0	NA
BANGOR PD	Bangor (B)	Police	X	X	17.8	83.2	630
PPL Martins Creek Stream Electric Station	Bangor (B)	Electric		X	-	-	-
Gaffrey Funeral Home	Bangor (B)	User Defined		X	-	-	-
United States Post Office	Bangor (B)	User Defined		X	-	-	-
Bath Sewer Plant	Bath (B)	WWTF	X	X	-	-	-
USGS Lehigh River Gauge at Bethlehem, PA	Bethlehem (C)	User Defined	X	X	-	-	-
Morning Call	Bethlehem (C)	User Defined	X	X	-	-	-
Historic Bethlehem Partnership	Bethlehem (C)	User Defined		X	-	-	-
Fritch, Inc.	Bethlehem (C)	Natural Gas	X	X	-	-	-
Golden Eagle Courier Systems, Inc.	Bethlehem (C)	Bus	X		-	-	-
Moravian College-South	Bethlehem (C)	School	X	X	8.5	49.0	480
St Lukes Union Station	Bethlehem (C)	Medical		X	-	-	-
Bio Med Sciences Inc	Bethlehem (C)	Medical		X	-	-	-



SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Name	Municipality	Type	Exposure		Potential Loss from 1% Flood Event		
			1% Event	0.2% Event	Structure Damage	Content Damages	Days to 100-Percent Functional
Orasure Technologies Inc.	Bethlehem (C)	Medical		X	-	-	-
Movarian College-South	Bethlehem (C)	School		X	-	-	-
EATMA EAST ALLEN GARDENS WATER SYS	East Allen (T)	Potable Water	X	X	-	-	-
E BANGOR MUNI AUTH WATER SYS	East Bangor (B)	Potable Water	X	X	-	-	-
Quality Inn	Easton (C)	User Defined	X	X	43.7	56.8	NA
Easton (Lehigh River) Boat Access Ramp	Easton (C)	User Defined	X	X	10.4	29.9	NA
United States Post Office	Easton (C)	User Defined	X	X	0.0	0.0	NA
Easton (Delaware River) Boat Access Ramp	Easton (C)	User Defined	X	X	47.1	100.0	NA
Easton - Phillipsburg Toll Bridge	Easton (C)	User Defined	X	X	0.0	0.0	NA
PA WATER RESCUE	Easton (C)	Fire	X	X	22.7	97.0	630
USGS Lehigh River Gage at Easton PA	Easton (C)	User Defined	X	X	-	-	-
Carish Rico	Easton (C)	WWTF		X	-	-	-
Bachmann Publick House	Easton (C)	User Defined		X	-	-	-
Lou Reda Productions	Easton (C)	User Defined		X	-	-	-
Easton Irregular	Easton (C)	User Defined		X	-	-	-
DAR Parsons Taylor House	Easton (C)	User Defined		X	-	-	-
First Presbyterian Church	Easton (C)	User Defined		X	-	-	-
St. John's Evangelical Lutheran Church	Easton (C)	User Defined		X	-	-	-
First Presbyterian Church	Easton (C)	Shelter		X	-	-	-
Binney & Smith	Forks (T)	User Defined	X	X	15.9	76.7	NA
USGS Lehigh River Gage at Glendon PA	Glendon (B)	User Defined	X	X	-	-	-
WESTGATE WATER SYS	Hanover (T)	Potable Water	X	X	-	-	-
WESTGATE WATER SYS	Hanover (T)	Potable Water	X	X	-	-	-
VILLAGE VIEW WATER SYS	Hanover (T)	Potable Water	X	X	-	-	-



SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Name	Municipality	Type	Exposure		Potential Loss from 1% Flood Event		
			1% Event	0.2% Event	Structure Damage	Content Damages	Days to 100-Percent Functional
Yeagers Pharmacy	Hellertown (B)	Medical		X	-	-	-
HELLERTOWN PD	Hellertown (B)	Police		X	-	-	-
TREICHLERS WATER SYS	Lehigh (T)	Potable Water	X	X	-	-	-
LEHIGH TWP MUN AUTH	Lehigh (T)	WWTF		X	-	-	-
Sandt's Eddy Boat Access Ramp	Lower Mt Bethel (T)	User Defined	X	X	7.5	24.0	NA
PPL Public Boat Access Ramp	Lower Mt Bethel (T)	User Defined	X	X	8.0	25.0	NA
Rivers Edge	Lower Mt Bethel (T)	User Defined	X		-	-	-
James Palmeri Funeral Home	Lower Mt Bethel (T)	User Defined		X	-	-	-
SE-WY-CO FIRE	Lower Saucon (T)	Fire	X	X	2.0	2.3	NA
Whisper Hollow North	Moore (T)	Mobile Home	X		-	-	-
Herd Manufactured Homes	Moore (T)	Potable Water		X	-	-	-
Duck Duck Goose	Northampton (B)	User Defined		X	0.0	0.0	NA
Northampton Borough	Northampton (B)	User Defined	X	X	0.0	0.0	NA
Unknown name (Senior)	Northampton (B)	User Defined	X	X	9.5	6.4	NA
Saint John the Baptist Elementary School	Northampton (B)	School	X	X	8.0	45.5	480
NORTHAMPTON REGIONAL EMS	Northampton (B)	Fire	X	X	10.1	22.5	480
Sacred Heart Outpatient Lab Services	Northampton (B)	Medical		X	0.0	0.0	NA
Northampton Boro PD	Northampton (B)	Police		X	-	-	-
Little People Country Club	Palmer (T)	User Defined	X	X	25.6	35.2	NA
Palmer Township Muni Water System	Palmer (T)	Potable Water	X	X	-	-	-
United States Post Office	Portland (B)	User Defined		X	0.0	0.0	NA
PORTLAND & VICINITY AMBULANCE CORPS	Portland (B)	Fire		X	0.0	0.0	NA
USGS Bushkill Creek Gauge Route 33	Tatamy (B)	User Defined	X	X	-	-	-
USGS Bushkill Creek Gauge SR2017 brdg	Tatamy (B)	User Defined	X	X	-	-	-



SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Name	Municipality	Type	Exposure		Potential Loss from 1% Flood Event		
			1% Event	0.2% Event	Structure Damage	Content Damages	Days to 100-Percent Functional
Doe Hollow Boat Access Ramp	Upper Mt Bethel (T)	User Defined	X	X	91.0	100.0	NA
Portland - Columbia Pedestrian Bridge	Upper Mt Bethel (T)	User Defined	X	X	91.0	100.0	NA
Bethany Home	Upper Mt Bethel (T)	Senior		X	-	-	-
KELLOW'S	Upper Nazareth (T)	Mobile Home	X		-	-	-
USGS Lehigh River Gauge at Walnutport, PA	Walnutport (B)	User Defined	X	X	-	-	-
Interstate 78 Toll Bridge	Williams (T)	User Defined	X	X	-	-	-

Source: FEMA, 2004; FEMA, 2011; HAZUS-MH 2.1

Notes:

X = indicates the facility location as provided by the Lehigh Valley plan participants is located in the DFIRM flood zone.

NA = HAZUS-MH 2.1 does not estimate the days to 100-percent functional for user-defined facilities.

- = There is no damage estimate either because the 0.2% annual chance flood event potential loss estimates were not run in HAZUS or HAZUS did not calculate potential loss estimates for some facilities located in the DFIRM flood hazard zone. This may be because even though these facilities are located within the boundary of the flood depth grid generated by HAZUS, the depth of flooding does not amount to any damages to the structure or contents according to the depth damage function used in HAZUS.

B = Borough; C = City; T = Township; % = Percent



4.3.4.5.6 Impact on the Economy

For the impact on the economy, estimated losses from a flood event are considered. Losses include, but are not limited to, general building stock damages, agricultural losses, business interruption, impacts to tourism and loss of tax base within the Lehigh Valley. Damages to general building stock can be quantified using HAZUS-MH as discussed above. Other economic components such as loss of facility use, functional downtime and social economic factors are less measurable with a high degree of certainty. For the purposes of this analysis, general building stock damages are discussed further.

Flooding can cause extensive damage to public utilities and disruptions to the delivery of services. Loss of power and communications may occur; and drinking water and wastewater treatment facilities may be temporarily out of operation. Flooded streets and road blocks make it difficult for emergency vehicles to respond to calls for service. Floodwaters can washout sections of roadway and bridges (Foster, Date Unknown).

Direct building losses are the estimated costs to repair or replace the damage caused to the building. The potential damage estimated to the general building stock inventory associated with the 1% flood is approximately \$0.6 billion. This estimated building damage represents approximately one-percent of the Lehigh Valley's overall total general building stock inventory exposed to this hazard. These dollar value losses to the Lehigh Valley's total building inventory replacement value, in addition to damages to roadways and infrastructure, would greatly impact both Counties' tax base and the local economy.

When a flood occurs, the agricultural industry is at risk in terms of economic impact and damage (i.e., damaged crop, financial loss to the farmer). For Lehigh County, the market value of all agricultural products sold was \$72 million with 73% in crop sales. In 2007, according to the Census of Agriculture, the market value of all agricultural products sold from Northampton County was greater than \$31.7 million with 70% in crop sales (USDA, 2007).

Specific agricultural loss information (monetary losses per agricultural product) was not available at the time this plan was drafted. However, given professional knowledge and historic loss information available, 40-percent (Lehigh County) and 60-percent (Northampton County) loss estimates for crops as a result of major flood events is considered conservative estimates of potential losses for this hazard. These losses would be devastating to the local agricultural economy.

HAZUS-MH estimates the amount of debris generated from the flood events as a result of the 1% annual chance flood event. The model breaks down debris into three categories: 1) finishes (dry wall, insulation, etc.); 2) structural (wood, brick, etc.) and 3) foundations (concrete slab and block, rebar, etc.). The distinction is made because of the different types of equipment needed to handle the debris. Table 4.3.4-11 summarizes the debris HAZUS-MH 2.1 estimates for each municipality in the Lehigh Valley.

Table 4.3.4-11. Estimated Debris Generated from the 1% Flood Event

Municipality	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Lehigh County				
Alburtis Borough	4	4	0	0
Allentown, City of	10,668	2,990	4,258	3,420
Bethlehem, City of	874	163	402	309
Catasauqua Borough	2,116	625	837	653
Coopersburg Borough	33	33	0	0

SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Municipality	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Coplay Borough	76	40	22	14
Emmaus Borough	192	126	38	28
Fountain Hill Borough	2,660	79	1,482	1,099
Hanover Township	30	11	11	8
Heidelberg Township	101	84	10	7
Lower Macungie Township	3,522	1,452	1,200	871
Lower Milford Township	490	223	152	115
Lowhill Township	883	231	371	281
Lynn Township	1,041	407	377	257
Macungie Borough	31	31	0	0
North Whitehall Township	940	388	317	234
Salisbury Township	1,001	285	384	332
Slatington Borough	765	251	296	217
South Whitehall Township	1,326	739	327	260
Upper Macungie Township	2,218	812	816	591
Upper Milford Township	930	532	227	171
Upper Saucon Township	686	646	24	16
Washington Township	397	201	114	82
Weisenberg Township	26	23	2	1
Whitehall Township	4,617	1,271	1,853	1,493
Lehigh County (est. total)	35,628	11,648	13,521	10,458
Municipality	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Northampton County				
Allen Township	656	315	200	141
Bangor Borough	1,801	1,106	406	289
Bath Borough	40	40	0	0
Bethlehem Township	1,379	708	383	289
Bethlehem, City of	2,926	794	1,299	833
Bushkill Township	176	156	11	10
Chapman Borough	2	2	0	0
East Allen Township	70	66	2	2
East Bangor Borough	24	19	2	3
Easton, City of	15,277	1,871	7,912	5,495
Forks Township	563	202	198	163
Freemansburg Borough	2,728	631	1,204	894
Glendon Borough	2	2	0	0
Hanover Township	115	115	0	0
Hellertown Borough	99	99	0	0
Lehigh Township	343	165	97	81
Lower Mt. Bethel Township	1,945	496	842	607
Lower Nazareth Township	197	178	11	8



SECTION 4.3.4: RISK ASSESSMENT – FLOOD

Municipality	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Lower Saucon Township	723	504	126	92
Moore Township	73	64	4	4
Nazareth Borough	18	18	0	0
North Catasauqua Borough	221	87	81	53
Northampton Borough	1,816	807	602	407
Palmer Township	623	404	130	89
Pen Argyl Borough	5	5	0	0
Plainfield Township	59	50	5	4
Portland Borough	472	180	165	127
Roseto Borough	3	1	1	1
Stockertown Borough	97	75	13	9
Tatamy Borough	133	127	4	2
Upper Mt. Bethel Township	3,197	844	1,376	977
Upper Nazareth Township	383	161	125	97
Walnutport Borough	241	58	94	89
Washington Township	412	270	80	62
West Easton Borough	759	259	283	216
Williams Township	2,042	341	961	740
Wilson Borough	32	10	12	10
Wind Gap Borough	49	49	0	0
Northampton County (est. total)	39,700	11,277	16,628	11,795

Source: HAZUS-MH 2.1

Note: est. = Estimated

4.3.4.5.7 Impact on the Environment

Floods are naturally occurring events that benefit riparian systems which have not been disrupted by human Actions. Such benefits include groundwater recharge and the introduction of nutrient rich sediment improving soil fertility. However, the destruction of riparian buffers, changes to land-use and land-cover throughout a watershed, and introduction of chemical or biological contaminants which often accompany human presence cause environmental harm when floods occur. Hazardous material facilities are potential sources of contamination during flood events. Other environmental impacts of flooding include: waterborne diseases, heavy siltation, erosion of stream banks and riverbeds, destruction of aquatic habitat, damage to water and sewer infrastructure located in floodplains, increased acid mine drainage, damage or loss of crops and drowning of both humans and animals.

4.3.4.5.8 Future Growth and Development

Areas targeted for potential future growth and development in the next five (5) to ten (10) years have been identified across the Lehigh Valley at the municipal level. Refer to the jurisdictional annexes in Volume II of this Plan. Table B.1 in each jurisdictional annex lists the location of the potential new development and its exposure (if any) to known flood hazard zones. Any areas of growth could be potentially impacted by the flood hazard if located within the identified hazard areas.

4.3.4.5.9 Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as flood events. While predicting changes of flood events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2006).

Pennsylvania's Department of Environmental Protection was directed by the Climate Change Act (Act 70 of 2008) to initiate a study of the potential impacts of global climate change on the Commonwealth. The June 2009 Pennsylvania Climate Impact Assessment's main findings indicate it is very likely that Pennsylvania will experience increased temperatures in the 21st century. An increase in the variability of temperature and precipitation may lead to increased frequency and/or severity of storm events. Summer floods and general stream flow variability are projected to increase due to increased variability in precipitation. Even with the anticipated increase in winter precipitation as rain rather than snow, increased winter temperatures and a reduced snowpack may decrease rain-on-snow events and thus major flooding events in Pennsylvania. This conclusion however remains speculative until further studies can validate. Future improvements in modeling smaller scale climatic processes can be expected and will lead to improved understanding of how the changing climate will alter temperature, precipitation, storms and flood events in Pennsylvania (Shortle et. al, 2009).

4.3.4.5.10 Additional Data and Next Steps

A HAZUS-MH flood analysis was conducted for the Lehigh Valley using the most current and best available data including updated building and critical facility inventories, DFIRMs, FIS, 2008 3.2-foot LiDAR DEM and default model demographic data. For future plan updates, more accurate exposure and loss estimates can be produced by replacing the national default demographic inventory with 2010 U.S. Census data. The updated building inventory can be analyzed at the structure, not Census block level, for individualized building results. In addition, a 0.2% depth grid may be generated similar to the 1% depth grid to estimate potential losses for the Lehigh Valley for this event. As Lehigh and Northampton County assessor databases continue to be updated, the general building inventory should also be maintained. In the future, FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) will be providing the flood depth and analysis grids as part of the DFIRM deliverable. These depth grids can be incorporated into HAZUS and used to calculate the potential losses to the Lehigh Valley inventory. The utilization of the Risk MAP depth grids and the updated general building stock inventory on a structural level will provide even more accurate flood loss estimates.

4.3.5 Hailstorm

This section provides a profile and vulnerability assessment for the hailstorm hazard. Hailstorms occur when ice crystals form within a low pressure front due to the rapid rise of warm air into the upper atmosphere and the subsequent cooling of the air mass. Frozen droplets gradually accumulate on the ice crystals until, having developed sufficient weight, they fall as precipitation in the form of balls or irregularly shaped masses of ice greater than 0.75 inches in diameter (i.e., hailstones) (FEMA, 1997). The size of hailstones is a direct function of the size and severity of the storm. High velocity updraft winds are required to keep hail in suspension in thunderclouds. The strength of the updraft is a function of the intensity of heating at the Earth's surface.

4.3.5.1 Location and Extent

Hail precipitation is often produced at the front of a severe thunderstorm system. Hailstorms are not limited to any particular geographic area of the Lehigh Valley. Neither the duration of the storm nor the extent of area affected by such an occurrence can be predicted.

4.3.5.2 Range of Magnitude

Hail can vary in size from less than an inch to several inches in diameter, and can cause significant damage to crops and property. Damage is dependent on the size, duration, and intensity of hail precipitation. Those who do not seek shelter could face serious injury. Automobiles and aircraft are particularly susceptible to damage. Since hail precipitation usually occurs during thunderstorm events, the impacts of other hazards associated with thunderstorms (i.e. strong winds, intense precipitation, lightning, etc.) often occur simultaneously.

Based on reports from the National Climatic Data Center (NCDC), the Lehigh Valley's worst hailstorm incident occurred in 2007, when \$250,000 in damages were claimed due to hailstorms. Hail as large as two-inches in diameter fell across the central and southern parts of Northampton County on August 17th, reaching as far as Williams Township. Half dollar size hail fell in the City of Bethlehem. Penny-size hail fell in Nazareth Borough, and other reports indicated the presence of hail in Lehigh County. The thunderstorms which precipitated the hail moved across Pennsylvania and New Jersey during the afternoon and the evening of August 17th.

4.3.5.3 Past Occurrence

The NCDC report contains references to hail as a reported storm incident in the Lehigh Valley from 1950 to 2011, as shown in Table 4.3.5-1 below. Seventy-six separate reports were issued throughout the Lehigh Valley in this time period. Some reports represented different times of day or different localities in regards to the same storm. According to these reports, the Lehigh Valley has experienced hail ranging in size from 0.75" to 2.5" in diameter, with property damage from two separate events totaling \$350,000 and crop damage from one event amounting to \$50,000. No deaths or injuries have been recorded due to hail in the Lehigh Valley.

Table 4.3.5-1. History of Hailstorms in the Lehigh Valley

Location	Date	Diameter (inches)	Deaths	Injuries	Property Damage (\$)	Crop Damage (\$)
Lehigh County						
Lehigh County	5/24/1962	1.25	0	0	0	0
Lehigh County	4/30/1984	1.00	0	0	0	0
Lehigh County	6/16/1985	1.00	0	0	0	0
Lehigh County	6/16/1985	1.00	0	0	0	0
Lehigh County	6/24/1985	1.75	0	0	0	0
Lehigh County	6/24/1985	1.75	0	0	0	0
Lehigh County	8/2/1986	1.00	0	0	0	0
Lehigh County	8/2/1986	1.75	0	0	0	0
Lehigh County	7/17/1988	0.75	0	0	0	0
Lehigh County	7/5/1990	0.75	0	0	0	0
Lehigh County	7/5/1990	0.75	0	0	0	0
Slatedale	6/4/1996	0.75	0	0	0	0
Bethlehem	7/1/2001	0.75	0	0	0	0
Macungie	5/15/2004	0.75	0	0	0	0
Schnecksville	4/24/2006	0.75	0	0	0	0
Schnecksville	5/26/2006	0.75	0	0	0	0
Bethlehem	7/18/2006	1.25	0	0	0	0
New Smithville, Weisenberg (T)	5/31/2007	0.75	0	0	0	0
Bethlehem	8/17/2007	0.75	0	0	0	0
Bethlehem	8/17/2007	2.00	0	0	250,000	0
Breinigsville	6/10/2008	1.00	0	0	0	0
Catasauqua	6/10/2008	1.00	0	0	0	0
Allentown	7/17/2008	0.88	0	0	0	0
Allentown	8/10/2008	1.00	0	0	0	0
Lyon Vly, Lowhill (T)	8/10/2008	1.00	0	0	0	0
East Texas	3/29/2009	0.88	0	0	0	0
Catasauqua	3/29/2009	1.00	0	0	0	0
Coffeetown, North Whitehall (T)	3/29/2009	1.00	0	0	0	0
Macungie Knepper Arp	3/29/2009	1.75	0	0	0	0
Dillingersville, Lower Milford (T)	6/15/2009	0.88	0	0	0	50,000
Allentown	6/15/2009	1.00	0	0	0	0
Schnecksville	5/14/2010	1.75	0	0	0	0
Allentown	5/14/2010	1.75	0	0	0	0
New Tripoli	5/14/2010	2.50	0	0	0	0

SECTION 4.3.5: RISK ASSESSMENT – HAILSTORM

Location	Date	Diameter (inches)	Deaths	Injuries	Property Damage (\$)	Crop Damage (\$)
Fogelsville	5/14/2010	2.50	0	0	100,000	0
Fogelsville	5/27/2010	0.88	0	0	0	0
Germansville	5/27/2010	1.00	0	0	0	0
Slatington	7/21/2010	1.00	0	0	0	0
Allentown	9/22/2010	0.75	0	0	0	0
Fogelsville	5/15/2011	0.88	0	0	0	0
Breinigsville	5/19/2011	0.75	0	0	0	0
Edgemont	5/26/2011	1.00	0	0	0	0
Allentown	6/1/2011	0.75	0	0	0	0
Bethlehem	6/1/2011	0.75	0	0	0	0
Lehigh County Total	N/A	N/A	0	0	\$350,000	\$50,000
Northampton County						
Northampton County	7/3/1975	0.75	0	0	0	0
Northampton County	6/16/1985	1.00	0	0	0	0
Northampton County	6/16/1985	1.00	0	0	0	0
Northampton County	6/24/1985	1.75	0	0	0	0
Northampton County	7/29/1986	1.00	0	0	0	0
Northampton County	7/29/1986	1.75	0	0	0	0
Northampton County	8/2/1986	1.75	0	0	0	0
Northampton County	7/9/1990	1.75	0	0	0	0
Northampton County	6/7/1992	1.75	0	0	0	0
Wind Gap	7/18/1997	1.00	0	0	0	0
Chapman	9/2/1998	0.75	0	0	0	0
Walnutport	6/7/1999	0.88	0	0	0	0
Easton	5/24/2000	0.75	0	0	0	0
Tatamy	5/24/2000	1.00	0	0	0	0
Easton	5/24/2000	1.00	0	0	0	0
Glendon	5/24/2000	1.25	0	0	0	0
Glendon	5/29/2001	0.75	0	0	0	0
Zucksville, Forks (T)	8/2/2002	0.88	0	0	0	0
Palmer Hgts	7/9/2006	0.88	0	0	0	0
Cherryville, Lehigh (T)	8/17/2007	0.88	0	0	0	0
Nazareth	8/17/2007	1.00	0	0	0	0
Martins Creek, Lower Mt.	8/2/2008	0.75	0	0	0	0

SECTION 4.3.5: RISK ASSESSMENT – HAILSTORM

Location	Date	Diameter (inches)	Deaths	Injuries	Property Damage (\$)	Crop Damage (\$)
Bethel (T)						
Berlinsville, Lehigh (T)	8/13/2008	0.88	0	0	0	0
Farmersville, Bethlehem (T)	5/23/2009	1.00	0	0	0	0
Walnutport	6/15/2009	1.75	0	0	0	0
Bath	6/30/2009	0.88	0	0	0	0
Ulhers, Forks (T)	7/17/2009	1.00	0	0	0	0
Glendon	5/27/2010	1.75	0	0	0	0
Nazareth	9/13/2010	0.75	0	0	0	0
Ulhers, Forks (T)	5/19/2011	0.75	0	0	0	0
Farmersville, Bethlehem (T)	6/1/2011	1.00	0	0	0	0
Northampton County Total	N/A	N/A	0	0	\$0	\$0

Source: National Climatic Data Center, 2010

Note: T – Township; N/A – not applicable

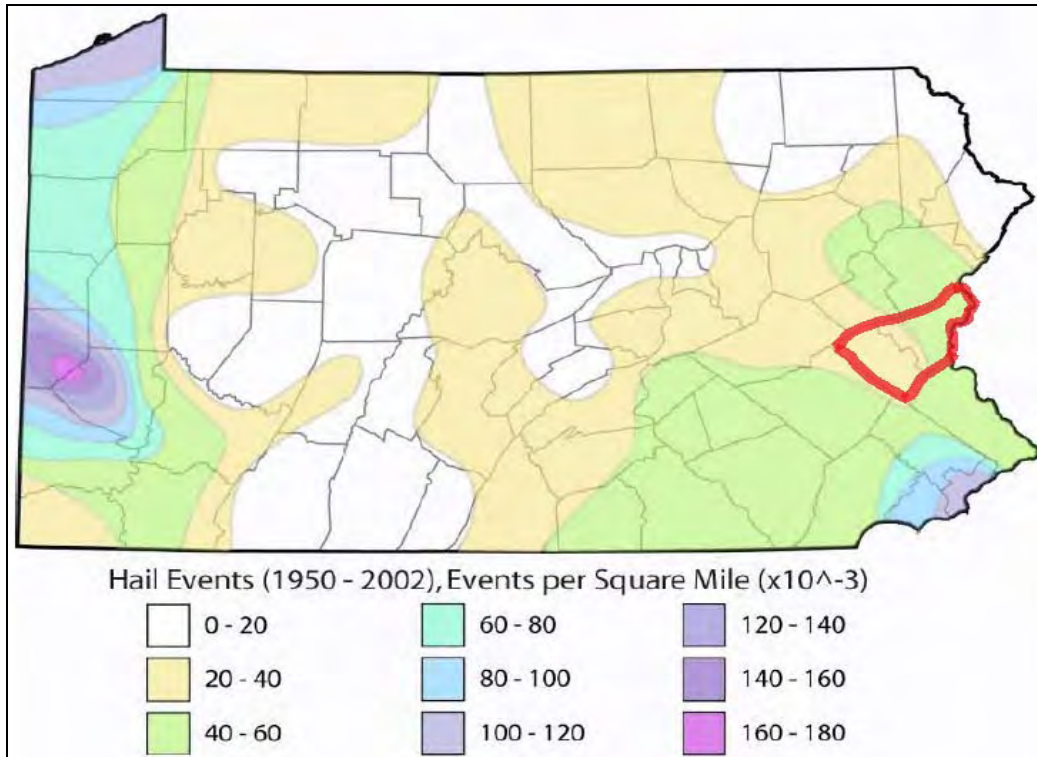
According to the U.S. Department of Agriculture Risk Management Agency, hailstorm events between 1950 and 2011 have resulted in \$13,772 in crop insurance claims (NCDC, 2012). There have been no reported crop insurance claims due to hail in the Valley during 16 of the last 23 years.

The Commonwealth of Pennsylvania 2010 All-Hazard Mitigation Plan (PA HMP) states that approximately 96% of hailstorm events throughout the Commonwealth occurred during the months of April, May, June, July, August, and September. In addition, approximately 87% of historic hailstorm events have occurred during the afternoon (noon to 5 pm) or evening (5 pm to 9 pm) hours. Both of these results are consistent with historical hailstorm reports from the Lehigh Valley, and the relationship between hail and thunderstorms.

4.3.5.4 Future Occurrence

It is not possible to predict the formation of a hailstorm with more than a few days' lead time. The past occurrences described above, however, indicate that hailstorm events in the Lehigh Valley will occur every year throughout the months of April and August. Using events collected state-wide between 1950 and 2002, Figure 4.3.5-1 below shows the number of hail events per square mile across Pennsylvania. Based on this historical data, the east and northeast sections of Northampton County can expect to experience a higher number of hailstorm events compared to other areas in the Lehigh Valley. The Lehigh Valley as a whole has experienced significantly fewer hailstorm events per square mile than areas in the western and southeastern parts of Pennsylvania.

Figure 4.3.5-1. Hail Events Per Square Mile in Pennsylvania



Source: PEMA, 2010

Note: The red highlight indicates the location of the Lehigh Valley

The future occurrence of hailstorms can be considered *likely* as defined by the Risk Factor Methodology probability criteria (refer to Section 4.4).

4.3.5.5 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For hail events, the entire Lehigh Valley has been identified as the hazard area. Therefore, all assets in the Lehigh Valley (population, structures, critical facilities and lifelines), as described in the Regional Profile section, are vulnerable. The following text evaluates and estimates the potential impact of hailstorms on the Lehigh Valley including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety of residents, (2) general building stock, (3) critical facilities, (4) economy, and (5) future growth and development
- Effect of climate change on vulnerability
- Further data collections that will assist understanding this hazard over time

4.3.5.5.1 Overview of Vulnerability

The entire Lehigh Valley, including all critical infrastructure, is vulnerable to the effects of hail, as the storm cells that produce this hazard can develop over any part of the region. The area of damage due to

these storms is relatively small, since a single storm does not cause widespread devastation, but it may cause damage in a focused area.

As a hazard, hail can cause serious damage to automobiles, aircraft, skylights, livestock, and crops. Areas of the Lehigh Valley with large amounts of farmland and high agricultural yields are more likely to be affected by hailstorm hazards. Most notably, corn and soybean crops can be damaged to the point of total loss, especially if an event occurs later in the growing season (PEMA, 2010).

4.3.5.5.2 Data and Methodology

National weather databases, the PA HMP, and local resources were used to collect and analyze hazard impacts on the Lehigh Valley.

4.3.5.5.3 Impact on Life, Health and Safety

The entire population of the Lehigh Valley is considered exposed to the hail hazard. People located outdoors (i.e., recreational activities and farming) are considered most vulnerable to the hazard. This is because there is little to no warning and shelter may not be available. Moving to a lower risk location will decrease a person’s vulnerability.

4.3.5.5.4 Impact on General Building Stock, Critical Facilities and the Economy

Hailstorms primarily affect agricultural products. The facilities that are most vulnerable to hailstorm threats are those that are food and agriculture-related. These food and agricultural critical facilities are both food producers and food manufacturers. These facilities are located in both urban and rural areas and would be directly or indirectly impacted by a hailstorm event. According to the State HMP, Lehigh and Northampton Counties each have one food/agricultural state facility within their borders, as compared to Lancaster County, with 17 state food/agricultural facilities (the most of any Pennsylvania county).

As discussed earlier in the Past Occurrence subsection, historical hailstorm property damage has totaled \$350,000 and crop damage to \$50,000 in the Lehigh Valley. Jurisdictional loss estimation stems from lost agricultural revenues throughout the Lehigh Valley. The USDA Census of Agriculture enumerates farmland acreage by county as well as the annual market value of all agricultural products sold by county, from 2007. As shown in Table 4.3.5-2 below, if a hailstorm were to eliminate the entire agricultural yield from both counties in Lehigh Valley, total losses could top \$100 million.

Table 4.3.5-2. Estimated Jurisdictional Losses Relating to Agricultural Production (USDA Census of Agriculture 2007)

Location	Potential Impacted Farmland Acreage	Market Value of all Agricultural Products
Lehigh County	84,643	\$72,059,000
Northampton County	68,252	\$31,762,000

Source: PEMA, 2010

4.3.5.5.5 Future Growth and Development

Areas targeted for potential future growth and development in the next five (5) to ten (10) years have been identified across the Lehigh Valley at the municipal level. Refer to the jurisdictional annexes in Volume II of this Plan. Table B.1 in each jurisdictional annex lists the location of the potential new development and its exposure (if any) to known hazard zones. Any areas of growth could be potentially impacted by the hailstorm hazard because the entire region is exposed and vulnerable.

4.3.5.5.6 Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as hailstorms. While predicting changes of storm events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2006).

Pennsylvania's Department of Environmental Protection was directed by the Climate Change Act (Act 70 of 2008) to initiate a study of the potential impacts of global climate change on the Commonwealth. The June 2009 Pennsylvania Climate Impact Assessment's main findings indicate it is very likely that Pennsylvania will experience increased temperatures in the 21st century. An increase in the variability of temperature and precipitation may very well lead to increased frequency and/or severity of hailstorm events. Future improvements in modeling smaller scale climatic processes such as thunderstorms and associated hailstorms can be expected and will lead to improved understanding of how the changing climate will alter storms, such as hailstorm events, in Pennsylvania (Shortle et. al, 2009).

4.3.5.5.7 Additional Data and Next Steps

The assessment above identifies vulnerable populations and potential structural and economic losses associated with this hazard of concern. The collection of additional/actual loss data specific to the Plan participants will further enhance the Lehigh Valley's vulnerability assessment.

4.3.6 Landslide

This section provides a profile and vulnerability assessment for the landslide hazard. According to the U.S. Geological Survey (USGS), “ground failure” is the term used to describe zones of ground cracking, fissuring, and localized horizontal and vertical permanent ground displacement that may be caused by surface rupture along faults; secondary movement on shallow faults; shaking-induced compaction of natural deposits in sedimentary basins and river valleys; liquefaction of loose, sandy sediment (USGS, 2005); landslides; and land subsidence and sinkholes. For the purpose of this HMP, the ground failure hazard to which the Lehigh Valley is vulnerable includes, but is not limited to, landslides, which are further defined as follows:

A landslide is described in the Commonwealth of Pennsylvania 2010 Standard All-Hazard Mitigation Plan (PA HMP) as the downward and outward movement of slope-forming soil, rock, and vegetation reacting to the force of gravity. Materials can move up to 120 miles per hour (mph) or more, and slides can last a few seconds or a few minutes, or can be gradual, slower movements over several hours or days. There are several different types of landslides including:

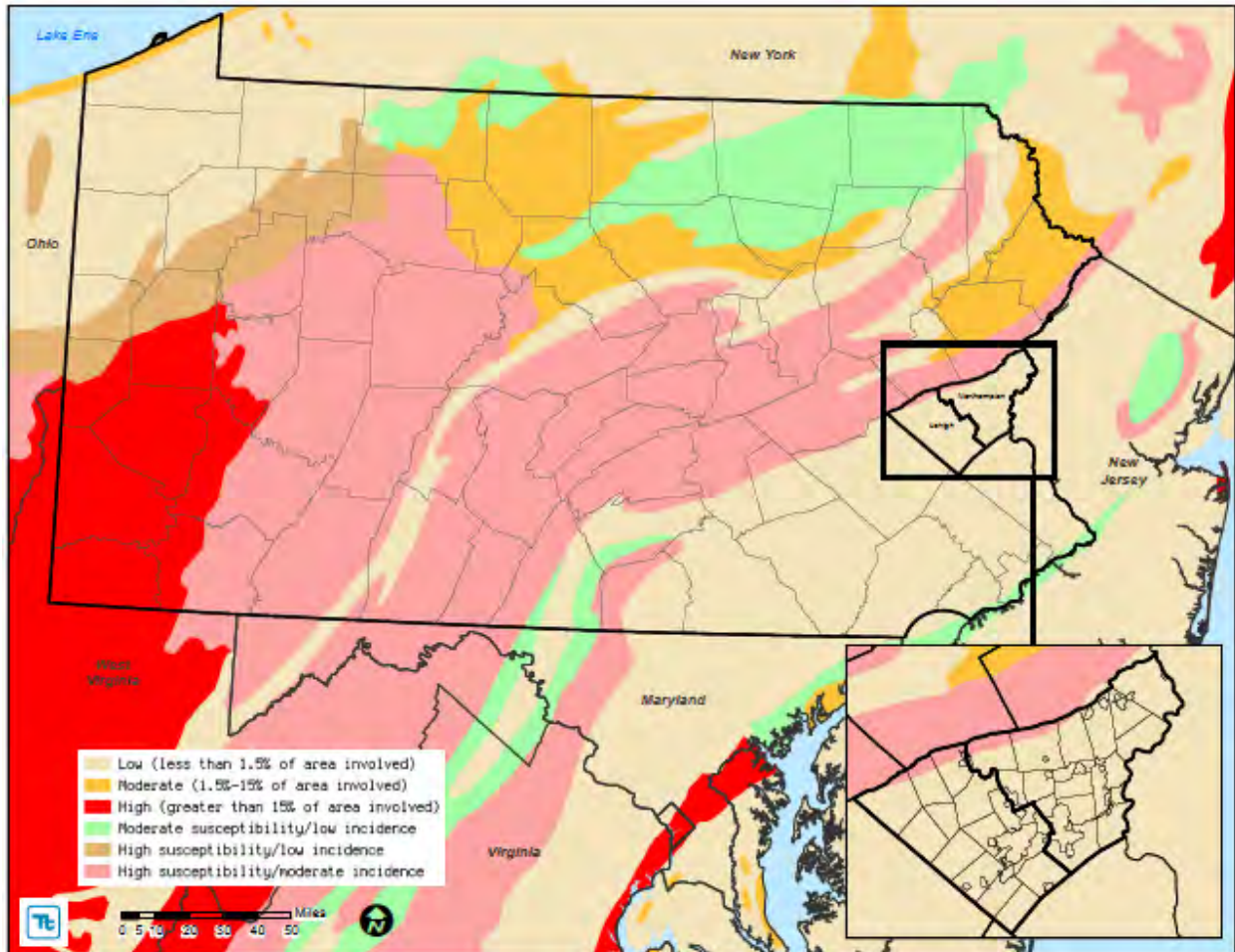
- *Rock Falls* are when a mass detaches from a steep slope or cliff and descends by free-fall, bounding, or rolling.
- *Rock Topples* are when a mass tilts or rotates forward as a unit.
- *Slides* are when a mass displaces on one or more recognizable surfaces, which may be curved or planar.
- *Flows* are when a mass moves downslope with a fluid motion. A significant amount of water may or may not be part of the mass (PEMA, 2010).

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. 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 and Wilshusen, 2001). Human activities that contribute to slope failure include altering the natural slope gradient, increasing soil water content, and removing vegetation cover.

4.3.6.1 Location and Extent

According to the PA HMP, landslides have occurred in many parts of Pennsylvania but are most abundant and troublesome in much of the western and north central portions of the state and adjacent states. Rockfalls and other slope failures can occur in areas of the Lehigh Valley with moderate to steep slopes. Areas experiencing erosion, decline in vegetation cover, and earthquakes are also susceptible to landslides. Figure 4.3.6-1 shows areas of low, moderate, and high landslide susceptibility as determined by the USGS.

Figure 4.3.6-1. U.S Geological Survey. Landslide Incidence and Susceptibility



Source: Godt, 2011 (Geology WMS Layer from the National Atlas of the United States)

4.3.6.2 Range of Magnitude

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

Both the State HMP and the Pennsylvania Geological Survey indicate that the landslide susceptibility in the Lehigh Valley is low. The Lehigh Valley's worst-case scenario is for a landslide to hit the Lehigh Gap, or any busy roadway in this area including the intersection of Routes 145, 248 and 873. This scenario is based on a rough overlay of steep slopes and major roadways and/or urban/populated areas throughout the Valley. This specific area is based on the topographic and land use conditions for this area. A landslide into the Lehigh River from the adjacent slopes could divert or entirely block water flows resulting in flood effects upstream. Also, depending on the time of day and the number of vehicles on the road at that time, a slide over one of the riverside roadways in either Lehigh Gap or Slatington Borough could potentially trigger a severe traffic accident, resulting in multiple fatalities.

4.3.6.3 Past Occurrence

Outside of impacts to important transportation routes, landslide history is not documented as completely (if at all) as other hazards, primarily because landslides are not always seen, and therefore historical landslide occurrences in the Lehigh Valley are not well known. PEMA records list one mud slide incident in Hanover Township (L), when heavy rainfall in March, 2007, created a mudslide and hazardous road conditions. Dauphin Drive in Hanover Township (L) was temporarily closed, and no injuries were reported. While there have been no incidents of major landslide recorded in the Lehigh Valley, geological conditions coupled with human-caused changes in slope vegetation in some areas and changing weather patterns create the need to examine the potential for this particular type of ground failure to occur in the future.

4.3.6.4 Future Occurrence

Mismanaged, intense development in steeply sloped areas could increase the frequency of landslides in the Lehigh Valley. Building and road construction are contributing development factors to landslides, as they can often undermine or steepen otherwise stable soil.

Any events that do occur would take place in steeply sloped areas that do not feature extensive land development or many structures. Increased deforestation and soil disturbances caused by development on sloped areas further increases these risks. As timbering and development of sloped land continues the risk of significant landslides increases.

Based on available historical data, the future occurrence of landslides can be considered *unlikely* as defined by the Risk Factor Methodology probability criteria (refer to Section 4.4).

4.3.6.5 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. The following section discusses the potential impact of the landslide hazard on the Lehigh Valley including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety, (2) general building stock, (3) critical facilities, (4) economy and (5) future growth and development
- Effect of climate change on vulnerability
- Further data collections that will assist understanding this hazard over time

4.3.6.5.1 Overview of Vulnerability

Vulnerability to ground failure hazards is a function of location, soil type, geology, type of human activity, use, and frequency of events. The effects of landslides on people and structures can be lessened by total avoidance of hazard areas or by restricting, prohibiting, or imposing conditions on hazard-zone activity. Local governments can reduce landslide effects through land use policies and regulations. Individuals can reduce their exposure to hazards by educating themselves on past hazard history of the site and by making inquiries to planning and engineering departments of local governments (National Atlas, 2007).

Table 4.3.6-1 below summarizes the area of each municipality in the approximate high susceptibility/moderate incidence landslide hazard area.

SECTION 4.3.6: RISK ASSESSMENT – LANDSLIDE

Table 4.3.6-1. Area Located in the Approximate High Susceptibility/Moderate Incidence Landslide Hazard Area

Municipality	Total Area (sq. mi.)	Area Exposed			
		High Susceptibility/Moderate Incidence (sq. mi.)	Percent of Total	Low Susceptibility (sq. mi.)	Percent of Total
Lehigh County					
Alburtis Borough	0.71	0	0	0.71	100
Allentown, City of	18.02	0	0	18.02	100
Bethlehem, City of	4.4	0	0	4.4	100
Catasauqua Borough	1.3	0	0	1.3	100
Coopersburg Borough	0.94	0	0	0.94	100
Coplay Borough	0.63	0	0	0.63	100
Emmaus Borough	2.9	0	0	2.9	100
Fountain Hill Borough	0.76	0	0	0.76	100
Hanover Township	4.3	0	0	4.3	100
Heidelberg Township	24.7	6.5	26.3	18.2	73.7
Lower Macungie Township	22.5	0	0	22.5	100
Lower Milford Township	19.7	0	0	19.7	100
Lowhill Township	14.1	0	0	14.1	100
Lynn Township	41.7	4.5	10.8	37.2	89.2
Macungie Borough	0.99	0	0	0.99	100
North Whitehall Township	28.5	0	0	28.5	100
Salisbury Township	11.3	0	0	11.3	100
Slatington Borough	1.4	0.4	28.6	1	71.4
South Whitehall Township	17.2	0	0	17.2	100
Upper Macungie Township	26.2	0	0	26.2	100
Upper Milford Township	18.0	0	0	18	100
Upper Saucon Township	24.7	0	0	24.7	100
Washington Township	23.7	9.1	38.4	14.6	61.6
Weisenberg Township	26.8	0	0	26.8	100
Whitehall Township	12.8	0	0	12.8	100
Lehigh County (est. total)	348.3	20.5	5.9	327.8	94.1
Northampton County					
Allen Township	11.3	0	0	11.3	100
Bangor Borough	1.5	0	0	1.5	100
Bath Borough	0.9	0	0	0.9	100
Bethlehem Township	14.7	0	0	14.7	100
Bethlehem, City of	15.0	0	0	15	100
Bushkill Township	25.7	1.9	7.4	23.8	92.6
Chapman Borough	0.4	0	0	0.4	100
East Allen Township	14.6	0	0	14.6	100
East Bangor Borough	0.9	0	0	0.9	100
Easton, City of	4.4	0	0	4.4	100
Forks Township	12.3	0	0	12.3	100
Freemansburg Borough	0.8	0	0	0.8	100
Glendon Borough	0.8	0	0	0.8	100

SECTION 4.3.6: RISK ASSESSMENT – LANDSLIDE

Municipality	Total Area (sq. mi.)	Area Exposed			
		High Susceptibility/ Moderate Incidence (sq. mi.)	Percent of Total	Low Susceptibility (sq. mi.)	Percent of Total
Hanover Township	6.6	0	0	6.6	100
Hellertown Borough	1.3	0	0	1.3	100
Lehigh Township	29.8	11.1	37.2	18.7	62.8
Lower Mt. Bethel Township	24.6	0	0	24.6	100
Lower Nazareth Township	13.6	0	0	13.6	100
Lower Saucon Township	24.5	0	0	24.5	100
Moore Township	37.7	8.52	22.6	29.18	77.4
Nazareth Borough	1.7	0	0	1.7	100
North Catasauqua Borough	0.8	0	0	0.8	100
Northampton Borough	2.6	0	0	2.6	100
Palmer Township	10.4	0	0	10.4	100
Pen Argyl Borough	1.4	0	0	1.4	100
Plainfield Township	24.5	0	0	24.5	100
Portland Borough	0.6	0	0	0.6	100
Roseto Borough	0.6	0	0	0.6	100
Stockertown Borough	1.0	0	0	1	100
Tatamy Borough	0.6	0	0	0.6	100
Upper Mt. Bethel Township	44.0	0.0006	<1	43.9994	99.9
Upper Nazareth Township	7.5	0	0	7.5	100
Walnutport Borough	0.8	0	0	0.8	100
Washington Township	18.0	0	0	18	100
West Easton Borough	0.3	0	0	0.3	100
Williams Township	18.6	0	0	18.6	100
Wilson Borough	1.2	0	0	1.2	100
Wind Gap Borough	1.4	0	0	1.4	100
Northampton County (est. total)	377.2	21.5	5.7	355.9	94.3

Source: Godt, 2011 (Geology WMS Layer from the National Atlas of the United States)

Notes: est. = Estimated; sq. mi. = Square miles

4.3.6.5.2 Data and Methodology

Unlike the flood, wind and earthquake hazards, there are no standard loss estimation models or methodologies for the landslide hazard. In an attempt to estimate the Lehigh Valley’s vulnerability, the Geology - Landslide Incidence and Susceptibility GIS layer from National Atlas was used to coarsely define the general landslide susceptible area (herein “approximate hazard area”) (Figure 4.3.6-1). The limitations of this analysis are recognized and are only used to provide a general estimate. Over time additional data will be collected to allow better analysis for this hazard. Available information and a preliminary assessment are provided below.

According to Radbruch-Hall et.al., the Landslide Incidence and Susceptibility GIS layer from National Atlas ‘...was prepared by evaluating formations or groups of formations shown on the geologic map of the United States (King and Beikman, 1974) and classifying them as having high, medium, or low landslide incidence (number of landslides) and being of high, medium, or low susceptibility to landsliding. Thus, those map units or parts of units with more than 15 percent of their area involved in

landsliding were classified as having high incidence; those with 1.5 to 15 percent of their area involved in landsliding, as having medium incidence; and those with less than 1.5 percent of their area involved, as having low incidence. This classification scheme was modified where particular lithofacies are known to have variable landslide incidence or susceptibility. In continental glaciated areas, additional data were used to identify surficial deposits that are susceptible to slope movement. Susceptibility to landsliding was defined as the probable degree of response of the areal rocks and soils to natural or artificial cutting or loading of slopes or to anomalously high precipitation. High, medium, and low susceptibility are delimited by the same percentages used in classifying the incidence of landsliding. For example, it was estimated that a rock or soil unit characterized by high landslide susceptibility would respond to widespread artificial cutting by some movement in 15 percent or more of the affected area. We did not evaluate the effect of earthquakes on slope stability, although many catastrophic landslides have been generated by ground shaking during earthquakes. Areas susceptible to ground failure under static conditions would probably also be susceptible to failure during earthquakes’ (Radbruch-Hall, 1982).

4.3.6.5.3 Impact on Life, Health and Safety

To estimate the population located within the landslide hazard areas, the approximate hazard area boundaries were overlaid upon the 2010 Census population data (U.S. Census, 2010). The Census blocks with their center (centroid) within the boundary of the high susceptibility/moderate incidence landslide hazard area were used to calculate the estimated population considered exposed to this hazard. Table 4.3.6-2 summarizes the population exposed to this hazard by municipality (U.S. Census 2010).

Table 4.3.6-2. Population Located in the High Susceptibility/Moderate Incidence Landslide Hazard Area

Municipality	Total Pop.	Population Exposed			
		High Susceptibility/ Moderate Incidence	Percent of Total	Low Susceptibility	Percent of Total
Lehigh County					
Alburtis Borough	2,361	0	0.0	2,361	100
Allentown, City of	118,032	0	0.0	118,032	100
Bethlehem, City of	19,343	0	0.0	19,343	100
Catasauqua Borough	6,436	0	0.0	6,436	100
Coopersburg Borough	2,386	0	0.0	2,386	100
Coplay Borough	3,192	0	0.0	3,192	100
Emmaus Borough	11,211	0	0.0	11,211	100
Fountain Hill Borough	4,597	0	0.0	4,597	100
Hanover Township	1,571	0	0.0	1,571	100
Heidelberg Township	3,416	311	9.1	3,105	90.9
Lower Macungie Township	30,633	0	0.0	30,633	100
Lower Milford Township	3,775	0	0.0	3,775	100
Lowhill Township	2,173	0	0.0	2,173	100
Lynn Township	4,229	360	8.5	3,869	91.5
Macungie Borough	3,074	0	0.0	3,074	100
North Whitehall Township	15,703	0	0.0	15,703	100
Salisbury Township	13,505	0	0.0	13,505	100
Slatington Borough	4,232	636	15.0	3,596	85.0
South Whitehall Township	19,180	0	0.0	19,180	100
Upper Macungie Township	20,063	0	0.0	20,063	100

SECTION 4.3.6: RISK ASSESSMENT – LANDSLIDE

Municipality	Total Pop.	Population Exposed			
		High Susceptibility/ Moderate Incidence	Percent of Total	Low Susceptibility	Percent of Total
Upper Milford Township	7,292	0	0.0	7,292	100
Upper Saucon Township	14,808	0	0.0	14,808	100
Washington Township	6,624	1,248	18.8	5,376	81.2
Weisenberg Township	4,923	0	0.0	4,923	100
Whitehall Township	26,738	0	0.0	26,738	100
Lehigh County	349,497	2,555	0.7	346,942	99.3
Northampton County					
Allen Township	4,269	0	0.0	4,269	100
Bangor Borough	5,273	0	0.0	5,273	100
Bath Borough	2,693	0	0.0	2,693	100
Bethlehem Township	23,730	0	0.0	23,730	100
Bethlehem, City of	55,639	0	0.0	55,639	100
Bushkill Township	8,178	361	4.4	7,817	95.6
Chapman Borough	199	0	0.0	199	100
East Allen Township	4,903	0	0.0	4,903	100
East Bangor Borough	1,172	0	0.0	1,172	100
Easton, City of	26,800	0	0.0	26,800	100
Forks Township	14,721	0	0.0	14,721	100
Freemansburg Borough	2,636	0	0.0	2,636	100
Glendon Borough	440	0	0.0	440	100
Hanover Township	10,866	0	0.0	10,866	100
Hellertown Borough	5,898	0	0.0	5,898	100
Lehigh Township	10,526	3,583	34.0	6,943	66.0
Lower Mt. Bethel Township	3,101	0	0.0	3,101	100
Lower Nazareth Township	5,674	0	0.0	5,674	100
Lower Saucon Township	10,772	0	0.0	10,772	100
Moore Township	9,198	731	7.9	8,467	92.1
Nazareth Borough	5,746	0	0.0	5,746	100
North Catasauqua Borough	2,849	0	0.0	2,849	100
Northampton Borough	9,926	0	0.0	9,926	100
Palmer Township	20,691	0	0.0	20,691	100
Pen Argyl Borough	3,595	0	0.0	3,595	100
Plainfield Township	6,138	0	0.0	6,138	100
Portland Borough	519	0	0.0	519	100
Roseto Borough	1,567	0	0.0	1,567	100
Stockertown Borough	927	0	0.0	927	100
Tatamy Borough	1,203	0	0.0	1,203	100
Upper Mt. Bethel Township	6,706	0	0.0	6,706	100
Upper Nazareth Township	6,231	0	0.0	6,231	100
Walnutport Borough	2,070	0	0.0	2,070	100
Washington Township	5,122	0	0.0	5,122	100
West Easton Borough	1,257	0	0.0	1,257	100
Williams Township	5,884	0	0.0	5,884	100
Wilson Borough	7,896	0	0.0	7,896	100



SECTION 4.3.6: RISK ASSESSMENT – LANDSLIDE

Municipality	Total Pop.	Population Exposed			
		High Susceptibility/ Moderate Incidence	Percent of Total	Low Susceptibility	Percent of Total
Wind Gap Borough	2,720	0	0.0	2,720	100
Northampton County (est. total)	297,735	4,675	1.6	293,060	98.4

Source: U.S. Census 2010; Godt, 2011 (Geology WMS Layer from the National Atlas of the United States)
 Note: Pop. = population

4.3.6.5.4 Impact on General Building Stock

In general, the built environment located in the high susceptibility zones and the population, structures and infrastructure located downslope are vulnerable to this hazard. In an attempt to estimate the general building stock vulnerable to this hazard, the associated building replacement values (buildings and contents) were determined for the identified Census blocks within the approximate hazard area. In summary, less than one percent of the general building stock is vulnerable. Table 4.3.6-3 lists the replacement value (structure and contents) of general building stock exposed to this hazard.

Table 4.3.6-3. General Building Stock Located in the High Susceptibility/Moderate Incidence Landslide Hazard Area

Municipality	Total GBS	GBS Exposed (Structure and Contents)			
		High Susceptibility/ Moderate Incidence	Percent of Total	Low Susceptibility	Percent of Total
Lehigh County					
Alburtis Borough	\$280,994,000	\$0	0.0	\$280,994,000	100
Allentown, City of	\$20,982,347,000	\$0	0.0	\$20,982,347,000	100
Bethlehem, City of	\$4,769,721,000	\$0	0.0	\$4,769,721,000	100
Catasauqua Borough	\$934,748,000	\$0	0.0	\$934,748,000	100
Coopersburg Borough	\$421,475,000	\$0	0.0	\$421,475,000	100
Coplay Borough	\$406,752,000	\$0	0.0	\$406,752,000	100
Emmaus Borough	\$2,088,277,000	\$0	0.0	\$2,088,277,000	100
Fountain Hill Borough	\$1,101,911,000	\$0	0.0	\$1,101,911,000	100
Hanover Township	\$2,254,652,000	\$0	0.0	\$2,254,652,000	100
Heidelberg Township	\$550,037,000	\$34,753,000	6.3	\$515,284,000	93.7
Lower Macungie Township	\$5,924,050,000	\$0	0.0	\$5,924,050,000	100
Lower Milford Township	\$534,598,000	\$0	0.0	\$534,598,000	100
Lowhill Township	\$371,530,000	\$0	0.0	\$371,530,000	100
Lynn Township	\$612,033,000	\$21,778,000	3.6	\$590,255,000	96.4
Macungie Borough	\$533,007,000	\$0	0.0	\$533,007,000	100
North Whitehall Township	\$2,850,746,000	\$0	0.0	\$2,850,746,000	100
Salisbury Township	\$3,606,044,000	\$0	0.0	\$3,606,044,000	100
Slatington Borough	\$715,470,000	\$177,154,000	24.8	\$538,316,000	75.2
South Whitehall Township	\$4,885,829,000	\$0	0.0	\$4,885,829,000	100

SECTION 4.3.6: RISK ASSESSMENT – LANDSLIDE

Municipality	Total GBS	GBS Exposed (Structure and Contents)			
		High Susceptibility/ Moderate Incidence	Percent of Total	Low Susceptibility	Percent of Total
Upper Macungie Township	\$10,206,499,000	\$0	0.0	\$10,206,499,000	100
Upper Milford Township	\$1,178,767,000	\$0	0.0	\$1,178,767,000	100
Upper Saucon Township	\$3,171,479,000	\$0	0.0	\$3,171,479,000	100
Washington Township	\$893,760,000	\$226,895,000	25.4	\$666,865,000	74.6
Weisenberg Township	\$1,189,552,000	\$0	0.0	\$1,189,552,000	100
Whitehall Township	\$5,424,311,000	\$0	0.0	\$5,424,311,000	100
Lehigh County (est. total)	\$75,888,589,000	\$460,580,000	0.6	\$75,428,009,000	99.4
Northampton County					
Allen Township	\$712,840,000	\$0	0.0	\$712,840,000	100
Bangor Borough	\$926,661,000	\$0	0.0	\$926,661,000	100
Bath Borough	\$471,748,000	\$0	0.0	\$471,748,000	100
Bethlehem Township	\$5,752,889,000	\$0	0.0	\$5,752,889,000	100
Bethlehem, City of	\$9,934,952,000	\$0	0.0	\$9,934,952,000	100
Bushkill Township	\$1,289,529,000	\$20,129,000	1.6	\$1,269,400,000	98.4
Chapman Borough	\$32,434,000	\$0	0.0	\$32,434,000	100
East Allen Township	\$1,104,833,000	\$0	0.0	\$1,104,833,000	100
East Bangor Borough	\$118,151,000	\$0	0.0	\$118,151,000	100
Easton, City of	\$4,848,037,000	\$0	0.0	\$4,848,037,000	100
Forks Township	\$3,177,595,000	\$0	0.0	\$3,177,595,000	100
Freemansburg Borough	\$361,483,000	\$0	0.0	\$361,483,000	100
Glendon Borough	\$89,841,000	\$0	0.0	\$89,841,000	100
Hanover Township	\$3,484,970,000	\$0	0.0	\$3,484,970,000	100
Hellertown Borough	\$888,848,000	\$0	0.0	\$888,848,000	100
Lehigh Township	\$1,487,389,000	\$405,674,000	27.3	\$1,081,715,000	72.7
Lower Mt. Bethel Township	\$502,664,000	\$0	0.0	\$502,664,000	100
Lower Nazareth Township	\$2,194,429,000	\$0	0.0	\$2,194,429,000	100
Lower Saucon Township	\$1,968,200,000	\$0	0.0	\$1,968,200,000	100
Moore Township	\$1,223,870,000	\$100,078,000	8.2	\$1,123,792,000	91.8
Nazareth Borough	\$1,312,606,000	\$0	0.0	\$1,312,606,000	100
North Catasauqua Borough	\$386,289,000	\$0	0.0	\$386,289,000	100
Northampton Borough	\$1,843,226,000	\$0	0.0	\$1,843,226,000	100
Palmer Township	\$4,169,701,000	\$0	0.0	\$4,169,701,000	100
Pen Argyl Borough	\$651,065,000	\$0	0.0	\$651,065,000	100
Plainfield Township	\$1,086,698,000	\$0	0.0	\$1,086,698,000	100
Portland Borough	\$162,069,000	\$0	0.0	\$162,069,000	100
Roseto Borough	\$276,318,000	\$0	0.0	\$276,318,000	100
Stockertown Borough	\$298,470,000	\$0	0.0	\$298,470,000	100
Tatamy Borough	\$216,261,000	\$0	0.0	\$216,261,000	100
Upper Mt. Bethel Township	\$1,311,378,000	\$0	0.0	\$1,311,378,000	100
Upper Nazareth Township	\$1,071,480,000	\$0	0.0	\$1,071,480,000	100
Walnutport Borough	\$506,739,000	\$0	0.0	\$506,739,000	100
Washington Township	\$875,751,000	\$0	0.0	\$875,751,000	100



Municipality	Total GBS	GBS Exposed (Structure and Contents)			
		High Susceptibility/Moderate Incidence	Percent of Total	Low Susceptibility	Percent of Total
West Easton Borough	\$267,628,000	\$0	0.0	\$267,628,000	100
Williams Township	\$1,200,406,000	\$0	0.0	\$1,200,406,000	100
Wilson Borough	\$1,731,473,000	\$0	0.0	\$1,731,473,000	100
Wind Gap Borough	\$532,380,000	\$0	0.0	\$532,380,000	100
Northampton County (est. total)	\$58,471,301,000	\$525,881,000	0.9	\$57,945,420,000	99.1

Source: Godt, 2011 (Geology WMS Layer from the National Atlas of the United States)

Note: est. = Estimated; GBS = General Building Stock

4.3.6.5.5 Impact on Critical Facilities

The approximate landslide hazard area was used to identify the essential facilities located within the identified high susceptibility/moderate incidence zone. Table 4.3.6-4 lists these essential (i.e., police, fire, EOCs and hospitals) as identified by the Lehigh Valley plan participants.

Table 4.3.6-4. Essential Critical Facilities in the High Susceptibility/Moderate Incidence Landslide Hazard Area

Name	Municipality	Type
Lehigh County		
Commonwealth of PA	Heidelberg Township	User Defined
Slatington Elementary School	Slatington Borough	School
Northern Lehigh High School	Slatington Borough	School
Northern Lehigh Middle School	Slatington Borough	School
Northampton County		
Blue Ridge Veterinary Clinic	Lehigh Township	User Defined
Lehigh Township	Lehigh Township	User Defined
Personal Care Home	Lehigh Township	User Defined
Liza's House Personal Care Home	Lehigh Township	User Defined
United States Post Office	Lehigh Township	User Defined
PA DOT - Stockpile Danielsville	Lehigh Township	User Defined
LEHIGH TWP PD	Lehigh Township	Police
Pond View Manor Personal Care Home	Lehigh Township	User Defined

Source: Godt, 2011 (Geology WMS Layer from the National Atlas of the United States)

4.3.6.5.6 Impact on the Economy

Landslide’s impact on the economy and estimated dollar losses are difficult to measure. As stated earlier, landslides can impose direct and indirect impacts on society. Direct costs include the actual damage sustained by buildings, property and infrastructure. Indirect costs, such as clean-up costs, business interruption, loss of tax revenues, reduced property values, and loss of productivity are difficult to measure. Additionally, ground failure threatens transportation corridors, fuel and energy conduits and communication lines (USGS, 2003). Estimated potential damages to general building stock can be

quantified as discussed above. For the purposes of this analysis, general building stock damages are discussed further.

Direct building losses are the estimated costs to repair or replace the damage caused to the building. The estimated replacement value of general building stock located in landslide susceptible areas is nearly \$1 billion. This estimate represents less than one-percent of the total building stock value inventory in the Lehigh Valley. These dollar value losses to the region's total building inventory replacement value would impact the local tax base and economy.

4.3.6.5.7 Future Growth and Development

Areas targeted for potential future growth and development in the next five (5) to ten (10) years have been identified across the Lehigh Valley at the municipal level. Refer to the jurisdictional annexes in Volume II of this HMP. Table B.1 in each jurisdictional annex lists the location of the potential new development and its exposure (if any) to known hazard zones. It is anticipated that new development within the identified high susceptibility/moderate incidence landslide hazard area will be exposed to such risks.

4.3.6.5.8 Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as severe storms, including those which may bring intense and/or prolonged precipitation (U.S. Environmental Protection Agency [EPA], 2006). An increase in rainfall intensity and duration will saturate the soil and potentially erode the local landscape and impact slope stability. This may lead to an increase of landslide events in the Lehigh Valley.

While predicting changes in these types of events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (EPA, 2006). The potential effects of climate change on the Lehigh Valley's vulnerability to landslide events shall need to be considered as a greater understanding of regional climate change impacts develop.

4.3.6.5.9 Additional Data and Next Steps

More detailed landslide susceptibility zones can be generated so that communities can more specifically identify high hazard areas. A pilot study was conducted for Schenectady County, New York as described in the 2011 Draft New York State Hazard Mitigation Plan to develop higher resolution landslide susceptibility zones. The methodology included using the Natural Resource Conservation Services (NRCS) Digital Soil Survey soil units and their associated properties including the American of State Highway Transportation Officials (AASHTO) rating, liquid limit, hydrologic group, percentage of silt and clay, erosion potential and slope derived from high resolution digital elevation models. Obtaining historic damages to buildings and infrastructure incurred due to landslides will also help with loss estimates and future modeling efforts, given a margin of uncertainty. Further, research on rainfall thresholds for forecasting landslide potential may also be an option for the Lehigh Valley.

4.3.7 Lightning Strike

This section provides a profile and vulnerability assessment for the lightning strike hazard. Lightning is a rapid discharge of electrical energy in the atmosphere. When the charge difference between the ground and the cloud becomes too large, a conductive channel of air develops between the cloud and the ground, and a small amount of charge (step leader) starts moving toward the ground. When it nears the ground, an upward leader of opposite charge connects with the step leader. At the instant this connection is made, a powerful discharge occurs between the cloud and the ground and the discharge is seen as a bright flash of lightning.

4.3.7.1 Location and Extent

More than 100,000 thunderstorms occur in the United States (U.S.) each year, with lightning striking more than 25 million points on the ground during that same period causing numerous injuries and fatalities (NOAA, Date Unknown). Lightning can occur with all thunderstorms, making all of the Lehigh Valley susceptible. Different geographic areas experience varying event frequencies, but in all cases lightning strikes and associated fatalities occur primarily during the summer months.

While the impact of lightning events is highly localized, strong storms can result in numerous widespread events over a broad area. According to the Commonwealth of Pennsylvania 2010 Standard All-Hazard Mitigation Plan (PA HMP), Northampton County has one of the highest lightning risks of all counties in Pennsylvania. Lehigh County is not listed among one of the top five most at-risk counties.

4.3.7.2 Range of Magnitude

Because lightning damage is largely unreported, statistics vary considerably. The insurance industry, however, estimates that 6.5 percent of all property/casualty claims are related to lightning strikes. While it is difficult to quantify lightning losses, it is estimated that \$4 to \$5 billion in damage occurs each year across the U.S. Likewise, the cost of lightning protection to safeguard critical equipment and facilities from lightning strikes during severe weather is enormous (BCPC, 2011).

Each year, lightning strikes across the U.S. are responsible for an average of between 55 and 60 fatalities, several hundred injuries, and billions of dollars in property damage. Many case histories show observed heart damage, inflated lungs, and brain damage in lightning fatalities. Loss of consciousness, amnesia, paralysis and burns are reported by many who have survived. Deaths and injuries to livestock and other animals, thousands of forest and brush fires, as well as damage to buildings, communications systems, power lines, and electrical systems are also the result of lightning (PEMA, 2010).

Between 2000 and 2010, Pennsylvania ranked 10th among all states in the U.S. with 13 deaths, representing approximately three percent of all lightning-caused deaths in the U.S. over that period of time (NOAA, NWS, 2012). Between 1959 and 1994, Pennsylvania ranked third among all states in the U.S. with 644 casualties (i.e. combination of deaths and injuries). This represents approximately five percent of casualties which occurred throughout the U.S over that 35-year period (PEMA, 2010).

The Lehigh Valley's worst lightning event in terms of property damage occurred on August 25, 2007, when lightning struck a church in Plainfield Township, resulting in a fire and an estimated \$250,000 in damage. Shortly after the church was struck, lightning struck and destroyed a saw mill in Upper Mount Bethel Township, which resulted in an additional \$1 million dollars in loss. No injuries were reported.

SECTION 4.3.7: RISK ASSESSMENT – LIGHTNING STRIKE

With regards to loss of life and injuries, available data (see Table 4.3.7-1) identifies a lightning fatality in Bethlehem Township in August of 2009. On July 19, 2011, a father and daughter were struck by lightning as they stood under a tree at the Moore Township Recreation Fields in Northampton County. The father was holding an umbrella over his daughter's head when they were both thrown to the ground by the lightning bolt. The father had burns on his feet, stomach and leg and felt numbness and a burning sensation. The daughter suffered a flash burn to her right eye (NCDC, 2012).

4.3.7.3 Past Occurrence

A lightning “event” is defined as a lightning strike which results in fatality, injury, and/or property or crop damage (PEMA, 2010). Records from the National Climatic Data Center (NCDC) and the Pennsylvania Emergency Incident Reporting System (PEIRS) show that there were 74 reported lightning events in the Lehigh Valley between 1993 and 2011 (refer to Table 4.3.7-1 below). Between 1993 and 2011, Northampton County recorded 46 lightning events, averaging 2.5 events every year. Lehigh County only experienced 28 recorded events over the same time period. Sixty of the 62 municipalities in the Lehigh Valley reported five or fewer events over this 18 year period. Of the Lehigh Valley municipalities with the highest numbers of lightning events, the City of Easton reported eight events, the City of Allentown reported seven events, and the City of Bethlehem reported six events.

Table 4.3.7-1. Lehigh Valley Recorded Lightning Events

County	Location	Date	Death	Injuries	Property Damage (\$)
Lehigh County					
Lehigh	City of Allentown	9/15/1993	0	0	50,000
Lehigh	City of Allentown	6/6/1994	0	0	-
Lehigh	City of Allentown	7/17/1995	0	2	-
Lehigh	City of Allentown	5/13/2000	0	0	50,000
Lehigh	Whitehall Township	7/1/2001	0	0	5,000
Lehigh	Lower Milford Township	5/13/2002	0	0	-
Lehigh	Upper Saucon Township	8/2/2002	0	0	-
Lehigh	Macungie Borough	7/22/2003	0	0	81,000
Lehigh	Salisbury Township	8/3/2003	0	1	-
Lehigh	City of Allentown	8/3/2003	0	0	-
Lehigh	City of Allentown	6/6/2005	0	0	-
Lehigh	Whitehall Township	6/6/2005	0	0	250,000
Lehigh	Upper Milford Township	7/1/2005	0	0	-
Lehigh	North Whitehall Township	8/8/2005	0	0	10,000
Lehigh	Macungie Borough	6/19/2006	0	0	-
Lehigh	South Whitehall Township	7/5/2007	0	0	1,000
Lehigh	Whitehall Township	7/29/2007	0	0	1,000,000
Lehigh	Macungie Borough	6/10/2008	0	0	10,000
Lehigh	Upper Saucon Township	8/8/2008	0	0	10,000
Lehigh	North Whitehall Township	8/13/2008	0	0	50,000
Lehigh	South Whitehall Township	4/11/2011	0	0	1,000
Lehigh	City of Allentown	7/24/2011	0	0	25,000

SECTION 4.3.7: RISK ASSESSMENT – LIGHTNING STRIKE

County	Location	Date	Death	Injuries	Property Damage (\$)
Northampton County					
Northampton	Upper Mount Bethel Township	7/8/1994	0	0	-
Northampton	Lehigh Township	7/11/1995	0	0	-
Northampton	City of Bethlehem	7/11/1995	0	0	200,000
Northampton	Nazareth Borough	7/17/1995	0	0	-
Northampton	Nazareth Borough	7/17/1995	0	0	-
Northampton	Hellertown Borough	8/5/1995	0	0	40,000
Northampton	City of Bethlehem	3/19/1996	0	0	-
Northampton	Tatamy Borough	6/17/1996	0	0	-
Northampton	Moore Township	7/3/1996	0	0	40,000
Northampton	Belfast, Plainfield Township	7/8/1996	0	1	-
Northampton	Wilson Borough	5/6/1997	0	0	20,000
Northampton	Bath Borough	8/16/1997	0	0	100,000
Northampton	City of Easton	5/6/1998	0	0	-
Northampton	Pen Argyl Borough	5/25/1998	0	0	-
Northampton	Wind Gap Borough	5/29/1998	0	0	-
Northampton	Lehigh Township	5/10/2000	0	1	-
Northampton	Nazareth Borough	5/13/2000	0	1	-
Northampton	City of Easton	5/13/2000	0	1	-
Northampton	Nazareth Borough	5/18/2000	0	0	-
Northampton	City of Easton	5/24/2000	0	0	-
Northampton	City of Easton	6/11/2000	0	1	-
Northampton	City of Bethlehem	12/17/2000	0	0	10,000
Northampton	Wilson Borough	4/9/2001	0	0	-
Northampton	City of Bethlehem	7/1/2001	0	0	1,000
Northampton	Forks Township, Washington Township	7/10/2001	0	0	10,000
Northampton	Forks Township, Washington Township	7/10/2001	0	0	50,000
Northampton	City of Bethlehem	8/12/2001	0	1	-
Northampton	City of Easton	6/27/2002	0	0	-
Northampton	Forks Township	8/3/2003	0	0	250,000
Northampton	Countywide	5/12/2004	0	0	-
Northampton	Bethlehem Township	5/15/2004	0	1	-
Northampton	Bethlehem Township	6/17/2004	0	0	-
Northampton	Lower Mount Bethel Township	3/28/2005	0	0	140,000
Northampton	Newburg, Lower Nazareth Township	6/6/2005	0	0	-
Northampton	City of Easton	6/6/2005	0	0	-
Northampton	City of Easton	7/10/2005	0	0	-
Northampton	Bath Borough	1/14/2006	0	0	50,000

SECTION 4.3.7: RISK ASSESSMENT – LIGHTNING STRIKE

County	Location	Date	Death	Injuries	Property Damage (\$)
Northampton	Glendon Borough	6/19/2006	0	0	-
Northampton	City of Bethlehem	6/21/2006	0	0	5,000
Northampton	City of Easton	6/27/2007	0	0	10,000
Northampton	Bethlehem Township	7/10/2007	0	0	100,000
Northampton	Moore Township	8/8/2007	0	0	55,000
Northampton	Belfast, Plainfield Township	8/25/2007	0	0	1,300,000
Northampton	Moore Township	5/23/2009	0	0	350,000
Northampton	Bethlehem Township	8/5/2009	1	0	-
Northampton	Moore Township	7/19/2011	0	2	-
Lehigh Valley Total			1	12	\$4,274,000

Source: NCDC, 2012; PEIRS, 2012

4.3.7.4 Future Occurrence

Lightning strikes that result in multiple fatalities have never been reported in the Lehigh Valley. Those that resulted in multiple injuries and/or extensive property damage have occurred 35 times over 18 years of record (1993 to 2011). The future occurrence of lightning activity in the Lehigh Valley is anticipated, and the susceptibility to damage from these events will remain unchanged. The future occurrence of lightning strikes can be considered *likely* as defined by the Risk Factor Methodology probability criteria (refer to Section 4.4).

4.3.7.5 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For lightning events, the entire Lehigh Valley has been identified as the hazard area. Therefore, all assets (population, structures, critical facilities and lifelines), as described in Section 2, are vulnerable. The following text evaluates and estimates the potential impact of lightning strike events on the Lehigh Valley including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety, (2) general building stock, (3) critical facilities, (4) economy and (5) future growth and development
- Effect of climate change on vulnerability
- Further data collections that will assist understanding this hazard over time

4.3.7.5.1 Overview of Vulnerability

Evaluation of NCDC and PEIRS lightning data for the Lehigh Valley, along with data from the current and previous versions of the PA HMP, show that while the absolute number of lightning events has changed for individual municipalities, the basic pattern of vulnerability across the Lehigh Valley has remained relatively consistent.

The potential for lightning strikes will continue to exist for all 62 municipalities in the Lehigh Valley. The direct and indirect losses associated with these events include injury and loss of life, damage to

structures and infrastructure, agricultural losses, utility failure (power outages), and stress on community resources.

Lehigh County is a StormReady county. This designation is obtained through participation in the National Weather Service (NWS) StormReady Program, which includes six guidelines met by the County:

- **Communication** – A 24-hour warning point (WP) must be fully staffed at all times, and a County Emergency Operations Center (EOC) must be established.
- **NWS Information Reception** – At least four redundant systems must be in place at the WP to receive weather warnings.
- **Hydrometeorological Monitoring** – At least four methods of monitoring hydrometeorological data must be available.
- **Local Warning Dissemination** – There must be at least four redundant systems to notify the County of severe weather warnings, and there must be National Weather Radio-Specific Area Messaging Encoding receivers in public facilities.
- **Community Preparedness** – The County must present at least four annual weather safety talks, spotters and dispatchers must be trained biennially, and the County must host or co-host NWS spotter training annually.
- **Administration** – The County must also meet a number of administrative criteria that include formal hazardous weather operations planning, biennial visits of the County Emergency Management Coordinator (EMC) to the NWS office, and annual visits by an NWS official to the County.

Meeting the criteria of the StormReady program results in a decrease in vulnerability to all severe weather events, including lightning strikes.

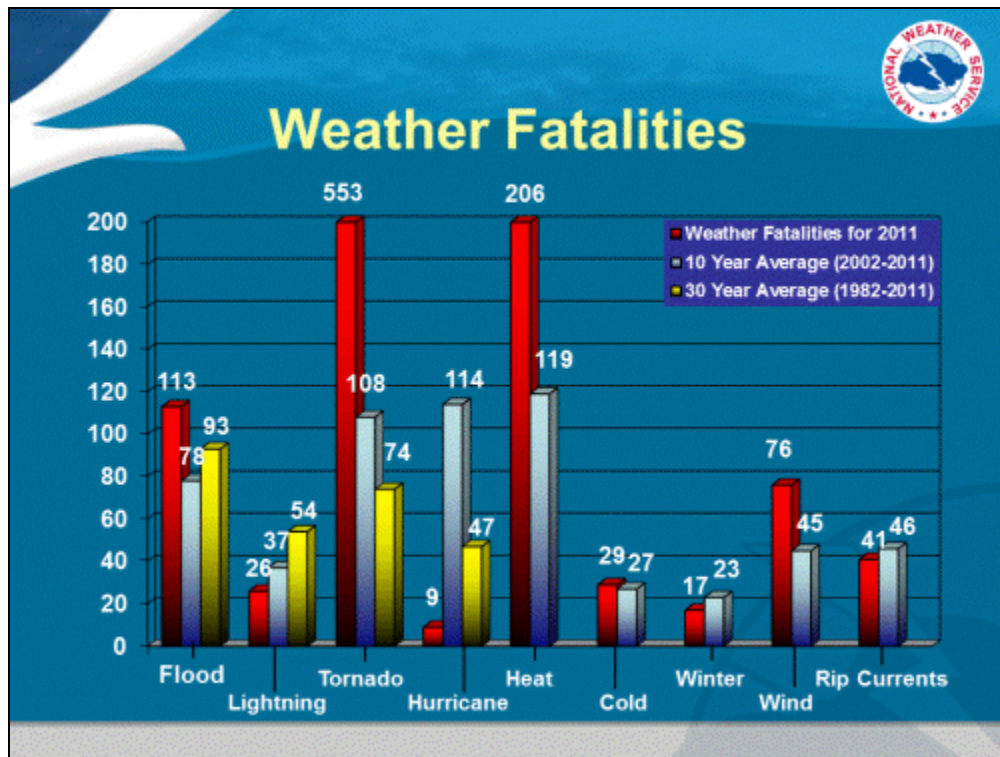
4.3.7.5.2 Data and Methodology

National weather databases and local resources were used to collect and analyze lightning impacts on the Lehigh Valley.

4.3.7.5.3 Impact on Life, Health and Safety

Across the U.S., the ten year average (2001 to 2011) for fatalities caused by lightning is 37 while the 30-year average (1982 to 2011) is 54 (NOAA, 2012). Refer to Figure 4.3.7-1 for an illustration of these statistics. According to NOAA, there has been one fatality and 12 injuries as a result of lightning events from 1993 to 2011 in the Lehigh Valley (NCDC, 2012; PEIRS, 2012).

Figure 4.3.7-1. Weather Fatalities in the U. S.



Source: NOAA, 2012

The entire population of the Lehigh Valley is considered exposed to the lightning hazard. Lightning strikes in Pennsylvania occur primarily during the summer months. In general, population and building density have a correlation with hazard vulnerability and loss. The urban areas of the Lehigh Valley are at greater lightning risk than others due to higher population density. Populations located outdoors are considered at risk and more vulnerable to a lightning strike compared to being inside a shelter. Moving to a lower risk location will decrease a person’s vulnerability.

4.3.7.5.4 Impact on General Building Stock, Critical Facilities and the Economy

For the purposes of this Plan, the entire general building stock and all infrastructure of the Lehigh Valley are considered exposed to the lightning strike hazard. In general, urban and suburban areas in the Lehigh Valley are at greater lightning risk than more rural areas others due to higher population and structure density. Taller buildings can act as lightning rods; therefore, they naturally have experienced greater vulnerability and loss during past lightning strike events (PEMA, 2010).

The precise vulnerability of lightning strikes will depend on a facility’s height vis-à-vis surrounding buildings as well as the absence or presence of a lightning rod or other lightning channeling technology in the structure. According to the PA HMP, fire departments, schools, and police departments are the most vulnerable to lightning strikes. Food and agriculture facilities that raise livestock may also be more vulnerable to lightning strikes as these animals tend to shelter under trees in storm situations. It is important to note that most of the food and agriculture-related critical facilities are privately owned farms that may own sizeable herds of livestock, but the Commonwealth critical facilities list does not indicate which of the farms own herds. Finally, if the entertainment and recreation facilities are outdoor recreation spaces with wide open spaces, there may be added lightning strike vulnerability (PEMA, 2010).

According to NOAA’s Technical Paper on *Lightning Fatalities, Injuries, and Damage Reports in the United States from 1959 - 1994*, monetary losses for lightning events range from less than \$50 to greater than \$5 Million (larger losses associated with forest fires with homes destroyed and crop loss) (NOAA, 1997). Lightning can be responsible for damages to buildings; cause electrical, forest and/or wildfires; and damage infrastructure such as power transmission lines and communication towers. Agricultural losses can be devastating due to lightning and resulting fires.

The PA HMP identified Northampton County as one of five counties throughout the state as highly vulnerable to lightning strike hazards. The County hosts 246 state critical facilities of the total 1,521 state critical facilities spread among the five vulnerable counties (PEMA, 2010).

The State HMP estimated jurisdictional losses for the five counties most threatened by lightning strike, including Northampton County. Using GIS, losses for the County were estimated to total over \$36 Million. No estimates were prepared for Lehigh County, as it was not evaluated as a highly vulnerable county to the lightning strike hazard. Note that losses due to lightning strikes will differ based on the magnitude of the event and the lightning protection measures on a given facility (PEMA, 2010).

4.3.7.5.5 Future Growth and Development

Areas targeted for potential future growth and development in the next five (5) to ten (10) years have been identified across the Lehigh Valley at the municipal level. Refer to the jurisdictional annexes in Volume II of this Plan. Table B.1 in each jurisdictional annex lists the location of the potential new development and its exposure (if any) to known hazard zones. It is anticipated that new development will be exposed to the lightning strike hazard.

4.3.7.5.6 Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as storms, including those which may bring lightning. While predicting changes of lightning events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2006).

Since the 1970s, globally there has been an increase in ‘tropical cyclone destructiveness’. This increased tropical cyclone intensity and duration correlates with sea surface temperature. This suggests that future increases of tropical sea surface temperature may lead to future increases in tropical cyclone intensity and duration. However, there is a high level of uncertainty regarding the relationship between climate change and storm events. Future improvements in modeling smaller scale climatic processes can be expected and will lead to improved understanding of how the changing climate will alter temperature, precipitation and storms events in Pennsylvania (Shortle et. al, 2009).

4.3.7.5.7 Additional Data and Next Steps

The assessment above identifies vulnerable populations and potential structural and economic losses associated with the lightning strike hazard. Research at NOAA and other private organizations is ongoing to improve warning and threat information for the public. The continued collection of additional/actual loss data specific to the Plan participants will further enhance the Lehigh Valley’s vulnerability assessment.

4.3.8 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 U.S. Environmental Protection Agency (EPA), radon is estimated to cause approximately 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 [PA DEP], 2009). This section provides a profile and vulnerability assessment for the radon exposure hazard.

4.3.8.1 Location and Extent

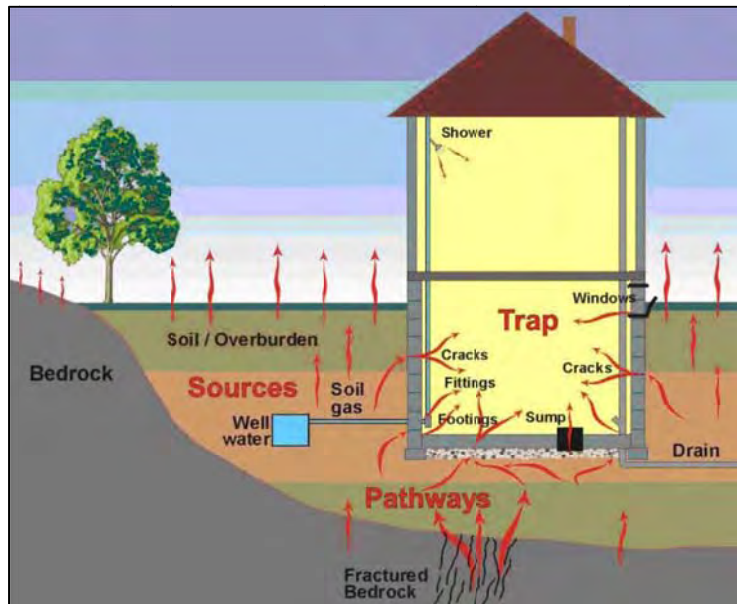
Radioactivity caused by airborne radon has been recognized for many years as an important component in the natural background radioactivity exposure of humans. It was not until the 1980s that the wide geographic distribution of elevated values in houses and the possibility of extremely high radon values in houses were recognized. In 1984, routine monitoring of employees leaving the Limerick nuclear power plant near Reading, PA, showed that readings on Mr. Stanley Watras frequently exceeded expected radiation levels, yet only natural, nonfission- product radioactivity was detected on him. Radon levels in his home were detected around 2,500 pico Curies per Liter (pCi/L), much higher than the 4 pCi/L guideline of the EPA or even the 67 pCi/L limit for uranium miners. As a result of this event, the Reading Prong section of Pennsylvania where Watras lived became the focus of the first large-scale radon scare in the world.

However, radon (i.e. ^{222}Rn), which has a half-life of 3.8 days, is a widespread hazard. The distribution of radon is correlated with the distribution of radium (i.e. ^{226}Ra), its immediate radioactive parent, and with uranium, its original ancestor. Due to the short half-life of radon, the distance that radon atoms can travel from their parent before decay is generally limited to distances of feet or tens of feet. Three sources of radon in houses are now recognized:

- Radon in soil air that flows into the house;
- Radon dissolved in water from private wells and exsolved during water usage; this is rarely a problem in Pennsylvania; and
- Radon emanating from uranium-rich building materials (e.g. concrete blocks or gypsum wallboard); this is not known to be a problem in Pennsylvania (PEMA, 2010).

Figure 4.3.8-1 illustrates radon entry points into a home.

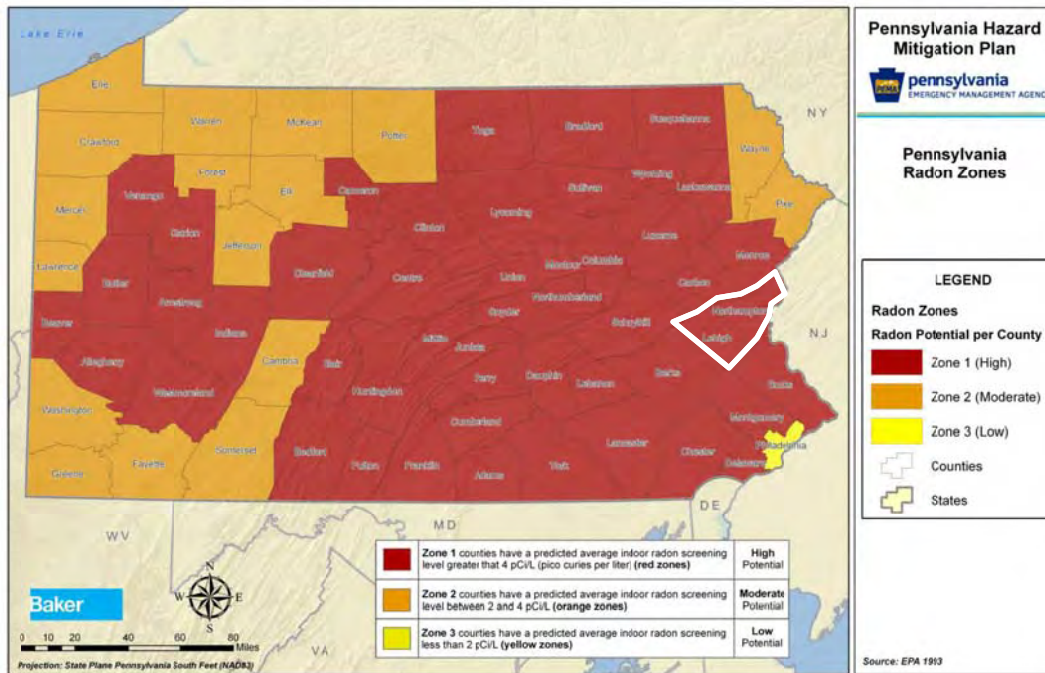
Figure 4.3.8-1: Sketch of Radon Entry Points into a House



Source: PEMA 2010, Arizona Geological Survey 2006

Each county in Pennsylvania is classified as having a low, moderate, or high radon hazard potential. A majority of counties across the Commonwealth, particularly counties in eastern Pennsylvania, have a high hazard potential. The average indoor radon screening level for these counties is greater than 4 pCi/L. Lehigh and Northampton Counties are both located in Zone 1 – High Radon Potential as noted in Figure 4.3.8-2 below.

Figure 4.3.8-2: Radon Hazard Zones in Pennsylvania



Source: PEMA 2010, EPA 1993 (white highlight added)

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

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

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

Areas of very elevated uranium content (>50 parts per million [ppm]) around uranium deposits and prospects: Although very high levels of radon can occur in such areas, the hazard normally is restricted to within a few hundred feet of the deposit. In Pennsylvania, such localities occupy an insignificant area.

Areas of common rocks having higher than average uranium content (5 to 50 ppm): In Pennsylvania, such rock types include granitic and felsic alkali igneous rocks and black shales. In the Reading Prong, high uranium values in rock or soil and high radon levels in houses are associated with Precambrian granitic gneisses commonly containing 10 to 20 ppm uranium, but locally containing more than 500 ppm uranium. In Pennsylvania, elevated uranium occurs in black shales of the Devonian Marcellus Formation and possibly the Ordovician Martinsburg Formation. High radon values are locally present in areas underlain by these formations.

Areas of soil or bedrock that have normal uranium content but properties that promote high radon levels in houses: This group is incompletely understood at present. Relatively high soil permeability can lead to high radon, the clearest example being houses built on glacial eskers. Limestone-dolomite soils also appear to be predisposed for high radon levels in houses, perhaps because of the deep clay-rich residuum in which radium is concentrated by weathering on iron oxide or clay surfaces, coupled with moderate porosity and permeability. The importance of carbonate soils is indicated by the fact that radon contents in 93 percent of a sample of houses built on limestone-dolomite soils near State College, Centre County, exceeded 4 pCi/L, and 21 percent exceeded 20 pCi/L, even though the uranium values in the underlying bedrock are all in the normal range of 0.5 to 5 ppm uranium (PEMA, 2010).

According to the state plan, radon tends to exist as a gas or as a dissolved atomic component in groundwater. In Pennsylvania, the most problematic source of radon in houses is radon in soil gas that flows into the house. Even a small rate of soil gas inflow can lead to elevated radon concentrations in a house. The state plan indicates that current data on the abundance and distribution of radon in

SECTION 4.3.8: RISK ASSESSMENT – RADON EXPOSURE

Pennsylvania homes is incomplete and biased, but the plan identifies general patterns. Values exceeding the Environmental Protection Agency’s guidelines occur in all regions of the state. The highest proportion of elevated values includes a zone extending from central Pennsylvania to southeast Pennsylvania that appears to include the Lehigh Valley (LVHMP, 2006).

4.3.8.2 Range of Magnitude

Exposure to radon is the second leading cause of lung cancer after smoking. It is the number one cause of lung cancer among non-smokers. As stated earlier, radon is responsible for about 21,000 lung cancer deaths every year; approximately 2,900 of which occur among people who have never smoked. Lung cancer is the only known effect on human health from exposure to radon in air and thus far, there is no evidence that children are at greater risk of lung cancer than are adults (EPA, 2010). The main hazard is actually from the radon daughter products (218Po, 214Pb, 214Bi), which may become attached to lung tissue and induce lung cancer by their radioactive decay. Table 4.3.8-1 shows the relationship between various radon levels, probability of lung cancer, comparable risks from other hazards, and action thresholds.

Table 4.3.8-1. Radon Risk for Smokers and Non-Smokers

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	Fix structure
8	About 120 people could get lung cancer	30 times the risk of dying in a fall	Fix structure
4	About 62 people could get lung cancer	5 times the risk of dying in a car crash	Fix structure
2	About 32 people could get lung cancer	6 times the risk of dying from poison	Consider fixing between 2 and 4 pCi/L
1.3	About 20 people could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2 pCi/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	Fix structure
8	About 15 people could get lung cancer	4 times the risk of dying in a fall	Fix structure
4	About 7 people could get lung cancer	The risk of dying in a car crash	Fix structure
2	About 4 people could get lung cancer	The risk of dying from poison	Consider fixing between 2 and 4 pCi/L
1.3	About 2 people could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2 pCi/L is difficult
0.4		(Average outdoor radon level)	
<small>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.</small>			

Source: EPA, 2010



SECTION 4.3.8: RISK ASSESSMENT – RADON EXPOSURE

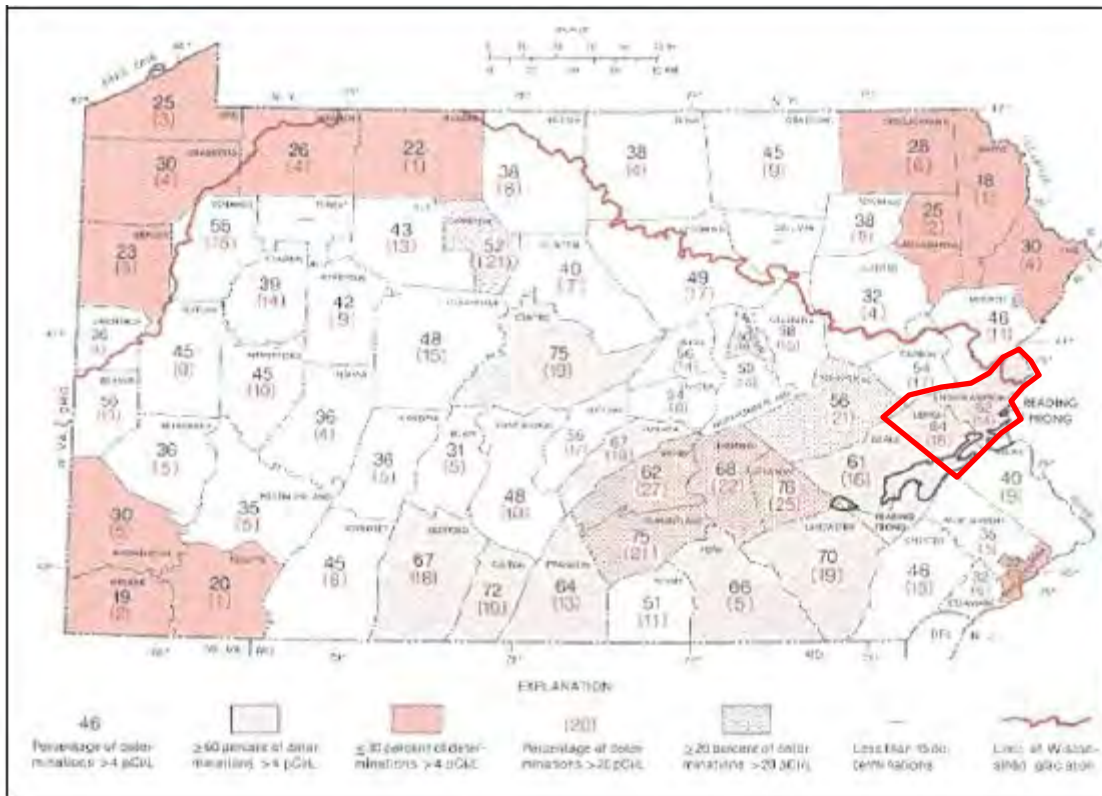
According to the EPA, the average radon concentration in the indoor air of U.S. homes is about 1.3 pCi/L. The EPA recommends homes be fixed if the radon level is 4 pCi/L or more. However, because there is no known safe level of exposure to radon, the EPA also recommends that Americans consider fixing their home for radon levels between 2 pCi/L and 4 pCi/L. As shown in Table 4.3.8-1, a smoker exposed to radon has a much higher risk of lung cancer.

The worst-case scenario for radon exposure would be that a large area of tightly sealed homes provided residents high levels of exposure over a prolonged period of time without the resident being aware. This worst-case scenario exposure then could lead to a large number of people with cancer attributed to the radon exposure (PEMA, 2010).

4.3.8.3 Past Occurrence

Current data on abundance and distribution of radon in Pennsylvania houses is considered incomplete and potentially biased, but some general patterns exist (see Figure 4.3.8-3).

Figure 4.3.8-3: Percentage of Pennsylvania homes having radon levels greater than 4 pCi/L



Source: PEMA 2010, PADER (now PADEP) 1989 (red highlight added)
 Note: State-sponsored samples in the Reading Prong are not included

Values exceeding the EPA guideline of 4 pCi/L occur in all regions of the Commonwealth. The highest proportion of elevated radon values in the Commonwealth exist in a zone extending from central Pennsylvania to southeastern Pennsylvania, and in the Reading Prong which includes the Lehigh Valley. High values in the latter area are attributed to known uranium-rich granitic gneisses (Smith, 1976; Gunderson et al., 1988), accentuated by local factors such as shear zones, and include a surprising number of extremely high radon values (>200 pCi/L). Information on average radon levels by zip code in

Pennsylvania can be obtained from the DEP at: http://www.dep.state.pa.us/RadiationProtection_Apps/Radon/.0.4 (Average outdoor radon level) (PEMA 2010).

4.3.8.4 Future Occurrence

Radon exposure is inevitable given present soil, geologic, and geomorphic factors across Pennsylvania. Development in areas where previous radon levels have been significantly high will continue to be more susceptible to exposure. However, new incidents of concentrated exposure may occur with future development or deterioration of older structures. Exposure can be limited with proper testing for both past and future development, and appropriate mitigation measures (PEMA, 2010). The future occurrence of radon exposure can be considered *likely* as defined by the Risk Factor Methodology probability criteria (refer to Section 4.4).

4.3.8.5 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. The following section discusses the potential impact of the radon exposure hazard on the Lehigh Valley including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety, (2) general building stock and critical facilities, (3) economy, (4) environment and (5) future growth and development
- Further data collections that will assist understanding this hazard over time

4.3.8.5.1 Overview of Vulnerability

Radon exposure is of particular concern in the Lehigh Valley due to its location within a High Potential (Level 1) EPA Radon Zone. While structural factors (e.g. building construction and engineered mitigation measures) can influence the level of radon exposure, all residents and structures within the Lehigh Valley are vulnerable to radon exposure.

4.3.8.5.2 Data and Methodology

The 2010 U.S. Census data and the custom building inventory for the Lehigh Valley was used to support an evaluation of assets exposed to this hazard and the potential impacts associated with this hazard. Per the 2010 Pennsylvania State Hazard Mitigation Plan, an average radon mitigation system cost of \$1200 was applied to 20% of the building stock to evaluate economic vulnerability.

4.3.8.5.3 Impact on Life, Health and Safety

For the purposes of this Plan, the entire population of the Lehigh Valley is exposed to the risk of radon exposure. Exposure to radon is the second leading cause of lung cancer after smoking. It is the number one cause of lung cancer among non-smokers. Radon is responsible for approximately 21,000 lung cancer deaths every year; approximately 2,900 of which occur among people who have never smoked.

Lung cancer is the only known effect on human health from exposure to radon in air and thus far, there is no evidence that children are at greater risk of lung cancer than are adults (USEPA, 2010).

Per Figure 4.3.8-3, 64% and 62% of homes in Lehigh and Northampton Counties, respectively, have measured radon levels exceeding 4 pCi/L, while 16% and 14% exceed 20 pCi/L in Lehigh and Northampton Counties, respectively. Excess human cancer risk due to radon exposure at these levels is identified in Table 4.3.8-1.

4.3.8.5.4 Impact on General Building Stock and Critical Facilities

While the entire general building stock and critical facility inventory in the Lehigh Valley is exposed to radon, radon does not result in direct damage to structures and facilities. Rather, engineering methods installed to mitigate human exposure to radon in structures results in economic costs described in the following subsection.

4.3.8.5.5 Impact on the Economy

Currently (2008), the EPA determines that an average radon mitigation system costs \$1,200. The EPA also states that current state surveys show that one home in five has elevated radon levels. Using this methodology, radon loss estimation is factored by assuming that 20% of the buildings within the High Potential (Level 1) counties have elevated radon values and each would require a radon mitigation system installed at the EPA estimated average of \$1,200.

According to this methodology, estimated radon mitigation costs for residential structures in the Lehigh Valley could exceed \$60 million. Per Figure 4.3.8-3, 64% and 62% of homes in Lehigh and Northampton Counties, respectively, have measured radon levels exceeding 4 pCi/L, thus the estimated costs for radon mitigation in the Lehigh Valley may be significantly higher than that estimated using the EPA methodology where only 20% of structures are considered for mitigation.

4.3.8.5.6 Impact on the Environment

Radon exposure has minimal environmental impacts. Due to the relatively short half-life of radon, it tends to only affect living and breathing organisms such as humans or pets which are routinely in contained areas (i.e. basement or house) where the gas is released (PEMA, 2010).

4.3.8.5.7 Future Growth and Development

Areas targeted for potential future growth and development in the next five (5) to ten (10) years have been identified across the Lehigh Valley at the municipal level. Refer to the jurisdictional annexes in Volume II of this Plan. Table B.1 in each jurisdictional annex lists the location of the potential new development and its exposure (if any) to known hazard zones. For the radon exposure hazard, the Lehigh Valley in its entirety has been identified as the hazard area. Therefore, any new development will be exposed to such risk.

Measures to reduce human exposure to radon in structures are readily available, and can be incorporated during new construction at significantly lower cost and greater effectiveness as opposed to retrofitting existing structures.

4.3.8.5.8 Additional Data and Next Steps

The assessment above identifies human health and economic losses associated with this hazard of concern; however these estimates are based on national epidemiological statistics and generalized estimates of costs to mitigate structures in the Lehigh Valley. As specific structural conditions affect human exposure to radon, direct radon measurements within facilities are needed to properly assess the level of health risk, and indicate the need for mitigation measures. Further, a consideration of radon exposure risk, and installation of mitigation measures as appropriate are recommended by the EPA during all new construction.

4.3.9 Subsidence/Sinkhole

This section provides a profile and vulnerability assessment for the subsidence/sinkhole hazard. According to the U.S. Geological Survey (USGS), “ground failure” is the term used to describe zones of ground cracking, fissuring, and localized horizontal and vertical permanent ground displacement that may be caused by surface rupture along faults; secondary movement on shallow faults; shaking-induced compaction of natural deposits in sedimentary basins and river valleys; liquefaction of loose, sandy sediment (USGS, 2005); landslides; and land subsidence and sinkholes. For the purpose of this HMP, the ground failure hazard to which the Lehigh Valley is vulnerable includes, but is not limited to, land subsidence or sinkholes, which are further defined as follows:

Land subsidence can be defined as the sudden sinking or gradual downward settling of the earth’s surface with little or no horizontal motion, owing to the subsurface movement of earth materials (USGS, 2007). Subsidence often occurs through the loss of subsurface support in Karst terrain, which may result from a number of natural and human-caused occurrences. Karst is a distinctive topography in which the landscape is largely shaped by the dissolving action of water on carbonate bedrock (usually limestone, dolomite, or marble).

Sinkholes, the type of subsidence most frequently seen in the Lehigh Valley, are a natural and common geologic feature in areas with underlying limestone, carbonate rock, salt beds, or other rocks that are soluble in water. Over periods of time measured in thousands of years, the carbonate bedrock can be dissolved through acidic rain water moving in fractures or cracks in the bedrock. This creates larger openings in the rock through which water and overlying soil materials will travel. Over time, the deposited soils compromise the strength of the bedrock, until it is unable to support the land surface above, and a collapse or sinkhole occurs. In this example the sinkhole occurs naturally, but in other cases the root causes of a sinkhole are anthropogenic, especially those that involve changes to the water balance of an area including: over-withdrawal of groundwater, diverting surface water from a large area and concentrating it in a single point, artificially creating ponds of surface water, and drilling new water wells. These actions can also serve to accelerate the natural processes of bedrock degradation, which can have a direct impact on sinkhole creation.

Both natural and man-made sinkholes can occur without warning. Slumping or falling fence posts, trees, or foundations; sudden formation of small ponds; wilting vegetation; discolored well water; and/or structural cracks in walls and floors, are all specific signs that a sinkhole is forming. They can form into steep-walled holes to bowl or cone shaped depressions. When sinkholes occur in developed areas they can cause severe property damage, injury and loss of life, disruption of utilities, and damage to roadways. In urban and suburban areas, sinkholes can destroy highways and buildings.

4.3.9.1 Location and Extent

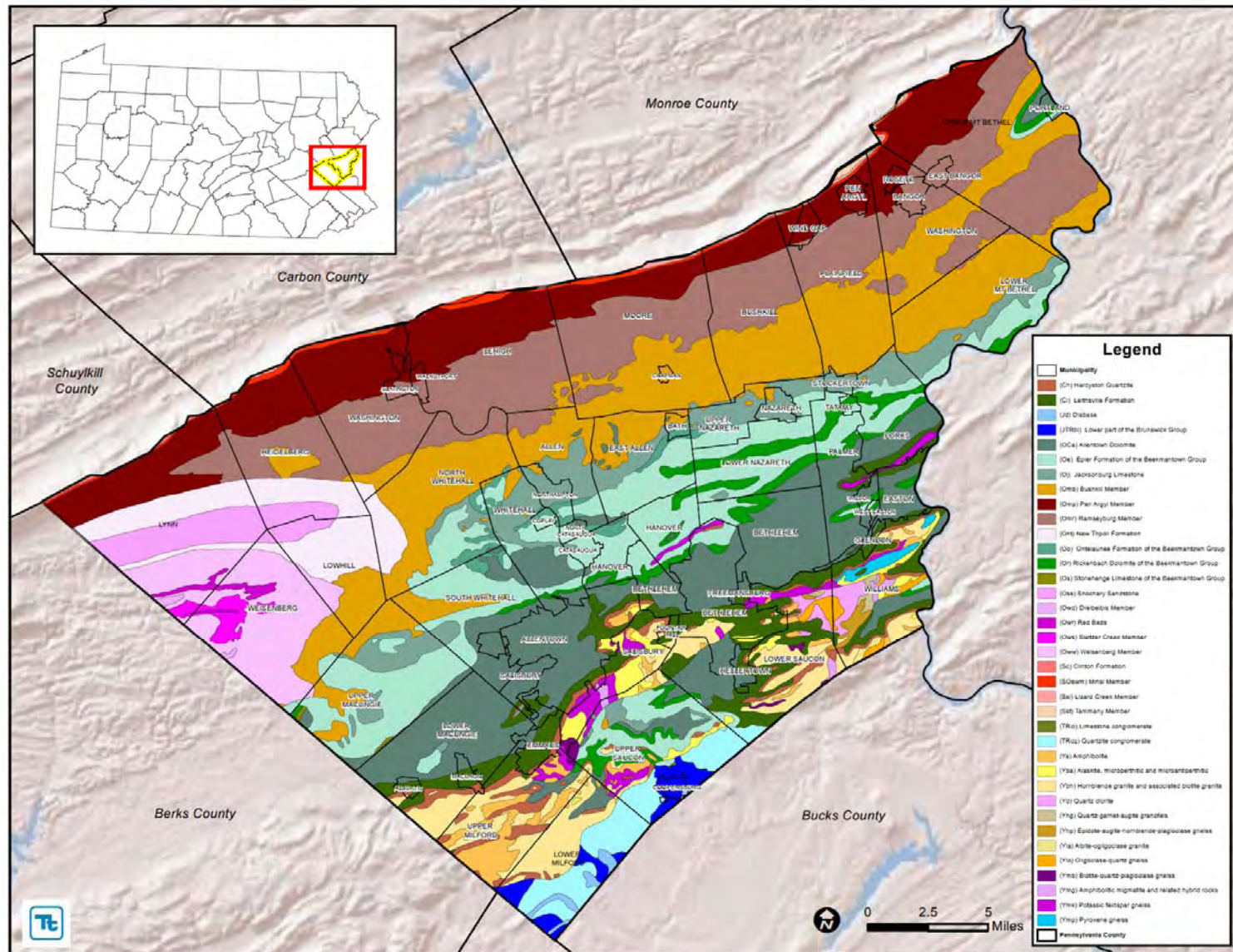
Forty-seven of the 62 municipalities in Lehigh and Northampton counties (or about 76% of municipalities) are underlain entirely or in part by carbonate bedrock. The carbonate rock formations have developed karst landforms, resulting in significant land subsidence problems. These limestone and dolomite formations underlie the heart of the Lehigh Valley’s urban core, and soils produced from the weathering of carbonate bedrock also provide the area’s most fertile farmland. The bedrock itself serves as a source of raw material for the cement industry. The Saucon Valley of Lehigh County is one of the most common sinkhole locations throughout Pennsylvania.

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Figure 4.3.9-1 illustrates the geology across the Lehigh Valley. Figure 4.3.9-2 illustrates the areas of Pennsylvania subject to natural subsidence due to the presence of limestone bedrock. Locations of known subsidence and sinkhole events as well as cave locations are also shown.

More specifically, Figure 4.3.9-3 shows the distribution of limestone in the Lehigh Valley and the areas vulnerable to subsidence. Figure 4.3.9-4 shows the areas of the region that are underlain by carbonate bedrock that are characterized by closed depressions, sinkholes and caves (karst features).

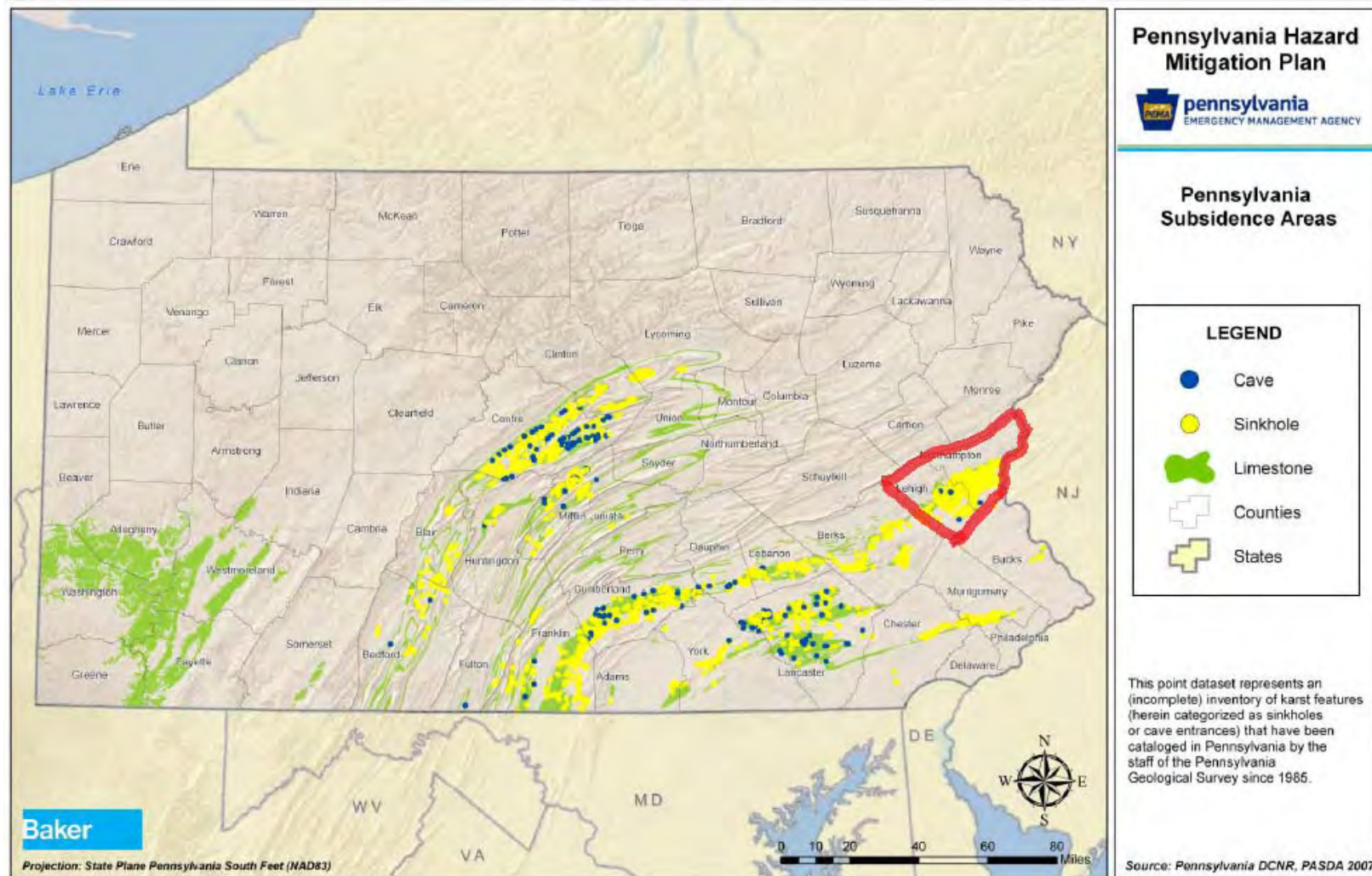
Figure 4.3.9-1. Lehigh Valley Geology



Source: LVPC, 2011; ESRI, 2009

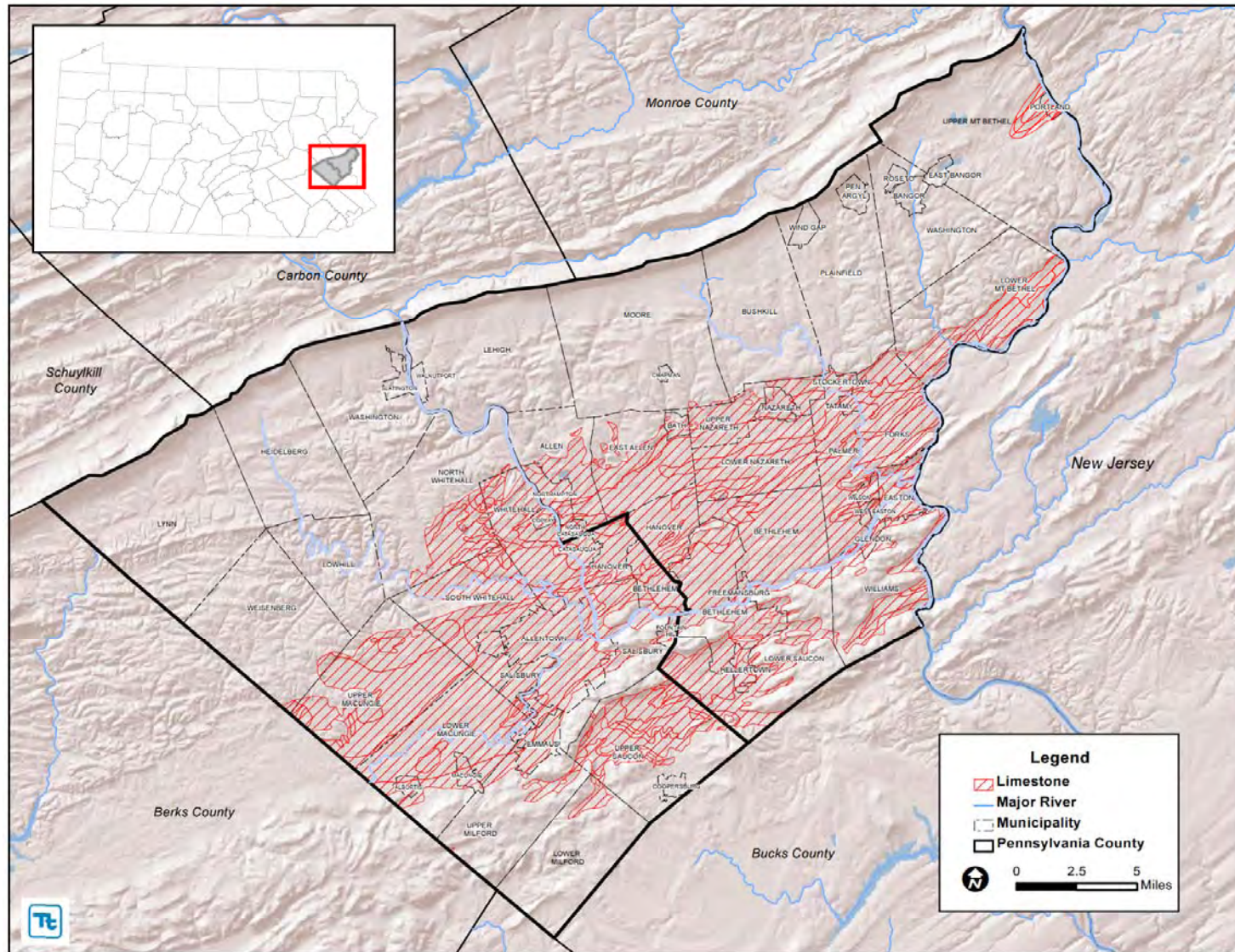


Figure 4.3.9-2. Areas of Pennsylvania Subject to Natural Subsidence Due to the Presence of Limestone Bedrock



Source: 2010 PA HMP (highlight added)

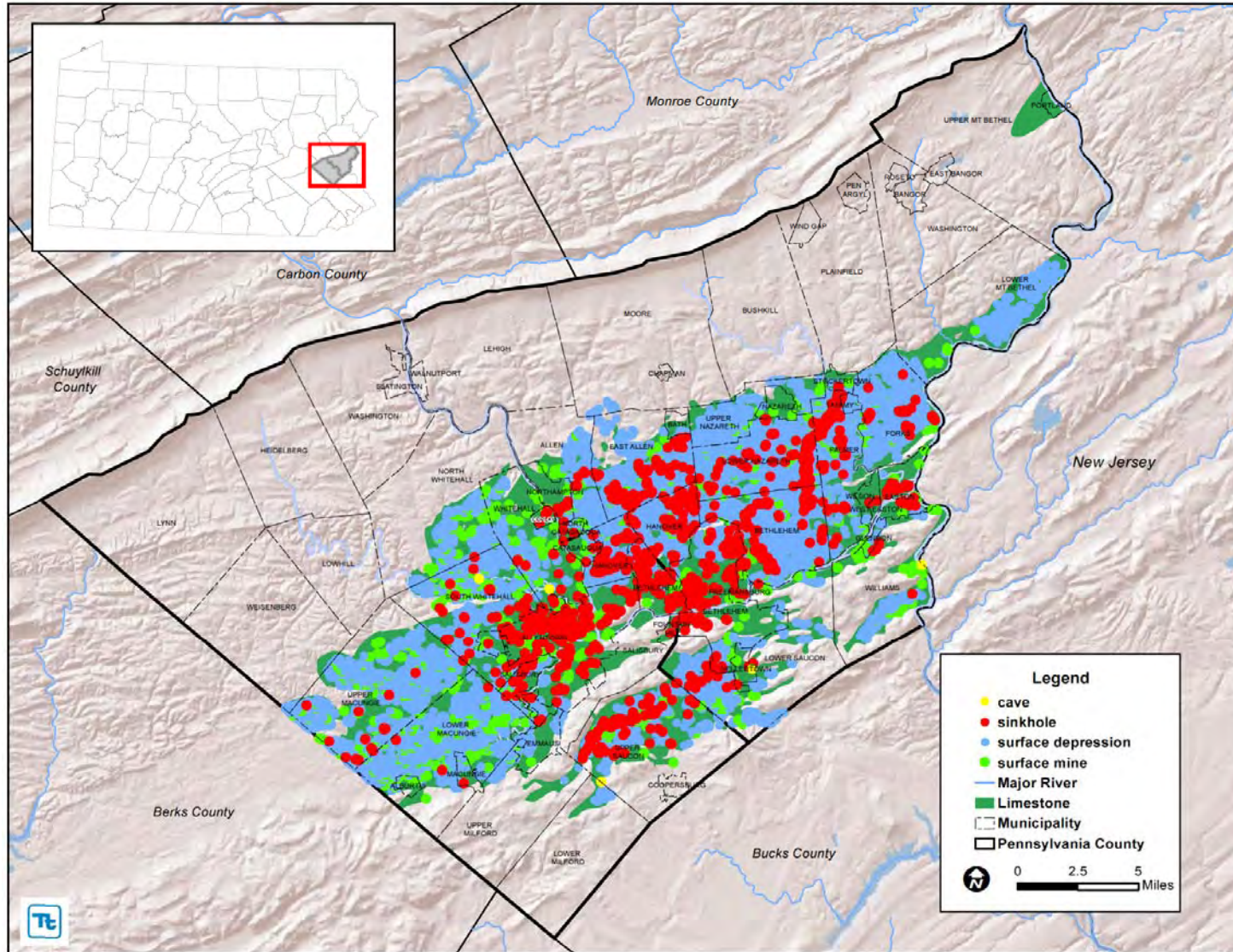
Figure 4.3.9-3. Lehigh Valley Limestone Geology



Source: LVPC, 2011; ESRI, 2009



Figure 4.3.9-4. Karst Features and Subsidence/Sinkhole Events in the Lehigh Valley



Source: PASDA, 2007 (Bureau of Topographic and Geologic Survey, Department of Conservation and Natural Resources)

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

The following municipalities have identified near-surface limestone, and are therefore vulnerable to sinkholes:

Lehigh County

Alburtis Borough
City of Allentown
City of Bethlehem
Catasauqua Borough
Coplay Borough
Emmaus Borough
Fountain Hill Borough
Hanover Township
Lower Macungie Township
Lower Milford Township
Macungie Borough
North Whitehall Township
Salisbury Township
South Whitehall Township
Upper Macungie Township
Upper Milford Township
Upper Saucon Township
Weisenberg Township
Whitehall Township

Northampton County

Allen Township
Bath Borough
City of Bethlehem
Bethlehem Township
Bushkill Township
East Allen Township
City of Easton
Forks Township
Freemansburg Borough
Glendon Borough
Hanover Township
Hellertown Borough
Lower Mt. Bethel Township
Lower Nazareth Township
Lower Saucon Township
Moore Township
Nazareth Borough
Northampton Borough
North Catasauqua Borough
Palmer Township
Plainfield Township
Portland Borough
Stockertown Borough
Tatamy Borough
Upper Mt. Bethel Township
Upper Nazareth Township
West Easton Borough
Williams Township
Wilson Borough

In summary, in Lehigh County, 19 of the 25 municipalities and approximately 80,399 acres are within the carbonate area. In Northampton County, 29 of 38 municipalities with approximately 87,516 acres are within the carbonate area for a total of 167,915 acres (262.4 square miles) in the Lehigh Valley. In Lehigh County, only five (5) of the 19 municipalities have less than 50% of their total acres in carbonate areas. These include Lower Milford Township, North Whitehall Township, Salisbury Township, Upper Milford Township and Weisenberg Township. Both Lower Milford Township and Weisenberg Township have less than 5% of their total acres in a carbonate area and, therefore, have a much lower hazard risk than the other municipalities.

In Northampton County, only eight (8) of the 29 municipalities have less than 50% of their total acres underlain by carbonate bedrock. These include Allen Township, Bushkill Township, Lower Mt. Bethel Township, Lower Saucon Township, Moore Township, Plainfield Township, Upper Mt. Bethel Township and Williams Township. Of these, Bushkill Township, Moore Township, Plainfield Township and Upper Mt. Bethel Township have less than 5% of their total acres in a carbonate area and also have a much lower hazard risk than the other municipalities. For purposes of this plan, we have assumed that the higher the percentage of carbonate bedrock in a municipality, the higher the risk for sinkhole formation.

While fewer karst features have been mapped in existing urban areas, human activity can often be the cause of a subsidence or sinkhole event. Furthermore, the lack of karst features exhibited in maps of urban areas is likely a result of development activities that disguise, cover, or fill existing features rather than an absence of the features themselves (PADCNr, 2003). Leaking water pipes or structures that convey storm-water runoff may also result in areas of subsidence as the water dissolves substantial amounts of rock over time. In some cases, construction, land grading or earthmoving activities that cause changes in stormwater flow can trigger sinkhole events. Subsidence or sinkhole events may occur in the presence of mining activity, especially in areas where the cover of a mine is thin, even in areas where bedrock is not necessarily conducive to their formation. Piggott and Eynon (1978) indicated that sinkhole development normally occurs where the interval to the ground surface is less than three to five times the thickness of the extracted seam and the maximum interval is up to ten times the thickness of the extracted seam. Sub-surface (i.e. underground) extraction of materials such as oil, gas, coal, metal ores (i.e. copper, iron, and zinc), clay, shale, limestone, or water may result in slow-moving or abrupt shifts in the ground surface.

4.3.9.2 Range of Magnitude

Based on the geologic formations underlying parts of the Lehigh Valley, subsidence and sinkhole events may occur gradually or abruptly. 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. If long-term subsidence or sinkhole formation is not recognized and mitigation measures are not implemented, fractures or complete collapse of building foundations and roadways may result. The photographs shown in Figure 4.3.9-5 through Figure 4.3.9-7 show several sinkholes that have occurred in Northampton County, and provide examples of the severe damage sinkholes can inflict on property and infrastructure.

Figure 4.3.9-5. Collapse of Creek Bank and Yard along Bushkill Creek



Source: LVHMP, 2006 (Photograph courtesy of Hercules Cement Co.)

Figure 4.3.9-6. Norfolk Southern Railroad Bridge Wingwall Sinking into a Water-filled Sinkhole along Bushkill Creek



Source: LVHMP, 2006 (Photograph courtesy of the Brookwood Group)

Figure 4.3.9-7: Sinkhole at Corporate Plaza Building in the City of Allentown, Lehigh County, PA in February, 1994



Source: PA HMP, 2010 (Photograph by William E. Kochanov. PADCNR, 2009)

Sinkholes also may have negative effects on local groundwater. Groundwater in limestone and other similar carbonate rock formations can be easily polluted, because water moves readily from the earth's surface down through solution cavities and fractures, thus undergoing very little filtration. Contaminants such as sewage, fertilizers, herbicides, pesticides, or industrial products are of concern.

The worst-case scenario for subsidence and sinkholes in the Lehigh Valley would be for a sinkhole to form in one of the three major urban areas, namely Allentown, the City of Bethlehem, and City of Easton. A sinkhole in any one of these cities, either in a highly trafficked pedestrian area or under one of the many high traffic roadways or bridges, could potentially cause significant property damage and/or loss of life. Refer to the Vulnerability Assessment for further details on the population, general building stock and critical facilities and infrastructure vulnerable to this hazard.

4.3.9.3 Past Occurrence

Historic records indicate the Lehigh Valley has been impacted by subsidence and sinkholes. According to the Pennsylvania Department of Conservation and Natural Resources' Sinkhole Inventory Online Database, there have been 464 recorded sinkholes in Lehigh County and 658 in Northampton County. Figure 4.3.9-4 illustrates the locations of these sinkhole events.

From 2008 to 2011, PennDOT Engineering District 5-0 reported road or lane closures due to sinkholes in seven (7) municipalities throughout the Lehigh Valley. PEMA records from January 2007 to January 2009 include an additional six (6) municipalities with sinkhole events during this period. Table 4.3.9-1 summarizes historic sinkhole events in the Lehigh Valley from 2007 to 2011.

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Table 4.3.9-1. Reported Sinkholes in the Lehigh Valley, 2007-2011

Municipality	PENN DOT	PEMA	Description
City of Allentown	X		Not available
Bethlehem Township	X	X	<p>1) Sinkhole in the roadway, cross street of Brodhead Road. Tractor trailer stuck in sinkhole up to frame.</p> <p>2) Bethlehem city water authority called asking for Fire Dept. to respond to a water main break; wanted to make sure a building was stable. Fire command required codes inspector come out as a garage is being undermined by the sinkhole. Fire Dept. indicated slight shift of the foundation. No injuries.</p> <p>3) Fire Dept. responded for possible structural damage to the Circuit City warehouse building due to a large sinkhole forming outside the employees break room. Building was evacuated and there were several cracks in the structure near the sinkhole.</p>
Bushkill Township		X	Sinkhole reported at cross streets of Old Mill and Bushkill Center roads, which started as pot hole now getting larger and becoming sinkhole.
City of Easton	X		Not available
Freemansburg Borough		X	Sinkhole in parking lot.
Hanover Township		X	Caller reports a sinkhole approximately 6' by 5' and 20' deep along the side of the off ramp.
Lehigh Township	X		Not available
Lower Nazareth Township		X	<p>1) Sinkhole starting in roadway. 1 vehicle reporting damage.</p> <p>2) In the area of where repair work was done on a water line, report says a patch is now sinking.</p>
Palmer Township		X	<p>1) Area of Tracy Elementary School, sinkhole started in the road but adjacent to school property;</p> <p>2) Sinkhole in the roadway with a visible dimension of 1ft by 1ft, but unknown how deep or spread beneath the road surface.</p>
Tatamy Borough	X		Not available
West Easton Borough	X		Not available
Whitehall Township	X		Not available
Wind Gap Borough		X	Large sinkhole opening up in the middle of the roadway.

Source: PennDOT, 2012; PEMA, 2009

The sinkhole activity in recent years has affected residents of the Lehigh Valley, and the record rainfall coupled with a minor earthquake in 2011 could have caused more sinkholes to open than usual (Muschick, 2012). Those affected include four Allentown homes rendered uninhabitable in December 2011 after a water main break and sinkhole that originally damaged eight (8) houses and temporarily displaced about 25 residents from their homes. The hole also disrupted several graves in the neighboring Union and West End Cemetery (McEvoy, 2012). Other sinkhole damage in 2011 occurred on Irma Drive in Hanover Township (L) (The Morning Call, 2012), in Whitehall Township (Watchdog, 2011), and in Bethlehem Township (N). In 2008, a 200 foot sinkhole opened up in Easton (Lewis, 2011).

According to the 2006 Lehigh Valley Hazard Mitigation Plan, the area from Nazareth Borough to Stockertown Borough and Tatamy Borough in Northampton County were plagued with sinkhole

problems in the early to mid-2000's. The new Nazareth Area Middle School on Tatamy Road had a sinkhole in its parking lot that was expensive and difficult to fix. Other occurrences in Northampton County included sinkholes opening up on three (3) residential properties near Newburg Road in Lower Nazareth Township. Sinkholes opened up on farmland near the border of Palmer and Upper Nazareth Townships threatening a Nazareth Borough Municipal Authority sewer line. Sinkholes damaged roadways in both Townships. Damage amounts for these events are not known.

Sinkholes along the Bushkill Creek led to the closure of the bridge on the main road between Tatamy Borough and Stockertown Borough in 2000. During the time when PennDOT was attempting to repair the sinkholes near the bridge, a large sinkhole opened up in the rear yard of a residence to the south and west of the bridge, and a portion of the creek bank adjacent to the property collapsed. The damage extended from the creek bank to the location of the original sinkhole repair.

In terms of monetary damages, the worst sinkhole event on record was reported in January 2004. A sinkhole caused structural damage to the northbound Route 33 Bridge over the Bushkill Creek. PennDOT closed the bridge and determined the bridge needed to be demolished and replaced. The southbound bridge was also replaced for a total project cost of about \$6 million. This event resulted in a disaster declaration by the Governor.

On December 8, 2004, a large sinkhole opened up on St. John Street in Easton. A two-block section of the road was closed when a 200-foot long and 30-foot deep sinkhole opened. An apartment building with seven (7) units nearby had to be demolished. The state allocated \$300,000 for the road repair work.

The February 1994 event in the City of Allentown, shown in Figure 4.3.9-7, is one of the worst known events in Pennsylvania. The sinkhole measured 100-feet long, 50-feet wide and 20-feet deep and collapsed a portion of 7th Street and the adjoining new Corporate Plaza Building in downtown Allentown. The building was ultimately demolished and replaced with a parking lot. Damage amounts are not known.

News reports identified 13 sinkholes or clusters of sinkholes that had been active during the late 1980s. The sinkholes ranged in size from one in the City of Bethlehem, that measured three feet in diameter with a depth of five feet, to one in Upper Saucon Township that measured 120 feet in diameter with a depth of 55 feet.

In seven (7) instances, sinkholes engulfed public roads. In five of these seven instances the collapse of the road was accompanied by the disruption of underground utility lines as the lines broke or service was cut-off to prevent problems. The roads damaged were located in Macungie Borough, Allentown, Upper Saucon Township, and Hanover Township (L), Easton, City of Bethlehem and Bethlehem Township. In each instance the road was closed for repairs. While some repairs could be accomplished quickly, others involved repair periods as long as three years (Upper Saucon Township) before the damage could be fixed.

According to the State hazard mitigation plan, the road in Upper Saucon Township cost nearly \$800,000 to repair and a new sinkhole opened outside the repair area within six months. These sinkholes also damaged privately-owned structures. A sinkhole occurrence damaged a church and a college dormitory in Allentown. In the case of the dormitory, 51 students had to be relocated for nearly one month. Homes in the City of Bethlehem, Hanover Township (L), and Bethlehem Township were damaged. More specific details on these events are not known.

These sinkhole event descriptions are just a sampling of some of the sinkhole occurrences in the Lehigh Valley. Many others have occurred over the years. It should be noted that many other sinkhole

occurrences go unreported as they occur on private property and do not endanger structures such as in farm fields and woodlots.

4.3.9.4 Future Occurrence

Sinkhole occurrence is a continuing phenomenon and is fairly common in the carbonate areas of the Lehigh Valley, and the probability of a sinkhole forming in the Lehigh Valley is high. As these areas become increasingly developed the strain on underground aquifers will increase. This will pose an even greater threat for sinkholes in those areas resulting from groundwater depletion.

Based on geological conditions, subsidence events are likely to occur in the future for the areas of the Lehigh Valley underlain by carbonate bedrock and experiencing increased development. It would be difficult to calculate potential losses for all existing buildings, critical facilities and infrastructure due to sinkhole formation as the hazard area amounts to approximately one third of the entire Lehigh Valley. However, the future occurrence of subsidence and sinkholes is considered *likely* as defined by the Risk Factor Methodology probability criteria (refer to Section 4.4).

4.3.9.5 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. The following section discusses the potential impact of the subsidence and sinkhole hazard on the Lehigh Valley including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety, (2) general building stock, (3) critical facilities, (4) economy and (5) future growth and development
- Effect of climate change on vulnerability
- Further data collections that will assist understanding this hazard over time

4.3.9.5.1 Overview of Vulnerability

Approximately 35% of the Lehigh Valley is underlain by carbonate bedrock. The carbonate rock formations have developed karst landforms, resulting in significant land subsidence problems. Table 4.3.9-2 below summarizes the areas within Lehigh Valley underlain by limestone and within the subsidence/sinkhole hazard area defined for this planning effort.

Table 4.3.9-2. Area Located in the Approximate Subsidence/Sinkhole Hazard Area

Municipality	Total Area (sq. mi.)	Area Exposed	
		Approx. Hazard Area (Limestone) (sq. mi.)	Percent of Total
Lehigh County			
Alburtis Borough	0.71	0.63	88.7
Allentown, City of	18.02	15.9	88.2
Bethlehem, City of	4.4	4.2	95.5
Catasauqua Borough	1.3	1.3	100
Coopersburg Borough	0.94	0	0.0

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Municipality	Total Area (sq. mi.)	Area Exposed	
		Approx. Hazard Area (Limestone) (sq. mi.)	Percent of Total
Coplay Borough	0.63	0.63	100
Emmaus Borough	2.9	2.5	86.2
Fountain Hill Borough	0.76	0.51	67.1
Hanover Township	4.3	4.3	100
Heidelberg Township	24.7	0	0.0
Lower Macungie Township	22.5	18.9	84.0
Lower Milford Township	19.7	0.98	5.0
Lowhill Township	14.1	0	0.0
Lynn Township	41.7	0	0.0
Macungie Borough	0.99	0.85	85.9
North Whitehall Township	28.5	7.0	24.6
Salisbury Township	11.3	4.5	39.8
Slatington Borough	1.4	0	0.0
South Whitehall Township	17.2	14.5	84.3
Upper Macungie Township	26.2	21.1	80.5
Upper Milford Township	18.0	2.3	12.8
Upper Saucon Township	24.7	12.8	51.8
Washington Township	23.7	0	0.0
Weisenberg Township	26.8	0.7	2.6
Whitehall Township	12.8	12.2	95.3
Lehigh County (est. total)	348.3	125.8	36.1
Northampton County			
Allen Township	11.3	4.8	42.5
Bangor Borough	1.5	0.0	0.0
Bath Borough	0.9	0.6	66.7
Bethlehem Township	14.7	14.7	100
Bethlehem, City of	15.0	12.7	84.7
Bushkill Township	25.7	0.09	0.4
Chapman Borough	0.4	0	0.0
East Allen Township	14.6	9.7	66.4
East Bangor Borough	0.9	0	0.0
Easton, City of	4.4	4.4	100
Forks Township	12.3	11.6	94.3
Freemansburg Borough	0.8	0.7	87.5
Glendon Borough	0.8	0.76	95.0
Hanover Township	6.6	6.3	95.5
Hellertown Borough	1.3	1.2	92.3
Lehigh Township	29.8	0	0.0

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Municipality	Total Area (sq. mi.)	Area Exposed	
		Approx. Hazard Area (Limestone) (sq. mi.)	Percent of Total
Lower Mt. Bethel Township	24.6	10.5	42.7
Lower Nazareth Township	13.6	13.6	100
Lower Saucon Township	24.5	11.3	46.1
Moore Township	37.7	0.17	0.5
Nazareth Borough	1.7	1.5	88.2
North Catasauqua Borough	0.8	0.8	100
Northampton Borough	2.6	2.5	96.2
Palmer Township	10.4	10.2	98.1
Pen Argyl Borough	1.4	0	0.0
Plainfield Township	24.5	0.08	0.3
Portland Borough	0.6	0.57	95.0
Roseto Borough	0.6	0	0.0
Stockertown Borough	1.0	0.9	90.0
Tatamy Borough	0.57	0.57	100
Upper Mt. Bethel Township	44.0	2	4.5
Upper Nazareth Township	7.5	6.8	90.7
Walnutport Borough	0.8	0	0.0
Washington Township	18.0	0.0	0.0
West Easton Borough	0.3	0.3	100
Williams Township	18.6	6.2	33.3
Wilson Borough	1.2	1.2	100
Wind Gap Borough	1.4	0	0.0
Northampton County (est. total)	377.2	136.7	36.3

Source: LVPC, 2011

Note: Approx. = Approximate; est. = Estimated; sq.mi. = Square Miles

4.3.9.5.2 Data and Methodology

Unlike the flood, wind and earthquake hazards, there are no standard loss estimation models or methodologies for the subsidence/sinkhole hazard. In an attempt to estimate the Lehigh Valley's vulnerability, the portion of the region underlain by limestone bedrock is considered exposed to natural subsidence. To determine what assets are exposed to this hazard, available and appropriate GIS data was overlaid upon the hazard area. The limitations of this analysis are recognized and are only used to provide a general estimate. Over time additional data will be collected to allow better analysis for this hazard. Available information and a preliminary assessment are provided below.

4.3.9.5.3 Impact on Life, Health and Safety

To estimate the population exposed, the approximate hazard area (limestone boundary) was overlaid upon the 2010 Census population data (U.S. Census, 2010). The Census blocks with their center (centroid)

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

within the boundary were used to calculate the estimated population exposed to this hazard. Table 4.3.9-3 summarizes the Lehigh Valley population exposed to this hazard by municipality (U.S. Census 2010).

Table 4.3.9-3. Population Located in the Approximate Subsidence/Sinkhole Hazard Area (U.S. Census 2010)

Municipality	Total Pop.	Population Exposed	
		Approx. Pop. Hazard Area (Limestone)	Percent of Total
Lehigh County			
Alburtis Borough	2,361	2,233	94.6
Allentown, City of	118,032	108,966	92.3
Bethlehem, City of	19,343	18,305	94.6
Catasauqua Borough	6,436	6,364	100.0
Coopersburg Borough	2,386	0	0.0
Coplay Borough	3,192	3,192	100.0
Emmaus Borough	11,211	10,776	96.1
Fountain Hill Borough	4,597	3,855	83.9
Hanover Township	1,571	1,552	100.0
Heidelberg Township	3,416	0	0.0
Lower Macungie Township	30,633	29,511	96.3
Lower Milford Township	3,775	315	8.3
Lowhill Township	2,173	0	0.0
Lynn Township	4,229	0	0.0
Macungie Borough	3,074	2,673	87.0
North Whitehall Township	15,703	3,576	22.8
Salisbury Township	13,505	8,734	64.7
Slatington Borough	4,232	0	0.0
South Whitehall Township	19,180	17,754	92.6
Upper Macungie Township	20,063	16,792	83.7
Upper Milford Township	7,292	1,349	18.5
Upper Saucon Township	14,808	7,242	48.9
Washington Township	6,624	0	0.0
Weisenberg Township	4,923	78	1.6
Whitehall Township	26,738	26,452	98.9
Lehigh County (est. total)	349,497	269,719	77.2
Northampton County			
Allen Township	4,269	2,334	54.7
Bangor Borough	5,273	0	0.0
Bath Borough	2,693	1,986	73.7
Bethlehem Township	23,730	23,730	100.0
Bethlehem, City of	55,639	46,386	83.4
Bushkill Township	8,178	5	0.1

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Municipality	Total Pop.	Population Exposed	
		Approx. Pop. Hazard Area (Limestone)	Percent of Total
Chapman Borough	199	0	0.0
East Allen Township	4,903	3,510	71.6
East Bangor Borough	1,172	0	0.0
Easton, City of	26,800	26,800	100.0
Forks Township	14,721	13,999	95.1
Freemansburg Borough	2,636	2,284	86.6
Glendon Borough	440	431	98.0
Hanover Township	10,866	10,014	92.2
Hellertown Borough	5,898	5,500	93.3
Lehigh Township	10,526	0	0.0
Lower Mt. Bethel Township	3,101	1,521	49.0
Lower Nazareth Township	5,674	5,674	100.0
Lower Saucon Township	10,772	6,634	61.6
Moore Township	9,198	0	0.0
Nazareth Borough	5,746	5,219	90.8
North Catasauqua Borough	2,849	2,849	100.0
Northampton Borough	9,926	9,119	91.9
Palmer Township	20,691	20,208	97.7
Pen Argyl Borough	3,595	0	0.0
Plainfield Township	6,138	0	0.0
Portland Borough	519	519	100.0
Roseto Borough	1,567	0	0.0
Stockertown Borough	927	882	95.1
Tatamy Borough	1,203	1,203	100.0
Upper Mt. Bethel Township	6,706	458	6.8
Upper Nazareth Township	6,231	6,176	99.1
Walnutport Borough	2,070	0	0.0
Washington Township	5,122	0	0.0
West Easton Borough	1,257	1,257	100.0
Williams Township	5,884	1,447	24.6
Wilson Borough	7,896	7,896	100.0
Wind Gap Borough	2,720	0	0.0
Northampton County (est. total)	297,735	208,041	69.9

Source: U.S. Census 2010; LVPC, 2011

Note: est. = Estimated; Pop = Population; Approx. = Approximate

4.3.9.5.4 Impact on General Building Stock

As noted above, there are no standard loss estimation models for the subsidence/sinkhole hazard. In general, the built environment located on limestone is exposed to this hazard. In an attempt to estimate the general building stock vulnerable to this hazard, the associated building replacement values (buildings and contents) were determined for the identified Census blocks within the approximate hazard area. Table 4.3.9-4 lists the replacement value (structure and contents) of general building stock exposed to this hazard.

Table 4.3.9-4. Estimated General Building Stock Located in the Approximate Subsidence/Sinkhole Hazard Area

Municipality	Total GBS	GBS Exposed	
		GBS in the Hazard Area (Limestone)	Percent of Total
Lehigh County			
Alburtis Borough	\$280,994,000	\$260,211,000	92.6
Allentown, City of	\$20,982,347,000	\$19,786,869,000	94.3
Bethlehem, City of	\$4,769,721,000	\$3,997,481,000	83.8
Catasauqua Borough	\$934,748,000	\$934,748,000	100
Coopersburg Borough	\$421,475,000	\$0	0.0
Coplay Borough	\$406,752,000	\$406,752,000	100
Emmaus Borough	\$2,088,277,000	\$1,941,753,000	93.0
Fountain Hill Borough	\$1,101,911,000	\$1,017,804,000	92.4
Hanover Township	\$2,254,652,000	\$2,254,652,000	100
Heidelberg Township	\$550,037,000	\$0	0.0
Lower Macungie Township	\$5,924,050,000	\$5,808,936,000	98.1
Lower Milford Township	\$534,598,000	\$49,509,000	9.3
Lowhill Township	\$371,530,000	\$0	0.0
Lynn Township	\$612,033,000	\$0	0.0
Macungie Borough	\$533,007,000	\$485,312,000	91.1
North Whitehall Township	\$2,850,746,000	\$621,455,000	21.8
Salisbury Township	\$3,606,044,000	\$2,877,181,000	79.8
Slatington Borough	\$715,470,000	\$0	0.0
South Whitehall Township	\$4,885,829,000	\$4,402,054,000	90.1
Upper Macungie Township	\$10,206,499,000	\$9,459,262,000	92.7
Upper Milford Township	\$1,178,767,000	\$301,499,000	25.6
Upper Saucon Township	\$3,171,479,000	\$1,883,848,000	59.4
Washington Township	\$893,760,000	\$0	0.0
Weisenberg Township	\$1,189,552,000	\$9,653,000	0.8
Whitehall Township	\$5,424,311,000	\$5,372,477,000	99.0
Lehigh County (est. total)	\$75,888,589,000	\$61,871,456,000	81.5
Northampton County			
Allen Township	\$712,840,000	\$416,615,000	58.4
Bangor Borough	\$926,661,000	\$0	0.0

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Municipality	Total GBS	GBS Exposed	
		GBS in the Hazard Area (Limestone)	Percent of Total
Bath Borough	\$471,748,000	\$358,406,000	76.0
Bethlehem Township	\$5,752,889,000	\$5,752,889,000	100
Bethlehem, City of	\$9,934,952,000	\$8,919,123,000	89.8
Bushkill Township	\$1,289,529,000	\$442,000	0.0
Chapman Borough	\$32,434,000	\$0	0.0
East Allen Township	\$1,104,833,000	\$931,866,000	84.3
East Bangor Borough	\$118,151,000	\$0	0.0
Easton, City of	\$4,848,037,000	\$4,848,037,000	100
Forks Township	\$3,177,595,000	\$3,056,845,000	96.2
Freemansburg Borough	\$361,483,000	\$348,983,000	96.5
Glendon Borough	\$89,841,000	\$81,925,000	91.2
Hanover Township	\$3,484,970,000	\$3,304,385,000	94.8
Hellertown Borough	\$888,848,000	\$834,188,000	93.9
Lehigh Township	\$1,487,389,000	\$0	0.0
Lower Mt. Bethel Township	\$502,664,000	\$301,214,000	59.9
Lower Nazareth Township	\$2,194,429,000	\$2,194,429,000	100
Lower Saucon Township	\$1,968,200,000	\$1,304,733,000	66.3
Moore Township	\$1,223,870,000	\$0	0.0
Nazareth Borough	\$1,312,606,000	\$1,224,625,000	93.3
North Catasauqua Borough	\$386,289,000	\$386,289,000	100
Northampton Borough	\$1,843,226,000	\$1,759,718,000	95.5
Palmer Township	\$4,169,701,000	\$4,015,404,000	96.3
Pen Argyl Borough	\$651,065,000	\$0	0.0
Plainfield Township	\$1,086,698,000	\$3,410,000	0.3
Portland Borough	\$162,069,000	\$162,069,000	100
Roseto Borough	\$276,318,000	\$0	0.0
Stockertown Borough	\$298,470,000	\$290,839,000	97.4
Tatamy Borough	\$216,261,000	\$216,261,000	100
Upper Mt. Bethel Township	\$1,311,378,000	\$79,523,000	6.1
Upper Nazareth Township	\$1,071,480,000	\$1,060,276,000	99.0
Walnutport Borough	\$506,739,000	\$0	0.0
Washington Township	\$875,751,000	\$0	0.0
West Easton Borough	\$267,628,000	\$267,628,000	100
Williams Township	\$1,200,406,000	\$417,524,000	34.8
Wilson Borough	\$1,731,473,000	\$1,731,473,000	100
Wind Gap Borough	\$532,380,000	\$0	0.0
Northampton County (est. total)	\$58,471,301,000	\$44,269,119,000	75.7

Source: LVPC, 2011
Notes: GBS = General Building Stock



SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Please note this data does not include agricultural buildings for Northampton County.

4.3.9.5.5 Impact on Critical Facilities

It is recognized that a number of critical facilities, transportation and utility assets are located in the hazard area, and are also exposed to subsidence/sinkholes. Table 4.3.9-5 summarizes essential facilities (police, fire, medical and school facilities) identified by the Lehigh Valley plan participants that are located within the identified hazard area.

Table 4.3.9-5. Critical Facilities Located in the Identified Hazard Area (Limestone)

Name	Municipality	Type
Lehigh County		
ALBURTIS FIRE CO	Alburtis (B)	Fire
ALBURTIS ELEMENTARY SCHOOL	Alburtis (B)	School
St. Luke's Hospital Allentown	Allentown (C)	Medical
Lehigh Valley Hospital - 17th & Chew	Allentown (C)	Medical
Sacred Heart Hospital	Allentown (C)	Medical
WESCOSVILLE FIRE COMPANY	Allentown (C)	Fire
WESTERN SALISBURY FIRE CO	Allentown (C)	Fire
CETRONIA FIRE COMPANY	Allentown (C)	Fire
WOODLAWN FIRE CO #1	Allentown (C)	Fire
WOODLAWN FIRE CO #1	Allentown (C)	Fire
W SALISBURY VOL FIRE CO#3	Allentown (C)	Fire
CITY OF ALLENTOWN	Allentown (C)	Fire
CITY OF ALLENTOWN	Allentown (C)	Fire
CITY OF ALLENTOWN	Allentown (C)	Fire
CITY OF ALLENTOWN	Allentown (C)	Fire
CITY OF ALLENTOWN	Allentown (C)	Fire
CITY OF ALLENTOWN	Allentown (C)	Fire
CITY OF ALLENTOWN	Allentown (C)	Fire
HANOVER TOWNSHIP	Allentown (C)	Fire
UNION TERRACE ELEMENTARY SCHOOL	Allentown (C)	School
WILLIAM ALLEN HIGH SCHOOL	Allentown (C)	School
ST CATHERINE OF SIENA	Allentown (C)	School
ST CATHERINE OF SIENA	Allentown (C)	School
RAUB MIDDLE SCHOOL	Allentown (C)	School
WILLIAM ALLEN HIGH SCHOOL	Allentown (C)	School
WILLIAM ALLEN HIGH SCHOOL	Allentown (C)	School
LEHIGH PARKWAY ELEMENTARY SCHOOL	Allentown (C)	School
LINCOLN ELEMENTARY SCHOOL	Allentown (C)	School
MUHLENBERG ELEMENTARY SCHOOL	Allentown (C)	School

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Name	Municipality	Type
JACKSON ELEMENTARY SCHOOL	Allentown (C)	School
TREXLER MIDDLE SCHOOL	Allentown (C)	School
ST FRANCIS OF ASSISI	Allentown (C)	School
MCKINLEY ELEMENTARY SCHOOL	Allentown (C)	School
CLEVELAND ELEMENTARY SCHOOL	Allentown (C)	School
WASHINGTON ELEMENTARY SCHOOL	Allentown (C)	School
CENTRAL ELEMENTARY SCHOOL	Allentown (C)	School
JEFFERSON ELEMENTARY SCHOOL	Allentown (C)	School
SOUTH MOUNTAIN MIDDLE SCHOOL	Allentown (C)	School
ROOSEVELT ELEMENTARY SCHOOL	Allentown (C)	School
WILSON EARLY CHILDHOOD CENTER	Allentown (C)	School
WILEY HOUSE	Allentown (C)	School
ROBERTO CLEMENTE CHARTER SCHOOL	Allentown (C)	School
ALLENTOWN CENTRAL CATHOLIC HIGH SCHOOL	Allentown (C)	School
SACRED HEART ELEMENTARY SCHOOL	Allentown (C)	School
ALLENTOWN CENTRAL CATHOLIC HIGH SCHOOL	Allentown (C)	School
SHERIDAN ELEMENTARY SCHOOL	Allentown (C)	School
HOLY SPIRIT SCHOOL	Allentown (C)	School
HARRISON-MORTON MIDDLE SCHOOL	Allentown (C)	School
DIERUFF HIGH SCHOOL	Allentown (C)	School
RITTER ELEMENTARY SCHOOL	Allentown (C)	School
LEHIGH VALLEY CHRISTIAN HIGH SCHOOL	Allentown (C)	School
MIDWAY MANOR EARLY EDUCATION CENTER	Allentown (C)	School
KINGS WAY ACADEMY	Allentown (C)	School
THE LUTHERAN ACADEMY	Allentown (C)	School
ST PAULS SCHOOL	Allentown (C)	School
MERCY DAY SCHOOL	Allentown (C)	School
OUR LADY HELP OF CHRISTIANS SCHOOL	Allentown (C)	School
HOLY SPIRIT ELEMENTARY SCHOOL	Allentown (C)	School
HIRAM DODD ELEMENTARY SCHOOL	Allentown (C)	School
CITY OF BETHLEHEM	Bethlehem (C)	Fire
CITY OF BETHLEHEM	Bethlehem (C)	Fire
REGIONAL ACADEMIC STANDARDS ACADEMY	Bethlehem (C)	School
CENTENNIAL SCHOOL	Bethlehem (C)	School
CLEARVIEW ELEMENTARY SCHOOL	Bethlehem (C)	School
JAMES BUCHANAN ELEMENTARY SCHOOL	Bethlehem (C)	School

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Name	Municipality	Type
WILEY HOUSE	Bethlehem (C)	School
CALYPSO ELEMENTARY SCHOOL	Bethlehem (C)	School
NITSCHMANN MIDDLE SCHOOL	Bethlehem (C)	School
VITALISTIC THERAPEUTIC SCHOOL	Bethlehem (C)	School
CENTRAL CHRISTIAN ACADEMY	Bethlehem (C)	School
NOTRE DAME SCHOOL	Bethlehem (C)	School
ST SIMON & JUDE SCHOOL	Bethlehem (C)	School
SOUTHWARK HOSE CO #9	Catasauqua (B)	Fire
EAST END FIRE CO	Catasauqua (B)	Fire
ST MARYS CATHOLIC SCHOOL	Catasauqua (B)	School
LINCOLN MIDDLE SCHOOL	Catasauqua (B)	School
CATASAUQUA HIGH SCHOOL	Catasauqua (B)	School
SHECKLER ELEMENTARY SCHOOL	Catasauqua (B)	School
BORO OF COPLAY	Coplay (B)	Fire
BORO OF EMMAUS	Emmaus (B)	Fire
CITIZENS FIRE CO	Emmaus (B)	Fire
CITIZENS FIRE CO	Emmaus (B)	Fire
EMMAUS HIGH SCHOOL	Emmaus (B)	School
EMMAUS HIGH SCHOOL	Emmaus (B)	School
JEFFERSON ELEMENTARY SCHOOL	Emmaus (B)	School
LINCOLN ELEMENTARY SCHOOL	Emmaus (B)	School
ST ANNES PAROCHIAL SCHOOL	Emmaus (B)	School
BORO OF FOUNTAIN HILL	Fountain Hill (B)	Fire
St. Luke's Hospital - Bethlehem	Fountain Hill (B)	Medical
FOUNTAIN HILL ELEMENTARY SCHOOL	Fountain Hill (B)	School
HOLY CHILD SCHOOL	Fountain Hill (B)	School
LOWER MACUNGIE TWP	Lower Macungie (T)	Fire
THE HILLSIDE SCHOOL	Lower Macungie (T)	School
LOWER MACUNGIE MIDDLE SCHOOL	Lower Macungie (T)	School
LOWER MACUNGIE ELEMENTARY SCHOOL	Lower Macungie (T)	School
WESCOSVILLE ELEMENTARY SCHOOL	Lower Macungie (T)	School
EYER MIDDLE SCHOOL	Lower Macungie (T)	School
SHOEMAKER ELEMENTARY SCHOOL	Lower Macungie (T)	School
MACUNGIE ELEMENTARY SCHOOL	Lower Macungie (T)	School
LOWER MILFORD TWP FIRE CO #1	Lower Milford (T)	Fire
MACUNGIE FIRE CO #1	Macungie (B)	Fire

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Name	Municipality	Type
TRI-CLOVER FIRE CO	North Whitehall (T)	Fire
KERNSVILLE ELEMENTARY SCHOOL	North Whitehall (T)	School
IRONTON ELEMENTARY SCHOOL	North Whitehall (T)	School
Lehigh Valley Hospital - Cedar Crest	Salisbury (T)	Medical
SALISBURY MIDDLE SCHOOL	Salisbury (T)	School
WESTERN SALISBURY ELEMENTARY SCHOOL	Salisbury (T)	School
THE SWAIN SCHOOL	Salisbury (T)	School
SALISBURY HIGH SCHOOL	Salisbury (T)	School
HARRY S TRUMAN ELEMENTARY SCHOOL	Salisbury (T)	School
WILEY HOUSE	Salisbury (T)	School
WILEY HOUSE	Salisbury (T)	School
LEHIGH CHRISTIAN ACADEMY	Salisbury (T)	School
ST THOMAS MORE	Salisbury (T)	School
Westfield Hospital	South Whitehall (T)	Medical
ST JOSEPH THE WORKER ELEMENTARY SCHOOL	South Whitehall (T)	School
PARKWAY MANOR ELEMENTARY SCHOOL	South Whitehall (T)	School
SPRINGHOUSE MIDDLE SCHOOL	South Whitehall (T)	School
OREFIELD MIDDLE SCHOOL	South Whitehall (T)	School
PARKLAND HIGH SCHOOL	South Whitehall (T)	School
CETRONIA ELEMENTARY SCHOOL	South Whitehall (T)	School
KRATZER ELEMENTARY SCHOOL	South Whitehall (T)	School
JEWISH DAY SCHOOL	South Whitehall (T)	School
JEWISH DAY SCHOOL	South Whitehall (T)	School
JEWISH DAY SCHOOL	South Whitehall (T)	School
ALLENTOWN CHRISTIAN SCHOOL	South Whitehall (T)	School
DATZYK MONTESSORI SCHOOL	South Whitehall (T)	School
FOGELSVILLE VOL FIRE CO	Upper Macungie (T)	Fire
UPPER MACUNGIE TWP	Upper Macungie (T)	Fire
TREXLERTOWN GOOD WILL FIRE CO #1	Upper Macungie (T)	Fire
FOGELSVILLE ELEMENTARY SCHOOL	Upper Macungie (T)	School
FRED J JAINDL ELEMENTARY SCHOOL	Upper Macungie (T)	School
EMMAUS BAPTIST ACADEMY	Upper Milford (T)	School
SOUTH MOUNTAIN AREA MEDIC V INC	Upper Saucon (T)	Fire
UPPER SAUCON TWP	Upper Saucon (T)	Fire
UPPER SAUCON TWP VOLUNTEER FIRE CO 1	Upper Saucon (T)	Fire
HOPEWELL ELEMENTARY SCHOOL	Upper Saucon (T)	School

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Name	Municipality	Type
SOUTHERN LEHIGH MIDDLE SCHOOL	Upper Saucon (T)	School
SOUTHERN LEHIGH HIGH SCHOOL	Upper Saucon (T)	School
ASSUMPTION BVM SCHOOL	Upper Saucon (T)	School
EGYPT FIRE CO #1	Whitehall (T)	Fire
W CATASAUQUA FIRE CO	Whitehall (T)	Fire
HOKENDAUQUA FIRE CO #1	Whitehall (T)	Fire
LAUREL FIRE CO #1 INC	Whitehall (T)	Fire
LAUREL FIRE CO #1	Whitehall (T)	Fire
FULLERTON FIRE CO #1	Whitehall (T)	Fire
LEHIGH VALLEY 7TH DAY ADVENTIST SCHOOL	Whitehall (T)	School
WHITEHALL-COPLAY HIGH SCHOOL	Whitehall (T)	School
WHITEHALL-COPLAY MIDDLE SCHOOL	Whitehall (T)	School
STECKEL ELEMENTARY SCHOOL	Whitehall (T)	School
GOCKLEY ELEMENTARY SCHOOL	Whitehall (T)	School
CHRIST THE KING SCHOOL	Whitehall (T)	School
ST STEPHENS SCHOOL	Whitehall (T)	School
ST ELIZABETH SCHOOL	Whitehall (T)	School
Northampton County		
COLONIAL REGIONAL PD	Bath (B)	Police
BATH BORO FIRE FIGHTERS AMBULANCE	Bath (B)	Fire
BATH BORO FIRE FIGHTERS	Bath (B)	Fire
Bath Drug	Bath (B)	Medical
George Wolf Elementary School	Bath (B)	School
Sacred Heart Elementary School	Bath (B)	School
ST LUKES UNION STATION	Bethlehem (C)	Medical
ST LUKES PHYSICAL THERAPY	Bethlehem (C)	Medical
Medical	Bethlehem (C)	Medical
DENTIST OFFICE	Bethlehem (C)	Medical
Medical	Bethlehem (C)	Medical
NEW ST. MEDICAL CNT	Bethlehem (C)	Medical
Medical	Bethlehem (C)	Medical
Quest Diagnostic Inc.	Bethlehem (C)	Medical
Quest Diagnostics Inc.	Bethlehem (C)	Medical
Superior Cardiac Imaging Mobile Svs	Bethlehem (C)	Medical
Baxter Healthcare	Bethlehem (C)	Medical
Bio Med Sciences Inc.	Bethlehem (C)	Medical

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Name	Municipality	Type
C & S Medical Supply Inc.	Bethlehem (C)	Medical
Hess Healthcare Services	Bethlehem (C)	Medical
Orasure Technologies Inc.	Bethlehem (C)	Medical
Sun Inn Preservation Association	Bethlehem (C)	Medical
Liberty Senior High School	Bethlehem (C)	School
Gateway School of the Lehigh Valley	Bethlehem (C)	School
Moravian College-South	Bethlehem (C)	School
St. Anne's School	Bethlehem (C)	School
Edgeboro School	Bethlehem (C)	School
Moravian College-North	Bethlehem (C)	School
Marvine Elementary School	Bethlehem (C)	School
Lincoln Elementary School	Bethlehem (C)	School
Spring Garden Elementary School	Bethlehem (C)	School
Bethlehem Catholic High School	Bethlehem (C)	School
Thomas Jefferson Elementary School	Bethlehem (C)	School
Governor Wolf Elementary School	Bethlehem (C)	School
East Hills Middle School	Bethlehem (C)	School
Holy Infancy School	Bethlehem (C)	School
Lehigh University	Bethlehem (C)	School
Lehigh University	Bethlehem (C)	School
Lehigh University	Bethlehem (C)	School
Lehigh University	Bethlehem (C)	School
Broughal Middle School	Bethlehem (C)	School
Northeast Middle School	Bethlehem (C)	School
William Penn Elementary School	Bethlehem (C)	School
Lehigh University - Saucon Field Complex	Bethlehem (C)	School
Moravian Academy Lower School	Bethlehem (C)	School
Moravian Academy Middle School	Bethlehem (C)	School
BETHLEHEM TWP PD	Bethlehem (T)	Police
BETHLEHEM TWP EMS	Bethlehem (T)	Fire
NANCY RUN FIRE DEPT	Bethlehem (T)	Fire
BETHLEHEM TWP FIRE CO	Bethlehem (T)	Fire
ST LUKES RIVERSIDE	Bethlehem (T)	Medical
DUNKIN DONUT/ MINI MART	Bethlehem (T)	Medical
COORDINATED HEALTH SERVICES	Bethlehem (T)	Medical
Health Network Laboratories	Bethlehem (T)	Medical

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Name	Municipality	Type
St. Lukes Hospital	Bethlehem (T)	Medical
Digirad Imaging Solutions	Bethlehem (T)	Medical
Invatec	Bethlehem (T)	Medical
Freedom High School	Bethlehem (T)	School
Freedom High School	Bethlehem (T)	School
Bethlehem Area Vocational Tech School	Bethlehem (T)	School
Our Lady of Perpetual Church and School	Bethlehem (T)	School
Moravian Academy	Bethlehem (T)	School
Northampton County Area Comm College	Bethlehem (T)	School
Northampton County Area Comm College	Bethlehem (T)	School
Miller Heights Elementary School	Bethlehem (T)	School
Farmersville Elementary School	Bethlehem (T)	School
Notre Dame High School	Bethlehem (T)	School
EAST ALLEN TWP AMBULANCE CORPS	East Allen (T)	Fire
EAST ALLEN TWP FIRE CO	East Allen (T)	Fire
BATH COMMUNITY MED	East Allen (T)	Medical
Health Network Laboratories	East Allen (T)	Medical
NORTHAMPTON COUNTY SHERIFF DEPT	Easton (C)	Police
EASTON CITY PD	Easton (C)	Police
EASTON EMERGENCY SQUAD	Easton (C)	Fire
EASTON CITY FIRE DEPT - CENTRAL	Easton (C)	Fire
EASTON CITY FIRE DEPT - COLLEGE HILL	Easton (C)	Fire
EASTON CITY FIRE DEPT - SOUTH SIDE	Easton (C)	Fire
PA WATER RECUE	Easton (C)	Fire
Medical	Easton (C)	Medical
EASTON CHIROPRACTIC	Easton (C)	Medical
Easton Catholic and EC-ST Joseph ES	Easton (C)	School
March Elementary School	Easton (C)	School
Cheston Elementary School	Easton (C)	School
Cheston Elementary School	Easton (C)	School
Cheston Elementary School	Easton (C)	School
Cheston Elementary School	Easton (C)	School
Cheston Elementary School	Easton (C)	School
Cheston Elementary School	Easton (C)	School
Lafayette College	Easton (C)	School
Lafayette College	Easton (C)	School
Easton Area Middle School	Easton (C)	School

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Name	Municipality	Type
FORKS TWP PD	Forks (T)	Police
FORKS TWP EMS	Forks (T)	Fire
FORKS TWP FIRE DEPT	Forks (T)	Fire
MEDIC 9 - SOUTH	Forks (T)	Fire
Quest Diagnostics Inc.	Forks (T)	Medical
Forks Elementary School	Forks (T)	School
Paxinosa ES and Shawnee Intermediate	Forks (T)	School
Career Institute of Technology	Forks (T)	School
FREEMANSBURG PD	Freemansburg (B)	Police
FREEMANSBURG FIRE	Freemansburg (B)	Fire
Freemansburg Elementary School	Freemansburg (B)	School
HANOVER TWP EMS	Hanover (T)	Fire
HANOVER TWP FIRE	Hanover (T)	Fire
ST. LUKES NORTH	Hanover (T)	Medical
Medical	Hanover (T)	Medical
CAMPBELL MEDICAL CEN	Hanover (T)	Medical
Radiology & MRI of Bethlehem	Hanover (T)	Medical
St. Lukes Hospital	Hanover (T)	Medical
Boas Surgical Inc.	Hanover (T)	Medical
Helping Hands Medical Supply	Hanover (T)	Medical
Homestar Medical Equip & Infusion Center	Hanover (T)	Medical
Lincare	Hanover (T)	Medical
Asa Packer Elementary School	Hanover (T)	School
Hanover Elementary School	Hanover (T)	School
Miller Keystone Blood Center	Hanover (T)	Medical
Visiting Nurse Association	Hanover (T)	Medical
HELLERTOWN PD	Hellertown (B)	Police
DEWEY FIRE COMPANY AMBULANCE	Hellertown (B)	Fire
METRO EMS	Hellertown (B)	Fire
DEWEY FIRE COMPANY	Hellertown (B)	Fire
SAUCON VALLEY FAMILY PRACTICE	Hellertown (B)	Medical
Quest Diagnostics Inc.	Hellertown (B)	Medical
St. Lukes Hospital	Hellertown (B)	Medical
Yeagers Pharmacy	Hellertown (B)	Medical
LOWER MT BETHEL FIRE CO	Lower Mt. Bethel (T)	Fire
HECKTOWN EMS	Lower Nazareth (T)	Fire

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Name	Municipality	Type
HECKTOWN FIRE CO	Lower Nazareth (T)	Fire
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical
Any Lab Test Now	Lower Nazareth (T)	Medical
Easton Hospital Laboratory Services	Lower Nazareth (T)	Medical
Health Network Laboratories	Lower Nazareth (T)	Medical
Progressive Physicians Vascular Lab	Lower Nazareth (T)	Medical
Lower Nazareth Elementary School	Lower Nazareth (T)	School
LOWER SAUCON PD	Lower Saucon (T)	Police
SE-WY-CO FIRE	Lower Saucon (T)	Fire
LEITHSVILLE FIRE CO	Lower Saucon (T)	Fire
STEEL CITY FIRE CO	Lower Saucon (T)	Fire
Saucon Valley School District Campus	Lower Saucon (T)	School
NAZARETH PD	Nazareth (B)	Police
NANZARETH BORO EMS	Nazareth (B)	Fire
VIGILANCE HOSE CO	Nazareth (B)	Fire
Medical	Nazareth (B)	Medical
Quest Diagnostics, Inc.	Nazareth (B)	Medical
Nazareth Medical Equipment	Nazareth (B)	Medical
Shafer Elementary School	Nazareth (B)	School
Holy Family School	Nazareth (B)	School
Holy Family School	Nazareth (B)	School
Holy Family School	Nazareth (B)	School
Holy Family School	Nazareth (B)	School
NORTH CATASAUQUA PD	North Catasauqua (B)	Police

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Name	Municipality	Type
CHARITON HOSE CO	North Catasaquua (B)	Fire
N CATASAUQUA MEDICAL	North Catasaquua (B)	Medical
NORTHAMPTON BORO PD	Northampton (B)	Police
NORTHAMPTON REGIONAL EMS	Northampton (B)	Fire
NORTHAMPTON BORO FIRE DEPT	Northampton (B)	Fire
NORTH. MEDICAL ARTS	Northampton (B)	Medical
Health Network Laboratories	Northampton (B)	Medical
Sacred Heart Outpatient Lab Services	Northampton (B)	Medical
Newhard Pharmacy	Northampton (B)	Medical
Webb Medical Systems	Northampton (B)	Medical
Franklin Elementary School	Northampton (B)	School
Our Lady of Hungary Elementary School	Northampton (B)	School
Saint John the Baptist Elementary School	Northampton (B)	School
Northampton Area Jr and Sr HS	Northampton (B)	School
Wolf Elementary School	Northampton (B)	School
Bethlehem Area Vo-Tech School	Northampton (B)	School
Washington Elementary School	Northampton (B)	School
Washington Elementary School	Northampton (B)	School
PALMER TWP PD	Palmer (T)	Police
SUBURBAN EMS	Palmer (T)	Fire
PALMER TWP FIRE - STATION 2	Palmer (T)	Fire
PALMER TWP FIRE	Palmer (T)	Fire
DIAGNOSTIC IMAGING	Palmer (T)	Medical
UNIT 3 PALMER MED	Palmer (T)	Medical
Medical	Palmer (T)	Medical
UNIT 5 PALMER MED	Palmer (T)	Medical
UNIT 2 PALMER MED	Palmer (T)	Medical
UNIT 6 PALMER MED	Palmer (T)	Medical
GASTROENTEROLOGY CENTER	Palmer (T)	Medical
UNIT 4 PALMER MED	Palmer (T)	Medical
UNIT 1 PALMER MED	Palmer (T)	Medical
DENTAL OFFICE	Palmer (T)	Medical
DR. BODY, DENTIST	Palmer (T)	Medical
BOONSWANG MED OFF	Palmer (T)	Medical
Easton Hospital Laboratory Services	Palmer (T)	Medical
Pinnacle Lab	Palmer (T)	Medical

SECTION 4.3.9: RISK ASSESSMENT – SUBSIDENCE/SINKHOLE

Name	Municipality	Type
Youngs Medical Equipment	Palmer (T)	Medical
Easton Area High School	Palmer (T)	School
Palmer Elementary School	Palmer (T)	School
Edward Tracy Elementary School	Palmer (T)	School
Redi-Care Medical Center	Palmer (T)	Medical
PORTLAND PD	Portland (B)	Police
PORTLAND & VICINITY AMBULANCE CORPS	Portland (B)	Fire
PORTLAND HOOK & LADDER	Portland (B)	Fire
STOCKERTOWN PD	Stockertown (B)	Police
LIBERTY HOSE CO	Stockertown (B)	Fire
TATAMY PD	Tatamy (B)	Police
TATAMY BORO FIRE DEPT	Tatamy (B)	Fire
UPPER NAZARETH TWP PD	Upper Nazareth (T)	Police
EAST LAWN FIRE CO	Upper Nazareth (T)	Fire
Nazareth Area Junior and Senior HS	Upper Nazareth (T)	School
Nazareth Area Junior and Senior HS	Upper Nazareth (T)	School
Nazareth Area Middle School	Upper Nazareth (T)	School
WEST EASTON FIRE DEPT	West Easton (B)	Fire
WILLIAMS TWP EMS	Williams (T)	Fire
WILSON BORO PD	Wilson (B)	Police
WILSON BORO FIRE DEPT	Wilson (B)	Fire
Easton Hospital	Wilson (B)	Medical
EASTON HOSPITAL	Wilson (B)	Medical
DOUGLAS D DITMARS MD	Wilson (B)	Medical
HAY SCHOOL	Wilson (B)	Medical
Easton Hospital Laboratory Services	Wilson (B)	Medical
Northampton Imaging Specialists	Wilson (B)	Medical
Quest Diagnostics Inc.	Wilson (B)	Medical
Bell Apothecary	Wilson (B)	Medical
Philip F. Lauer Middle School	Wilson (B)	School
Wilson Elementary School	Wilson (B)	School
Wilson Area High School	Wilson (B)	School
Easton Children's Home	Wilson (B)	School
Avona Elementary School	Wilson (B)	School
Avona Elementary School	Wilson (B)	School

Notes: B = Borough; C = City; T = Township

4.3.9.5.6 Impact on the Economy

Subsidence and sinkholes can also severely impact roads and infrastructure. As noted earlier, these limestone and dolomite formations underlie the heart of the Lehigh Valley’s urban core including many of the major roadways through the region. The Lehigh Valley is served by six (6) expressways, two (2) of which are Interstate highways located in the identified subsidence/sinkhole hazard area (I-78 and I-476). Other expressways exposed include Route 22, Route 33, a portion of Route 309, and a portion of Route 378 through the City of Bethlehem. Bridges with high traffic volumes in the area include the Route 22 Lehigh River Bridge, Hamilton Street and Tilghman Street bridges in Allentown; Hill-to-Hill, Fahy, and Minsi Trail bridges in the City of Bethlehem; 25th Street Bridge in Palmer Township and the 3rd Street Bridge in Easton. It is not possible to estimate potential future economic losses due to subsidence/sinkhole events at this time.

4.3.9.5.7 Future Growth and Development

Areas targeted for potential future growth and development in the next five (5) to ten (10) years have been identified across the Lehigh Valley at the municipal level. Refer to the jurisdictional annexes in Volume II of this HMP. Table B.1 in each jurisdictional annex lists the location of the potential new development and its exposure (if any) to known hazard zones. It is anticipated that new development within the identified hazard areas will be exposed to such risks.

4.3.9.5.8 Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes (U.S. Environmental Protection Agency [EPA], 2006).

Climate change factors such as an extended growing season, higher temperatures, and the possibility of more intense, less frequent summer rainfall, may lead to changes in water resource availability. As stated earlier in this profile, changes to the water balance of an area including over-withdrawal of groundwater, diverting surface water from a large area and concentrating it in a single point, artificially creating ponds of surface water, and drilling new water wells will cause sinkholes. These actions can also serve to accelerate the natural processes of bedrock degradation, which can have a direct impact on sinkhole creation.

The potential effects of climate change on the Lehigh Valley’s vulnerability to subsidence/sinkhole events shall need to be considered as a greater understanding of regional climate change impacts develop.

4.3.9.5.9 Additional Data and Next Steps

While it is not possible to predict when and where the next event may take place, the Lehigh Valley emergency services including local fire and police departments are well-equipped and prepared to respond to emergencies as they arise. The status of subsidence/sinkhole risk in the Lehigh Valley will continue to be monitored and ongoing and new mitigation efforts will continue to be developed.

4.3.10 Wildfire

This section provides a profile and vulnerability assessment for the wildfire hazard. A wildfire is an uncontrolled fire spreading 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. A wildland fire is a wildfire in an area in which development is essentially nonexistent, except for roads, railroads, power lines, and similar facilities. A wildland-urban interface (WUI) fire is a wildfire in a geographical area where structures and other human development meet or intermingle with wildland or vegetative fuels.

Wildfires can occur at any time of the year, but are most likely to occur in the Lehigh Valley during a drought, and can occur in fields, grass, and brush as well as in the forest itself. Under dry conditions or drought, wildfires have the potential to burn forests as well as croplands. Any small fire in a wooded area, if not quickly detected and suppressed, has the potential to 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.

4.3.10.1 Location and Extent

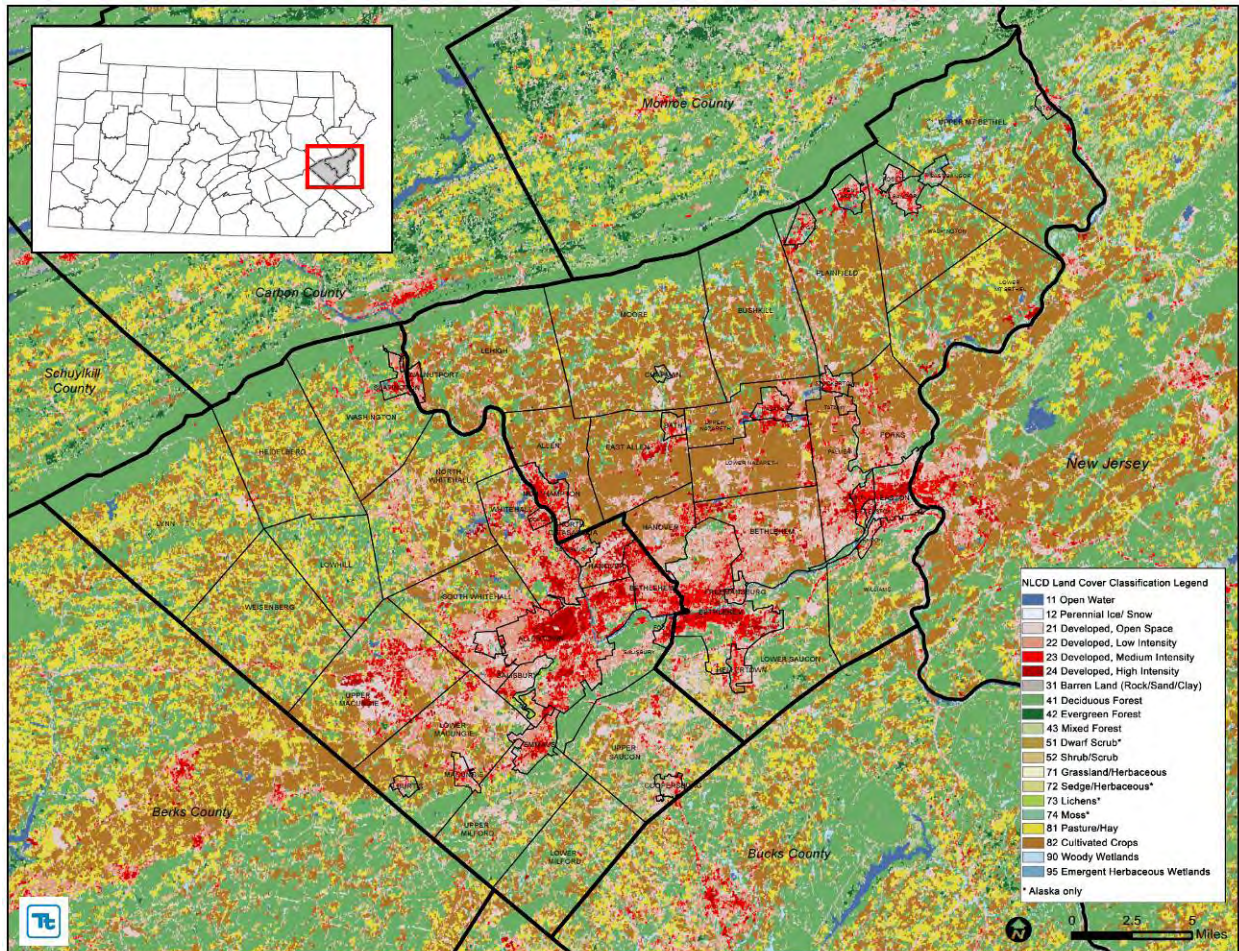
According to 2006 land use/land cover data, nearly 30 percent of the land in the Lehigh Valley is developed, nearly 40 percent is farmland and 30 percent is forested (Table 4.3.10-1) (USGS, 2011). As shown in Figure 4.3.10-1 below, urban areas are located adjacent to forests and farmlands. Both vegetation and structures serve as fuel for wildfire events.

Table 4.3.10-1. Land Use Summary for the Lehigh Valley

Land Use Category	Total Area (square miles)	Percent of Total
Barren (Quarry)	1.8	0.2
Developed	202.4	27.9
Farmland	288.2	39.7
Forested	217.6	30.0
Water	6.8	0.9
Wetlands	8.7	1.2
TOTAL	725.5	100

Source: USGS, 2011

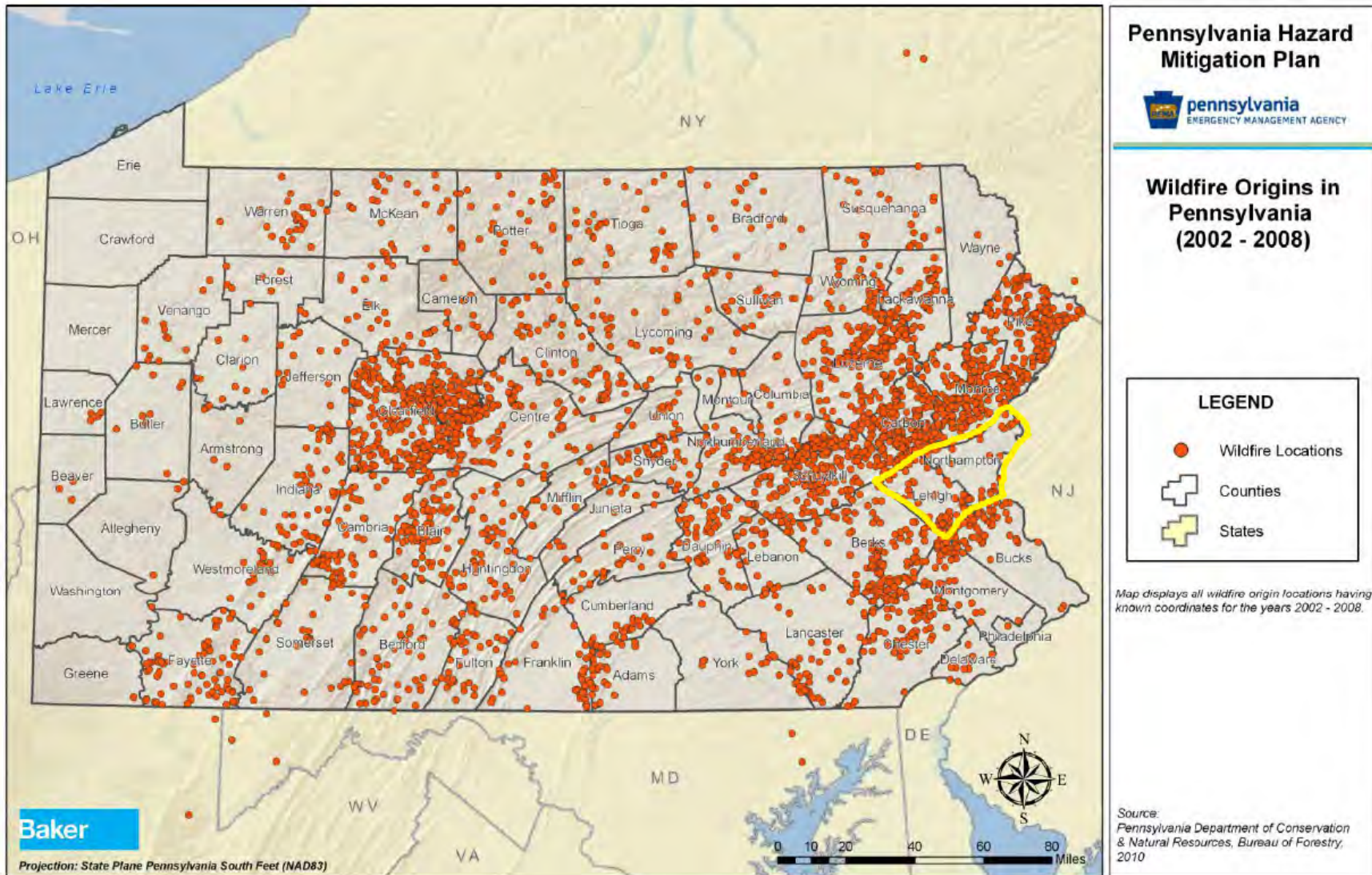
Figure 4.3.10-1. Land Cover in the Lehigh Valley



Source: USGS, 2011

Figure 4.3.10-2 shows the locations of wildfires throughout Pennsylvania that the PA DCNR, Bureau of Forestry (BOF) responded to from 2002 to 2008. Wildfires are known to be an under reported event. Many wildfires occur every year and are suppressed by volunteer fire departments without any response or assistance from BOF. Therefore, such locally controlled blazes may not be represented in BOF records.

Figure 4.3.10-2. Location of Wildfire Events responded to by BOF from 2002-2008



Source: PEMA, 2010 (highlight added)



There are several tools available to estimate fire potential location and extent including, but not limited to the Wildland/Urban Interface, Wildland Fire Assessment System and Pennsylvania Department of Conservation and Natural Resources (PA DCNR) Priority Landscape Analysis. These tools are discussed in further detail below.

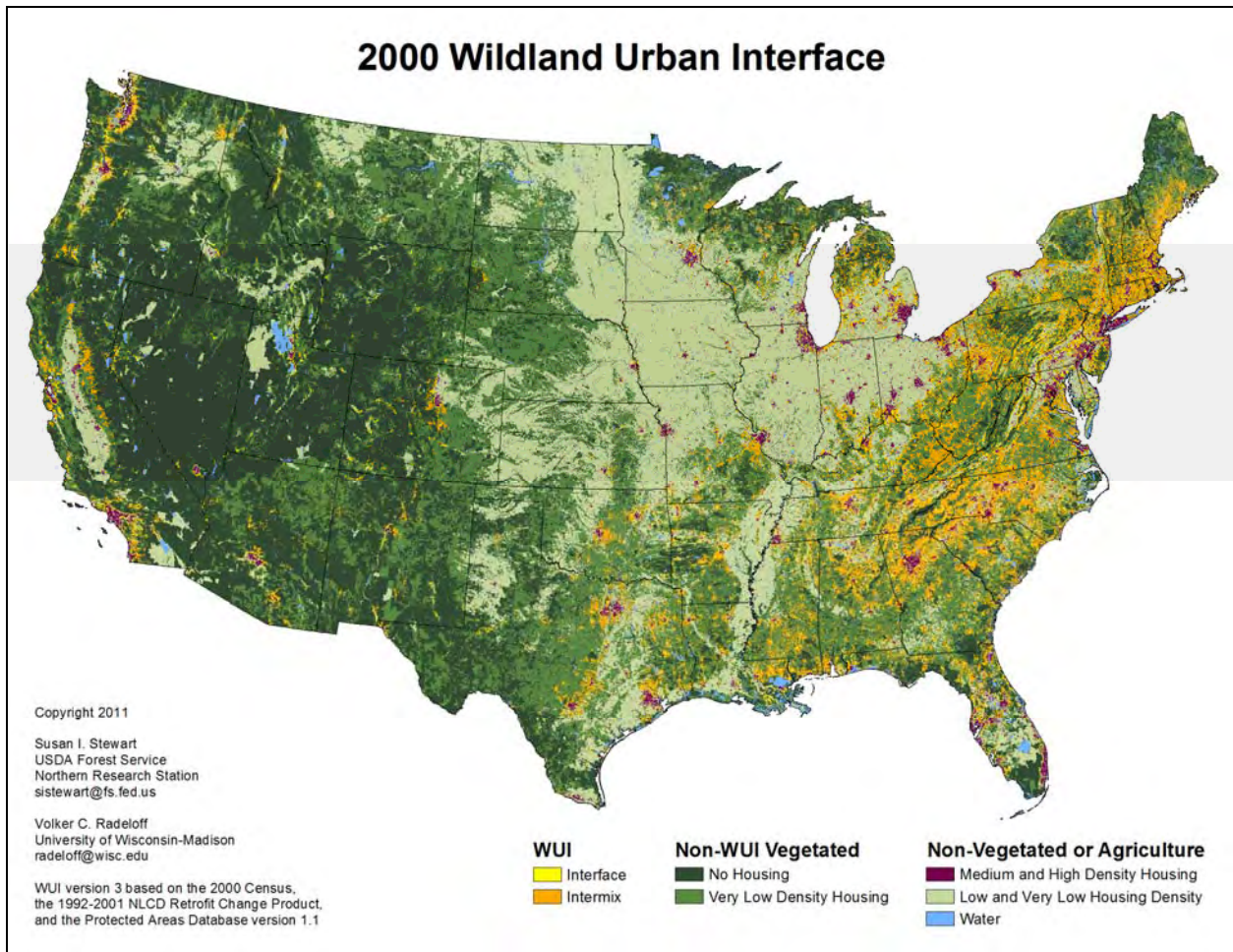
Wildland/Urban Interface (WUI)

The WUI is the area where houses and wildland vegetation coincide. The WUI is divided into two categories: intermix and interface. Intermix WUI are areas where housing and vegetation ‘intermingle’. Intermix areas have more than one house per 40 acres and have more than 50-percent vegetation. Interface WUI are areas with housing in the vicinity of contiguous wildland vegetation. Interface areas have more than one house per 40 acres, have less than 50-percent vegetation, and are within 1.5 miles of an area over 1,235 acres that is more than 75-percent vegetated (University of Wisconsin, Date Unknown).

The California Fire Alliance determined that areas within 1.5 miles of wildland vegetation are the approximate distance that firebrands can be carried from a wildland fire to the roof of a house. Therefore, even structures not located within the forest are at risk to wildfire. This buffer distance, along with housing density and vegetation type were used to define the WUI (University of Wisconsin, Date Unknown).

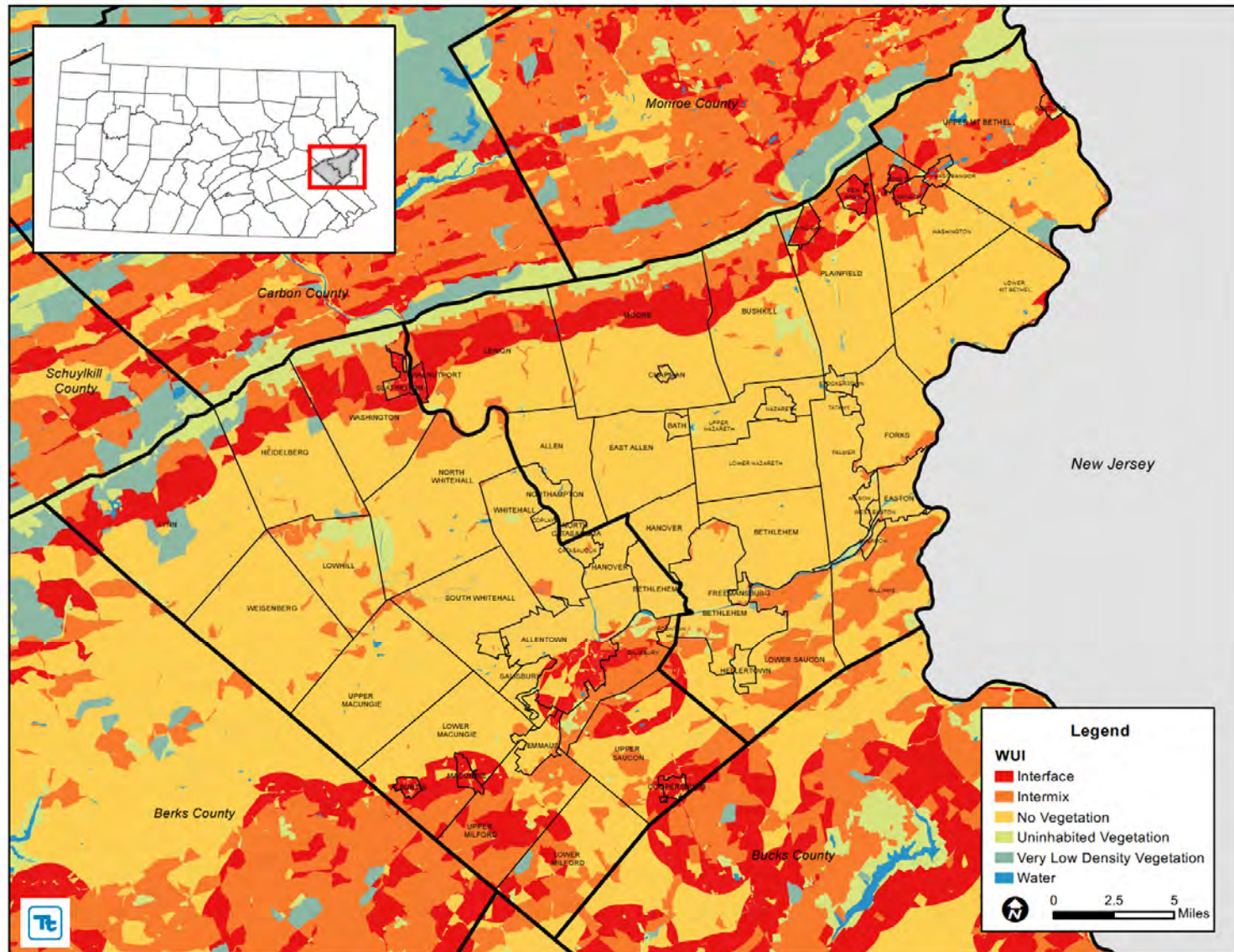
Concentrations of WUI can be seen along the east coast of the U.S. including the Lehigh Valley, where housing density rarely falls below the threshold of one housing unit per 40 acres and forest cover is abundant. Areas where recreation and tourism dominate are also places where WUI is common (Stewart et al., 2003). Figure 4.3.10-33 depicts the WUI for the U.S. in 2000 and Figure 4.3.10-4 illustrates the WUI for the Lehigh Valley. Across the Lehigh Valley, approximately 27-percent is classified as WUI.

Figure 4.3.10-3. WUI for the U.S. in 2000



Source: Radeloff et al, 2005

Figure 4.3.10-4. WUI for the Lehigh Valley



Source: Radeloff et al, 2005



Wildland Fire Assessment System (WFAS)

The WFAS is an internet-based information system maintained at the National Interagency Fire Center (NIFC) in Boise, Idaho that provides a national view of weather and fire potential, including national fires danger, weather maps and satellite-derived “Greenness” maps (USFS, 1994-2007). Each day during the fire season, national maps of selected fire weather and fire danger components of the National Fire Danger Rating System (NFDRS) are produced by the WFAS (WFAS, 2012). The Fire Danger Rating level, shown in Table 4.3.10-2 below, takes into account current and antecedent weather, fuel types, and both live and dead fuel moisture. The adjective class rating is a method of normalizing rating classes across different fuel models, indexes, and station locations. It is based primarily on a fuel model cataloged for the station, the fire danger index selected to reflect staffing levels, and climatological class breakpoints. This information is provided by local station managers (WFAS, 2012).

Table 4.3.10-2. Fire Danger Rating and Color Code

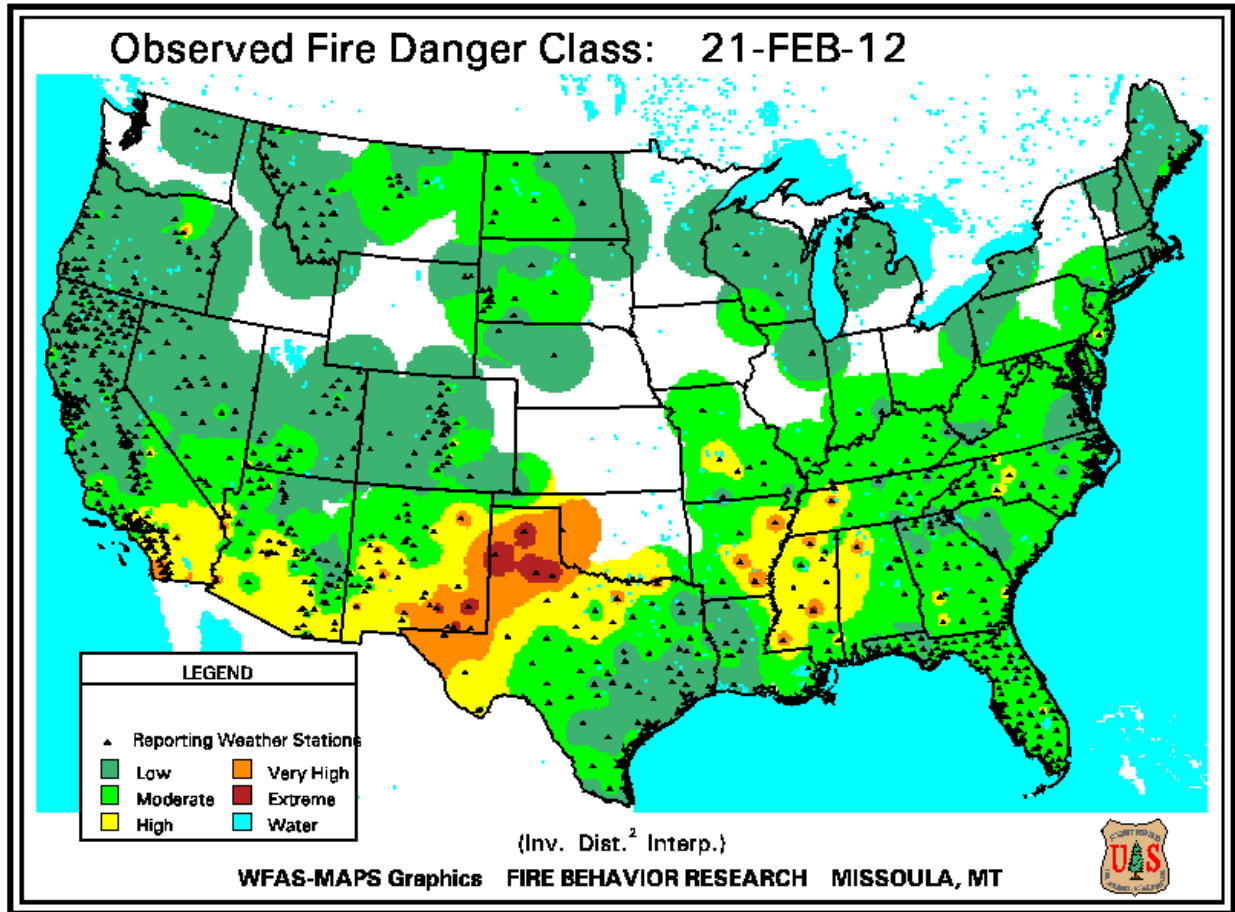
Fire Danger Rating and Color Code	Description
<p>Low (L) (Dark Green)</p>	<p>Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spotting.</p>
<p>Moderate (M) (Light Green or Blue)</p>	<p>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.</p>
<p>High (H) (Yellow)</p>	<p>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.</p>
<p>Very High (VH) (Orange)</p>	<p>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.</p>
<p>Extreme (E) (Red)</p>	<p>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 (trunks, branches, and tree tops) 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.</p>

Source: USFS, 2007

Observed fire danger maps are also provided on a daily basis by the U.S. Forest Service. Observation maps are based on the mid-afternoon observations from the fire weather network as reported to the

Weather Information Management System (WIMS) (PEMA, 2010). Figure 4.3.10-5 illustrates an example of an observed fire danger map for February 22, 2012.

Figure 4.3.10-5. Observed Fire Danger Map (February 22, 2012)



Source: USFS, 2012

Note: Dark Green (low), Light Green (moderate), Yellow (high), Orange (very high), Red (extreme)

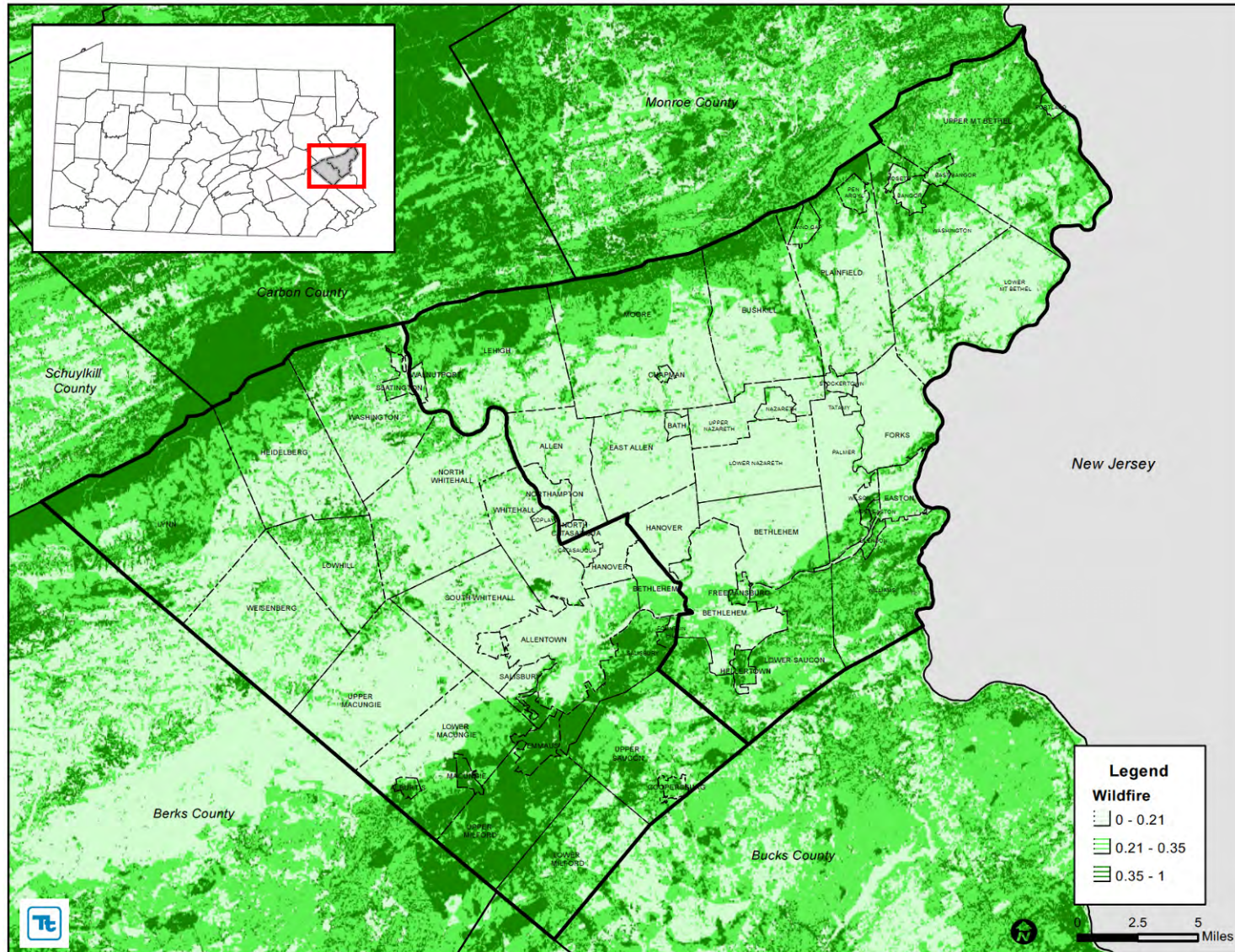
Pennsylvania Department of Conservation and Natural Resources Priority Landscape Analysis

The PA DCNR conducted a wildfire priority landscape analysis identifying areas where wildland fires are predicted to occur and become problematic. The areas are classified into high, medium and low categories. The high classification is defined as an area prone to extreme fire behavior, with potential to cause extensive property damage, or which could threaten the safety of the Commonwealth’s citizens. Five datasets were used for this analysis:

- 2002 Wildland Urban Interface (WUI)
- 2006 LANDFIRE
- 2002 – 2008 Pennsylvania Wildfire Point Origin Occurrences
- Percent Slope
- 2009 Local Assessment of Values, Risks, Hazards

The WUI classifies areas where homes and other human development meet or intermingle with undeveloped land. LANDFIRE characterizes the land’s vegetation into fuel models that predict different fire behavior intensities. The PA wildfire Point Origin Occurrences are records of wildland fire origins that have been reported. Percent slope aids in determining fire behavior from the terrain. The local assessment of values, risks, and hazards is a municipality-based rating system – this assessment has been made by local wildland fire managers (PA DCNR, date unknown). Figure 4.3.10-6 illustrates the output for the wildfire priority landscapes model for the Lehigh Valley.

Figure 4.3.10-6. Wildfire Priority Landscapes in the Lehigh Valley



Source: PADCNr

Notes: Low Priority = 0 – 0.21 (light green); Medium Priority = 0.21 – 0.35 (medium green); High Priority = 0.35 – 1 (dark green)

Most high priority areas are found along the northern tier of the Lehigh Valley, along the Blue Mountain, bordering Schuylkill, Carbon and Monroe Counties. In addition, large high priority areas are found in Alburtis Borough, Emmaus Borough, Fountain Hill Borough, Macungie Borough, Salisbury Township and Upper Milford Township. Please note that other high priority areas are also found scattered throughout the Lehigh Valley. These areas have favorable fuels, intermixed areas of vegetation and development, and are “hotspots” of past wildland fire occurrences.

Areas that have been categorized as ‘medium’ priority areas exhibit favorable fuels, but do not have a history of wildland fire occurrence or do not have intermixed areas of vegetation and development. In the Lehigh Valley, the medium priority areas tend to be concentrated along the northern and southern tier. The low priority areas, located in the central portion of the Lehigh Valley, have unfavorable fuels, a lack of wildland fire occurrence, a significant amount of agriculture and/or other non-forest land uses.

The greatest potential for wildfires is in the spring months of March, April and May, and the autumn months of October and November. These months generally bring clear skies, high winds, low relative humidity, and prolonged periods of dry weather. In the spring, bare trees allow sunlight to reach the forest floor, drying fallen leaves and other ground debris. The same theory applies for the fall; however, the dryer conditions are a more crucial factor. Most wildfires in Pennsylvania are caused by people, often by debris burns. Several fires have started in a person’s backyard and traveled through dead grasses and weeds into bordering woodlands. According to the Pennsylvania 2010 All-Hazard Mitigation Plan (PEMA, 2010), ninety-two percent of Pennsylvania wildfires burn less than ten acres and are suppressed within the first burning period.

4.3.10.2 Range of Magnitude

Wildfire events in the Lehigh Valley can range from small fires that can be managed by local firefighters to large fires impacting many acres of land. Large events may require evacuation from one or more communities and necessitate regional or national firefighting support. The impact of a severe wildfire can be devastating. A wildfire has the potential to kill people, livestock, fish and wildlife. They often destroy property, valuable timber, forage and recreational and scenic resources.

The largest wildfire in Pennsylvania in recent years burned 10,000 acres in the north-central area of the Commonwealth. This fire was controlled within a week. It destroyed five cabins, but there was no loss of life. Several other fires have burned over 2,000 acres each and again have been controlled within a week of the reported start.

Wildfires in the Lehigh Valley have generally been small and easily contained. Since 2000, single events have been as minor as a small brushfire, while others have involved up to 100 acres. The worst-case scenario for the Lehigh Valley is a multiple-acre fire occurring during a period of drought, which could cause the fire to spread rapidly. Because much of the Valley is characterized by a wildland-urban interface, severe property damage could occur. Refer to the ‘Vulnerability Assessment’ below for additional details on potential losses in the Lehigh Valley.

4.3.10.3 Past Occurrence

The 2010 PA HMP notes that the number of reported wildfires and acres burned in the Lehigh Valley between 2002 and 2008 were 130 and 269.37 acres, respectively. Table 4.3.10-3 lists all wildfires that were recorded in the National Climatic Data Center (NCDC) Storm Events Database and/or in the Pennsylvania Emergency Incident Reporting System (PEIRS). This collection of data suggests a total of 10 wildfire events were recorded in Lehigh County, burning approximately 89 acres between 2000 and

SECTION 4.3.10: RISK ASSESSMENT – WILDFIRE

2009, and 26 events reported in Northampton County during that same time frame, with a total 256.41 acres burned. It should be noted that the table below groups events where multiple brushfires occurred on the same day into one record which reduces the total count of annual events when compared to annual records from other sources.

Table 4.3.10-3. Reported Wildfires in the Lehigh Valley

Date	County	Location	Acres Burned	Deaths	Injuries	Property Damage (\$)
10/28/2000	Lehigh	Lehigh Township	10	0	0	0
11/3/2000	Northampton	Moore and Allen Townships	50	0	0	0
7/9/2002	Lehigh	Lynn Township	Unknown			
8/2/2002	Northampton	Lehigh Township	100	0	0	0
5/19/2003	Lehigh	Washington Township	1			
4/10/2005	Northampton	East Allen Township	5	0	0	0
4/2/2006	Northampton	Lower Mount Bethel Township	1	0	0	0
11/7/2006	Lehigh	Washington Township	Unknown	0	0	0
3/23/2007	Northampton	Lower Nazareth Township	Unknown	0	1	0
3/29/2007	Northampton	Upper Mount Bethel Township	Unknown	0	0	0
3/30/2007	Northampton	Lehigh Township	Unknown	0	0	0
4/21/2007	Lehigh	Washington Township	70	0	1	0
4/22/2007	Northampton	Williams Township	1	0	0	0
4/23/2007	Northampton	Bethlehem	Unknown	0	0	1.2M
4/25/2007	Northampton	Lower Saucon Township	15	0	0	0
5/6/2007	Northampton	Washington Township	0.2	0	0	0
5/14/2007	Northampton	Lower Saucon Township	3	0	0	0
5/15/2007	Lehigh	Upper Milford Township	2	0	0	0
5/29/2007	Northampton	Lower Saucon Township	0.4	0	0	0
7/1/2007	Northampton	Moore Township	1	0	0	0
7/21/2007	Northampton	Lehigh Township	Unknown	0	0	0
3/25/2008	Northampton	Plainfield, Palmer, and Lower Nazareth Townships	2	0	0	0
3/26/2008	Northampton	Lower Nazareth Township	50	0	0	0

SECTION 4.3.10: RISK ASSESSMENT – WILDFIRE

Date	County	Location	Acres Burned	Deaths	Injuries	Property Damage (\$)
3/30/2008	Northampton	Hanover Township	2	0	0	0
4/11/2008	Lehigh	Lower Macungie Township	Unknown	0	0	0
4/15/2008	Northampton	Washington Township, Upper Mount Bethel Township, Bangor Borough, East Bangor Borough	20	0	0	0
4/18/2008	Lehigh	Heidelberg, Upper Milford, and Washington Townships	Unknown	0	0	0
4/19/2008	Lehigh	Lower Milford, Lower Saucon, and Upper Saucon Townships	Unknown	0	0	0
4/23/2008	Northampton	Lower Saucon Township	5	0	0	0
4/24/2008	Northampton	Lehigh Township	Unknown	0	0	0
9/24/2008	Northampton	Lehigh Township	0.01	0	0	0
2/12/2009	Northampton	Hellertown Borough	0.1	0	0	0
3/22/2009	Northampton	Bushkill Township	0.5	0	0	0
3/23/2009	Northampton	Lower Saucon, Nazareth, Northampton, Hanover, Moore and Plainfield Townships	Unknown	0	0	0
3/23/2009	Northampton	Hanover Township	0.2	0	0	0
4/24/2009	Lehigh	Salisbury Township	6	0	0	0

Source: NCDC, 2012; PEIRS, 2012

Some of the more significant wildfire events reported in Table 4.3.10-3 are described below.

In October 2000, unseasonably dry weather, freshly fallen leaves, and breezy wind conditions led to three brush fires along the Carbon County/Northampton County line. The first occurred on the 28th at the summit of Blue Mountain near Lehigh Gap when a camp fire went out of control. The second and largest fire occurred the same afternoon near the summit of Blue Mountain, mainly on the Lehigh Township side of the mountain. Nearly 20 fire departments responded. Approximately 10 acres were charred before it was brought under control. The third fire occurred in Lower Towamensing Township, Carbon County. No property damage or injuries were reported. Less than one week later, a pair of wildfires occurred in northwestern Northampton County. In Moore Township, a wildfire burned 30 acres of timber and brush along the Blue Mountain. In Allen Township, a wildfire consumed 20 acres of brush near the Gourmet Inn. Firefighters were able to contain the fire before it could reach nearby homes (LVHMP, 2006).

In November 2001, a drought warning was issued for eastern Pennsylvania due to unseasonably dry weather. From February to September of 2002, the Lehigh Valley was under a drought emergency (NRCC, 2012; PEMA, 2010; PADEP, 2012). In August, 2002, a forest fire consumed approximately 100

acres of forest and underbrush near Blue Mountain in Lehigh Township. Lightning apparently initiated the fire just south of the Appalachian Trail. It spread quickly because of the dead underbrush caused by the drought. About 500 firefighters battled the blaze. Blue Mountain Drive was closed on August 3rd and part of the 4th until the fire was contained (LVHMP, 2006).

On April 21, 2007, a wildfire consumed 70 acres in Washington Township in the Blue Mountain area. It was the biggest brush fire in Pennsylvania that year to date. Four fire companies were needed to extinguish the blaze. The rocky ground where the fire occurred and the recent windy, dry weather made it difficult to suppress the fire (NCDC, 2010). Only two days later, a wildfire that started in the brush from discarded cigarettes damaged several homes in the City of Bethlehem and forced two dozen people from their home. Gusty southwest winds and warm weather made it difficult for firefighters to battle the blaze (NCDC, 2010).

Later that same month, on April 25th, a wildfire consumed approximately 11 acres of woodland on the south side of South Mountain in Lower Saucon Township. The fire occurred at the corner of the Lehigh University Mountaintop Campus. Approximately 100 emergency responders from four counties helped extinguish the blaze. The fire was reported around 9:15 am, was under control at noon and was extinguished at 3:45 pm. Reportedly, the incident began as two fires that occurred between North Mountain Drive and Seidersville Road that merged into one larger blaze (NCDC, 2010).

There were many wildfire reports in the Lehigh Valley in 2008. In March, wildfires occurred during the afternoons of the 25th and 26th in Northampton County. On the 25th, a control burn went out of control as gusty south winds helped spread the fire and it burned two acres in Plainfield Township (NCDC, 2010). On the 26th, an unattended wood fire in Palmer Township spread to nearby grasses. Gusty west winds carried embers which caught on nearby grasses (NCDC, 2010). Another brush fire occurred in Lower Nazareth Township that afternoon (NCDC, 2010). Less than one week later, a wildfire started by a youth playing with a homemade potato gun burned two acres of wooded property in Hanover Township before it was contained on the evening of the 30th (NCDC, 2010). No evacuations or property damage occurred (NCDC, 2010, PEIRS, 2012).

Still in 2008, a brush fire occurred on the grounds of the Lehigh Valley Country Club on the afternoon of the April 11. The fire was contained in about 30 minutes (NCDC, 2010). April 2008 was a drier than normal month, which led to an above average number of wildfires across Pennsylvania. Twenty-three separate brush fires occurred on April 15th along six miles of railroad track from the southern part of Bangor Borough east to just past Sand Pit Road in Upper Mount Bethel Township. There were six fires alone within five hundred yards of each other in Bangor Borough. The fires began during the early afternoon and took until the evening for all of them to be extinguished. Ten fire companies assisted. Other brush fires occurred in Washington Township, Upper Mount Bethel Township, Bangor Borough and East Bangor Borough that day (NCDC, 2010). Later that week, about a half dozen brush fires occurred on Blue Mountain in Carbon and Lehigh Counties on April 18th. An airplane from the State Bureau of Forestry dumped water on the fires (NCDC, 2010).

4.3.10.4 Future Occurrence

Wildfire experts say that demographic trends in the northeast U.S. are contributing to increased wildfire risks. Recent census data shows more homes being built in rural areas closer to wildland areas. Forested areas are cleared for housing, and fuels in the form of logging slash and understory vegetation remain in close proximity to new residences, increasing the potential for wildfires. This trend, along with changing weather patterns and increasingly hot, dry periods throughout the U.S., increases wildfire risk in many communities (PA DCNR, 2012).

While there have been years with zero wildfires reported, it is likely that wildfires will affect the Lehigh Valley every year. However, the likelihood of one of those fires attaining significant size and intensity is unpredictable and highly dependent on environmental conditions and firefighting response. Weather conditions, particularly drought events, increase the likelihood of wildfires occurring. Based on reported occurrences from the most recent years on record, and considering that the reporting of occurrences increased significantly between 2007 and 2009 as compared to 2000 through 2006, the Lehigh Valley can expect two to 13 wildfires each year. However, there may be several years with no wildfires reported. The future occurrence of wildfires can therefore be considered *likely* as defined by the Risk Factor Methodology probability criteria (Section 4.4).

It is important to note that 98% of wildfires in Pennsylvania are human-caused (PEMA, 2010). Thus, there is rationale for including this hazard under the summary of human-made hazards. Nonetheless, the critical inference to draw from this statistic is the fact that the occurrence of future wildfire events will strongly depend on patterns of human activity. Events are more likely to occur in wildfire-prone areas experiencing new or additional development.

4.3.10.5 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed and vulnerable in the identified hazard area. The following text evaluates and estimates the potential impact of the wildfire hazard on the Lehigh Valley including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety, (2) general building stock, (3) critical facilities, (4) economy and (5) future growth and development
- Effects of climate change on vulnerability
- Further data collections that will assist understanding this hazard over time

4.3.10.5.1 Overview of Vulnerability

Wildfire hazards can impact significant areas of land, as evidenced by wildfires throughout the U.S. in recent years. Fire in urban areas has the potential for great damage to infrastructure, loss of life, and strain on lifelines and emergency responders because of the high density of population and structures that can be impacted in these areas. Wildfire, however can spread quickly, become a huge fire complex consisting of thousands of acres, and present greater challenges for allocating resources, defending isolated structures, and coordinating multi-jurisdictional response.

4.3.10.5.2 Data and Methodology

Information regarding the wildfire hazard included input and data from PA DCNR, University of Wisconsin - Madison, and the Steering Committee. For the purposes of this risk assessment, the WUI (interface and intermix) obtained through the SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin-Madison defines the wildfire hazard area. The asset data (population, building stock and critical facilities) presented in the Regional Profile (Section 2) was used to support an evaluation of assets exposed and the potential impacts and losses associated with this hazard. To determine what assets are exposed to wildfire, available and appropriate GIS data was overlaid upon the hazard area. The limitations of this analysis are recognized, and as such the analysis is only used to provide a general estimate.

4.3.10.5.3 Impact on Life, Health and Safety

As demonstrated by historic wildfire events, potential losses include human health and life of residents and responders. The most vulnerable populations include emergency responders and those within a short distance of the interface between the built environment and the wildland environment.

To estimate the Lehigh Valley population vulnerable to the wildfire hazard, the population located within the WUI were overlaid upon the 2010 Census population data (U.S. Census, 2010). The Census blocks with their center within the hazard area were used to calculate the estimated population exposed to the wildfire hazard (approximately 78,414 people in Lehigh County and 42,459 people in Northampton County). Table 4.3.10-4 summarizes the estimated population exposed by municipality.

Table 4.3.10-4. Estimated Population Located within the WUI in the Lehigh Valley

Municipality	US. Census 2010 Population	Estimated Population Exposed	Percent Total
Lehigh County			
Alburtis Borough	2,361	2,321	98.3
Allentown, City of	118,032	27,329	23.2
Bethlehem, City of	19,343	0	0.0
Catasauqua Borough	6,436	132	2.1
Coopersburg Borough	2,386	2,087	87.5
Coplay Borough	3,192	0	0.0
Emmaus Borough	11,211	1,326	11.8
Fountain Hill Borough	4,597	393	8.5
Hanover Township	1,571	0	0.0
Heidelberg Township	3,416	621	18.2
Lower Macungie Township	30,633	6,096	19.9
Lower Milford Township	3,775	1,679	44.5
Lowhill Township	2,173	361	16.6
Lynn Township	4,229	1,729	40.9
Macungie Borough	3,074	3,069	99.8
North Whitehall Township	15,703	595	3.8
Salisbury Township	13,505	8,269	61.2
Slatington Borough	4,232	4,180	98.8
South Whitehall Township	19,180	130	0.7
Upper Macungie Township	20,063	279	1.4
Upper Milford Township	7,292	5,174	71.0
Upper Saucon Township	14,808	7,212	48.7
Washington Township	6,624	3,496	52.8
Weisenberg Township	4,923	265	5.4
Whitehall Township	26,738	1,671	6.2
Lehigh County (est. total)	349,497	78,414	22.4
Northampton County			
Allen Township	4,269	0	0
Bangor Borough	5,273	3,538	67.1

SECTION 4.3.10: RISK ASSESSMENT – WILDFIRE

Municipality	US. Census 2010 Population	Estimated Population Exposed	Percent Total
Bath Borough	2,693	0	0
Bethlehem Township	23,730	0	0
Bethlehem, City of	55,639	1,849	3.3
Bushkill Township	8,178	2,056	25.1
Chapman Borough	199	15	7.5
East Allen Township	4,903	14	0.3
East Bangor Borough	1,172	439	37.5
Easton, City of	26,800	216	0.8
Forks Township	14,721	577	3.9
Freemansburg Borough	2,636	162	6.1
Glendon Borough	440	87	19.8
Hanover Township	10,866	184	1.7
Hellertown Borough	5,898	0	0
Lehigh Township	10,526	5,155	49.0
Lower Mt. Bethel Township	3,101	73	2.4
Lower Nazareth Township	5,674	0	0
Lower Saucon Township	10,772	3,766	35.0
Moore Township	9,198	2,211	24.0
Nazareth Borough	5,746	0	0
North Catasauqua Borough	2,849	0	0
Northampton Borough	9,926	0	0
Palmer Township	20,691	64	0.3
Pen Argyl Borough	3,595	3,559	99.0
Plainfield Township	6,138	2,050	33.4
Portland Borough	519	519	100.0
Roseto Borough	1,567	1,561	99.6
Stockertown Borough	927	43	4.6
Tatamy Borough	1,203	0	0
Upper Mt. Bethel Township	6,706	3,922	58.5
Upper Nazareth Township	6,231	0	0
Walnutport Borough	2,070	2,048	98.9
Washington Township	5,122	2,383	46.5
West Easton Borough	1,257	0	0
Williams Township	5,884	3,245	55.1
Wilson Borough	7,896	3	0.0
Wind Gap Borough	2,720	2,720	100
Northampton County (est. total)	297,735	42,459	14.3

4.3.10.5.4 Impact on General Building Stock

The most vulnerable structures to wildfire events are those within the WUI. Buildings constructed of wood or vinyl siding are generally more likely to be impacted by the fire hazard than buildings constructed of brick or concrete. To estimate the Lehigh Valley buildings exposed to the wildfire hazard, the WUI was overlaid upon the updated building inventory at the structure level. The replacement cost value of the structures with their center in the WUI were totaled. Table 4.3.10-5 summarizes the estimated building stock inventory exposed by municipality.

Table 4.3.10-5. Building Stock Replacement Value Located within the WUI in the Lehigh Valley

Municipality	Total GBS (Structure and Contents)	Total GBS Exposed	Percent of Total
Lehigh County			
Alburtis Borough	\$280,994,000	\$257,378,000	91.6
Allentown, City of	\$20,982,347,000	\$3,072,054,000	14.6
Bethlehem, City of	\$4,769,721,000	\$0	0.0
Catasauqua Borough	\$934,748,000	\$14,619,000	1.6
Coopersburg Borough	\$421,475,000	\$385,177,000	91.4
Coplay Borough	\$406,752,000	\$0	0.0
Emmaus Borough	\$2,088,277,000	\$168,785,000	8.1
Fountain Hill Borough	\$1,101,911,000	\$41,465,000	3.8
Hanover Township	\$2,254,652,000	\$0	0.0
Heidelberg Township	\$550,037,000	\$77,120,000	14.0
Lower Macungie Township	\$5,924,050,000	\$1,027,786,000	17.3
Lower Milford Township	\$534,598,000	\$174,521,000	32.6
Lowhill Township	\$371,530,000	\$46,163,000	12.4
Lynn Township	\$612,033,000	\$200,641,000	32.8
Macungie Borough	\$533,007,000	\$516,984,000	97.0
North Whitehall Township	\$2,850,746,000	\$94,664,000	3.3
Salisbury Township	\$3,606,044,000	\$1,148,986,000	31.9
Slatington Borough	\$715,470,000	\$671,993,000	93.9
South Whitehall Township	\$4,885,829,000	\$23,197,000	0.5
Upper Macungie Township	\$10,206,499,000	\$53,968,000	0.5
Upper Milford Township	\$1,178,767,000	\$763,090,000	64.7
Upper Saucon Township	\$3,171,479,000	\$1,261,991,000	39.8
Washington Township	\$893,760,000	\$462,033,000	51.7
Weisenberg Township	\$1,189,552,000	\$31,188,000	2.6
Whitehall Township	\$5,424,311,000	\$174,029,000	3.2
Lehigh County (est. total)	\$75,888,589,000	\$10,667,832,000	14.1
Northampton County			
Allen Township	\$712,840,000	\$0	0
Bangor Borough	\$926,661,000	\$608,284,000	65.6
Bath Borough	\$471,748,000	\$361,000	0
Bethlehem Township	\$5,752,889,000	\$1,520,000	0
Bethlehem, City of	\$9,934,952,000	\$284,580,000	3

SECTION 4.3.10: RISK ASSESSMENT – WILDFIRE

Municipality	Total GBS (Structure and Contents)	Total GBS Exposed	Percent of Total
Bushkill Township	\$1,289,529,000	\$334,644,000	26.0
Chapman Borough	\$32,434,000	\$256,000	0.8
East Allen Township	\$1,104,833,000	\$0	0
East Bangor Borough	\$118,151,000	\$38,568,000	32.6
Easton, City of	\$4,848,037,000	\$111,917,000	2.3
Forks Township	\$3,177,595,000	\$102,674,000	3.2
Freemansburg Borough	\$361,483,000	\$29,109,000	8.1
Glendon Borough	\$89,841,000	\$27,025,000	30.1
Hanover Township	\$3,484,970,000	\$33,133,000	1.0
Hellertown Borough	\$888,848,000	\$0	0
Lehigh Township	\$1,487,389,000	\$625,281,000	42.0
Lower Mt. Bethel Township	\$502,664,000	\$10,020,000	2.0
Lower Nazareth Township	\$2,194,429,000	\$0	0
Lower Saucon Township	\$1,968,200,000	\$551,970,000	28.0
Moore Township	\$1,223,870,000	\$297,230,000	24.3
Nazareth Borough	\$1,312,606,000	\$0	0
North Catasauqua Borough	\$386,289,000	\$0	0
Northampton Borough	\$1,843,226,000	\$0	0
Palmer Township	\$4,169,701,000	\$19,210,000	0
Pen Argyl Borough	\$651,065,000	\$611,158,000	93.9
Plainfield Township	\$1,086,698,000	\$451,033,000	41.5
Portland Borough	\$162,069,000	\$109,642,000	67.7
Roseto Borough	\$276,318,000	\$262,354,000	94.9
Stockertown Borough	\$298,470,000	\$9,863,000	3.3
Tatamy Borough	\$216,261,000	\$0	0
Upper Mt. Bethel Township	\$1,311,378,000	\$717,082,000	54.7
Upper Nazareth Township	\$1,071,480,000	\$0	0
Walnutport Borough	\$506,739,000	\$495,247,000	97.7
Washington Township	\$875,751,000	\$443,483,000	50.6
West Easton Borough	\$267,628,000	\$0	0.0
Williams Township	\$1,200,406,000	\$568,436,000	47.4
Wilson Borough	\$1,731,473,000	\$0	0
Wind Gap Borough	\$532,380,000	\$523,983,000	98.4
Northampton County (est. total)	\$58,471,301,000	\$7,268,063,000	12.4

Source: Lehigh County GIS; Northampton County GIS; Radeloff et al, 2005

Notes: GBS = General Building Stock; WUI = Wildland-Urban Interface

4.3.10.5.5 Impact on Critical Facilities

It is recognized that a number of critical facilities are located in the wildfire hazard area, and are also vulnerable to the threat of wildfire. Many of these facilities are the locations for vulnerable populations (i.e., schools, senior facilities) and responding agencies to wildfire events (i.e., fire, police). Table 4.3.10-6 summarizes critical facilities identified by the Lehigh Valley plan participants that are located within the wildfire hazard area.

Figure 4.3.10-6. Critical Facilities in WUI in the Lehigh Valley

Name	Municipality	Type
Lehigh County		
ALBURTIS FIRE CO	Alburtis (B)	Fire
ALBURTIS ELEMENTARY SCHOOL	Alburtis (B)	School
CITY OF ALLENTOWN	Allentown (C)	Fire
SALISBURY TWP	Allentown (C)	Fire
SALISBURY TWP SCHOOL AUTH	Allentown (C)	Fire
SALISBURY FIRE CO #1	Allentown (C)	Fire
LEHIGH PARKWAY ELEMENTARY SCHOOL	Allentown (C)	School
JEFFERSON ELEMENTARY SCHOOL	Allentown (C)	School
SOUTH MOUNTAIN MIDDLE SCHOOL	Allentown (C)	School
ROOSEVELT ELEMENTARY SCHOOL	Allentown (C)	School
WILSON EARLY CHILDHOOD CENTER	Allentown (C)	School
HIRAM DODD ELEMENTARY SCHOOL	Allentown (C)	School
SALISBURY HOUSE OF NORTHEAST PA INC	Allentown (C)	Senior
EAST END FIRE CO	Catasauqua (B)	Fire
LIBERTY BELL ELEMENTARY SCHOOL	Coopersburg (B)	School
U S POSTAL SERVICE	Coopersburg (B)	Government
EYER MIDDLE SCHOOL	Lower Macungie (T)	School
SHOEMAKER ELEMENTARY SCHOOL	Lower Macungie (T)	School
MACUNGIE ELEMENTARY SCHOOL	Lower Macungie (T)	School
Legacy Oaks at Lehigh Valley	Lower Macungie (T)	Senior
LYNNPORT COMM FIRE CO #1	Lynn (T)	Fire
COUNTY OF LEHIGH	North Whitehall (T)	Government
SALISBURY HIGH SCHOOL	Salisbury (T)	School
HARRY S TRUMAN ELEMENTARY SCHOOL	Salisbury (T)	School
WILEY HOUSE	Salisbury (T)	School
WILEY HOUSE	Salisbury (T)	School
COUNTY OF LEHIGH	Salisbury (T)	Government
BORO OF SLATINGTON	Slatington (B)	Fire
BORO OF SLATINGTON	Slatington (B)	Fire
BORO OF SLATINGTON	Slatington (B)	Fire
SLATINGTON ELEMENTARY SCHOOL	Slatington (B)	School
NORTHERN LEHIGH HIGH SCHOOL	Slatington (B)	School
NORTHERN LEHIGH MIDDLE SCHOOL	Slatington (B)	School
ST JOHN NEUMANN REGIONAL SCHOOL	Slatington (B)	School
UPPER MILFORD WESTERN DIST FIRE CO 1	Upper Milford (T)	Fire
SOUTH MOUNTAIN AREA MEDIC V INC	Upper Saucon (T)	Fire

SECTION 4.3.10: RISK ASSESSMENT – WILDFIRE

Name	Municipality	Type
ASSUMPTION BVM SCHOOL	Upper Saucon (T)	School
EMERALD STAR HOSE COMPANY #1	Washington (T)	Fire
CITIZENS FIRE CO	Washington (T)	Fire
WASHINGTON TWP	Washington (T)	Government
WASHINGTON TWP	Washington (T)	Government
Northampton County		
BANGOR FIRE DEPT - LIBERTY	Bangor (B)	Fire
BANGOR FIRE DEPT - RESCUE	Bangor (B)	Fire
BLUE VALLEY RESCUE	Bangor (B)	Fire
147 N 11TH ST	Bangor (B)	Medical
129 N 11TH ST	Bangor (B)	Medical
BANGOR DENTAL ASSO.	Bangor (B)	Medical
BANGOR PD	Bangor (B)	Police
Learning Locomotion	Bangor (B)	Child Day Care
Fiore Funeral Home	Bangor (B)	Funeral Home
Bangor Public Library	Bangor (B)	Libraries
United States Post Office	Bangor (B)	USPS Mail Centers (Post Offices)
Bangor Borough	Bangor (B)	Municipal Building
Donegan Elementary School	Bethlehem (C)	School
Zion First Hungarian Lutheran Church	Bethlehem (C)	Shelter
Christ Evangelical Congregational Church of Williams T	Easton (C)	Shelter
Arndt's Lutheran Church	Easton (C)	Shelter
Family YMCA of Easton	Easton (C)	Child Day Care
LEHIGH TWP PD	Lehigh (T)	Police
PERSONAL CARE HOME	Lehigh (T)	Senior
Blue Ridge Veterinary Clinic	Lehigh (T)	Animal Care
Liza's House Personal Care Home	Lehigh (T)	Adult Day Care
United States Post Office	Lehigh (T)	USPS Mail Centers (Post Office)
Lehigh Township	Lehigh (T)	Municipal Building
PPL Boat Access Ramp	Lower Mt Bethel (T)	Waterways
PPL Public Boat Access Ramp	Lower Mt Bethel (T)	Waterways
Riverton - Belvidere Bridge	Lower Mt Bethel (T)	Bridges
SE-WY-CO FIRE	Lower Saucon (T)	Fire
SOUTHEASTERN FIRE CO	Lower Saucon (T)	Fire
STEEL CITY FIRE CO	Lower Saucon (T)	Fire
LOWER SAUCON PD	Lower Saucon (T)	Police
Lehigh University	Lower Saucon (T)	School
IMMED.CARE FCTY/M/R	Lower Saucon (T)	Senior
IMMED.CARE FCTY M/R	Lower Saucon (T)	Senior
VNA HOSPICE @ ST LUKES	Lower Saucon (T)	Senior

SECTION 4.3.10: RISK ASSESSMENT – WILDFIRE

Name	Municipality	Type
District Court 03-2-04	Lower Saucon (T)	Judicial Building (Courthouse)
Lower Saucon Township	Lower Saucon (T)	Municipal Building
Salem UCC Cemetery	Moore (T)	Cemeteries
Amy Pysher's Child Care Center	Moore (T)	Child Day Care
Woodstone Country Club	Moore (T)	Golf Courses
138th State Legislative District	Moore (T)	State Building
St. Michael's Cemetery	Northampton	Cemeteries
PA DOT - Stockpile Danielsville	Northampton	Municipal Building
PA DOT - Stockpile Pen Argyl	Northampton	Municipal Building
PEN ARGYL FIRE CO	Pen Argyl (B)	Fire
PEN ARGYL PD	Pen Argyl (B)	Police
Pen Argyl Junior-Senior High School	Pen Argyl (B)	School
Immaculate Conception School	Pen Argyl (B)	School
MORNING STAR MANOR	Pen Argyl (B)	Senior
AVH Veterninary Group	Pen Argyl (B)	Animal Care
Morning Star Manor	Pen Argyl (B)	Adult Day Care
Kid's Campus Nursery and Day Care	Pen Argyl (B)	Child Day Care
United States Post Office	Pen Argyl (B)	USPS Mail Centers (Post Office)
Pen Argyl Borough	Pen Argyl (B)	Municipal Building
FAMILY CARE CENT INC	Plainfield (T)	Medical
WIND GAP PROF CENTER	Plainfield (T)	Medical
Wind Gap Middle School	Plainfield (T)	School
CHANDLER ESTATES IV	Plainfield (T)	Senior
Chandler Estate, Inc.	Plainfield (T)	Adult Day Care
Operation Smart Start	Plainfield (T)	Child Day Care
PORTLAND & VICINITY AMBULANCE CORPS	Portland (B)	Fire
PORTLAND PD	Portland (B)	Police
United States Post Office	Portland (B)	USPS Mail Centers (Post Office)
Portland Borough	Portland (B)	Municipal Building
ROSETO FIRE CO	Roseto (B)	Fire
ROSETO PD	Roseto (B)	Police
Our Lady of Mount Carmel School	Roseto (B)	School
Our Lady of Mount Carmel Cemetery	Roseto (B)	Cemeteries
United States Post Office	Roseto (B)	USPS Mail Centers (Post Office)
Roseto Borough	Roseto (B)	Municipal Building
Christ Evang Lutheran Church Cemetery	Upper Mt Bethel (T)	Cemeteries
Bangor Area School District Day Care	Upper Mt Bethel (T)	Child Day Care
Slate Belt Child Care	Upper Mt Bethel (T)	Child Day Care
Wee Love & Care Day Care	Upper Mt Bethel (T)	Child Day Care
Driftstone Delaware Boat Access Ramp	Upper Mt Bethel (T)	Waterways

SECTION 4.3.10: RISK ASSESSMENT – WILDFIRE

Name	Municipality	Type
Portland - Columbia Pedestrian Bridge	Upper Mt Bethel (T)	Bridges
MOUNT BETHEL FIRE CO	Upper Mt. Bethel (T)	Fire
NORTH BAQNGOR FIRE DEPT	Upper Mt. Bethel (T)	Fire
DIAMOND FIRE CO	Walnutport (B)	Fire
WALNUTPORT MED. OFFI	Walnutport (B)	Medical
NORTHERN LEHIGH MED	Walnutport (B)	Medical
WALNUTPORT BORO PD	Walnutport (B)	Police
Walnutport Elementary School	Walnutport (B)	School
CANAL SIDE MANOR	Walnutport (B)	Senior
Pond View Manor Personal Care Home	Walnutport (B)	Assisted Living
Hill Street Children's Center	Walnutport (B)	Child Day Care
Kidz Place	Walnutport (B)	Child Day Care
United States Post Office	Walnutport (B)	USPS Mail Centers (Post Office)
Walnutport Borough	Walnutport (B)	Municipal Building
LIBERTY EMS	Washington (T)	Fire
MEDIC 9 – NORTH	Washington (T)	Fire
Washington Elementary School	Washington (T)	School
Childhood Treasures Day Care	Washington (T)	Child Day Care
WILLIAMS TWP EMS	Williams (T)	Fire
WILLIAMS TWP FIRE DEPT	Williams (T)	Fire
Williams Township Elementary School	Williams (T)	School
Country Classics at Morgan Hill	Williams (T)	Senior
The Center for Animal Health & Welfare	Williams (T)	Animal Care
Abby Burns Daycare	Williams (T)	Child Day Care
Morgan Hill Day Care	Williams (T)	Child Day Care
Christ Evangelical Congregational Church	Williams (T)	Religious
Williams Township	Williams (T)	Municipal Building
WIND GAP EMS	Wind Gap (B)	Fire
BLUE MT EMS	Wind Gap (B)	Fire
WIND GAP FIRE DEPT	Wind Gap (B)	Fire
FRENIENIUS MEDICAL CARE	Wind Gap (B)	Medical
S BROADWAY	Wind Gap (B)	Medical
WIND GAP PD	Wind Gap (B)	Police
WALDEN III ASSTD LIVING	Wind Gap (B)	Senior
District Court 03-3-02	Wind Gap (B)	Judicial Building (Courthouse)
Children's Center of Wind Gap	Wind Gap (B)	Child Day Care
United States Post Office	Wind Gap (B)	USPS Mail Centers (Post Office)
Wind Gap Borough	Wind Gap (B)	Municipal Building

Source: Lehigh County GIS; Northampton County GIS; Steering Committee; Radeloff et al, 2005

Notes: B = Borough; C = City; PD = Police Department; T = Township

4.3.10.5.6 Impact on the Economy

Wildfire events can have major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed businesses and decreases in tourism. Wildfire can also severely impact roads and infrastructure. The Interstates I-78 and I-476, major east to west and north to south corridors through the Lehigh Valley, both have portions that run through WUI areas. This should be considered for evacuation route purposes.

4.3.10.5.7 Future Growth and Development

Areas targeted for potential future growth and development in the next five (5) to ten (10) years have been identified across the Lehigh Valley at the municipal level. Refer to the jurisdictional annexes in Volume II of this HMP. Table B.1 in each jurisdictional annex lists the location of the potential new development and its exposure (if any) to known hazard zones. It is anticipated that any new development and new residents in the WUI will be exposed to the wildfire hazard.

4.3.10.5.8 Effect of Climate Change on Vulnerability

According to the U.S. Fire Service (USFS), climate change will likely alter the atmospheric patterns that affect fire weather. Changes in fire patterns will, in turn, impact carbon cycling, forest structure, and species composition. Climate change associated with elevated greenhouse gas concentrations may create an atmospheric and fuel environment that is more conducive to large, severe fires (USFS, 2011).

Fire interacts with climate and vegetation (fuel) in predictable ways. Understanding the climate/fire/vegetation interactions is essential for addressing issues associated with climate change that include:

- Effects on regional circulation and other atmospheric patterns that affect fire weather
- Effects of changing fire regimes on the carbon cycle, forest structure, and species composition, and
- Complications from land use change, invasive species and an increasing wildland-urban interface (USFS, 2011).

It is projected that higher summer temperatures will likely increase the high fire risk by 10 to 30-percent. Fire occurrence and/or area burned could increase across the U.S. due to the increase of lightning activity, the frequency of surface pressure and associated circulation patterns conducive to surface drying, and fire-weather conditions, in general, which are conducive to severe wildfires. Warmer temperatures will also increase the effects of drought and increase the number of days each year with flammable fuels and extending fire seasons and areas burned (USFS, 2011).

Pennsylvania's Department of Environmental Protection was directed by the Climate Change Act (Act 70 of 2008) to initiate a study of the potential impacts of global climate change on the Commonwealth. The June 2009 PA Climate Impact Assessment's main findings indicate Pennsylvania may be at increased risk for wildfires, but it is unclear as to how large the increase in risk will be (Shortle et. al, 2009).

Future changes in fire frequency and severity are difficult to predict. Global and regional climate changes associated with elevated greenhouse gas concentrations could alter large weather patterns, thereby affecting fire-weather conditions that are conducive to extreme fire behavior (USFS, 2011).

4.3.10.5.9 Additional Data and Next Steps

The custom building inventory developed for this Plan should be updated as data regarding the construction of structures, such as roofing material, fire detection equipment, structure age, etc. are available. As stated earlier, buildings constructed of wood or vinyl siding are generally more likely to be impacted by the fire hazard than buildings constructed of brick or concrete. The proximity of these building types to the WUI should be identified for further evaluation. Development and availability of such data would permit a more detailed estimate of potential vulnerabilities, including loss of life and potential structural damages.

In locations where homes are at risk for wildfires, the BOF’s Wildland-Urban Interface Guidance Document is available to assist homeowners, community associations, local government and developers to assess and mitigate the potential dangers of a wildfire. The guidance also provides information for developing an action plan in coordination with local emergency managers. Communities at risk for wildfires can adopt by local ordinance the “International Wildland-Urban Interface Code” of the Uniform Construction Code.

4.3.11 Windstorm, Tornado

This section provides a profile and vulnerability assessment for the windstorm and tornado hazard. For the purpose of this Plan, the wind hazard includes various types of wind events, including windstorms, and tornadoes, which are defined below.

Wind is air moving from high to low pressure. It is the rough horizontal movement of air (as opposed to an air current) caused by uneven heating of the Earth's surface. It occurs at all scales, from local breezes generated by heating of land surfaces and lasting tens of minutes to global winds resulting from solar heating of the Earth (FEMA, 1997). There are different types of damaging winds – straight-line winds, downdrafts, downbursts, microburst, gust front, derecho and bow echo.

- Straight-line wind is a term used to define any thunderstorm wind that is not associated with rotation. Straight-line winds are the movement of air from areas of higher pressure to areas of lower pressure – the greater the difference in pressure, the stronger the winds. It is a term used mainly to differentiate from tornadic winds.
- Downdrafts are a small-scale column of air that rapidly sinks toward the ground and usually results in a downburst.
- Downbursts are a strong downdraft with horizontal dimensions larger than 2.5 miles resulting in an outward burst or damaging winds on or near the ground. They are usually associated with thunderstorms, but can occur with rain storms too weak to produce thunder.
- Microbursts are a small, concentrated downburst that produces an outward burst of damaging winds near the surface. They are typically short-lived, lasting only five to 10 minutes, with maximum wind speeds of up to 168 mph.
- A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. They are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm (NSSL, 2006).
- A derecho is a widespread and long-lived windstorm associated with thunderstorms that are often curved in shape (Johns et al., 2011). The two major influences on the atmospheric circulation are the differential heating between the equator and the poles, and the rotation of the planet (FEMA, 1997).
- Bow echoes are radar echoes that are linear but bent outward in a bow shape. Damaging straight-line winds often occur near the center of a bow echo (crest). Bow echoes can be over 300 kilometers in length, last for several hours, and produce extensive swaths of wind damage at the ground (NSSL, 2006).

Windstorms are generally defined as sustained wind speeds of 40 miles per hour (mph) or greater lasting for one hour or longer, or winds of 58 mph or greater for any duration. Windstorm events are associated with cyclonic storms (for example, hurricanes), thunderstorms and tornadoes (FEMA, 1997).

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud. However, a condensation funnel does not need to reach to the ground for a tornado to be present; a debris cloud beneath a thunderstorm is all that is needed to confirm the presence of a tornado, even in the total absence of a funnel. A tornado is spawned by a thunderstorm (or sometimes as a result of a hurricane) and produced when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. The average forward speed of a tornado is 30 mph, but can vary from nearly stationary to 70 mph (NWS, 2009). Most

tornadoes have wind speeds of 100 mph or less, are approximately 250 feet across and travel a few miles before dissipating. Some tornadoes can attain wind speeds of more than 300 mph, stretch more than one mile across and stay on the ground for several miles (NOAA, 1995). The NOAA Storm Prediction Center (SPC) indicates that the total duration of a tornado can last between a few seconds to over one hour; however, a tornado typically lasts less than 10 minutes (Edwards, 2012).

High-wind velocity and wind-blown debris, along with lightning or hail, result in the damage caused by tornadoes. Destruction caused by tornadoes depends on the size, intensity, and duration of the storm. Tornadoes cause the greatest damage to structures that are light, such as residential homes and mobile homes, and tend to remain localized during impact (NVRC, 2006).

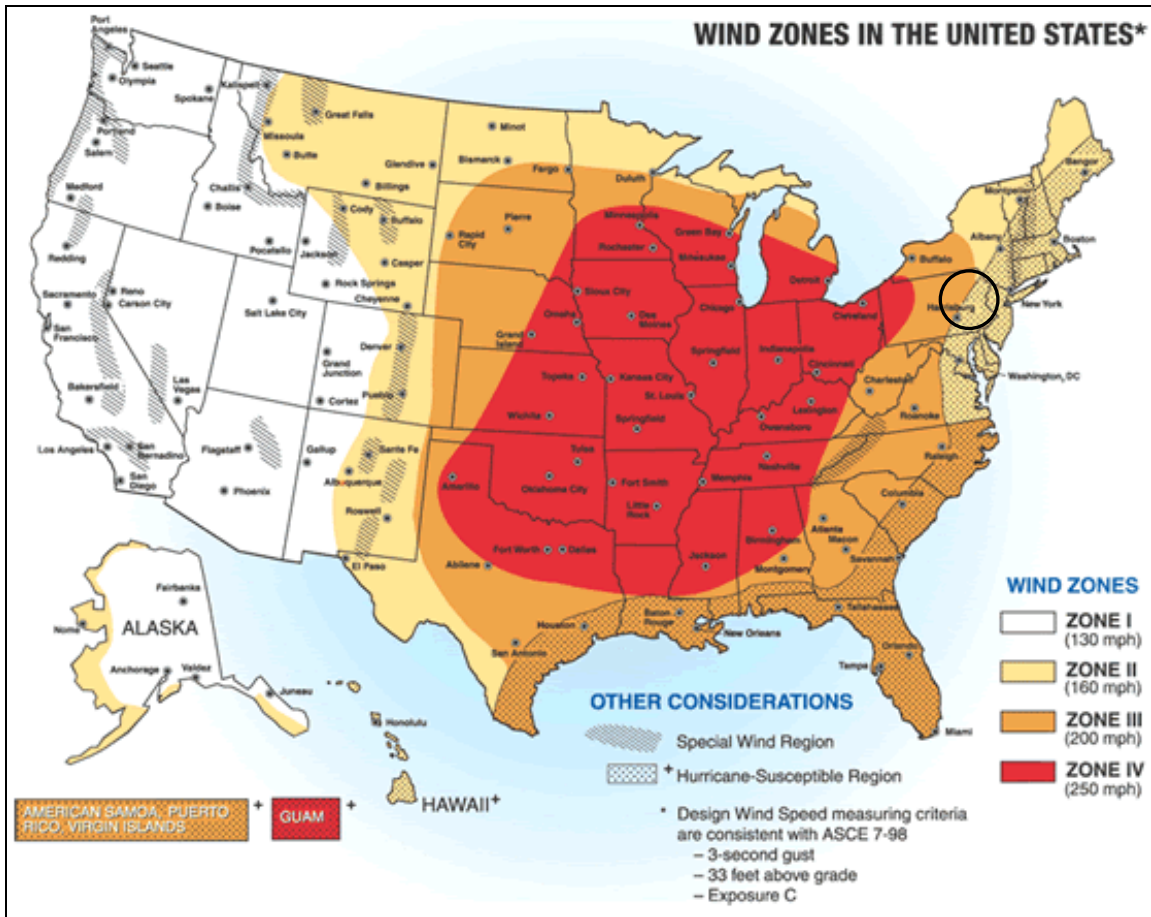
4.3.11.1 Location and Extent

Tornadoes and windstorms can occur throughout Pennsylvania. Tornadoes are usually localized; however, severe thunderstorms can result in conditions favorable to the formation of numerous or long-lived tornadoes. Straight-line winds and windstorms are experienced on a region-wide scale (PEMA, 2010).

Windstorms

Figure 4.3.11-1 indicates how the frequency and strength of windstorms impacts the U.S. and the general location of the most wind activity. This is based on 40 years of tornado history and 100 years of hurricane history, collected by FEMA. States located in Wind Zone IV have experienced the greatest number of tornadoes and the strongest tornadoes (NVRC, 2006). The Lehigh Valley is located in Wind Zone II with speeds up to 160 miles per hour. The Lehigh Valley is also located within the Hurricane Susceptibility Region, which extends along the northeastern coastline of the U.S. (FEMA, 2010). Table 4.3.11-1 describes the different wind zones of the U.S.

Figure 4.3.11-1. Wind Zones in the U.S.



Source: FEMA, 2010

Note: The black circle indicates the approximate location of the Lehigh Valley.

Table 4.3.11-1. Wind Zones in the U.S.

Wind Zones	Areas Affected
Zone I (130 mph)	All of Washington, Oregon, California, Idaho, Utah, and Arizona. Western parts of Montana, Wyoming, Colorado and New Mexico. Most of Alaska, except the east and south coastlines.
Zone II (160 mph)	Eastern parts of Montana, Wyoming, Colorado, and New Mexico. Most of North Dakota. Northern parts of Minnesota, Wisconsin and Michigan. Western parts of South Dakota, Nebraska and Texas. All New England States. Eastern parts of New York, Pennsylvania, Maryland, and Virginia. Washington, DC.
Zone III (200 mph)	Areas of Minnesota, South Dakota, Nebraska, Colorado, Kansas, Oklahoma, Texas, Louisiana, Mississippi, Alabama, Georgia, Tennessee, Kentucky, Pennsylvania, New York, Michigan, and Wisconsin. Most or all of Florida, Georgia, South Carolina, North Carolina, Virginia, West Virginia. All of American Samoa, Puerto Rico, and Virgin Islands.
Zone IV (250 mph)	Mid US including all of Iowa, Missouri, Arkansas, Illinois, Indiana, and Ohio and parts of adjoining states of Minnesota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Louisiana, Mississippi, Alabama, Georgia, Tennessee, Kentucky, Pennsylvania, Michigan, and Wisconsin. Guam.
Special Wind Region	Isolated areas in the following states: Washington, Oregon, California, Idaho, Utah, Arizona, Montana, Wyoming, Colorado, New Mexico. The borders between Vermont and New Hampshire; between New York,

Wind Zones	Areas Affected
Hurricane Susceptible Region	Massachusetts and Connecticut; between Tennessee and North Carolina. Southern US coastline from Gulf Coast of Texas eastward to include entire state of Florida. East Coastline from Maine to Florida, including all of Massachusetts, Connecticut, Rhode Island, Delaware, and Washington DC. All of Hawaii, Guam, American Samoa, Puerto Rico and Virgin Islands.

Source: FEMA, 2010

Tornadoes

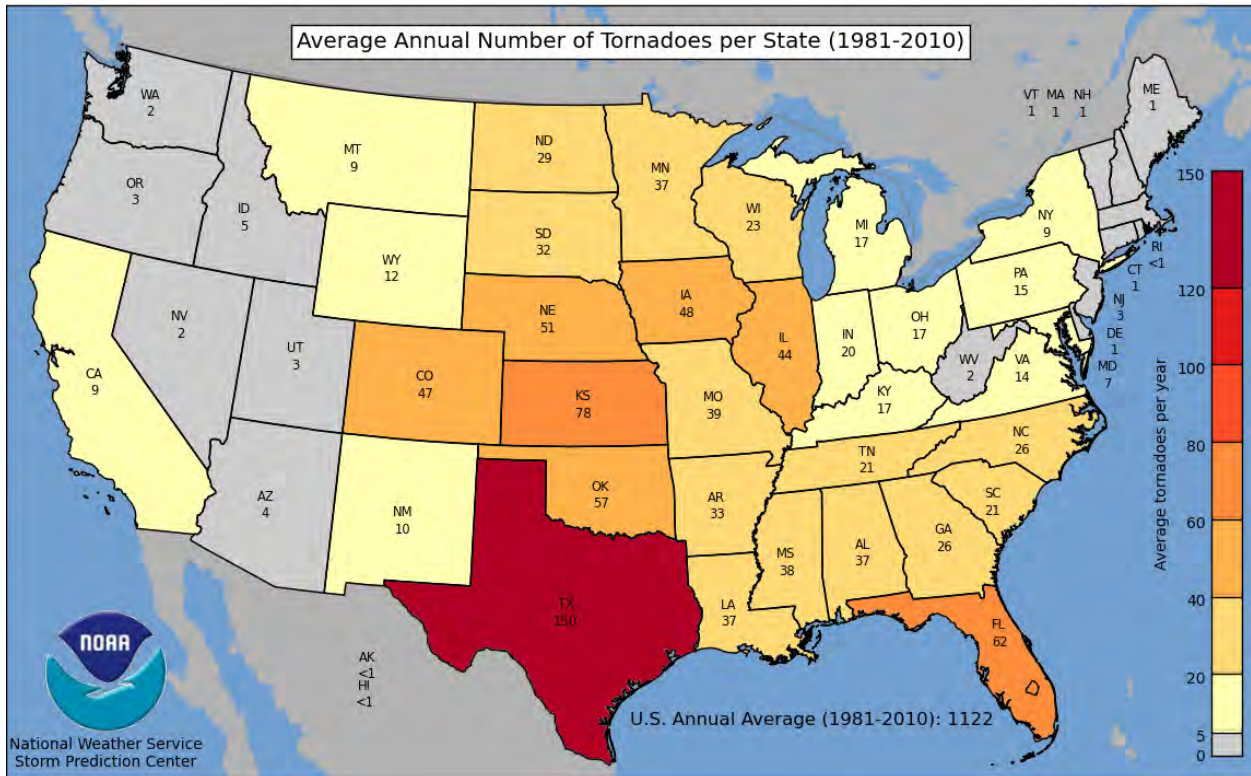
The U.S. experiences more tornadoes than any other country. In a typical year, approximately 1,000 tornadoes affect the U.S. The peak of the U.S. tornado season is April through June, with the highest concentration of tornadoes in the central U.S., although tornadoes can occur at any time of year (NWS, 2011). Tornadoes tend to strike in the afternoons and evening, the warmest hours of the day, with over 80% of all tornadoes striking between noon and midnight (New Jersey Office of Emergency Management, 2007).

Tornado movement is characterized in two ways: direction and speed of the spinning winds, and forward movement of the tornado/storm track. Rotational wind speeds of the vortex can range from 100 mph to more than 250 mph. In addition, the speed of forward motion can be zero to 45 or 50 mph. Therefore, some estimates place the maximum velocity (combination of ground speed, wind speed, and upper winds) of tornadoes at about 300 mph. The forward motion of the tornado path can be a few hundred yards or several hundred miles in length. The width of tornadoes can vary greatly, but generally range in size from less than 100 feet to over a mile in width. Some tornadoes never touch the ground and are short-lived, while others may touch the ground several times.

While the extent of tornado damage is usually localized, the extreme winds of this vortex can be among the most destructive on earth when they move through populated, developed areas.

Figure 4.3.11-2 shows the annual average number of tornadoes between 1981 and 2010 (NWS, 2012). The Commonwealth of Pennsylvania experienced an average of 15 tornado events annually between 1981 and 2010.

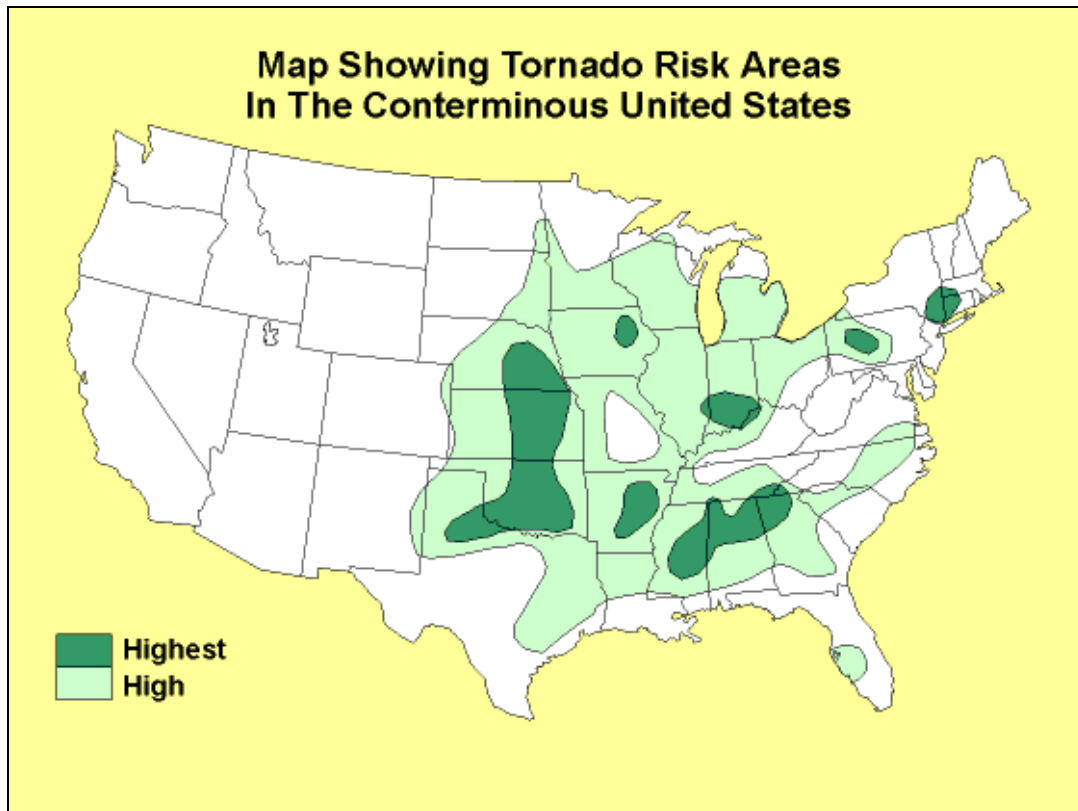
Figure 4.3.11-2. Annual Average Number of Tornadoes in the U.S., 1981 to 2010



Source: NWS, 2012

Figure 4.3.11-3 indicates that a large portion of Pennsylvania is at high risk for tornadoes; with a portion considered highest risk. The Lehigh Valley has an overall low risk for tornado occurrences. Details regarding historical tornado events are discussed in the Past Occurrences section of this profile.

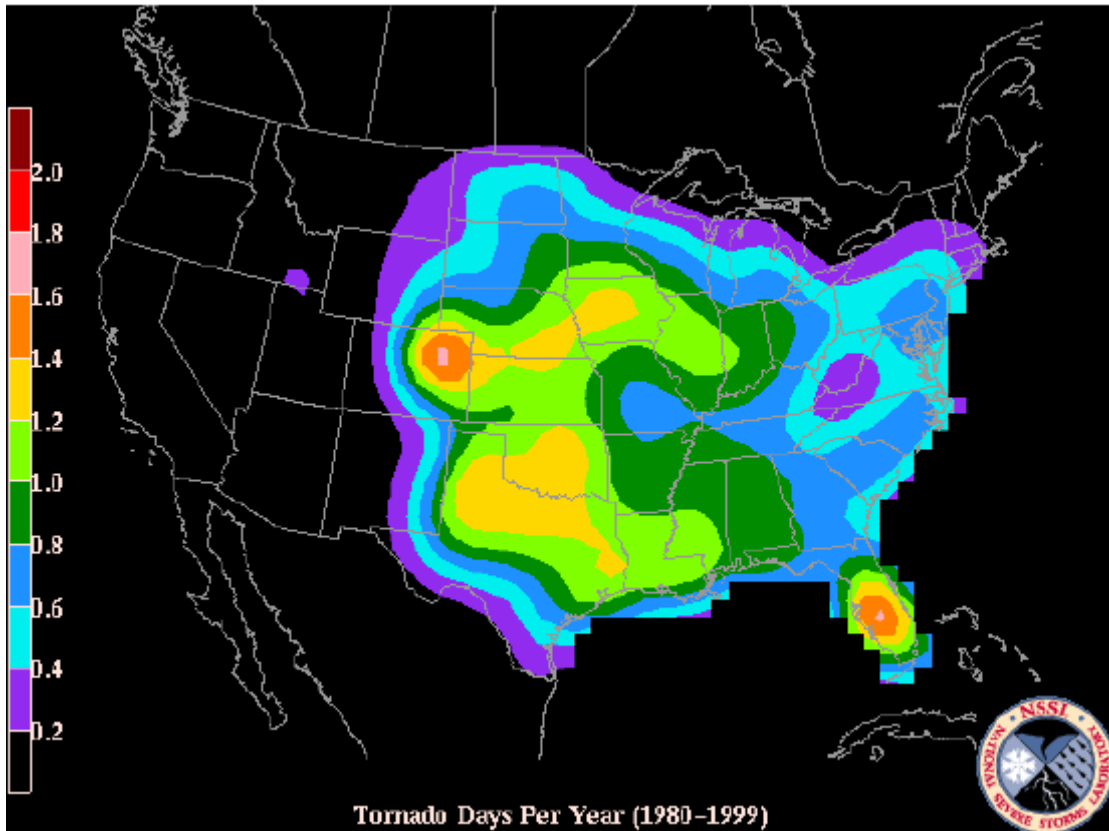
Figure 4.3.11-3. Tornado Risk in the U.S.



Source: American Red Cross, 2010

A study from NOAA’s National Severe Storms Laboratory (NSSL) provided estimates of the long-term threat from tornadoes. The NSSL used historical data to estimate the daily probability of tornado occurrences across the U.S., no matter the magnitude of the tornado. Figure 4.3.11-4 shows the estimates prepared by the NSSL. In Pennsylvania, it is estimated that the probability of a tornado occurring is 0.2 to 0.8 days per year. In the Lehigh Valley, it is estimated that the probability of a tornado occurring is 0.6 to 0.8 days per year (NSSL, 2003).

Figure 4.3.11-4. Total Annual Threat of Tornado Events in the U.S., 1980-1999



Source: NSSL, 2003

Note: The mean number of days per year with one or more events within 25 miles of a point is shown here. The fill interval for tornadoes is 0.2, with the purple starting at 0.2 days. For the non-tornadic threats, the fill interval is 1, with the purple starting at 1. For the significant (violent), it is 5 days per century (millennium)

4.3.11.2 Range of Magnitude

Windstorms are generally defined as sustained wind speeds of 40 mph or greater lasting for one hour or longer, or winds of 58 mph or greater for any duration. A tornado’s magnitude is classified using the Enhanced Fujita Scale, which is further discussed below.

The magnitude or severity of a tornado was originally categorized using the Fujita Scale (F-Scale) or Pearson Fujita Scale introduced in 1971, based on a relationship between the Beaufort Wind Scales (B-Scales) (measure of wind intensity) and the Mach number scale (measure of relative speed). It is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure (Tornado Project, Date Unknown). The F-Scale categorizes each tornado by intensity and area. The scale is divided into six categories, F0 (Gale) to F5 (Incredible) (Edwards, 2011). Table 4.3.11-2 explains each of the six F-Scale categories.

Table 4.3.11-2. Fujita Damage Scale

Scale	Wind Estimate (MPH)	Typical Damage
F0	< 73	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	261-318	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

Source: SPC, Date Unknown

Although the F-Scale has been in use for over 30 years, there are limitations of the scale. The primary limitations are a lack of damage indicators, no account of construction quality and variability, and no definitive correlation between damage and wind speed. These limitations have led to the inconsistent rating of tornadoes and, in some cases, an overestimate of tornado wind speeds. The limitations listed above led to the development of the Enhanced Fujita Scale (EF Scale). The Texas Tech University Wind Science and Engineering (WISE) Center, along with a forum of nationally renowned meteorologists and wind engineers from across the country, developed the EF Scale (WISE, 2004).

The EF Scale became operational on February 1, 2007. It is used to assign tornadoes a ‘rating’ based on estimated wind speeds and related damage. When tornado-related damage is surveyed, it is compared to a list of Damage Indicators (DIs) and Degree of Damage (DOD), which help better estimate the range of wind speeds produced by the tornado. From that, a rating is assigned, similar to that of the F-Scale, with six categories from EF0 to EF5, representing increasing degrees of damage. The EF Scale was revised from the original F-Scale to reflect better examinations of tornado damage surveys. This new scale has to do with how most structures are designed (NWS, 2008). Table 4.3.11-3 displays the EF Scale and each of its six categories.

SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

Table 4.3.11-3. Enhanced Fujita Damage Scale

EF-Scale Number	Intensity Phrase	Wind Speed (mph)	Type of Damage Done
EF0	Light tornado	65–85	Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF1	Moderate tornado	86-110	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	Significant tornado	111-135	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	Severe tornado	136-165	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	Devastating tornado	166-200	Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	Incredible tornado	>200	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (109 yd.); high-rise buildings have significant structural deformation; incredible phenomena will occur.

Source: NWS, 2008

In the Fujita Scale, there was a lack of clearly defined and easily identifiable damage indicators. The EF Scale takes into account more variables than the original F-Scale did when assigning a wind speed rating to a tornado. The EF Scale incorporates 28 DIs, such as building type, structures, and trees. For each damage indicator, there are eight DODs, ranging from the beginning of visible damage to complete destruction of the damage indicator. Table 4.3.11-4 lists the 28 DIs. Each one of these indicators has a description of the typical construction for that category of indicator. Each DOD in every category is given an expected estimate of wind speed, a lower bound of wind speed, and an upper bound of wind speed.

Table 4.3.11-4. EF Scale Damage Indicators

Number	Damage Indicator	Abbreviation	Number	Damage Indicator	Abbreviation
1	Small barns, farm outbuildings	SBO	15	School - 1-story elementary (interior or exterior halls)	ES
2	One- or two-family residences	FR12	16	School - jr. or sr. high school	JHSH
3	Single-wide mobile home (MHSW)	MHSW	17	Low-rise (1-4 story) bldg.	LRB
4	Double-wide mobile home	MHDW	18	Mid-rise (5-20 story) bldg.	MRB
5	Apt, condo, townhouse (3 stories or less)	ACT	19	High-rise (over 20 stories)	HRB
6	Motel	M	20	Institutional bldg. (hospital, govt. or university)	IB
7	Masonry apt. or motel	MAM	21	Metal building system	MBS
8	Small retail bldg. (fast food)	SRB	22	Service station canopy	SSC
9	Small professional (doctor office, branch bank)	SPB	23	Warehouse (tilt-up walls or heavy timber)	WHB
10	Strip mall	SM	24	Transmission line tower	TLT
11	Large shopping mall	LSM	25	Free-standing tower	FST
12	Large, isolated ("big box") retail bldg.	LIRB	26	Free standing pole (light, flag, luminary)	FSP
13	Automobile showroom	ASR	27	Tree - hardwood	TH
14	Automotive service building	ASB	28	Tree - softwood	TS

Source: SPC, Date Unknown

Since the EF Scale recently went into effect in February 2007, previous occurrences and losses associated with historic tornado events, described in the Past Occurrences section of this hazard profile, are based on the former Fujita Scale. Events after February 2007 are based on the Enhance Fujita Scale.

4.3.11.3 Past Occurrence

Many sources provided historical information regarding previous occurrences and losses associated with tornado and windstorm events throughout the Commonwealth of Pennsylvania and the Lehigh Valley. With so many sources reviewed for the purpose of this plan, loss and impact information for many events

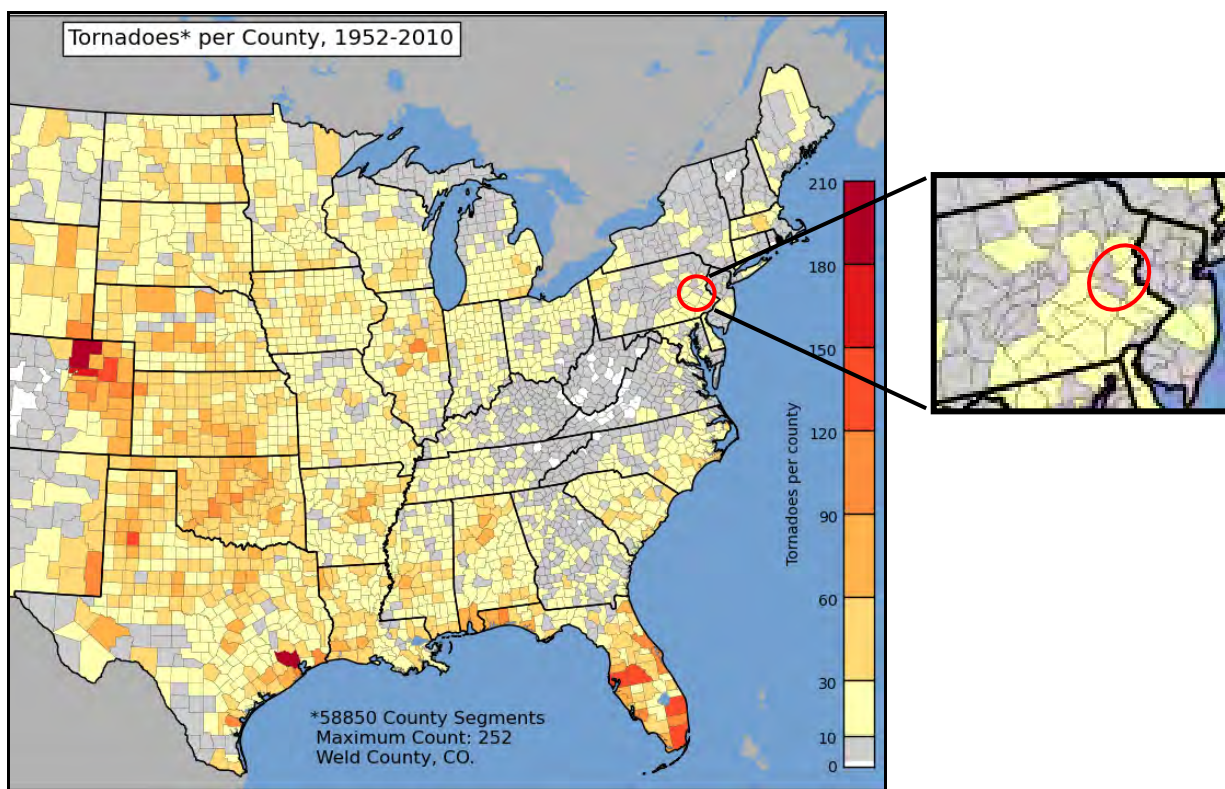
SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

According to NOAA’s NCDC storm events database, the Lehigh Valley experienced 503 tornado and windstorm events between April 30, 1950 and November 30, 2011. These events include funnel clouds, high winds, strong winds, thunderstorm winds and tornadoes. Total property damages, as a result of these windstorm and tornado events, were estimated at \$38.9 million. This total also includes damages to other counties.

Figure 4.3.11-5 shows the average number of tornadoes recorded between 1952 and 2010 by county across the U.S. (NWS, 2012). Lehigh and Northampton Counties experienced nine and eleven tornadoes between 1952 and 2010, respectively.

Figure 4.3.11-5: U.S. Tornado Summaries by County



Source: NWS, 2012

According to NOAA’s NCDC, there were ten recorded tornadoes in Lehigh County between 1950 and 2012. These tornadoes ranged in intensity from F0-F2. Of the ten tornadoes, two were categorized as F0, five were categorized as F1, and three were categorized as F2. The most severe tornado to hit Lehigh County since 2006 was an EF1 that touched down in East Side in 2008. This was the only confirmed tornado in the United States associated with Tropical Storm Hanna, and it produced widespread damages in Allentown exceeding \$1.5M. No deaths or injuries resulted from this storm. In Northampton County, there were 11 recorded tornadoes between 1958 and 2012. The intensity of the tornadoes ranged from F0-F3. Of the 11 tornadoes, two were categorized as F0, six were categorized as F1, two were categorized as F2, and one was categorized as an F3. There have been no recorded tornadoes in Northampton County since 1996 (NCDC, 2012).

SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

The most recent recorded tornado in the Lehigh Valley occurred on July, 14, 2010, and was recorded as a magnitude EF0. The thunderstorm-induced tornado touched down in areas of Lehigh County between Lynnwood and New Tripoli uprooting trees, flattening fields, and damaging homes. \$500,000 in property damages and no injuries were reported (NCDC, 2012).

According to the Hazard Research Lab at the University of South Carolina’s Spatial Hazard Events and Losses Database for the U.S. (SHELDUS), between 1960 and 2010, 424 windstorm and tornado events occurred within the Lehigh Valley. The database indicated that windstorm and tornado events and losses specifically associated with Lehigh and Northampton Counties and its municipalities totaled over \$17.8 million in property damage and over \$36,000 in crop damage. However, these numbers may vary due to the database identifying the location of the hazard event in various forms or throughout multiple counties or regions.

Between 1954 and 2012, the Commonwealth of Pennsylvania experienced four Federally-declared windstorm or tornado-related disasters (DR) or emergencies (EM) classified as one or a combination of the following disaster types: severe storms, flash flooding, flooding, and high winds. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations. Lehigh and Northampton Counties were not included in any of the declared disasters (FEMA, 2011). One high wind event in April 1975 resulted in a PEMA statewide disaster declaration. Impacts of the wind event on the Lehigh Valley are not known.

Based on all sources researched, select significant windstorm and tornado events that have affected the Lehigh Valley and its municipalities between April, 1975 and March, 2012, are identified in Table 4.3.11-5. With windstorm and tornado documentation for the Commonwealth of Pennsylvania being so extensive, not all sources have been identified or researched. Therefore, Table 4.3.11-5 may not include all events that have occurred throughout the Lehigh Valley and the region.

SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

Table 4.3.11-5. Tornado and Windstorm Events between 1975 and March 2012 in the Lehigh Valley

Dates of Event	Event Type	Location	Magnitude	Losses / Impacts	Source(s)
April 3-5, 1975	High Winds	Statewide	Unknown	One high wind event resulting in a statewide disaster declaration occurred in April 1975. The storm is noteworthy not only for the strength of the wind, but the length of occurrence. The strongest winds and most of the damage occurred on the 3rd. Many trees were uprooted or broken off, and houses and buildings were damaged, some with their roofs being blown off. Winds gusted to over 50 mph throughout the region. Impacts of the wind event on the Lehigh Valley are not known.	PEMA, NOAA
1981	Tornado	Northampton County	F3	This was the most severe tornado to occur in the County. An F3 tornado was recorded in Lehigh Township, impacting approximately 60 properties and causing over \$750K in damages.	LVHMP
August 11, 1983	Tornado	Northampton County	F1	An F1 tornado was recorded, causing two injuries in Northampton County and widespread property damages. Damage estimates reached \$25 Million.	NOAA
July 5, 1984	Tornado	Lehigh County	F3	A tornado-downburst outbreak in PA extended from Pricetown, Berks Co, to Macungie, Lehigh Co, moving east-north-east in the vicinity of New Jerusalem, Midway, and Alburdis. Numerous houses were destroyed or severely damaged, and estimated property damages reached \$2.5 Million. No injuries were reported.	NOAA
May 1995	Tornado	Lehigh County	F1	An F1 tornado was recorded in Lehigh County. The tornado briefly touched down in a rural area of Lower Milford Township. The roofs from two barns were peeled away and hundreds of trees were toppled. No property damage amounts were provided for this tornado.	LVHMP
November 8, 1996	Tornado	Lehigh and Northampton Counties	F2	An F2 tornado touched down near Danielsville in Lehigh Township (Northampton County). One person was injured and two families lost their homes. The County experienced approximately \$250K in damages.	LVHMP
November 13, 2003	High Wind	Lehigh and Northampton Counties	52 kts.	A high-wind event caused damages reported at \$2.2 Million. Three injuries and one death were reported in association with the event.	NOAA
December 1, 2006	High Wind	Lehigh and Northampton Counties	61 kts.	High winds, severe storm/thunderstorm winds were reported in Lehigh and Northampton Counties. Trees and wires were reported down in Upper Mount Bethel Township, and estimated wind speeds reached 70 mph at East Bangor. Trees and wires were reported down throughout Lehigh County, and a 62 mph thunderstorm wind gust was reported in Lehigh Township. Damages reached \$1 Million.	NOAA
September 6, 2008	Tornado	Lehigh County	EF1	The only confirmed tornado in the United States associated with Tropical Storm Hanna occurred in Allentown. An EF1 tornado with maximum wind gusts of about 95 mph touched down in East Allentown, damaging about 50 homes and the Louis E. Dieruff High School which was closed until September 10th. About 100 trees were damaged or destroyed, siding was torn from a few homes, and power lines were pulled down. The tornado	NOAA

SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

Dates of Event	Event Type	Location	Magnitude	Losses / Impacts	Source(s)
				path length was about 0.6 of a mile and its maximum path width was about 30 yards. No injuries were reported.	
February 12, 2009	Strong/high Winds	Lehigh and Northampton Counties	56 kts.	Strong to high winds averaging between 50 and 65 mph affected Eastern PA during the day on the 12 th . In Lehigh County, the roof was blown off a garage in Allentown, a billboard was bent along U.S. Route 22 in Whitehall Twp., and PA SR 309 was closed because of downed trees. Many trees and limbs were knocked down along the Ironton Rail in Whitehall, North Whitehall and Coplay. In Northampton County, downed power lines caused a destructive fire in Forks Township. A tree fell on a home in Bethlehem, and a church was damaged in Easton. In Northampton Borough, the roof blew off a building at 14th Street and Newport Avenue. At least six roadways were closed in the county including PA SR 611 in Upper Mount Bethel. In the Lehigh Valley, about 19,000 homes and businesses lost power including Westgate Mall in Bethlehem. Power was not fully restored in Eastern Pennsylvania until the 14th. Peak wind gusts included 64 mph in Forks Township (Northampton County). \$1.25M in property damages and no injuries were reported.	NOAA
July 14, 2010	Tornado	Lehigh County	EF0	An EF0 tornado touched down in Lynnville, Lehigh County, where three homes were damaged by the fallen trees. There were numerous trees toppled or sheared off in the area, and two cornfields were partially flattened. The tornado continued on a northward track and dissipated near New Tripoli. The tornado's path length was about 2.2 miles. Its maximum path length was 150 yards and its estimated maximum wind speed was 80 mph. \$500K in property damages and no injuries were reported.	NOAA

Note (1): Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of increased U.S. Inflation Rates.

FEMA Federal Emergency Management Agency
 K Thousand (\$)
 KTS Knots
 LVHMP Lehigh Valley Hazard Mitigation Plan

M Million (\$)
 NOAA National Oceanic Atmospheric Administration
 PEMA Pennsylvania Emergency Management Agency
 SR State Route



4.3.11.4 Future Occurrence

In Section 4.4, the identified hazards of concern for the Lehigh Valley were ranked according to relative risk. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. The probability of occurrence for severe windstorm and tornado events in the Lehigh Valley is considered ‘*likely*’ (between 10 and 100% annual probability) as defined by the Risk Factor Methodology probability criteria (Section 4.4).

The Lehigh Valley experiences strong winds on a frequent basis, and when those winds do strike, they can result in significant property damage, downed trees, and utility outages. It can reasonably be assumed future tornadoes will be similar in nature to those that have affected the Lehigh Valley in the past. It is estimated that the Lehigh Valley will continue to experience direct and indirect impacts of windstorms and tornadoes annually that may induce secondary hazards such as infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, and transportation delays, accidents and inconveniences.

4.3.11.5 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For severe windstorm and tornado events, the entire Lehigh Valley has been identified as the hazard area. Therefore, all assets in the Lehigh Valley (population, structures, critical facilities and lifelines), as described in the Regional Profile (Section 2), are vulnerable. The following text evaluates and estimates the potential impact of the wind hazard on the Lehigh Valley including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety of residents, (2) general building stock, (3) critical facilities, (4) economy, (5) environment, and (6) future growth and development
- Effect of climate change on vulnerability
- Further data collection that will assist understanding this hazard over time

4.3.11.5.1 Overview of Vulnerability

The high winds and air speeds of a windstorm and tornado often result in power outages, disruptions to transportation corridors and equipment, loss of workplace access, significant property damage, injuries and loss of life, and the need to shelter and care for individuals impacted by the events. A large amount of damage can be inflicted by trees, branches, and other objects that fall onto power lines, buildings, roads, vehicles, and, in some cases, people. The risk assessment for windstorm evaluates available data for a range of storms included in this hazard category.

Due to the Lehigh Valley’s inland location, losses from wind are primarily associated with severe thunderstorm or tropical depression/storm-related winds and rain (see flood discussion in Section 4.3.4). Secondary flooding associated with the torrential downpours during severe storms is also a primary concern in the Lehigh Valley. Both counties have experienced flooding in association with numerous severe storms in the past.

The entire inventory of the Lehigh Valley is at risk of being damaged or lost due to impacts of severe windstorms and tornados. Certain areas, infrastructure, and types of building are at greater risk than others due to proximity to falling hazards and manner of construction. Potential losses associated with

high wind events were calculated for the Lehigh Valley for two probabilistic hurricane events, the 100-year and 500-year Mean Return Period (MRP) wind events. The impacts on population, existing structures and critical facilities on the Lehigh Valley are presented below, following a summary of the data and methodology used.

4.3.11.5.2 Data and Methodology

After reviewing historic data, the HAZUS-MH methodology and model were used to analyze the wind hazard for the Lehigh Valley. Data used to assess this hazard include data available in the HAZUS-MH 2.1 hurricane model, professional knowledge, and information provided by the Steering Committee and regional stakeholders.

A probabilistic scenario was run for the Lehigh Valley for annualized losses and the 100- and 500-year MRPs were examined for the wind/severe storm hazard. Figures 4.3.11-6 and 4.3.11-7 show the HAZUS-MH maximum peak gust wind speeds that can be anticipated in the study area associated with the 100- and 500-year MRP hurricane events. The estimated hurricane track for the 100- and 500-year events is also shown. HAZUS estimates the 100-year MRP wind speeds for the Lehigh Valley to be 61 to 67 miles per hour (mph). This equates to a Tropical Storm. HAZUS estimates the 500-year MRP wind speeds for the Lehigh Valley to range from 81 to 85 mph. This equates to a Category One hurricane.

HAZUS-MH contains data on historic hurricane events and wind speeds. It also includes surface roughness and vegetation (tree coverage) maps for the area. Surface roughness and vegetation data support the modeling of wind force across various types of land surfaces. Hurricane and inventory data available in HAZUS-MH were used to evaluate potential losses from the 100- and 500-year MRP events (severe wind impacts). Other than data for critical facilities, the default data in HAZUS-MH 2.1 was the best available for use in this evaluation.

4.3.11.5.3 Impact on Life, Health and Safety

The impact of tornado, wind or severe storm events on life, health and safety is dependent upon several factors including the severity of the event and whether or not adequate warning time was provided to residents. It is assumed that the entire Lehigh Valley population (U.S. Census 2010 population of 647,232 people) is exposed to this storm hazard.

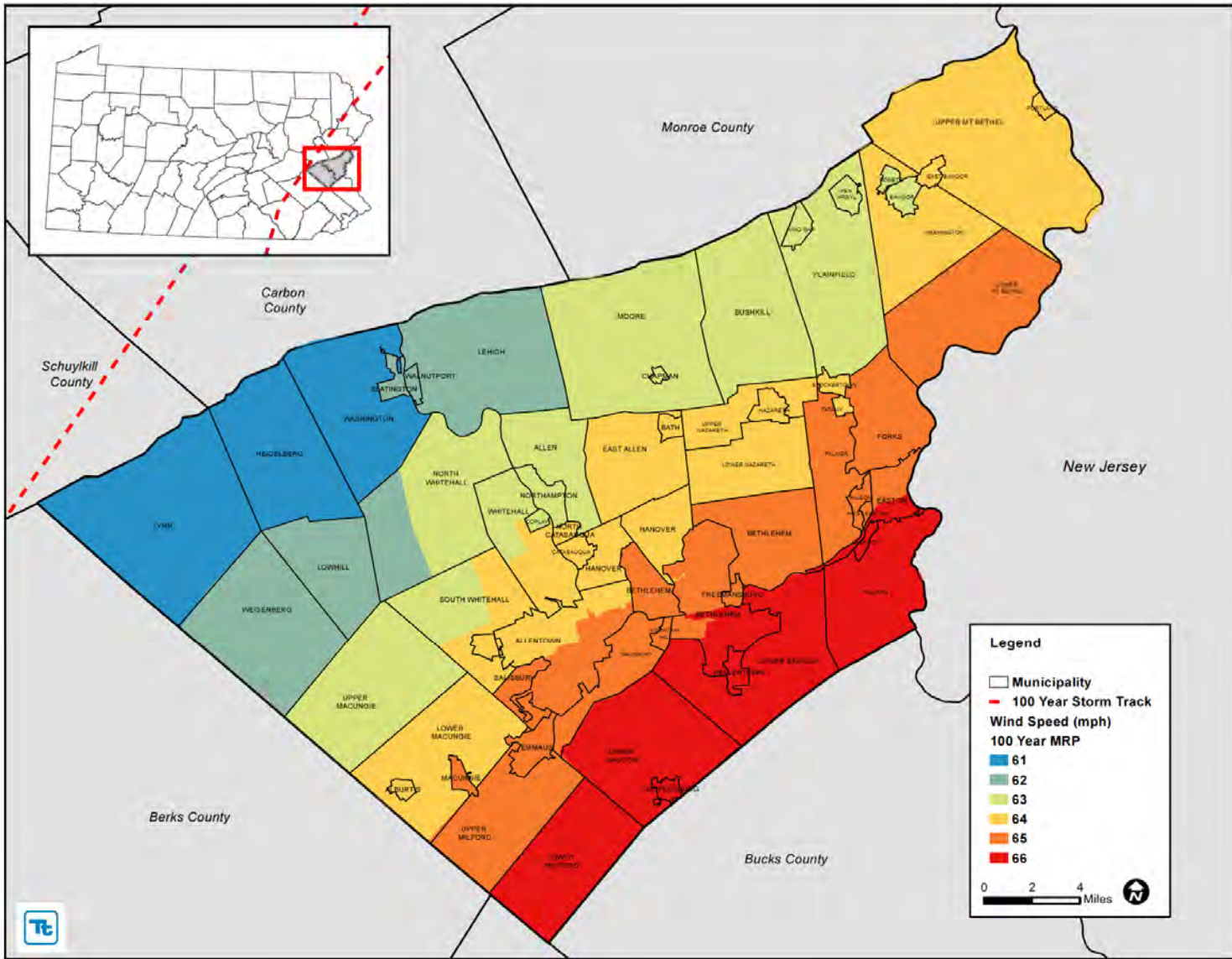
Unfortunately some tornadoes strike with little or no warning and residents must act quickly. The following populations are more vulnerable to a tornado or other type of wind or severe storm event: 1) population located in communities without, or have ineffective, early warning systems; 2) population with functional needs and/or over the age of 65 because they may have more difficulty evacuating or seeking shelter; 3) economically disadvantaged populations because they are likely to evaluate their risk and make decisions based on the major economic impact to their family and may not have funds to evacuate; 4) population with a language barrier unable to follow warning messages; 5) population in mobile homes; and 5) population in automobiles at the time of a tornado. The elderly and functional needs populations are considered most vulnerable because they require extra time or outside assistance to seek shelter and are more likely to seek or need medical attention which may not be available due to isolation during and/or after an event.

Residents may be displaced or require temporary to long-term sheltering. In addition, downed trees, damaged buildings and debris carried by high winds can lead to injury or loss of life. Socially vulnerable populations are most susceptible, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing.

SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

HAZUS-MH estimates there will be zero people displaced and zero people that may require temporary shelter due to a 100-year and 500-year MRP event.

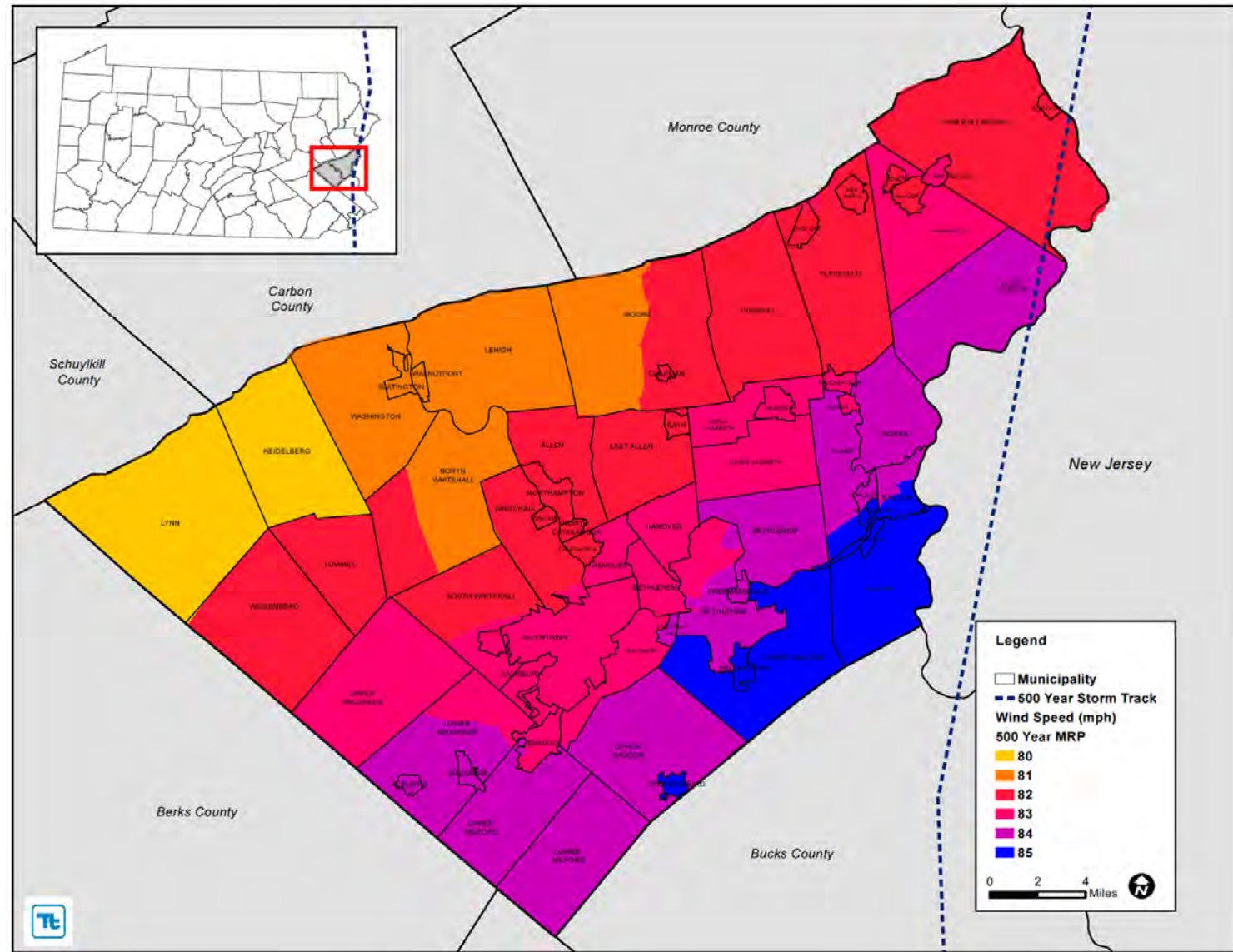
Figure 4.3.11-6. Wind Speeds and Storm Track for the 100-Year Mean Return Period Event in the Lehigh Valley



Source: HAZUS-MH 2.1



Figure 4.3.11-7. Wind Speeds and Storm Track for the 500-Year Mean Return Period Event in the Lehigh Valley



Source: HAZUS-MH 2.1

4.3.11.5.4 Impact on General Building Stock

Damage to buildings is dependent upon several factors including wind speed, storm duration, path of the storm track or tornado, distance from the tornado funnel and building construction. Because of differences in building construction, residential structures are generally more susceptible to wind damage than commercial and industrial structures. Wood and masonry buildings in general, regardless of their occupancy class, tend to experience more damage than concrete or steel buildings. High-rise buildings are also very vulnerable structures. Mobile homes are the most vulnerable to damage, even if tied down, and offer little protection to people inside.

According to HAZUS-MH’s wind model, direct wind-induced damage (wind pressures and windborne debris) to buildings is dependent upon the performance of components and cladding, including roof covering (shingles, tiles, membrane), roof sheathing (wood frame construction only), windows and doors and is modeled as such. Structural wall failures can occur for masonry and wood frame walls and uplift of whole roof systems due to failure at the roof/wall connections. Foundation failures (i.e., sliding, overturning and uplift) can potentially take place for manufactured homes.

After considering the population exposed to the severe storm hazard, the general building stock replacement value exposed to and damaged by 100- and 500-year MRP events was examined. Wind-only impacts from a severe storm are reported based on the probabilistic hurricane runs in HAZUS-MH 2.1. Potential damage is the modeled loss that could occur to the exposed inventory, including damage to structural and content value based on the wind-only impacts associated with a hurricane (using the methodology described in Section 4.3.11.5.2).

It is assumed that the entire general building stock for both Counties is exposed to the severe storm wind hazard. Expected building damage was evaluated by HAZUS across the following wind damage categories: no damage/very minor damage, minor damage, moderate damage, severe damage, and total destruction. Table 4.3.11-6 summarizes the definition of the damage categories.

Table 4.3.11-6. Description of Damage Categories

Qualitative Damage Description	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
<p>No Damage or Very Minor Damage</p> <p>Little of no visible damage from the outside.</p> <p>No broken windows, or failed roof deck.</p> <p>Minimal loss of roof cover, with no or very limited water penetration.</p>	≤ 2%	No	No	No	No	No
<p>Minor Damage</p> <p>Maximum of one broken window, door or garage door. Moderate roof cover loss that can be covered to prevent additional water entering the building. Marks or dents on walls requiring painting or patching for repair.</p>	> 2% and ≤ 15%	One window, door, or garage door failure	No	< 5 Impacts	No	No

SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

Qualitative Damage Description	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
<p>Moderate Damage</p> <p>Major roof cover damage, moderate window breakage. Minor roof sheathing failure.</p> <p>Some resulting damage to interior of building from water.</p>	> 15% and ≤ 50%	> the larger of 20% & 3 and ≤ 50%	1 to 3 Panels	Typically 5 to 10 Impacts	No	No
<p>Severe Damage</p> <p>Major window damage or roof sheathing loss.</p> <p>Major roof cover loss. Extensive damage to interior from water.</p>	> 50%	> one and ≤ the larger of 20% & 3	> 3 and ≤ 25%	Typically 10 to 20 Impacts	No	No
<p>Destruction</p> <p>Complete roof failure and/or failure of wall frame. Loss of more than 50% of roof sheathing.</p>	Typically > 50%	> 50%	> 25%	Typically > 20 Impacts	Yes	Yes

Source: HAZUS-MH Hurricane Technical Manual

For the 100-year MRP event, HAZUS-MH 2.1 estimates \$17.6 Million in building damages in Lehigh County and nearly \$10 Million in building damages in Northampton County. Residential buildings comprise the majority of the building inventory and are estimated to experience the majority of the damage (wood and masonry).

HAZUS estimates \$103 Million in damages to the general building stock (structure only) for Lehigh County and \$105.6 Million in building damages to Northampton County for the 500-year event. This is less than one-percent of the value of the building inventory. The residential buildings are estimated to experience the majority of the damage (wood and masonry). Table 4.3.11-7 summarizes the building value (structure only) damage estimated for the 100- and 500-year MRP wind-only events by occupancy class.

Because of differences in building construction, residential structures are generally more susceptible to wind damage than commercial and industrial structures. Wood and masonry buildings in general, regardless of their occupancy class, tend to experience more damage than concrete or steel buildings. The damage counts include buildings damaged at all severity levels from minor damage to total destruction. Total dollar damage reflects the overall impact to buildings at an aggregate level.

SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

Table 4.3.11-7. Estimated Building Replacement Value (Structure Only) Damaged by the 100-Year and 500-Year MRP Hurricane-Related Winds for All Occupancy Classes

Municipality	Total Building Damage				Residential Buildings		Commercial Buildings		Industrial Buildings	
	100 Year	% of Total	500 Year	% of Total	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year
Lehigh County										
Alburtis Borough	\$240,391	0.1	\$1,078,004	0.6	\$125,136	\$569,384	\$1,344	\$8,414	\$322	\$2,655
Allentown, City of	\$4,088,616	0.0	\$26,483,484	0.2	\$3,199,413	\$23,301,635	\$319,139	\$1,433,188	\$73,413	\$290,246
Bethlehem, City of	\$599,842	0.0	\$5,105,935	0.2	\$591,227	\$5,615,441	\$96,449	\$497,222	\$13,804	\$55,169
Catasauqua Borough	\$389,796	0.1	\$2,186,855	0.4	\$223,245	\$1,374,777	\$6,038	\$26,422	\$2,918	\$11,141
Coopersburg Borough	\$119,308	0.0	\$1,492,011	0.6	\$42,324	\$782,192	\$0	\$41,387	\$0	\$4,216
Coplay Borough	\$151,283	0.1	\$1,044,508	0.4	\$111,870	\$624,076	\$3,229	\$10,769	\$394	\$1,013
Emmaus Borough	\$439,713	0.0	\$3,420,139	0.3	\$347,059	\$2,909,213	\$23,932	\$126,288	\$6,907	\$26,135
Fountain Hill Borough	\$187,450	0.0	\$1,766,811	0.3	\$83,786	\$995,832	\$25,332	\$127,394	\$592	\$2,368
Hanover Township	\$133,192	0.0	\$763,703	0.1	\$61,059	\$501,133	\$70,051	\$390,376	\$19,173	\$80,599
Heidelberg Township	\$226,651	0.1	\$1,130,190	0.3	\$126,837	\$647,161	\$4,202	\$13,243	\$63	\$126
Lower Macungie Township	\$2,028,533	0.1	\$10,139,910	0.3	\$2,701,080	\$12,713,426	\$60,759	\$692,094	\$16,943	\$167,697
Lower Milford Township	\$275,761	0.1	\$2,347,629	0.7	\$170,030	\$1,809,029	\$1,764	\$24,369	\$0	\$0
Lowhill Township	\$165,007	0.1	\$651,280	0.3	\$140,486	\$572,174	\$3,006	\$9,319	\$69	\$138
Lynn Township	\$240,534	0.1	\$1,106,485	0.3	\$175,496	\$884,404	\$3,691	\$9,465	\$43	\$87
Macungie Borough	\$208,421	0.1	\$1,268,759	0.4	\$167,410	\$1,001,848	\$4,143	\$22,338	\$2,242	\$13,132
North Whitehall Township	\$938,642	0.1	\$4,046,622	0.2	\$1,084,339	\$4,229,944	\$28,332	\$107,345	\$715	\$2,092
Salisbury Township	\$781,738	0.0	\$5,852,059	0.3	\$626,759	\$4,344,398	\$74,247	\$386,437	\$2,766	\$8,526
Slatington Borough	\$112,460	0.0	\$662,858	0.2	\$97,326	\$632,672	\$6,009	\$13,649	\$931	\$1,862
South Whitehall Township	\$1,697,671	0.1	\$8,017,395	0.3	\$1,484,894	\$6,412,954	\$79,933	\$350,605	\$3,971	\$12,168
Upper Macungie Township	\$1,819,322	0.0	\$7,186,237	0.1	\$1,754,887	\$6,370,284	\$316,904	\$1,425,571	\$45,665	\$161,523
Upper Milford Township	\$297,406	0.0	\$2,182,485	0.3	\$358,376	\$2,731,216	\$7,530	\$50,223	\$895	\$4,905
Upper Saucon Township	\$602,688	0.0	\$5,417,230	0.3	\$576,818	\$6,754,861	\$34,020	\$344,129	\$2,091	\$16,029



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

Municipality	Total Building Damage				Residential Buildings		Commercial Buildings		Industrial Buildings	
	100 Year	% of Total	500 Year	% of Total	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year
Lehigh County										
Washington Township	\$204,987	0.0	\$1,148,336	0.2	\$209,795	\$1,207,530	\$8,092	\$20,043	\$412	\$953
Weisenberg Township	\$376,000	0.1	\$1,605,652	0.2	\$352,022	\$1,351,164	\$22,758	\$190,898	\$1,232	\$7,518
Whitehall Township	\$1,303,176	0.0	\$7,192,854	0.2	\$1,065,729	\$6,273,416	\$89,032	\$369,305	\$12,225	\$45,866
Lehigh County (est. total)	\$17,628,589	0.04	\$103,297,430	0.24	\$15,877,406	\$94,610,166	\$1,289,939	\$6,690,493	\$207,787	\$916,161

Municipality	Total Building Damage				Residential Buildings		Commercial Buildings		Industrial Buildings	
	100 Year	% of Total	500 Year	% of Total	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year
Northampton County										
Allen Township	\$447,165	0.06	\$1,966,084	0.3	\$439,691	\$1,909,357	\$2,425	\$17,174	\$970	\$12,393
Bangor Borough	\$80,993	0.01	\$1,162,765	0.1	\$80,993	\$1,069,749	\$0	\$43,965	\$0	\$31,360
Bath Borough	\$96,465	0.02	\$702,689	0.1	\$85,734	\$652,878	\$5,265	\$22,801	\$1,466	\$11,207
Bethlehem Township	\$883,402	0.02	\$10,198,786	0.2	\$758,244	\$8,947,199	\$39,426	\$365,342	\$64,710	\$745,359
Bethlehem, City of	\$1,339,768	0.01	\$14,477,421	0.1	\$1,149,086	\$13,055,371	\$89,800	\$603,366	\$24,056	\$437,417
Bushkill Township	\$426,155	0.03	\$3,063,420	0.2	\$412,824	\$2,988,734	\$6,691	\$34,380	\$1,315	\$17,766
Chapman Borough	\$8,585	0.03	\$51,146	0.2	\$7,910	\$48,097	\$252	\$816	\$136	\$1,017
East Allen Township	\$330,972	0.03	\$2,150,614	0.2	\$304,289	\$1,781,206	\$9,131	\$78,266	\$16,220	\$280,799
East Bangor Borough	\$15,968	0.01	\$219,409	0.2	\$15,968	\$214,282	\$0	\$3,045	\$0	\$725
Easton, City of	\$289,956	0.01	\$7,501,644	0.2	\$289,956	\$6,721,756	\$0	\$431,429	\$0	\$143,759
Forks Township	\$443,957	0.01	\$7,978,676	0.3	\$400,810	\$6,613,983	\$10,485	\$159,051	\$31,143	\$1,138,987
Freemansburg Borough	\$60,110	0.02	\$654,791	0.2	\$52,857	\$611,041	\$3,257	\$18,915	\$953	\$9,099
Glendon Borough	\$5,010	0.01	\$154,780	0.2	\$5,010	\$127,071	\$0	\$8,587	\$0	\$17,289



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

Municipality	Total Building Damage				Residential Buildings		Commercial Buildings		Industrial Buildings	
	100 Year	% of Total	500 Year	% of Total	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year
Northampton County										
Hanover Township	\$824,823	0.02	\$6,388,214	0.2	\$737,551	\$5,512,687	\$56,451	\$357,512	\$27,221	\$494,979
Hellertown Borough	\$111,684	0.01	\$1,837,314	0.2	\$111,684	\$1,719,605	\$0	\$71,447	\$0	\$29,121
Lehigh Township	\$526,269	0.04	\$2,703,375	0.2	\$508,570	\$2,628,360	\$8,739	\$31,271	\$3,177	\$20,354
Lower Mt. Bethel Township	\$64,784	0.01	\$1,186,393	0.2	\$63,661	\$1,125,049	\$527	\$35,674	\$495	\$21,204
Lower Nazareth Township	\$489,377	0.02	\$4,291,257	0.2	\$423,084	\$3,382,660	\$47,905	\$546,596	\$14,830	\$325,168
Lower Saucon Township	\$343,833	0.02	\$5,495,294	0.3	\$340,655	\$5,337,760	\$3,119	\$113,118	\$59	\$24,121
Moore Township	\$552,877	0.05	\$2,960,005	0.2	\$541,233	\$2,880,543	\$4,621	\$28,951	\$2,066	\$16,899
Nazareth Borough	\$183,446	0.01	\$1,685,809	0.1	\$148,917	\$1,492,890	\$19,704	\$88,326	\$9,547	\$81,066
North Catasauqua Borough	\$134,457	0.03	\$700,140	0.2	\$128,992	\$675,640	\$4,316	\$18,312	\$1,062	\$6,374
Northampton Borough	\$484,357	0.03	\$2,457,977	0.1	\$446,104	\$2,297,346	\$17,181	\$63,050	\$9,827	\$60,637
Palmer Township	\$583,995	0.01	\$9,454,605	0.2	\$557,546	\$8,161,992	\$6,180	\$257,622	\$18,617	\$957,860
Pen Argyl Borough	\$73,469	0.01	\$729,136	0.1	\$59,118	\$671,918	\$6,341	\$21,173	\$4,474	\$25,708
Plainfield Township	\$226,026	0.02	\$2,034,569	0.2	\$206,245	\$1,917,843	\$9,381	\$45,381	\$6,053	\$44,201
Portland Borough	\$7,066	0.00	\$149,006	0.1	\$7,066	\$123,542	\$0	\$9,070	\$0	\$14,609
Roseto Borough	\$27,865	0.01	\$385,771	0.1	\$27,865	\$360,807	\$0	\$9,973	\$0	\$9,230
Stockertown Borough	\$19,652	0.01	\$311,515	0.1	\$19,652	\$246,362	\$0	\$30,847	\$0	\$31,952
Tatamy Borough	\$41,156	0.02	\$479,849	0.2	\$39,425	\$423,766	\$95	\$4,491	\$1,046	\$44,604
Upper Mt. Bethel Township	\$115,105	0.01	\$1,980,195	0.2	\$114,781	\$1,829,354	\$553	\$56,344	\$240	\$92,291
Upper Nazareth Township	\$261,649	0.02	\$2,258,578	0.2	\$246,083	\$2,101,847	\$4,235	\$31,031	\$6,911	\$118,566
Walnutport Borough	\$84,327	0.02	\$442,334	0.1	\$70,915	\$396,415	\$3,976	\$10,662	\$8,101	\$32,403
Washington Township	\$111,873	0.01	\$1,533,177	0.2	\$110,512	\$1,462,019	\$385	\$33,656	\$63	\$24,569
West Easton Borough	\$12,998	0.00	\$346,167	0.1	\$12,998	\$289,985	\$0	\$23,166	\$0	\$26,817
Williams Township	\$112,011	0.01	\$2,978,464	0.2	\$112,011	\$2,830,370	\$0	\$34,121	\$0	\$95,077
Wilson Borough	\$64,038	0.00	\$2,048,243	0.1	\$64,038	\$1,785,767	\$0	\$145,205	\$0	\$56,663



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

Municipality	Total Building Damage				Residential Buildings		Commercial Buildings		Industrial Buildings	
	100 Year	% of Total	500 Year	% of Total	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year
Northampton County										
Wind Gap Borough	\$60,749	0.01	\$505,298	0.1	\$47,434	\$455,284	\$8,248	\$25,828	\$3,831	\$20,054
Northampton County (est. total)	\$9,946,390	0.02	\$105,624,908	0.2	\$9,149,514	\$94,850,536	\$368,688	\$3,879,964	\$258,588	\$5,521,706

Source: HAZUS-MH 2.1

Note: est. = Estimated; % = Percent



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

Annualized losses were also examined for the Lehigh Valley. A total of over \$3,000,000 is estimated as the annualized loss for the Lehigh Valley; see Table 4.3.11-8. Please note that annualized loss does not predict what losses will occur in any particular year.

Table 4.3.11-8. Summary of Estimated Annualized Wind General Building Stock Losses for the Lehigh Valley

Municipality	Total (Buildings + Contents)	Buildings	Contents
Lehigh County			
Alburtis Borough	\$6,945	\$5,681	\$721
Allentown, City of	\$310,440	\$249,033	\$33,068
Bethlehem, City of	\$83,045	\$60,590	\$15,915
Catasauqua Borough	\$17,108	\$13,960	\$1,779
Coopersburg Borough	\$9,434	\$7,424	\$1,198
Coplay Borough	\$7,145	\$6,082	\$547
Emmaus Borough	\$35,068	\$28,718	\$3,418
Fountain Hill Borough	\$13,509	\$10,817	\$1,552
Hanover Township	\$20,422	\$13,635	\$3,743
Heidelberg Township	\$12,045	\$9,367	\$1,590
Lower Macungie Township	\$202,750	\$152,312	\$32,588
Lower Milford Township	\$21,526	\$16,835	\$3,086
Lowhill Township	\$7,722	\$6,340	\$874
Lynn Township	\$14,747	\$11,685	\$1,926
Macungie Borough	\$12,765	\$10,081	\$1,664
North Whitehall Township	\$66,587	\$52,038	\$8,789
Salisbury Township	\$59,634	\$45,216	\$10,074
Slatington Borough	\$8,380	\$7,023	\$692
South Whitehall Township	\$93,980	\$72,315	\$13,858
Upper Macungie Township	\$149,035	\$106,565	\$25,753
Upper Milford Township	\$31,144	\$25,070	\$4,020
Upper Saucon Township	\$95,555	\$71,881	\$15,137
Washington Township	\$16,195	\$13,315	\$1,733
Weisenberg Township	\$29,626	\$21,169	\$5,417
Whitehall Township	\$86,189	\$69,407	\$9,359
Lehigh County (est. total)	\$1,410,996	\$1,086,560	\$198,499
Northampton County			
Allen Township	\$31,509	\$23,299	\$5,313
Bangor Borough	\$15,747	\$12,038	\$2,308
Bath Borough	\$9,592	\$7,399	\$1,330
Bethlehem Township	\$165,486	\$118,958	\$31,497
Bethlehem, City of	\$189,794	\$141,064	\$33,052

SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

Municipality	Total (Buildings + Contents)	Buildings	Contents
Bushkill Township	\$46,064	\$34,794	\$7,550
Chapman Borough	\$715	\$538	\$113
East Allen Township	\$40,648	\$27,680	\$8,820
East Bangor Borough	\$2,769	\$2,214	\$333
Easton, City of	\$108,525	\$78,909	\$19,090
Forks Township	\$149,256	\$100,864	\$34,290
Freemansburg Borough	\$8,301	\$6,320	\$1,339
Glendon Borough	\$2,524	\$1,709	\$577
Hanover Township	\$103,197	\$71,652	\$22,425
Hellertown Borough	\$23,138	\$17,661	\$3,555
Lehigh Township	\$40,242	\$31,108	\$5,835
Lower Mt. Bethel Township	\$19,542	\$14,422	\$3,406
Lower Nazareth Township	\$85,845	\$56,981	\$19,366
Lower Saucon Township	\$69,225	\$53,524	\$10,485
Moore Township	\$45,351	\$34,477	\$6,967
Nazareth Borough	\$24,191	\$17,359	\$4,781
North Catasauqua Borough	\$8,795	\$6,696	\$1,513
Northampton Borough	\$31,966	\$24,689	\$4,805
Palmer Township	\$155,801	\$109,991	\$31,488
Pen Argyl Borough	\$9,576	\$7,520	\$1,265
Plainfield Township	\$32,407	\$24,077	\$5,380
Portland Borough	\$2,688	\$1,892	\$529
Roseto Borough	\$5,064	\$3,919	\$736
Stockertown Borough	\$5,285	\$3,576	\$1,187
Tatamy Borough	\$8,276	\$5,546	\$2,010
Upper Mt. Bethel Township	\$32,141	\$23,263	\$6,144
Upper Nazareth Township	\$37,466	\$27,310	\$6,723
Walnutport Borough	\$7,162	\$5,032	\$1,566
Washington Township	\$21,611	\$16,582	\$3,234
West Easton Borough	\$5,393	\$3,856	\$952
Williams Township	\$40,722	\$30,979	\$6,393
Wilson Borough	\$29,768	\$22,122	\$4,585
Wind Gap Borough	\$6,864	\$5,287	\$1,002
Northampton County (est. total)	\$1,622,647	\$1,175,310	\$301,945

Source: HAZUS-MH 2.1

4.3.11.5.5 Impact on Critical Facilities

HAZUS-MH estimates the probability that critical facilities (i.e., medical facilities, fire/EMS, police, EOC, schools, and user-defined facilities such as shelters and municipal buildings) may sustain damage as a result of 100-year and 500-year MRP wind-only events. Additionally, HAZUS-MH estimates the loss of use for each facility in number of days.

HAZUS-MH estimates minimal damage (0 to 1-percent chance of minor damage) and zero loss of use for critical facilities as a result of a 100-year MRP event. Table 4.3.11-9 lists the estimated loss of use in days for each critical facility and the probability of sustaining the damage category as defined by the column heading, for the 500-year wind-only events. The damage categories are defined in Table 4.3.11-6, under “Impact on General Building Stock”.

SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

Table 4.3.11-9. Estimated Impacts to Critical Facilities by the 500-Year MRP Hurricane Event (Wind Only)

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
ALBURTIS FIRE CO	Alburtis (B)	Fire	0	1.0	0.0	0.0	0.0
ALBURTIS ELEMENTARY SCHOOL	Alburtis (B)	School	0	3.0	1.0	0.0	0.0
ALLEN TWP FIRE CO	Allen (T)	Fire	0	2.0	0.0	0.0	0.0
Lehigh Valley Lutheran School	Allen (T)	School	0	4.0	1.0	0.0	0.0
Willow Green	Allen (T)	User Defined	NA	5.0	0.0	0.0	0.0
Thrash Family Day Care	Allen (T)	User Defined	NA	3.0	0.0	0.0	0.0
Childhood Dreams Daycare	Allen (T)	User Defined	NA	5.0	0.0	0.0	0.0
Allen Township	Allen (T)	User Defined	NA	3.0	0.0	0.0	0.0
Zion's Stone Cemetery	Allen (T)	User Defined	NA	4.0	1.0	0.0	0.0
St. Luke's Hospital Allentown	Allentown (C)	Medical	0	4.0	4.0	2.0	0.0
Lehigh Valley Hospital - 17th & Chew	Allentown (C)	Medical	0	4.0	4.0	2.0	0.0
Sacred Heart Hospital	Allentown (C)	Medical	0	4.0	4.0	2.0	0.0
WESCOSVILLE FIRE COMPANY	Allentown (C)	Fire	0	2.0	0.0	0.0	0.0
WESTERN SALISBURY FIRE CO	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0
CETRONIA FIRE COMPANY	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0
WOODLAWN FIRE CO #1	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0
COMM FIRE CO #1 S WH TWP	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0
WOODLAWN FIRE CO #1	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0
W SALISBURY VOL FIRE CO#3	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0
CITY OF ALLENTOWN	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0
CITY OF ALLENTOWN	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0
CITY OF ALLENTOWN	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0
CITY OF ALLENTOWN	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0
CITY OF ALLENTOWN	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0
CITY OF ALLENTOWN	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
SALISBURY TWP	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0
SALISBURY TWP SCHOOL AUTH	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0
SALISBURY FIRE CO #1	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0
HANOVER TOWNSHIP	Allentown (C)	Fire	0	1.0	0.0	0.0	0.0
UNION TERRACE ELEMENTARY SCHOOL	Allentown (C)	School	0	2.0	1.0	0.0	0.0
WILLIAM ALLEN HIGH SCHOOL	Allentown (C)	School	0	2.0	1.0	0.0	0.0
ST CATHERINE OF SIENA	Allentown (C)	School	0	2.0	1.0	0.0	0.0
ST CATHERINE OF SIENA	Allentown (C)	School	0	2.0	1.0	0.0	0.0
RAUB MIDDLE SCHOOL	Allentown (C)	School	0	2.0	1.0	0.0	0.0
WILLIAM ALLEN HIGH SCHOOL	Allentown (C)	School	0	2.0	1.0	0.0	0.0
WILLIAM ALLEN HIGH SCHOOL	Allentown (C)	School	0	2.0	1.0	0.0	0.0
LEHIGH PARKWAY ELEMENTARY SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
LINCOLN ELEMENTARY SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
MUHLENBERG ELEMENTARY SCHOOL	Allentown (C)	School	0	2.0	1.0	0.0	0.0
JACKSON ELEMENTARY SCHOOL	Allentown (C)	School	0	2.0	1.0	0.0	0.0
TREXLER MIDDLE SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
ST FRANCIS OF ASSISI	Allentown (C)	School	0	3.0	1.0	0.0	0.0
MCKINLEY ELEMENTARY SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
CLEVELAND ELEMENTARY SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
WASHINGTON ELEMENTARY SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
CENTRAL ELEMENTARY SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
JEFFERSON ELEMENTARY SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
SOUTH MOUNTAIN MIDDLE SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
ROOSEVELT ELEMENTARY SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
WILSON EARLY CHILDHOOD CENTER	Allentown (C)	School	0	3.0	1.0	0.0	0.0
WILEY HOUSE	Allentown (C)	School	0	3.0	1.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
ROBERTO CLEMENTE CHARTER SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
ALLENTOWN CENTRAL CATHOLIC HIGH SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
SACRED HEART ELEMENTARY SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
ALLENTOWN CENTRAL CATHOLIC HIGH SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
SHERIDAN ELEMENTARY SCHOOL	Allentown (C)	School	0	2.0	1.0	0.0	0.0
HOLY SPIRIT SCHOOL	Allentown (C)	School	0	2.0	1.0	0.0	0.0
HARRISON-MORTON MIDDLE SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
MOSSER ELEMENTARY SCHOOL	Allentown (C)	School	0	2.0	1.0	0.0	0.0
DIERUFF HIGH SCHOOL	Allentown (C)	School	0	2.0	1.0	0.0	0.0
RITTER ELEMENTARY SCHOOL	Allentown (C)	School	0	2.0	1.0	0.0	0.0
LEHIGH VALLEY CHRISTIAN HIGH SCHOOL	Allentown (C)	School	0	2.0	1.0	0.0	0.0
MIDWAY MANOR EARLY EDUCATION CENTER	Allentown (C)	School	0	3.0	1.0	0.0	0.0
KINGS WAY ACADEMY	Allentown (C)	School	0	2.0	1.0	0.0	0.0
THE LUTHERAN ACADEMY	Allentown (C)	School	0	2.0	1.0	0.0	0.0
ST PAULS SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
MERCY DAY SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
OUR LADY HELP OF CHRISTIANS SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
HOLY SPIRIT ELEMENTARY SCHOOL	Allentown (C)	School	0	2.0	1.0	0.0	0.0
HIRAM DODD ELEMENTARY SCHOOL	Allentown (C)	School	0	3.0	1.0	0.0	0.0
LEHIGH COUNTY HUMANE SOC	Allentown (C)	User Defined	NA	2.0	0.0	0.0	0.0
CITY OF ALLENTOWN	Allentown (C)	User Defined	NA	3.0	0.0	0.0	0.0
CITY OF ALLENTOWN	Allentown (C)	User Defined	NA	2.0	0.0	0.0	0.0
CITY OF ALLENTOWN	Allentown (C)	User Defined	NA	2.0	0.0	0.0	0.0
SALISBURY HOUSE OF NORTHEAST PA INC	Allentown (C)	User Defined	NA	3.0	0.0	0.0	0.0
COMMONWEALTH OF PA	Allentown (C)	User Defined	NA	2.0	0.0	0.0	0.0
COMMONWEALTH OF PA	Allentown (C)	User Defined	NA	2.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
CITY OF ALLENTOWN	Allentown (C)	User Defined	NA	2.0	0.0	0.0	0.0
COMMONWEALTH OF PA	Allentown (C)	User Defined	NA	2.0	0.0	0.0	0.0
COMMONWEALTH OF PA	Allentown (C)	User Defined	NA	2.0	0.0	0.0	0.0
COMMONWEALTH OF PA	Allentown (C)	User Defined	NA	2.0	0.0	0.0	0.0
OCASIO RAYMOND S & BERTHA L	Allentown (C)	User Defined	NA	2.0	0.0	0.0	0.0
Medical	Bangor (B)	Medical	0	4.0	4.0	2.0	0.0
Medical	Bangor (B)	Medical	0	4.0	4.0	2.0	0.0
BANGOR DENTAL ASSO.	Bangor (B)	Medical	0	4.0	4.0	2.0	0.0
BANGOR FIRE DEPT - LIBERTY	Bangor (B)	Fire	0	1.0	0.0	0.0	0.0
BANGOR FIRE DEPT - RESCUE	Bangor (B)	Fire	0	1.0	0.0	0.0	0.0
BANGOR FIRE DEPT - SECOND WARD	Bangor (B)	Fire	0	1.0	0.0	0.0	0.0
BLUE VALLEY RESCUE	Bangor (B)	Fire	0	1.0	0.0	0.0	0.0
BANGOR PD	Bangor (B)	Police	0	2.0	0.0	0.0	0.0
Pius X High School	Bangor (B)	School	0	2.0	1.0	0.0	0.0
District Court 03-3-03	Bangor (B)	User Defined	NA	2.0	0.0	0.0	0.0
Gaffney Funeral Home	Bangor (B)	User Defined	NA	2.0	0.0	0.0	0.0
Learning Locomotion	Bangor (B)	User Defined	NA	3.0	0.0	0.0	0.0
United States Post Office	Bangor (B)	User Defined	NA	2.0	0.0	0.0	0.0
Bangor Public Library	Bangor (B)	User Defined	NA	1.0	0.0	0.0	0.0
Fiore Funeral Home	Bangor (B)	User Defined	NA	2.0	0.0	0.0	0.0
Bangor Borough	Bangor (B)	User Defined	NA	2.0	0.0	0.0	0.0
Saint John's Lutheran Church	Bath (B)	User Defined	NA	2.0	0.0	0.0	0.0
Christ Church United Church of Christ	Bath (B)	User Defined	NA	2.0	0.0	0.0	0.0
Bath Drug	Bath (B)	Medical	0	4.0	4.0	2.0	0.0
BATH BORO FIRE FIGHTERS AMBULANCE	Bath (B)	Fire	0	1.0	0.0	0.0	0.0
BATH BORO FIRE FIGHTERS	Bath (B)	Fire	0	1.0	0.0	0.0	0.0

SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
COLONIAL REGIONAL PD	Bath (B)	Police	0	2.0	0.0	0.0	0.0
George Wolf Elementary School	Bath (B)	School	0	3.0	1.0	0.0	0.0
Sacred Heart Elementary School	Bath (B)	School	0	3.0	1.0	0.0	0.0
ALEXANDRIA MANOR	Bath (B)	User Defined	NA	3.0	0.0	0.0	0.0
Bartholomew Funeral Home	Bath (B)	User Defined	NA	2.0	0.0	0.0	0.0
Mid-County Senior Center	Bath (B)	User Defined	NA	2.0	0.0	0.0	0.0
Bath Borough	Bath (B)	User Defined	NA	2.0	0.0	0.0	0.0
Christ Church United Church of Christ	Bath (B)	User Defined	NA	2.0	0.0	0.0	0.0
Learn-N-Play Daycare	Bath (B)	User Defined	NA	4.0	0.0	0.0	0.0
Sacred Heart Parish's Cemetery	Bath (B)	User Defined	NA	2.0	0.0	0.0	0.0
United States Post Office	Bath (B)	User Defined	NA	2.0	0.0	0.0	0.0
Lehigh Valley Hospital - Muhlenberg	Bethlehem (C)	Medical	0	5.0	5.0	3.0	0.0
ST LUKES UNION STATION	Bethlehem (C)	Medical	0	5.0	6.0	3.0	0.0
ST LUKES PHYSICAL THERAPY	Bethlehem (C)	Medical	0	5.0	7.0	4.0	0.0
Medical	Bethlehem (C)	Medical	0	5.0	6.0	3.0	0.0
DENTIST OFFICE	Bethlehem (C)	Medical	0	5.0	5.0	3.0	0.0
Medical	Bethlehem (C)	Medical	0	5.0	5.0	3.0	0.0
NEW ST. MEDICAL CNT	Bethlehem (C)	Medical	0	4.0	5.0	3.0	0.0
Medical	Bethlehem (C)	Medical	0	5.0	5.0	3.0	0.0
Quest Diagnostic Inc.	Bethlehem (C)	Medical	0	6.0	6.0	4.0	0.0
Quest Diagnostics Inc.	Bethlehem (C)	Medical	0	5.0	5.0	3.0	0.0
Superior Cardiac Imaging Mobile Svs	Bethlehem (C)	Medical	0	5.0	5.0	3.0	0.0
Baxter Healthcare	Bethlehem (C)	Medical	0	5.0	5.0	3.0	0.0
Bio Med Sciences Inc.	Bethlehem (C)	Medical	0	5.0	6.0	3.0	0.0
C & S Medical Supply Inc.	Bethlehem (C)	Medical	0	4.0	5.0	3.0	0.0
Hess Healthcare Services	Bethlehem (C)	Medical	0	5.0	5.0	3.0	0.0

SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Orasure Technologies Inc.	Bethlehem (C)	Medical	0	5.0	6.0	3.0	0.0
Sun Inn Preservation Association	Bethlehem (C)	Medical	0	4.0	5.0	3.0	0.0
CITY OF BETHLEHEM	Bethlehem (C)	Fire	0	1.0	0.0	0.0	0.0
CITY OF BETHLEHEM	Bethlehem (C)	Fire	0	1.0	0.0	0.0	0.0
REGIONAL ACADEMIC STANDARDS ACADEMY	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
CENTENNIAL SCHOOL	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
CLEARVIEW ELEMENTARY SCHOOL	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
JAMES BUCHANAN ELEMENTARY SCHOOL	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
WILEY HOUSE	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
CALYPSO ELEMENTARY SCHOOL	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
NITSCHMANN MIDDLE SCHOOL	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
VITALISTIC THERAPEUTIC SCHOOL	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
CENTRAL CHRISTIAN ACADEMY	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
NOTRE DAME SCHOOL	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
ST SIMON & JUDE SCHOOL	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Liberty Senior High School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Gateway School of the Lehigh Valley	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Moravian College-South	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
St. Anne's School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Edgeboro School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Moravian College-North	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Marvine Elementary School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Lincoln Elementary School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Spring Garden Elementary School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Bethlehem Catholic High School	Bethlehem (C)	School	0	4.0	1.0	0.0	0.0
Thomas Jefferson Elementary School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0

SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Governor Wolf Elementary School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
East Hills Middle School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Holy Infancy School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Lehigh University	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Lehigh University	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Lehigh University	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Lehigh University	Bethlehem (C)	School	0	2.0	0.0	0.0	0.0
Lehigh University	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Lehigh University	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Lehigh University	Bethlehem (C)	School	0	2.0	0.0	0.0	0.0
Broughal Middle School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Donegan Elementary School	Bethlehem (C)	School	0	2.0	1.0	0.0	0.0
STS Cyril & Methodius Parochial School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Northeast Middle School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
William Penn Elementary School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Lehigh University - Saucon Field Complex	Bethlehem (C)	School	2	8.0	6.0	0.0	0.0
Moravian Academy Lower School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Moravian Academy Middle School	Bethlehem (C)	School	0	3.0	1.0	0.0	0.0
Lehigh University Child Care	Bethlehem (C)	User Defined	NA	6.0	0.0	0.0	0.0
Stabler Arena	Bethlehem (C)	User Defined	NA	7.0	1.0	0.0	0.0
Murray H. Goodman Stadium	Bethlehem (C)	User Defined	NA	7.0	1.0	0.0	0.0
Ben Franklin Technology Center	Bethlehem (C)	User Defined	NA	6.0	1.0	0.0	0.0
Christ Lutheran Church of Lower Saucon	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Holiday Inn Express Hotel & Suites	Bethlehem (C)	User Defined	NA	5.0	0.0	0.0	0.0
Cantelmi Funeral Home P.C.	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Holy Ghost Cemetery	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Leeman-Turner Arena at Grace Hall	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Fritz Memorial United Methodist Church	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Fritz Memorial United Methodist Church	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Millie's Creative Child Care	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Saint Peter's Lutheran Church	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Zoellner Arts Center - Lehigh University	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Saints Cyril and Methodius Roman Catholic	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Head Start of the LV - St. Peter's	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
Lehigh Valley Child Care Campus Center	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
District Court 03-2-10	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Holy Infancy Roman Catholic Church	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Saint John's Windish Evangelical Church	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Bethlehem Area Public Library	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
United States Post Office	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Zion First Hungarian Lutheran Church	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Abbe Hall LLC	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
133rd State Legislative District	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Concordia Lutheran Church	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
L V COMM HEALTH CNTR	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Donegan Childcare	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
Happy Faces Day Care	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
Comfort Suites	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Bethlehem Press	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
National Museum of Industrial History	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Lehigh Valley Industrial Park Inc.	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
CITY OF BETHLEHEM	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Morning Call	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Bethlehem City	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Union Cemetery	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
Nisky Hill Cemetery	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
City of Bethlehem Health Bureau	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Bethlehem Area Public Library	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Hotel Bethlehem	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Historic Bethlehem Partnership	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Historic Bethlehem Parntership	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Moravian Village of Bethlehem	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Head Start of the Lehigh Valley - Unita*	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
John Herron Funeral Home	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
NURSING HOME	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Trinity Episcopal Church	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Trinity Episcopal Church	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Long Funeral Home	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Moravian Village	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
United States Post Office	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Christ Church- United Church of Christ	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Snyder-Hinkle Lunsford Funeral Home	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Historic Bethlehem Partnership	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Sun Inn Preservation Association	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
United States SS Administration	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Northampton County Area Agency on Aging	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Northampton County - Bechtel Building	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
18th State Senatorial District	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Bethlehem YMCA Child Care	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
District Court 03-2-01	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
American Heart Association	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Head Start of the Lehigh Valley - Salem	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
135th State Legislative District	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
United States Internal Revenue Service	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Kindercare Campus	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
United States Congressman Office	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Thomas Jefferson Child Care	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
Lehigh Valley Child Care at Fowler Cent*	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
William Penn Child Care	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
District Court 03-2-11	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Salisbury Behavioral Health	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
COUNTY OF LEHIGH	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Fairview Cemetery	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Giggles Kid's Club	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Lincoln Child Day Care	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Bethlehem Memorial Park Cemetery	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
Memorial Park Cemetery	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
Bethlehem Manor	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Blake Messman's Daycare	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Stefko Child Care Center	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Notre Dame of Bethlehem	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
First Presbyterian Church	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
First Presbyterian Church	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
Gaidula's Family Child Care	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
First Presbyterian Church	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
KIRKLAND VILLAGE (EASTWOOD)	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Spring Garden Child Care	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Holy Cross Evangelical Lutheran Church	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
Wesley United Methodist Church	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
Wesley United Methodist Church	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
Holy Saviour Cemetery	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
Atria Bethlehem	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
ARC of the Greater Lehigh Valley	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Valley Eye Surgical Center	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Bethlehem Township's Coolidge Building	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
St. Thomas UCC Cemetery	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
District Court 03-1-04	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Homewood Suites By Hilton	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Spark Child Care	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Bethlehem Township Community Center	Bethlehem (C)	User Defined	NA	6.0	1.0	0.0	0.0
Saint Mark's Evangelical Lutheran Church	Bethlehem (C)	User Defined	NA	3.0	0.0	0.0	0.0
ALEXANDRIA LIVING	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
First United Church of Christ	Bethlehem (C)	User Defined	NA	2.0	0.0	0.0	0.0
Northampton Community College	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
Ebenezer Bible Fellowship Church	Bethlehem (C)	User Defined	NA	4.0	0.0	0.0	0.0
ST LUKES RIVERSIDE	Bethlehem (T)	Medical	0	6.0	7.0	4.0	0.0
DUNKIN DONUT/ MINI MART	Bethlehem (T)	Medical	0	5.0	5.0	3.0	0.0
COORDINATED HEALTH SERVICES	Bethlehem (T)	Medical	0	5.0	6.0	3.0	0.0
Health Network Laboratories	Bethlehem (T)	Medical	0	9.0	10.0	6.0	0.0
St. Lukes Hospital	Bethlehem (T)	Medical	0	6.0	6.0	4.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Digirad Imaging Solutions	Bethlehem (T)	Medical	0	9.0	10.0	6.0	0.0
Invatec	Bethlehem (T)	Medical	0	8.0	9.0	5.0	0.0
BETHLEHEM TWP EMS	Bethlehem (T)	Fire	0	1.0	0.0	0.0	0.0
NANCY RUN FIRE DEPT	Bethlehem (T)	Fire	0	2.0	0.0	0.0	0.0
BETHLEHEM TWP FIRE CO	Bethlehem (T)	Fire	0	1.0	0.0	0.0	0.0
BETHLEHEM TWP PD	Bethlehem (T)	Police	0	3.0	0.0	0.0	0.0
Freedom High School	Bethlehem (T)	School	0	3.0	1.0	0.0	0.0
Freedom High School	Bethlehem (T)	School	0	3.0	1.0	0.0	0.0
Bethlehem Area Vocational Tech School	Bethlehem (T)	School	0	3.0	1.0	0.0	0.0
Our Lady of Perpetual Church and School	Bethlehem (T)	School	0	3.0	1.0	0.0	0.0
Moravian Academy	Bethlehem (T)	School	0	6.0	3.0	0.0	0.0
Northampton County Area Comm College	Bethlehem (T)	School	0	6.0	3.0	0.0	0.0
Northampton County Area Comm College	Bethlehem (T)	School	0	6.0	3.0	0.0	0.0
Miller Heights Elementary School	Bethlehem (T)	School	0	4.0	1.0	0.0	0.0
Farmersville Elementary School	Bethlehem (T)	School	0	8.0	5.0	0.0	0.0
Notre Dame High School	Bethlehem (T)	School	0	7.0	4.0	0.0	0.0
First Church of Christ	Bethlehem (T)	User Defined	NA	2.0	0.0	0.0	0.0
Caring Connection	Bethlehem (T)	User Defined	NA	4.0	0.0	0.0	0.0
Precious Ones Day Care	Bethlehem (T)	User Defined	NA	4.0	0.0	0.0	0.0
Miller Heights Child Care	Bethlehem (T)	User Defined	NA	5.0	0.0	0.0	0.0
United States Post Office	Bethlehem (T)	User Defined	NA	2.0	0.0	0.0	0.0
Animal Therapy Center	Bethlehem (T)	User Defined	NA	2.0	0.0	0.0	0.0
Bethlehem Township Coolidge Building	Bethlehem (T)	User Defined	NA	3.0	0.0	0.0	0.0
MANOR CARE	Bethlehem (T)	User Defined	NA	7.0	0.0	0.0	0.0
Bethlehem Township Community Center	Bethlehem (T)	User Defined	NA	6.0	1.0	0.0	0.0
Chapel Family Child Care	Bethlehem (T)	User Defined	NA	4.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Federal Express - Freight	Bethlehem (T)	User Defined	NA	4.0	0.0	0.0	0.0
Courtyard by Marriott - Bethlehem	Bethlehem (T)	User Defined	NA	8.0	0.0	0.0	0.0
Marriott Courtyard Bethlehem	Bethlehem (T)	User Defined	NA	8.0	0.0	0.0	0.0
United Parcel Service	Bethlehem (T)	User Defined	NA	4.0	0.0	0.0	0.0
Bethlehem Township Municipal Bldg	Bethlehem (T)	User Defined	NA	3.0	0.0	0.0	0.0
Farmersville Child Care	Bethlehem (T)	User Defined	NA	8.0	0.0	0.0	0.0
Northampton Country Club	Bethlehem (T)	User Defined	NA	4.0	0.0	0.0	0.0
Bethlehem Township	Bethlehem (T)	User Defined	NA	3.0	0.0	0.0	0.0
St. John's Lutheran of Farmersville	Bethlehem (T)	User Defined	NA	6.0	1.0	0.0	0.0
Green Pond Country Club	Bethlehem (T)	User Defined	NA	5.0	0.0	0.0	0.0
Lehigh Valley Friends Meetinghouse	Bethlehem (T)	User Defined	NA	2.0	0.0	0.0	0.0
Lehigh Valley Child Care Stone's Crossi*	Bethlehem (T)	User Defined	NA	5.0	0.0	0.0	0.0
Country Meadows	Bethlehem (T)	User Defined	NA	6.0	0.0	0.0	0.0
BLDG 1 & 2 COUNTRY MEADOWS BET	Bethlehem (T)	User Defined	NA	6.0	0.0	0.0	0.0
Comfort Inn	Bethlehem (T)	User Defined	NA	4.0	0.0	0.0	0.0
Northampton Memorial Shrine Inc.	Bethlehem (T)	User Defined	NA	3.0	0.0	0.0	0.0
Lehigh River Boat Access Ramp	Bethlehem (T)	User Defined	NA	7.0	1.0	0.0	0.0
BUSHKILL TWP EMS	Bushkill (T)	Fire	0	1.0	0.0	0.0	0.0
BUSHKILL TWP FIRE CO	Bushkill (T)	Fire	0	1.0	0.0	0.0	0.0
BUSHKILL TWP PD	Bushkill (T)	Police	0	3.0	0.0	0.0	0.0
Bushkill Elementary School	Bushkill (T)	School	0	2.0	0.0	0.0	0.0
Jacobsburg Historical Society	Bushkill (T)	User Defined	NA	1.0	0.0	0.0	0.0
Holy Cross Day Care Center	Bushkill (T)	User Defined	NA	5.0	0.0	0.0	0.0
Jacobsburg EE Center Bureau State Parks	Bushkill (T)	User Defined	NA	2.0	0.0	0.0	0.0
Little Buddies Childcare and Preschool	Bushkill (T)	User Defined	NA	3.0	0.0	0.0	0.0
Bushkill Township	Bushkill (T)	User Defined	NA	3.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Sullivan Trail Golf Course	Bushkill (T)	User Defined	NA	3.0	0.0	0.0	0.0
SOUTHWARK HOSE CO #9	Catasauqua (B)	Fire	0	1.0	0.0	0.0	0.0
EAST END FIRE CO	Catasauqua (B)	Fire	0	1.0	0.0	0.0	0.0
ST MARYS CATHOLIC SCHOOL	Catasauqua (B)	School	0	2.0	1.0	0.0	0.0
LINCOLN MIDDLE SCHOOL	Catasauqua (B)	School	0	2.0	1.0	0.0	0.0
CATASAUQUA HIGH SCHOOL	Catasauqua (B)	School	0	3.0	1.0	0.0	0.0
SHECKLER ELEMENTARY SCHOOL	Catasauqua (B)	School	0	4.0	1.0	0.0	0.0
CORROCHER JOHN C & ARLANA L	Catasauqua (B)	User Defined	NA	2.0	0.0	0.0	0.0
BORO OF CATASAUQUA	Catasauqua (B)	User Defined	NA	2.0	0.0	0.0	0.0
Catasauqua High School	Catasauqua (B)	User Defined	NA	4.0	0.0	0.0	0.0
Chapman Borough	Chapman (B)	User Defined	NA	2.0	0.0	0.0	0.0
Bethany Wesleyan Church	Lehigh (T)	User Defined	NA	3.0	0.0	0.0	0.0
Cummings Veterinary Hospital, LLC	Bethlehem (T)	User Defined	NA	3.0	0.0	0.0	0.0
COOPERSBURG FIRE CO	Coopersburg (B)	Fire	0	2.0	0.0	0.0	0.0
LIBERTY BELL ELEMENTARY SCHOOL	Coopersburg (B)	School	0	4.0	2.0	0.0	0.0
U S POSTAL SERVICE	Coopersburg (B)	User Defined	NA	3.0	0.0	0.0	0.0
BORO OF COPLAY	Coplay (B)	Fire	0	1.0	0.0	0.0	0.0
BATH COMMUNITY MED	East Allen (T)	Medical	0	4.0	5.0	2.0	0.0
Health Network Laboratories	East Allen (T)	Medical	0	4.0	5.0	2.0	0.0
EAST ALLEN TWP AMBULANCE CORPS	East Allen (T)	Fire	0	2.0	0.0	0.0	0.0
EAST ALLEN TWP FIRE CO	East Allen (T)	Fire	0	2.0	0.0	0.0	0.0
16th State Senatorial District	East Allen (T)	User Defined	NA	5.0	0.0	0.0	0.0
138th State Legislative District	East Allen (T)	User Defined	NA	5.0	0.0	0.0	0.0
East Allen Township	East Allen (T)	User Defined	NA	5.0	0.0	0.0	0.0
St. Peter's UCC Cemetery	East Allen (T)	User Defined	NA	4.0	1.0	0.0	0.0
EAST BANGOR FIRE CO	East Bangor (B)	Fire	0	1.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
EAST BANGOR PD	East Bangor (B)	Police	0	2.0	0.0	0.0	0.0
East Bangor Borough	East Bangor (B)	User Defined	NA	2.0	0.0	0.0	0.0
Medical	Easton (C)	Medical	0	5.0	6.0	4.0	0.0
EASTON CHIROPRACTIC	Easton (C)	Medical	0	5.0	6.0	4.0	0.0
EASTON EMERGENCY SQUAD	Easton (C)	Fire	0	1.0	0.0	0.0	0.0
EASTON CITY FIRE DEPT - CENTRAL	Easton (C)	Fire	0	1.0	0.0	0.0	0.0
EASTON CITY FIRE DEPT - COLLEGE HILL	Easton (C)	Fire	0	1.0	0.0	0.0	0.0
EASTON CITY FIRE DEPT - SOUTH SIDE	Easton (C)	Fire	0	1.0	0.0	0.0	0.0
PA WATER RECUE	Easton (C)	Fire	0	1.0	0.0	0.0	0.0
NORTHAMPTON COUNTY SHERIFF DEPT	Easton (C)	Police	0	2.0	0.0	0.0	0.0
EASTON CITY PD	Easton (C)	Police	0	3.0	0.0	0.0	0.0
Easton Catholic and EC-ST Joseph ES	Easton (C)	School	0	3.0	1.0	0.0	0.0
March Elementary School	Easton (C)	School	0	4.0	1.0	0.0	0.0
Cheston Elementary School	Easton (C)	School	0	3.0	1.0	0.0	0.0
Cheston Elementary School	Easton (C)	School	0	3.0	1.0	0.0	0.0
Cheston Elementary School	Easton (C)	School	0	3.0	1.0	0.0	0.0
Cheston Elementary School	Easton (C)	School	0	3.0	1.0	0.0	0.0
Cheston Elementary School	Easton (C)	School	0	3.0	1.0	0.0	0.0
Lafayette College	Easton (C)	School	0	3.0	1.0	0.0	0.0
Lafayette College	Easton (C)	School	0	3.0	1.0	0.0	0.0
Easton Area Middle School	Easton (C)	School	0	3.0	1.0	0.0	0.0
Saint John's Evangelical Lutheran Church	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Saint John's United Church of Christ	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Christ Evangelical Congregational Churc*	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Morello Funeral Home	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
River of God Fellowship Church	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
River of God Fellowship Church	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Hays Cemetery	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Holy Ghost Ukranian Catholic Church	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
New Life Presbyterian Church	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Saint Paul's Lutheran Church	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
St. Paul Lutheran Church	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Head Start of the LV - Easton Paul's	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0
Pride and Joy Educational Day Care	Easton (C)	User Defined	NA	5.0	0.0	0.0	0.0
Shiloh Baptist Church-Enrichment Center	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Shiloh Manor Inc.	Easton (C)	User Defined	NA	5.0	0.0	0.0	0.0
Greater Shiloh Church	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Family YMCA of Easton	Easton (C)	User Defined	NA	5.0	0.0	0.0	0.0
Head Start of the LV - Our Lady of Mercy	Easton (C)	User Defined	NA	5.0	0.0	0.0	0.0
Memorial United Church of Christ	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Salisbury Behavioral Health	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0
All My Children Daycare	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0
Northampton County - Archives Building	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Northampton County Archives	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
PRAXIS NURSING HOME	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0
EASTON NURSING CENT	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0
St. Anthony's Youth Center	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Saint Anthony's Youth Center	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Northampton County Courthouse	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Quality Inn	Easton (C)	User Defined	NA	5.0	0.0	0.0	0.0
NORTHAMPTON CTY DOMESTIC RELATIONS	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Faith Unity Church	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
NORTHAMPTON CTY CORONER OFFICE	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
NH Cty Courthouse & Gov Center	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
NORTHAMPTON COUNTY PRISON	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0
Northampton County Prison - Work Release	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Saint Bernard's Roman Catholic Church	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Christ Lutheran Church	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
United States SS Administration	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Christ Lutheran Church	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Dutchman Cemetery	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
St. Bernard's Oratory	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Saint John's Evangelical Lutheran Church	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Northampton County Juvenile Detention	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Northampton County Prison	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0
St. John's Evangelical Lutheran Church	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Lou Reda Productions	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Church of God by Faith Inc.	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Easton (Lehigh River) Boat Access Ramp	Easton (C)	User Defined	NA	6.0	0.0	0.0	0.0
DAR Parsons Taylor House	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Our Lady of Lebanon Church	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Pennsylvania Department of Health	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Second Baptist Church	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
United States Post Office	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
EASTON HOME/PRESBY SENIORS	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0
Easton (Delaware River) Boat Access Ramp	Easton (C)	User Defined	NA	6.0	0.0	0.0	0.0
Easton Irregular	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Olivet Wee Care Daycare and Nursery	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Olivet United Presbyterian Church	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Easton City	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Olivet United Presbyterian Church	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
District Court 03-2-05	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
United States National Park Service	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Binney & Smith Crayola Crayon Tours	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Hugh Moore Park & Museum	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
National Canal Museum	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
NC Historical & Genealogical Society	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
ACJC Day Care Center	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0
Head Start of the LV - Northampton Stre*	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0
First Evangelical Congregational Church	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
State Theatre Center for the Arts	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
First Evangelical Congregational Church	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
136th State Legislative District	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Bachmann Publick House	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Angel's Daycare Center	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0
Express Times	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Easton Area Public Library	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Northampton County - Governor Wolf Bldg	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
First United Church of Christ	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Third Street Alliance for Women & Child*	Easton (C)	User Defined	NA	5.0	0.0	0.0	0.0
Church of The Nazarene	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Trinity Episcopal Church	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
First Moravian Church	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
First Presbyterian Church	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
First Moravian Church	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
First Presbyterian Church	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Easton - Phillipsburg Toll Bridge	Easton (C)	User Defined	NA	6.0	0.0	0.0	0.0
Easton Cemetery Company	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Trinity Child Care	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0
Easton Heights Cemetery Company	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Family YMCA of Easton	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0
Fisher Stadium	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Lafayette Early Learning Center	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0
Saint Paul's Third Lutheran Church	Easton (C)	User Defined	NA	4.0	0.0	0.0	0.0
Lehigh Valley Child Care March School	Easton (C)	User Defined	NA	5.0	0.0	0.0	0.0
Arndt's Lutheran Church	Easton (C)	User Defined	NA	2.0	0.0	0.0	0.0
Faith Lutheran Church	Easton (C)	User Defined	NA	3.0	0.0	0.0	0.0
Creative Learning Center	Easton (C)	User Defined	NA	8.0	0.0	0.0	0.0
BORO OF EMMAUS	Emmaus (B)	Fire	0	1.0	0.0	0.0	0.0
CITIZENS FIRE CO	Emmaus (B)	Fire	0	2.0	0.0	0.0	0.0
CITIZENS FIRE CO	Emmaus (B)	Fire	0	2.0	0.0	0.0	0.0
EMMAUS HIGH SCHOOL	Emmaus (B)	School	0	3.0	1.0	0.0	0.0
EMMAUS HIGH SCHOOL	Emmaus (B)	School	0	3.0	1.0	0.0	0.0
JEFFERSON ELEMENTARY SCHOOL	Emmaus (B)	School	0	3.0	1.0	0.0	0.0
LINCOLN ELEMENTARY SCHOOL	Emmaus (B)	School	0	3.0	1.0	0.0	0.0
ST ANNES PAROCHIAL SCHOOL	Emmaus (B)	School	0	2.0	1.0	0.0	0.0
BORO OF EMMAUS	Emmaus (B)	User Defined	NA	2.0	0.0	0.0	0.0
BORO OF EMMAUS	Emmaus (B)	User Defined	NA	2.0	0.0	0.0	0.0
Quest Diagnostics Inc.	Forks (T)	Medical	0	9.0	9.0	6.0	0.0
FORKS TWP EMS	Forks (T)	Fire	0	2.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
FORKS TWP FIRE DEPT	Forks (T)	Fire	0	2.0	0.0	0.0	0.0
MEDIC 9 - SOUTH	Forks (T)	Fire	0	2.0	0.0	0.0	0.0
FORKS TWP PD	Forks (T)	Police	0	5.0	1.0	0.0	0.0
Forks Elementary School	Forks (T)	School	0	4.0	2.0	0.0	0.0
Paxinosa ES and Shawnee Intermediate	Forks (T)	School	0	6.0	3.0	0.0	0.0
Career Institute of Technology	Forks (T)	School	0	7.0	5.0	1.0	0.0
Riverview Golf & Country Club	Forks (T)	User Defined	NA	5.0	1.0	0.0	0.0
Binney & Smith	Forks (T)	User Defined	NA	2.0	0.0	0.0	0.0
Family YMCA of Easton	Forks (T)	User Defined	NA	4.0	0.0	0.0	0.0
Thoreau Veterinary Hospital	Forks (T)	User Defined	NA	6.0	1.0	0.0	0.0
Forks Township Community Center	Forks (T)	User Defined	NA	5.0	1.0	0.0	0.0
Family YMCA of Easton	Forks (T)	User Defined	NA	7.0	0.0	0.0	0.0
Lehigh Valley Child Care at Forks School	Forks (T)	User Defined	NA	5.0	0.0	0.0	0.0
Forks Township	Forks (T)	User Defined	NA	5.0	1.0	0.0	0.0
Goddard School	Forks (T)	User Defined	NA	6.0	0.0	0.0	0.0
Faith Lutheran Church	Forks (T)	User Defined	NA	3.0	0.0	0.0	0.0
Easton Animal Hospital	Forks (T)	User Defined	NA	4.0	0.0	0.0	0.0
Home Sweet Home	Forks (T)	User Defined	NA	7.0	0.0	0.0	0.0
VILLAGE AT SULLIVAN TRAIL	Forks (T)	User Defined	NA	5.0	0.0	0.0	0.0
The Village at Upstream Farm	Forks (T)	User Defined	NA	7.0	0.0	0.0	0.0
Riverview Estates	Forks (T)	User Defined	NA	8.0	0.0	0.0	0.0
Jacob's Farm	Forks (T)	User Defined	NA	7.0	0.0	0.0	0.0
Lehigh Valley Child Care Great Beginnin*	Forks (T)	User Defined	NA	6.0	0.0	0.0	0.0
PA Army Natl Guard - Easton Ctr	Forks (T)	User Defined	NA	6.0	1.0	0.0	0.0
Tech Tyke Center	Forks (T)	User Defined	NA	11.0	1.0	0.0	0.0
St. Luke's Hospital - Bethlehem	Fountain Hill (B)	Medical	0	4.0	5.0	3.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
FOUNTAIN HILL HOSE CO 1	Fountain Hill (B)	Fire	0	1.0	0.0	0.0	0.0
BORO OF FOUNTAIN HILL	Fountain Hill (B)	Fire	0	1.0	0.0	0.0	0.0
FOUNTAIN HILL ELEMENTARY SCHOOL	Fountain Hill (B)	School	0	2.0	1.0	0.0	0.0
HOLY CHILD SCHOOL	Fountain Hill (B)	School	0	3.0	1.0	0.0	0.0
FREEMANSBURG FIRE	Freemansburg (B)	Fire	0	1.0	0.0	0.0	0.0
FREEMANSBURG PD	Freemansburg (B)	Police	0	2.0	0.0	0.0	0.0
Freemansburg Elementary School	Freemansburg (B)	School	0	4.0	1.0	0.0	0.0
Freemansburg Borough	Freemansburg (B)	User Defined	NA	3.0	0.0	0.0	0.0
Freemansburg Child Care	Freemansburg (B)	User Defined	NA	4.0	0.0	0.0	0.0
Pembroke Pee Wee's Child Care	Freemansburg (B)	User Defined	NA	4.0	0.0	0.0	0.0
Glendon Borough	Glendon (B)	User Defined	NA	4.0	0.0	0.0	0.0
ST. LUKES NORTH	Hanover (T)	Medical	0	5.0	5.0	3.0	0.0
Medical	Hanover (T)	Medical	0	5.0	5.0	3.0	0.0
CAMPBELL MEDICAL CEN	Hanover (T)	Medical	0	5.0	5.0	3.0	0.0
Radiology & MRI of Bethlehem	Hanover (T)	Medical	0	6.0	7.0	4.0	0.0
St. Lukes Hospital	Hanover (T)	Medical	0	5.0	5.0	3.0	0.0
Boas Surgical Inc.	Hanover (T)	Medical	0	7.0	7.0	4.0	0.0
Helping Hands Medical Supply	Hanover (T)	Medical	0	5.0	5.0	3.0	0.0
Homestar Medical Equip & Infusion Center	Hanover (T)	Medical	0	5.0	5.0	3.0	0.0
Lincare	Hanover (T)	Medical	0	4.0	5.0	2.0	0.0
HANOVER TWP EMS	Hanover (T)	Fire	0	1.0	0.0	0.0	0.0
HANOVER TWP FIRE	Hanover (T)	Fire	0	1.0	0.0	0.0	0.0
Asa Packer Elementary School	Hanover (T)	School	0	3.0	1.0	0.0	0.0
Hanover Elementary School	Hanover (T)	School	0	4.0	2.0	0.0	0.0
HANOVER TOWNSHIP	Hanover (T)	User Defined	NA	2.0	0.0	0.0	0.0
Holy Cross Evangelical Lutheran Church	Hanover (T)	User Defined	NA	3.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Atria Bethlehem	Hanover (T)	User Defined	NA	4.0	0.0	0.0	0.0
SR QUARTERS AT MUHLE	Hanover (T)	User Defined	NA	4.0	0.0	0.0	0.0
Visiting Nurse Association	Hanover (T)	User Defined	NA	2.0	0.0	0.0	0.0
Miller Keystone Blood Center	Hanover (T)	User Defined	NA	2.0	0.0	0.0	0.0
Asa Packer Child Care	Hanover (T)	User Defined	NA	3.0	0.0	0.0	0.0
Holiday Inn Express Hotels & Suites	Hanover (T)	User Defined	NA	3.0	0.0	0.0	0.0
Hanover Glen	Hanover (T)	User Defined	NA	5.0	0.0	0.0	0.0
Hanover (N) Township	Hanover (T)	User Defined	NA	4.0	0.0	0.0	0.0
Hampton Inn & Suites	Hanover (T)	User Defined	NA	3.0	0.0	0.0	0.0
Best Western Conference Center	Hanover (T)	User Defined	NA	3.0	0.0	0.0	0.0
Hanover Child Care	Hanover (T)	User Defined	NA	5.0	0.0	0.0	0.0
Triangle Tech	Hanover (T)	User Defined	NA	2.0	0.0	0.0	0.0
Lehigh Valley Friends Meetinghouse	Hanover (T)	User Defined	NA	2.0	0.0	0.0	0.0
Division of Long Term Care - Dept Health	Hanover (T)	User Defined	NA	3.0	0.0	0.0	0.0
Department of Environmental Protection	Hanover (T)	User Defined	NA	3.0	0.0	0.0	0.0
Federal Express	Hanover (T)	User Defined	NA	2.0	0.0	0.0	0.0
Traditions of America at Hanover	Hanover (T)	User Defined	NA	11.0	1.0	0.0	0.0
Miller Keystone Blood Center	Hanover Township (T)	Medical	0	4.0	5.0	2.0	0.0
Visiting Nurse Association	Hanover Township (T)	Medical	0	4.0	5.0	2.0	0.0
GOODWILL FIRE CO	Heidelberg (T)	Fire	0	1.0	0.0	0.0	0.0
NORTHWESTERN LEHIGH HIGH SCHOOL	Heidelberg (T)	School	0	3.0	1.0	0.0	0.0
NORTHWESTERN LEHIGH MIDDLE SCHOOL	Heidelberg (T)	School	0	3.0	1.0	0.0	0.0
HEIDELBERG TWP	Heidelberg (T)	User Defined	NA	1.0	0.0	0.0	0.0
RITTER DEAN L & MARYBETH A	Heidelberg (T)	User Defined	NA	2.0	0.0	0.0	0.0
COMMONWEALTH OF PA	Heidelberg (T)	User Defined	NA	1.0	0.0	0.0	0.0
SAUCON VALLEY FAMILY PRACTICE	Hellertown (B)	Medical	0	5.0	7.0	4.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Quest Diagnostics Inc.	Hellertown (B)	Medical	0	7.0	9.0	6.0	0.0
St. Lukes Hospital	Hellertown (B)	Medical	0	5.0	7.0	4.0	0.0
Yeagers Pharmacy	Hellertown (B)	Medical	0	5.0	6.0	4.0	0.0
DEWEY FIRE COMPANY AMBULANCE	Hellertown (B)	Fire	0	1.0	0.0	0.0	0.0
METRO EMS	Hellertown (B)	Fire	0	1.0	0.0	0.0	0.0
DEWEY FIRE COMPANY	Hellertown (B)	Fire	0	1.0	0.0	0.0	0.0
HELLERTOWN PD	Hellertown (B)	Police	0	3.0	0.0	0.0	0.0
Christ Lutheran Center	Hellertown (B)	User Defined	NA	7.0	0.0	0.0	0.0
Hellertown Union Cemetery	Hellertown (B)	User Defined	NA	5.0	1.0	0.0	0.0
Saucon Valley Community Center	Hellertown (B)	User Defined	NA	3.0	0.0	0.0	0.0
Saucon Valley Community Center	Hellertown (B)	User Defined	NA	5.0	0.0	0.0	0.0
Heintzelman Funeral Home	Hellertown (B)	User Defined	NA	3.0	0.0	0.0	0.0
Hellertown Area Library	Hellertown (B)	User Defined	NA	5.0	1.0	0.0	0.0
United States Post Office	Hellertown (B)	User Defined	NA	3.0	0.0	0.0	0.0
Hellertown Borough	Hellertown (B)	User Defined	NA	3.0	0.0	0.0	0.0
SAUCON VALLEY MANOR/SENIORLIVI	Hellertown (B)	User Defined	NA	4.0	0.0	0.0	0.0
Silver Creek Country Club	Hellertown (B)	User Defined	NA	3.0	0.0	0.0	0.0
Society of Little Learners Child Care	Hellertown (B)	User Defined	NA	4.0	0.0	0.0	0.0
Saint Theresa School	Hellertown (B)	School	0	4.0	1.0	0.0	0.0
LEHIGH TWP FIRE CO	Lehigh (T)	Fire	0	1.0	0.0	0.0	0.0
LEHIGH TWP PD	Lehigh (T)	Police	0	1.0	0.0	0.0	0.0
Lehigh Township Elementary School	Lehigh (T)	School	0	5.0	2.0	0.0	0.0
United States Post Office	Lehigh (T)	User Defined	NA	1.0	0.0	0.0	0.0
Sharon's Day Care	Lehigh (T)	User Defined	NA	2.0	0.0	0.0	0.0
Teddy Bear Day Care	Lehigh (T)	User Defined	NA	6.0	0.0	0.0	0.0
Bethany Wesleyan Church	Lehigh (T)	User Defined	NA	3.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
United States Post Office	Lehigh (T)	User Defined	NA	3.0	0.0	0.0	0.0
St. Paul's UCC Indianland Cemetery	Lehigh (T)	User Defined	NA	2.0	0.0	0.0	0.0
District Court 03-3-01	Lehigh (T)	User Defined	NA	2.0	0.0	0.0	0.0
CHANDLER III	Lehigh (T)	User Defined	NA	4.0	0.0	0.0	0.0
Blue Ridge Veterinary Clinic	Lehigh (T)	User Defined	NA	2.0	0.0	0.0	0.0
Lehigh Township	Lehigh (T)	User Defined	NA	1.0	0.0	0.0	0.0
PERSONAL CARE HOME	Lehigh (T)	User Defined	NA	2.0	0.0	0.0	0.0
Liza's House Personal Care Home	Lehigh (T)	User Defined	NA	2.0	0.0	0.0	0.0
United States Post Office	Lehigh (T)	User Defined	NA	1.0	0.0	0.0	0.0
LOWER MACUNGIE TWP	Lower Macungie (T)	Fire	0	2.0	0.0	0.0	0.0
THE HILLSIDE SCHOOL	Lower Macungie (T)	School	0	7.0	3.0	0.0	0.0
LOWER MACUNGIE MIDDLE SCHOOL	Lower Macungie (T)	School	0	5.0	2.0	0.0	0.0
LOWER MACUNGIE ELEMENTARY SCHOOL	Lower Macungie (T)	School	0	5.0	2.0	0.0	0.0
WESCOSVILLE ELEMENTARY SCHOOL	Lower Macungie (T)	School	0	5.0	2.0	0.0	0.0
EYER MIDDLE SCHOOL	Lower Macungie (T)	School	0	5.0	2.0	0.0	0.0
SHOEMAKER ELEMENTARY SCHOOL	Lower Macungie (T)	School	0	5.0	2.0	0.0	0.0
MACUNGIE ELEMENTARY SCHOOL	Lower Macungie (T)	School	0	5.0	2.0	0.0	0.0
Legacy Oaks at Lehigh Valley	Lower Macungie (T)	User Defined	NA	7.0	0.0	0.0	0.0
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined	NA	5.0	1.0	0.0	0.0
Traditions at Wild Cherry Knoll	Lower Macungie (T)	User Defined	NA	6.0	0.0	0.0	0.0
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined	NA	4.0	0.0	0.0	0.0
Four Seasons at Farmington	Lower Macungie (T)	User Defined	NA	7.0	0.0	0.0	0.0
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined	NA	5.0	1.0	0.0	0.0
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined	NA	5.0	1.0	0.0	0.0
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined	NA	4.0	0.0	0.0	0.0
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined	NA	5.0	1.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined	NA	2.0	0.0	0.0	0.0
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined	NA	5.0	1.0	0.0	0.0
LOWER MACUNGIE TWP	Lower Macungie (T)	User Defined	NA	2.0	0.0	0.0	0.0
LOWER MILFORD TWP FIRE CO #1	Lower Milford (T)	Fire	0	4.0	1.0	0.0	0.0
LOWER MILFORD ELEMENTARY SCHOOL	Lower Milford (T)	School	0	7.0	4.0	0.0	0.0
PENNA DEPT OF TRANSPORTATION	Lower Milford (T)	User Defined	NA	7.0	1.0	0.0	0.0
Sandt's Eddy Boat Access Ramp	Lower Mt Bethel (T)	User Defined	NA	5.0	0.0	0.0	0.0
James Palmeri Funeral Home	Lower Mt Bethel (T)	User Defined	NA	3.0	0.0	0.0	0.0
PPL Boat Access Ramp	Lower Mt Bethel (T)	User Defined	NA	7.0	1.0	0.0	0.0
PPL Public Boat Access Ramp	Lower Mt Bethel (T)	User Defined	NA	7.0	1.0	0.0	0.0
LOWER MT BETHEL FIRE CO	Lower Mt. Bethel (T)	Fire	0	1.0	0.0	0.0	0.0
LOWER MT BETHEL TWP FIRE	Lower Mt. Bethel (T)	Fire	0	3.0	0.0	0.0	0.0
Lower Mount Bethel Township	Lower Mt. Bethel (T)	User Defined	NA	2.0	0.0	0.0	0.0
NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Any Lab Test Now	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
Easton Hospital Laboratory Services	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
Health Network Laboratories	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
Progressive Physicians Vascular Lab	Lower Nazareth (T)	Medical	0	7.0	7.0	4.0	0.0
HECKTOWN EMS	Lower Nazareth (T)	Fire	0	2.0	0.0	0.0	0.0
HECKTOWN FIRE CO	Lower Nazareth (T)	Fire	0	2.0	0.0	0.0	0.0
Lower Nazareth Elementary School	Lower Nazareth (T)	School	0	7.0	4.0	0.0	0.0
Governor Wolf	Lower Nazareth (T)	User Defined	NA	4.0	0.0	0.0	0.0
VCA Northside Animal Hospital	Lower Nazareth (T)	User Defined	NA	3.0	0.0	0.0	0.0
District Court 03-2-03	Lower Nazareth (T)	User Defined	NA	4.0	0.0	0.0	0.0
Nazareth Area Day Care	Lower Nazareth (T)	User Defined	NA	5.0	0.0	0.0	0.0
Lower Nazareth Township	Lower Nazareth (T)	User Defined	NA	6.0	0.0	0.0	0.0
Lehigh Valley Child Care Lower Nazareth	Lower Nazareth (T)	User Defined	NA	9.0	1.0	0.0	0.0
Towneplace Suites By Marriott	Lower Nazareth (T)	User Defined	NA	6.0	0.0	0.0	0.0
Trio Farms	Lower Nazareth (T)	User Defined	NA	9.0	1.0	0.0	0.0
SE-WY-CO FIRE	Lower Saucon (T)	Fire	0	1.0	0.0	0.0	0.0
LEITHSVILLE FIRE CO	Lower Saucon (T)	Fire	0	1.0	0.0	0.0	0.0
SOUTHEASTERN FIRE CO	Lower Saucon (T)	Fire	0	1.0	0.0	0.0	0.0
STEEL CITY FIRE CO	Lower Saucon (T)	Fire	0	1.0	0.0	0.0	0.0
LOWER SAUCON PD	Lower Saucon (T)	Police	0	3.0	0.0	0.0	0.0
Lehigh University	Lower Saucon (T)	School	0	2.0	0.0	0.0	0.0
Saucon Valley School District Campus	Lower Saucon (T)	School	5	7.0	4.0	0.0	0.0
Saucon Valley Animal Hospital	Lower Saucon (T)	User Defined	NA	3.0	0.0	0.0	0.0
New Jerusalem Evangelical Lutheran Church	Lower Saucon (T)	User Defined	NA	4.0	0.0	0.0	0.0
MARY ELLEN CONVALESC	Lower Saucon (T)	User Defined	NA	5.0	0.0	0.0	0.0
Saucon Valley Com Center Fore & Aft	Lower Saucon (T)	User Defined	NA	8.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
VNA HOSPICE @ ST LUKES	Lower Saucon (T)	User Defined	NA	5.0	0.0	0.0	0.0
District Court 03-2-04	Lower Saucon (T)	User Defined	NA	3.0	0.0	0.0	0.0
IMMED.CARE FCTY/M/R	Lower Saucon (T)	User Defined	NA	5.0	0.0	0.0	0.0
IMMED.CARE FCTY M/R	Lower Saucon (T)	User Defined	NA	5.0	0.0	0.0	0.0
Lower Saucon Township	Lower Saucon (T)	User Defined	NA	3.0	0.0	0.0	0.0
Woodland Hills Country Club	Lower Saucon (T)	User Defined	NA	4.0	0.0	0.0	0.0
COMMUNITY FIRE CO OF NEW TRIPOLI	Lynn (T)	Fire	0	1.0	0.0	0.0	0.0
NEW TRIPOLI FIRE CO	Lynn (T)	Fire	0	1.0	0.0	0.0	0.0
LYNNPORT COMM FIRE CO #1	Lynn (T)	Fire	0	1.0	0.0	0.0	0.0
NORTHWESTERN LEHIGH ELEMENTARY SCHOOL	Lynn (T)	School	0	3.0	1.0	0.0	0.0
LYNN TOWNSHIP	Lynn (T)	User Defined	NA	1.0	0.0	0.0	0.0
MACUNGIE FIRE CO #1	Macungie (B)	Fire	0	1.0	0.0	0.0	0.0
MOORE TWP EMS	Moore (T)	Fire	0	2.0	0.0	0.0	0.0
KLECKNERSVILLE RANGERS FIRE CO	Moore (T)	Fire	0	2.0	0.0	0.0	0.0
MOORE TWP PD	Moore (T)	Police	0	4.0	0.0	0.0	0.0
Moore Township Elementary School	Moore (T)	School	0	4.0	2.0	0.0	0.0
Whitetail Golf Club	Moore (T)	User Defined	NA	2.0	0.0	0.0	0.0
Southmoore Golf Course	Moore (T)	User Defined	NA	2.0	0.0	0.0	0.0
Emmanuel Lutheran Church Cemetery	Moore (T)	User Defined	NA	5.0	1.0	1.0	0.0
Covenant United Methodist Cemetery	Moore (T)	User Defined	NA	3.0	0.0	0.0	0.0
Moore Township	Moore (T)	User Defined	NA	4.0	0.0	0.0	0.0
Salem UCC Cemetery	Moore (T)	User Defined	NA	5.0	1.0	0.0	0.0
Woodstone Country Club	Moore (T)	User Defined	NA	2.0	0.0	0.0	0.0
Amy Pysher's Child Care Center	Moore (T)	User Defined	NA	3.0	0.0	0.0	0.0
138th State Legislative District	Moore (T)	User Defined	NA	4.0	0.0	0.0	0.0
Medical	Nazareth (B)	Medical	0	5.0	5.0	2.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Quest Diagnostics, Inc.	Nazareth (B)	Medical	0	4.0	5.0	2.0	0.0
St. Lukes Hospital	Nazareth (B)	Medical	0	5.0	5.0	2.0	0.0
Nazareth Medical Equipment	Nazareth (B)	Medical	0	4.0	5.0	2.0	0.0
NAZARETH BORO EMS	Nazareth (B)	Fire	0	1.0	0.0	0.0	0.0
VIGILANCE HOSE CO	Nazareth (B)	Fire	0	1.0	0.0	0.0	0.0
NAZARETH PD	Nazareth (B)	Police	0	2.0	0.0	0.0	0.0
Shafer Elementary School	Nazareth (B)	School	0	3.0	1.0	0.0	0.0
Holy Family School	Nazareth (B)	School	0	3.0	1.0	0.0	0.0
Holy Family School	Nazareth (B)	School	0	3.0	1.0	0.0	0.0
Holy Family School	Nazareth (B)	School	0	3.0	1.0	0.0	0.0
Holy Family School	Nazareth (B)	School	0	3.0	1.0	0.0	0.0
LV Child Care Nazareth Int School	Nazareth (B)	User Defined	NA	6.0	0.0	0.0	0.0
137th State Legislative District	Nazareth (B)	User Defined	NA	2.0	0.0	0.0	0.0
Saint John's Lutheran Church	Nazareth (B)	User Defined	NA	2.0	0.0	0.0	0.0
St. John's Lutheran Church	Nazareth (B)	User Defined	NA	2.0	0.0	0.0	0.0
St. John's Lutheran Day Care	Nazareth (B)	User Defined	NA	3.0	0.0	0.0	0.0
Nazareth Veterinary Center PC	Nazareth (B)	User Defined	NA	2.0	0.0	0.0	0.0
Saint John's United Church of Christ	Nazareth (B)	User Defined	NA	2.0	0.0	0.0	0.0
Kids Learning Kingdom	Nazareth (B)	User Defined	NA	5.0	0.0	0.0	0.0
St. John's United Church of Christ	Nazareth (B)	User Defined	NA	2.0	0.0	0.0	0.0
Nazareth Borough	Nazareth (B)	User Defined	NA	2.0	0.0	0.0	0.0
District Court 03-2-08	Nazareth (B)	User Defined	NA	2.0	0.0	0.0	0.0
Northampton Country Childcare	Nazareth (B)	User Defined	NA	3.0	0.0	0.0	0.0
Lehigh Valley Child Care Shafer School	Nazareth (B)	User Defined	NA	4.0	0.0	0.0	0.0
ALEXANDRIA MANOR	Nazareth (B)	User Defined	NA	3.0	0.0	0.0	0.0
Whitefield House Museum	Nazareth (B)	User Defined	NA	2.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Nazareth Memorial Library	Nazareth (B)	User Defined	NA	2.0	0.0	0.0	0.0
United States Post Office	Nazareth (B)	User Defined	NA	2.0	0.0	0.0	0.0
MORAVIAN HALL MORNING STAR	Nazareth (B)	User Defined	NA	3.0	0.0	0.0	0.0
Nazareth Key	Nazareth (B)	User Defined	NA	3.0	0.0	0.0	0.0
Martin Guitar Museum	Nazareth (B)	User Defined	NA	3.0	0.0	0.0	0.0
N CATASAUQUA MEDICAL	North Catasauqua (B)	Medical	0	4.0	4.0	2.0	0.0
CHARITON HOSE CO	North Catasauqua (B)	Fire	0	1.0	0.0	0.0	0.0
NORTH CATASAUQUA PD	North Catasauqua (B)	Police	0	2.0	0.0	0.0	0.0
North Catasauqua Borough	North Catasauqua (B)	User Defined	NA	2.0	0.0	0.0	0.0
Delabar Family	North Catasauqua (B)	User Defined	NA	4.0	0.0	0.0	0.0
TRI-CLOVER FIRE CO	North Whitehall (T)	Fire	0	1.0	0.0	0.0	0.0
TRI-CLOVER FIRE CO	North Whitehall (T)	Fire	0	1.0	0.0	0.0	0.0
LAURY'S STATION VOLUNTEER FIRE CO #1	North Whitehall (T)	Fire	0	1.0	0.0	0.0	0.0
NEFFS VOLUNTEER FIRE COMPANY	North Whitehall (T)	Fire	0	1.0	0.0	0.0	0.0
KERNSVILLE ELEMENTARY SCHOOL	North Whitehall (T)	School	0	2.0	0.0	0.0	0.0
LEHIGH CAREER & TECHNICAL INSTITUTE	North Whitehall (T)	School	0	2.0	0.0	0.0	0.0
SCHNECKSVILLE ELEMENTARY SCHOOL	North Whitehall (T)	School	0	3.0	1.0	0.0	0.0
IRONTON ELEMENTARY SCHOOL	North Whitehall (T)	School	0	4.0	1.0	0.0	0.0
NORTH WHITEHALL TWP	North Whitehall (T)	User Defined	NA	3.0	0.0	0.0	0.0
COUNTY OF LEHIGH	North Whitehall (T)	User Defined	NA	2.0	0.0	0.0	0.0
St. Michael's Cemetery	Northampton	User Defined	NA	2.0	0.0	0.0	0.0
PA DOT - Stockpile Hope Road	Northampton	User Defined	NA	6.0	1.0	0.0	0.0
PA DOT - Northampton Cty Maint District	Northampton	User Defined	NA	3.0	0.0	0.0	0.0
PA DOT - Stockpile Newburg	Northampton	User Defined	NA	6.0	1.0	0.0	0.0
PA DOT - Stockpile Danielsville	Northampton	User Defined	NA	1.0	0.0	0.0	0.0
PA DOT - Stockpile Pen Argyl	Northampton	User Defined	NA	2.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
NORTH. MEDICAL ARTS	Northampton (B)	Medical	0	3.0	3.0	1.0	0.0
Health Network Laboratories	Northampton (B)	Medical	0	4.0	3.0	1.0	0.0
Sacred Heart Outpatient Lab Services	Northampton (B)	Medical	0	4.0	3.0	1.0	0.0
Newhard Pharmacy	Northampton (B)	Medical	0	4.0	4.0	2.0	0.0
Webb Medical Systems	Northampton (B)	Medical	0	4.0	3.0	1.0	0.0
NORTHAMPTON REGIONAL EMS	Northampton (B)	Fire	0	1.0	0.0	0.0	0.0
NORTHAMPTON BORO FIRE DEPT	Northampton (B)	Fire	0	1.0	0.0	0.0	0.0
NORTHAMPTON BORO PD	Northampton (B)	Police	0	2.0	0.0	0.0	0.0
Franklin Elementary School	Northampton (B)	School	0	2.0	0.0	0.0	0.0
Our Lady of Hungary Elementary School	Northampton (B)	School	0	2.0	0.0	0.0	0.0
Saint John the Baptist Elementary School	Northampton (B)	School	0	2.0	0.0	0.0	0.0
Northampton Area Jr and Sr HS	Northampton (B)	School	0	2.0	0.0	0.0	0.0
Wolf Elementary School	Northampton (B)	School	0	2.0	0.0	0.0	0.0
Bethlehem Area Vo-Tech School	Northampton (B)	School	0	2.0	0.0	0.0	0.0
Washington Elementary School	Northampton (B)	School	0	2.0	0.0	0.0	0.0
Washington Elementary School	Northampton (B)	School	0	2.0	0.0	0.0	0.0
Duck Duck Goose	Northampton (B)	User Defined	NA	2.0	0.0	0.0	0.0
Grace United Church of Christ	Northampton (B)	User Defined	NA	2.0	0.0	0.0	0.0
Grace United Church of Christ	Northampton (B)	User Defined	NA	1.0	0.0	0.0	0.0
Assumption of the Virgin Mary	Northampton (B)	User Defined	NA	1.0	0.0	0.0	0.0
NORTHAMPTON VILLAGE	Northampton (B)	User Defined	NA	2.0	0.0	0.0	0.0
Our Lady of Hungary Church	Northampton (B)	User Defined	NA	1.0	0.0	0.0	0.0
Assumption of The Virgin Mary Ukranian	Northampton (B)	User Defined	NA	1.0	0.0	0.0	0.0
Northampton Borough	Northampton (B)	User Defined	NA	2.0	0.0	0.0	0.0
Northampton Community Center	Northampton (B)	User Defined	NA	2.0	0.0	0.0	0.0
Northampton Area Public Library	Northampton (B)	User Defined	NA	2.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
United States Post Office	Northampton (B)	User Defined	NA	2.0	0.0	0.0	0.0
183rd State Legislative District	Northampton (B)	User Defined	NA	2.0	0.0	0.0	0.0
District Court 03-2-07	Northampton (B)	User Defined	NA	2.0	0.0	0.0	0.0
Schisler Funeral Home	Northampton (B)	User Defined	NA	2.0	0.0	0.0	0.0
SACRED HEART LIVING	Northampton (B)	User Defined	NA	2.0	0.0	0.0	0.0
Unknown name	Northampton (B)	User Defined	NA	2.0	0.0	0.0	0.0
DIAGNOSTIC IMAGING	Palmer (T)	Medical	0	7.0	7.0	5.0	0.0
UNIT 3 PALMER MED	Palmer (T)	Medical	0	5.0	6.0	4.0	0.0
Medical	Palmer (T)	Medical	0	5.0	6.0	4.0	0.0
UNIT 5 PALMER MED	Palmer (T)	Medical	0	5.0	6.0	4.0	0.0
UNIT 2 PALMER MED	Palmer (T)	Medical	0	5.0	6.0	4.0	0.0
UNIT 6 PALMER MED	Palmer (T)	Medical	0	5.0	6.0	4.0	0.0
GASTROENTEROLOGY CENTER	Palmer (T)	Medical	0	5.0	6.0	4.0	0.0
UNIT 4 PALMER MED	Palmer (T)	Medical	0	5.0	6.0	4.0	0.0
UNIT 1 PALMER MED	Palmer (T)	Medical	0	5.0	6.0	4.0	0.0
DENTAL OFFICE	Palmer (T)	Medical	0	5.0	6.0	4.0	0.0
DR. BODY, DENTIST	Palmer (T)	Medical	0	5.0	6.0	4.0	0.0
BOONSWANG MED OFF	Palmer (T)	Medical	0	5.0	6.0	3.0	0.0
Easton Hospital Laboratory Services	Palmer (T)	Medical	0	5.0	6.0	4.0	0.0
Pinnacle Lab	Palmer (T)	Medical	0	5.0	6.0	4.0	0.0
Youngs Medical Equipment	Palmer (T)	Medical	0	7.0	7.0	4.0	0.0
SUBURBAN EMS	Palmer (T)	Fire	0	1.0	0.0	0.0	0.0
PALMER TWP FIRE - STATION 2	Palmer (T)	Fire	0	1.0	0.0	0.0	0.0
PALMER TWP FIRE	Palmer (T)	Fire	0	1.0	0.0	0.0	0.0
PALMER TWP PD	Palmer (T)	Police	0	4.0	0.0	0.0	0.0
Easton Area High School	Palmer (T)	School	0	4.0	1.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Palmer Elementary School	Palmer (T)	School	0	5.0	2.0	0.0	0.0
Edward Tracy Elementary School	Palmer (T)	School	0	4.0	1.0	0.0	0.0
Serenity	Palmer (T)	User Defined	NA	4.0	0.0	0.0	0.0
William Penn Animal Hospital	Palmer (T)	User Defined	NA	3.0	0.0	0.0	0.0
United States Post Office	Palmer (T)	User Defined	NA	3.0	0.0	0.0	0.0
Lehigh Valley Child Care at Easton	Palmer (T)	User Defined	NA	5.0	0.0	0.0	0.0
New Creation United Church of Christ	Palmer (T)	User Defined	NA	2.0	0.0	0.0	0.0
Holiday Inn Express	Palmer (T)	User Defined	NA	5.0	0.0	0.0	0.0
Charles Chrin Community Center of Palmer	Palmer (T)	User Defined	NA	5.0	0.0	0.0	0.0
MANOR CARE # 574	Palmer (T)	User Defined	NA	5.0	0.0	0.0	0.0
Patti Stout Group Child Day Care	Palmer (T)	User Defined	NA	5.0	0.0	0.0	0.0
Redi-Care Medical Center	Palmer (T)	User Defined	NA	3.0	0.0	0.0	0.0
Comfort Inn	Palmer (T)	User Defined	NA	5.0	0.0	0.0	0.0
Palmer Moravian Day School	Palmer (T)	User Defined	NA	4.0	0.0	0.0	0.0
Enclave at Knob Hill	Palmer (T)	User Defined	NA	4.0	0.0	0.0	0.0
Littlest Little People Country Club	Palmer (T)	User Defined	NA	4.0	0.0	0.0	0.0
Little People Country Club	Palmer (T)	User Defined	NA	4.0	0.0	0.0	0.0
Palmer Township	Palmer (T)	User Defined	NA	3.0	0.0	0.0	0.0
St. Paul's Third Lutheran Church	Palmer (T)	User Defined	NA	4.0	0.0	0.0	0.0
District Court 03-2-09	Palmer (T)	User Defined	NA	3.0	0.0	0.0	0.0
Easton Area Public Library	Palmer (T)	User Defined	NA	3.0	0.0	0.0	0.0
Hampton Inn	Palmer (T)	User Defined	NA	6.0	0.0	0.0	0.0
LPCC Extended Care at Tracy School	Palmer (T)	User Defined	NA	4.0	0.0	0.0	0.0
Traditions of Glenmoor	Palmer (T)	User Defined	NA	8.0	0.0	0.0	0.0
Highlands at Glenmoor North	Palmer (T)	User Defined	NA	12.0	1.0	0.0	0.0
Redi-Care Medical Center	Palmer Township (T)	Medical	0	5.0	6.0	4.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
PEN ARGYL FIRE CO	Pen Argyl (B)	Fire	0	1.0	0.0	0.0	0.0
PEN ARGYL PD	Pen Argyl (B)	Police	0	2.0	0.0	0.0	0.0
Pen Argyl Junior-Senior High School	Pen Argyl (B)	School	0	1.0	0.0	0.0	0.0
Immaculate Conception School	Pen Argyl (B)	School	0	2.0	0.0	0.0	0.0
MORNING STAR MANOR	Pen Argyl (B)	User Defined	NA	2.0	0.0	0.0	0.0
Morning Star Manor	Pen Argyl (B)	User Defined	NA	2.0	0.0	0.0	0.0
United States Post Office	Pen Argyl (B)	User Defined	NA	2.0	0.0	0.0	0.0
Pen Argyl Borough	Pen Argyl (B)	User Defined	NA	2.0	0.0	0.0	0.0
Kid's Campus Nursery and Day Care	Pen Argyl (B)	User Defined	NA	2.0	0.0	0.0	0.0
AVH Veterinary Group	Pen Argyl (B)	User Defined	NA	2.0	0.0	0.0	0.0
FAMILY CARE CENT INC	Plainfield (T)	Medical	0	6.0	6.0	3.0	0.0
WIND GAP PROF CENTER	Plainfield (T)	Medical	0	4.0	4.0	2.0	0.0
PLAINFIELD TWP FIRE & AMBULANCE	Plainfield (T)	Fire	0	1.0	0.0	0.0	0.0
PLAINFIELD TWP FIRE & AMBULANCE	Plainfield (T)	Fire	0	1.0	0.0	0.0	0.0
PLAINFIELD TWP PD	Plainfield (T)	Police	0	3.0	0.0	0.0	0.0
Wind Gap Middle School	Plainfield (T)	School	0	7.0	3.0	0.0	0.0
Plainfield Elementary School	Plainfield (T)	School	0	5.0	2.0	0.0	0.0
Sawmill Golf Course	Plainfield (T)	User Defined	NA	2.0	0.0	0.0	0.0
BELFAST PSP	Plainfield (T)	User Defined	NA	3.0	0.0	0.0	0.0
Plainfield Township	Plainfield (T)	User Defined	NA	3.0	0.0	0.0	0.0
CHANDLER ESTATES IV	Plainfield (T)	User Defined	NA	5.0	0.0	0.0	0.0
Operation Smart Start	Plainfield (T)	User Defined	NA	2.0	0.0	0.0	0.0
PORTLAND & VICINITY AMBULANCE CORPS	Portland (B)	Fire	0	1.0	0.0	0.0	0.0
PORTLAND HOOK & LADDER	Portland (B)	Fire	0	1.0	0.0	0.0	0.0
PORTLAND PD	Portland (B)	Police	0	2.0	0.0	0.0	0.0
Portland Borough	Portland (B)	User Defined	NA	2.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
United States Post Office	Portland (B)	User Defined	NA	2.0	0.0	0.0	0.0
ROSETO FIRE CO	Roseto (B)	Fire	0	1.0	0.0	0.0	0.0
ROSETO PD	Roseto (B)	Police	0	2.0	0.0	0.0	0.0
Our Lady of Mount Carmel School	Roseto (B)	School	0	2.0	1.0	0.0	0.0
Our Lady of Mount Carmel Cemetery	Roseto (B)	User Defined	NA	2.0	0.0	0.0	0.0
United States Post Office	Roseto (B)	User Defined	NA	2.0	0.0	0.0	0.0
Roseto Borough	Roseto (B)	User Defined	NA	2.0	0.0	0.0	0.0
Lehigh Valley Hospital - Cedar Crest	Salisbury (T)	Medical	0	5.0	5.0	3.0	0.0
SALISBURY MIDDLE SCHOOL	Salisbury (T)	School	0	3.0	1.0	0.0	0.0
WESTERN SALISBURY ELEMENTARY SCHOOL	Salisbury (T)	School	0	3.0	1.0	0.0	0.0
THE SWAIN SCHOOL	Salisbury (T)	School	0	3.0	1.0	0.0	0.0
SALISBURY HIGH SCHOOL	Salisbury (T)	School	0	3.0	1.0	0.0	0.0
HARRY S TRUMAN ELEMENTARY SCHOOL	Salisbury (T)	School	0	3.0	1.0	0.0	0.0
WILEY HOUSE	Salisbury (T)	School	0	2.0	1.0	0.0	0.0
WILEY HOUSE	Salisbury (T)	School	0	2.0	1.0	0.0	0.0
LEHIGH CHRISTIAN ACADEMY	Salisbury (T)	School	0	3.0	1.0	0.0	0.0
ST THOMAS MORE	Salisbury (T)	School	0	3.0	1.0	0.0	0.0
COUNTY OF LEHIGH	Salisbury (T)	User Defined	NA	1.0	0.0	0.0	0.0
BORO OF SLATINGTON	Slatington (B)	Fire	0	1.0	0.0	0.0	0.0
BORO OF SLATINGTON	Slatington (B)	Fire	0	1.0	0.0	0.0	0.0
BORO OF SLATINGTON	Slatington (B)	Fire	0	1.0	0.0	0.0	0.0
SLATINGTON ELEMENTARY SCHOOL	Slatington (B)	School	0	2.0	0.0	0.0	0.0
NORTHERN LEHIGH HIGH SCHOOL	Slatington (B)	School	0	2.0	0.0	0.0	0.0
NORTHERN LEHIGH MIDDLE SCHOOL	Slatington (B)	School	0	2.0	0.0	0.0	0.0
ST JOHN NEUMANN REGIONAL SCHOOL	Slatington (B)	School	0	1.0	0.0	0.0	0.0
BORO OF SLATINGTON	Slatington (B)	User Defined	NA	1.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Westfield Hospital	South Whitehall (T)	Medical	0	4.0	4.0	2.0	0.0
ST JOSEPH THE WORKER ELEMENTARY SCHOOL	South Whitehall (T)	School	0	5.0	2.0	0.0	0.0
PARKWAY MANOR ELEMENTARY SCHOOL	South Whitehall (T)	School	0	3.0	1.0	0.0	0.0
SPRINGHOUSE MIDDLE SCHOOL	South Whitehall (T)	School	0	3.0	1.0	0.0	0.0
OREFIELD MIDDLE SCHOOL	South Whitehall (T)	School	0	3.0	1.0	0.0	0.0
PARKLAND HIGH SCHOOL	South Whitehall (T)	School	0	6.0	3.0	0.0	0.0
CETRONIA ELEMENTARY SCHOOL	South Whitehall (T)	School	0	3.0	1.0	0.0	0.0
KRATZER ELEMENTARY SCHOOL	South Whitehall (T)	School	0	3.0	1.0	0.0	0.0
JEWISH DAY SCHOOL	South Whitehall (T)	School	0	3.0	1.0	0.0	0.0
JEWISH DAY SCHOOL	South Whitehall (T)	School	0	3.0	1.0	0.0	0.0
JEWISH DAY SCHOOL	South Whitehall (T)	School	0	3.0	1.0	0.0	0.0
ALLENTOWN CHRISTIAN SCHOOL	South Whitehall (T)	School	0	3.0	1.0	0.0	0.0
DATZYK MONTESSORI SCHOOL	South Whitehall (T)	School	0	3.0	1.0	0.0	0.0
CITY OF ALLENTOWN	South Whitehall (T)	User Defined	NA	2.0	0.0	0.0	0.0
LIBERTY HOSE CO	Stockertown (B)	Fire	0	1.0	0.0	0.0	0.0
STOCKERTOWN PD	Stockertown (B)	Police	0	2.0	0.0	0.0	0.0
United States Post Office	Stockertown (B)	User Defined	NA	3.0	0.0	0.0	0.0
Stockertown Borough	Stockertown (B)	User Defined	NA	2.0	0.0	0.0	0.0
TATAMY BORO FIRE DEPT	Tatamy (B)	Fire	0	2.0	0.0	0.0	0.0
TATAMY PD	Tatamy (B)	Police	0	3.0	0.0	0.0	0.0
United States Post Office	Tatamy (B)	User Defined	NA	3.0	0.0	0.0	0.0
Tatamy Borough	Tatamy (B)	User Defined	NA	3.0	0.0	0.0	0.0
FOGELSVILLE VOL FIRE CO	Upper Macungie (T)	Fire	0	1.0	0.0	0.0	0.0
UPPER MACUNGIE TWP	Upper Macungie (T)	Fire	0	1.0	0.0	0.0	0.0
TREXLERTOWN GOOD WILL FIRE CO #1	Upper Macungie (T)	Fire	0	1.0	0.0	0.0	0.0
FOGELSVILLE ELEMENTARY SCHOOL	Upper Macungie (T)	School	0	3.0	1.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
FRED J JAINDL ELEMENTARY SCHOOL	Upper Macungie (T)	School	0	3.0	1.0	0.0	0.0
COMMONWEALTH OF PA	Upper Macungie (T)	User Defined	NA	2.0	0.0	0.0	0.0
CITY OF ALLENTOWN	Upper Macungie (T)	User Defined	NA	3.0	0.0	0.0	0.0
CITY OF ALLENTOWN	Upper Macungie (T)	User Defined	NA	3.0	0.0	0.0	0.0
CITY OF ALLENTOWN	Upper Macungie (T)	User Defined	NA	3.0	0.0	0.0	0.0
UPPER MILFORD WESTERN DIST FIRE CO 1	Upper Milford (T)	Fire	0	2.0	0.0	0.0	0.0
EMMAUS BAPTIST ACADEMY	Upper Milford (T)	School	0	5.0	2.0	0.0	0.0
Mount Bethel Trinity Cemetery	Upper Mt Bethel (T)	User Defined	NA	4.0	1.0	0.0	0.0
Christ Evang Lutheran Church Cemetery	Upper Mt Bethel (T)	User Defined	NA	2.0	0.0	0.0	0.0
Bangor Area School District Day Care	Upper Mt Bethel (T)	User Defined	NA	4.0	0.0	0.0	0.0
Slate Belt Child Care	Upper Mt Bethel (T)	User Defined	NA	4.0	0.0	0.0	0.0
Wee Love & Care Day Care	Upper Mt Bethel (T)	User Defined	NA	2.0	0.0	0.0	0.0
Portland Power Plant Boat Access Ramp	Upper Mt Bethel (T)	User Defined	NA	5.0	0.0	0.0	0.0
Portland - Columbia Toll Bridge	Upper Mt Bethel (T)	User Defined	NA	5.0	0.0	0.0	0.0
Portland - Columbia Pedestrian Bridge	Upper Mt Bethel (T)	User Defined	NA	5.0	0.0	0.0	0.0
MOUNT BETHEL FIRE CO	Upper Mt. Bethel (T)	Fire	0	1.0	0.0	0.0	0.0
NORTH BAQNGOR FIRE DEPT	Upper Mt. Bethel (T)	Fire	0	1.0	0.0	0.0	0.0
Bangor Sr/Jr/Five Points/Dom DeFranco	Upper Mt. Bethel (T)	School	0	4.0	1.0	0.0	0.0
BETHANY HOME	Upper Mt. Bethel (T)	User Defined	NA	3.0	0.0	0.0	0.0
Upper Mount Bethel Township	Upper Mt. Bethel (T)	User Defined	NA	2.0	0.0	0.0	0.0
EAST LAWN FIRE CO	Upper Nazareth (T)	Fire	0	1.0	0.0	0.0	0.0
UPPER NAZARETH TWP PD	Upper Nazareth (T)	Police	0	3.0	0.0	0.0	0.0
Northampton County EOC	Upper Nazareth (T)	EOC	0	5.0	1.0	0.0	0.0
Nazareth Area Junior and Senior HS	Upper Nazareth (T)	School	0	4.0	2.0	0.0	0.0
Nazareth Area Junior and Senior HS	Upper Nazareth (T)	School	0	4.0	2.0	0.0	0.0
Nazareth Area Middle School	Upper Nazareth (T)	School	0	6.0	3.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
911 OFFICE BLDG	Upper Nazareth (T)	User Defined	NA	7.0	0.0	0.0	0.0
Gracedale Nursing Home	Upper Nazareth (T)	User Defined	NA	5.0	1.0	0.0	0.0
GRACEDALE	Upper Nazareth (T)	User Defined	NA	6.0	0.0	0.0	0.0
Upper Nazareth Township	Upper Nazareth (T)	User Defined	NA	3.0	0.0	0.0	0.0
SOUTH MOUNTAIN AREA MEDIC V INC	Upper Saucon (T)	Fire	0	2.0	0.0	0.0	0.0
UPPER SAUCON TWP	Upper Saucon (T)	Fire	0	3.0	1.0	0.0	0.0
UPPER SAUCON TWP VOLUNTEER FIRE CO 1	Upper Saucon (T)	Fire	0	2.0	0.0	0.0	0.0
HOPEWELL ELEMENTARY SCHOOL	Upper Saucon (T)	School	4	8.0	7.0	1.0	0.0
SOUTHERN LEHIGH MIDDLE SCHOOL	Upper Saucon (T)	School	6	7.0	5.0	0.0	0.0
SOUTHERN LEHIGH HIGH SCHOOL	Upper Saucon (T)	School	0	5.0	2.0	0.0	0.0
ASSUMPTION BVM SCHOOL	Upper Saucon (T)	School	6	8.0	5.0	0.0	0.0
ST MICHAELS SCHOOL	Upper Saucon (T)	School	4	7.0	4.0	0.0	0.0
WALNUTPORT MED. OFFI	Walnutport (B)	Medical	0	3.0	2.0	1.0	0.0
NORTHERN LEHIGH MED	Walnutport (B)	Medical	0	3.0	2.0	1.0	0.0
DIAMOND FIRE CO	Walnutport (B)	Fire	0	1.0	0.0	0.0	0.0
WALNUTPORT BORO PD	Walnutport (B)	Police	0	1.0	0.0	0.0	0.0
Walnutport Elementary School	Walnutport (B)	School	0	1.0	0.0	0.0	0.0
Seventh Day Adventist Church	Walnutport (B)	User Defined	NA	3.0	0.0	0.0	0.0
United States Post Office	Walnutport (B)	User Defined	NA	2.0	0.0	0.0	0.0
Walnutport Borough	Walnutport (B)	User Defined	NA	1.0	0.0	0.0	0.0
Hill Street Children's Center	Walnutport (B)	User Defined	NA	1.0	0.0	0.0	0.0
CANAL SIDE MANOR	Walnutport (B)	User Defined	NA	2.0	0.0	0.0	0.0
Kidz Place	Walnutport (B)	User Defined	NA	2.0	0.0	0.0	0.0
Pond View Manor Personal Care Home	Walnutport (B)	User Defined	NA	2.0	0.0	0.0	0.0
FRIEDENS FIRE COMPANY	Washington (T)	Fire	0	1.0	0.0	0.0	0.0
EMERALD STAR HOSE COMPANY #1	Washington (T)	Fire	0	1.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
CITIZENS FIRE CO	Washington (T)	Fire	0	1.0	0.0	0.0	0.0
WASHINGTON TWP FIRE CO	Washington (T)	Fire	0	2.0	0.0	0.0	0.0
LIBERTY EMS	Washington (T)	Fire	0	1.0	0.0	0.0	0.0
MEDIC 9 - NORTH	Washington (T)	Fire	0	1.0	0.0	0.0	0.0
WASHINGTON TWP PD	Washington (T)	Police	0	2.0	0.0	0.0	0.0
PETERS ELEMENTARY SCHOOL	Washington (T)	School	0	2.0	0.0	0.0	0.0
Washington Elementary School	Washington (T)	School	0	2.0	1.0	0.0	0.0
WASHINGTON TWP	Washington (T)	User Defined	NA	1.0	0.0	0.0	0.0
WASHINGTON TWP	Washington (T)	User Defined	NA	1.0	0.0	0.0	0.0
Washington (N) Township	Washington (T)	User Defined	NA	5.0	0.0	0.0	0.0
Five Points Veterinary Hospital	Washington (T)	User Defined	NA	2.0	0.0	0.0	0.0
Childhood Treasures Day Care	Washington (T)	User Defined	NA	2.0	0.0	0.0	0.0
WEISENBERG TWP	Weisenberg (T)	Fire	0	1.0	0.0	0.0	0.0
WEISENBERG ELEMENTARY SCHOOL	Weisenberg (T)	School	0	4.0	1.0	0.0	0.0
WEST EASTON FIRE DEPT	West Easton (B)	Fire	0	1.0	0.0	0.0	0.0
West Easton Borough	West Easton (B)	User Defined	NA	3.0	0.0	0.0	0.0
EGYPT FIRE CO #1	Whitehall (T)	Fire	0	1.0	0.0	0.0	0.0
W CATASAUQUA FIRE CO	Whitehall (T)	Fire	0	1.0	0.0	0.0	0.0
HOKENDAUQUA FIRE CO #1	Whitehall (T)	Fire	0	1.0	0.0	0.0	0.0
LAUREL FIRE CO #1 INC	Whitehall (T)	Fire	0	1.0	0.0	0.0	0.0
LAUREL FIRE CO #1	Whitehall (T)	Fire	0	1.0	0.0	0.0	0.0
FULLERTON FIRE CO #1	Whitehall (T)	Fire	0	1.0	0.0	0.0	0.0
LEHIGH VALLEY 7TH DAY ADVENTIST SCHOOL	Whitehall (T)	School	0	6.0	3.0	0.0	0.0
WHITEHALL-COPLAY HIGH SCHOOL	Whitehall (T)	School	0	4.0	1.0	0.0	0.0
WHITEHALL-COPLAY MIDDLE SCHOOL	Whitehall (T)	School	0	4.0	1.0	0.0	0.0
STECKEL ELEMENTARY SCHOOL	Whitehall (T)	School	0	4.0	1.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
GOCKLEY ELEMENTARY SCHOOL	Whitehall (T)	School	0	4.0	1.0	0.0	0.0
CHRIST THE KING SCHOOL	Whitehall (T)	School	0	3.0	1.0	0.0	0.0
ST STEPHENS SCHOOL	Whitehall (T)	School	0	4.0	1.0	0.0	0.0
ST ELIZABETH SCHOOL	Whitehall (T)	School	0	3.0	1.0	0.0	0.0
WHITEHALL TWP	Whitehall (T)	User Defined	NA	2.0	0.0	0.0	0.0
Briarwood Commons	Whitehall (T)	User Defined	NA	4.0	0.0	0.0	0.0
WILLIAMS TWP EMS	Williams (T)	Fire	0	1.0	0.0	0.0	0.0
WILLIAMS TWP FIRE DEPT	Williams (T)	Fire	0	1.0	0.0	0.0	0.0
Williams Township Elementary School	Williams (T)	School	0	3.0	1.0	0.0	0.0
St. John's Lutheran Church	Williams (T)	User Defined	NA	3.0	0.0	0.0	0.0
The Center for Animal Health & Welfare	Williams (T)	User Defined	NA	2.0	0.0	0.0	0.0
Williams Township	Williams (T)	User Defined	NA	3.0	0.0	0.0	0.0
Abby Burns Daycare	Williams (T)	User Defined	NA	5.0	0.0	0.0	0.0
Morgan Hill Day Care	Williams (T)	User Defined	NA	4.0	0.0	0.0	0.0
Christ Evangelical Congregational Church	Williams (T)	User Defined	NA	2.0	0.0	0.0	0.0
The Club at Morgan Hill	Williams (T)	User Defined	NA	4.0	0.0	0.0	0.0
Country Classics at Morgan Hill	Williams (T)	User Defined	NA	5.0	0.0	0.0	0.0
Interstate 78 Toll Bridge	Williams (T)	User Defined	NA	7.0	1.0	0.0	0.0
Easton Hospital	Wilson (B)	Medical	0	5.0	5.0	3.0	0.0
EASTON HOSPITAL	Wilson (B)	Medical	0	5.0	5.0	3.0	0.0
DOUGLAS D DITMARS MD	Wilson (B)	Medical	0	5.0	5.0	3.0	0.0
HAY SCHOOL	Wilson (B)	Medical	0	4.0	5.0	3.0	0.0
Easton Hospital Laboratory Services	Wilson (B)	Medical	0	5.0	5.0	3.0	0.0
Northampton Imaging Specialists	Wilson (B)	Medical	0	5.0	5.0	3.0	0.0
Quest Diagnostics Inc.	Wilson (B)	Medical	0	5.0	6.0	3.0	0.0
Bell Apothecary	Wilson (B)	Medical	0	5.0	6.0	3.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
WILSON BORO FIRE DEPT	Wilson (B)	Fire	0	1.0	0.0	0.0	0.0
WILSON BORO PD	Wilson (B)	Police	0	2.0	0.0	0.0	0.0
Philip F. Lauer Middle School	Wilson (B)	School	0	4.0	1.0	0.0	0.0
Wilson Elementary School	Wilson (B)	School	0	3.0	1.0	0.0	0.0
Wilson Area High School	Wilson (B)	School	0	3.0	1.0	0.0	0.0
Easton Children's Home	Wilson (B)	School	0	4.0	1.0	0.0	0.0
Avona Elementary School	Wilson (B)	School	0	4.0	1.0	0.0	0.0
Avona Elementary School	Wilson (B)	School	0	4.0	1.0	0.0	0.0
Lehigh Valley Child Care at Avona School	Wilson (B)	User Defined	NA	4.0	0.0	0.0	0.0
Wilson Borough	Wilson (B)	User Defined	NA	2.0	0.0	0.0	0.0
District Court 03-2-12	Wilson (B)	User Defined	NA	2.0	0.0	0.0	0.0
Miss Cheri's Daycare and Preschool	Wilson (B)	User Defined	NA	4.0	0.0	0.0	0.0
Finegan Funeral Home	Wilson (B)	User Defined	NA	2.0	0.0	0.0	0.0
24th State Senatorial District	Wilson (B)	User Defined	NA	2.0	0.0	0.0	0.0
EASTWOOD CONVALESCEN	Wilson (B)	User Defined	NA	4.0	0.0	0.0	0.0
EASTERN COMFORT ASSISTED LIV	Wilson (B)	User Defined	NA	4.0	0.0	0.0	0.0
Mary Meuser Memorial Library	Wilson (B)	User Defined	NA	2.0	0.0	0.0	0.0
State Health Center - Dept Health	Wilson (B)	User Defined	NA	2.0	0.0	0.0	0.0
FRENIENIUS MEDICAL CARE	Wind Gap (B)	Medical	0	4.0	4.0	2.0	0.0
Medical	Wind Gap (B)	Medical	0	4.0	3.0	1.0	0.0
WIND GAP EMS	Wind Gap (B)	Fire	0	1.0	0.0	0.0	0.0
BLUE MT EMS	Wind Gap (B)	Fire	0	1.0	0.0	0.0	0.0
WIND GAP FIRE DEPT	Wind Gap (B)	Fire	0	1.0	0.0	0.0	0.0
WIND GAP PD	Wind Gap (B)	Police	0	2.0	0.0	0.0	0.0
District Court 03-3-02	Wind Gap (B)	User Defined	NA	2.0	0.0	0.0	0.0
Wind Gap Borough	Wind Gap (B)	User Defined	NA	2.0	0.0	0.0	0.0



SECTION 4.3.11: RISK ASSESSMENT – WINDSTORM, TORNADO

500-Year Event							
Name	Municipality	Type	(Days)	Percent Probability of Sustaining Damage			
			Loss Of Use	Minor	Moderate	Severe	Complete
Children's Center of Wind Gap	Wind Gap (B)	User Defined	NA	2.0	0.0	0.0	0.0
United States Post Office	Wind Gap (B)	User Defined	NA	1.0	0.0	0.0	0.0
WALDEN III ASSTD LIVING	Wind Gap (B)	User Defined	NA	2.0	0.0	0.0	0.0

Source: HAZUS-MH 2.1
 Note: est. = Estimated; NA = Not Available



At this time, HAZUS-MH 2.1 does not estimate losses to transportation lifelines and utilities as part of the hurricane model. Transportation lifelines are not considered particularly vulnerable to the windstorm and tornado hazard; they are more vulnerable to cascading effects such as flooding, falling debris etc. Impacts to transportation lifelines affect both short-term (e.g., evacuation activities) and long-term (e.g., day-to-day commuting) transportation needs.

Utility structures could suffer damage associated with falling tree limbs or other debris. Such impacts can result in the loss of power, which can impact business operations and can impact the provision of heating or cooling to citizens (including the young and elderly, who are particularly vulnerable to temperature-related health impacts).

4.3.11.5.6 Impact on the Economy

Windstorms and tornados also impact the economy, including: loss of business function (e.g., tourism, recreation), damage to inventory, relocation costs, wage loss and rental loss due to the repair/replacement of buildings. HAZUS-MH estimates the total economic loss associated with each storm scenario (direct building losses and business interruption losses). Direct building losses are the estimated costs to repair or replace the damage caused to the building. This is reported in the “Impact on General Building Stock” section discussed earlier. Business interruption losses are the losses associated with the inability to operate a business because of the wind damage sustained during the storm or the temporary living expenses for those displaced from their home because of the event.

Impacts to transportation lifelines affect both short-term (e.g., evacuation activities) and long-term (e.g., day-to-day commuting) transportation needs. Utility infrastructure (power lines, gas lines, electrical systems) could suffer damage and impacts can result in the loss of power which can impact business operations. Post-event, there is a risk of fire, electrocution or an explosion.

Recovery and clean-up costs can also be costly and impact the economy as well. HAZUS-MH estimates the debris generated as a result of the 100- and 500-year wind events for the Lehigh Valley (Table 4.3.11-10 below).

4.3.11.5.7 Impact on the Environment

Tornado events are typically localized; therefore, environmental impacts are rarely widespread. The impacts of windstorms on the environment usually take place over a larger area. Severe damage to plant species is likely with both tornado and windstorm events. This includes uprooting or total destruction of trees, and increased threat of wildfire in areas of tree debris.

Table 4.3.11-10. Debris Production for 100- and 500-Year MRP Hurricane-Related Winds

Municipality	Brick and Wood (tons)		Concrete and Steel (tons)		Tree (tons)	
	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year
Lehigh County						
Alburtis Borough	4	71	0	0	10	92
Allentown, City of	93	3,659	0	0	257	2,548
Bethlehem, City of	19	761	0	0	128	1,131
Catasauqua Borough	2	185	0	0	17	256
Coopersburg Borough	0	120	0	0	2	237
Coplay Borough	0	58	0	0	5	31
Emmaus Borough	5	427	0	0	32	435
Fountain Hill Borough	1	151	0	0	4	168
Hanover Township	8	185	0	0	101	875
Heidelberg Township	2	60	0	0	327	1,693
Lower Macungie Township	183	1,683	0	4	716	4,673
Lower Milford Township	2	238	0	0	191	5,119
Lowhill Township	1	55	0	0	77	626
Lynn Township	2	83	0	0	512	2,400
Macungie Borough	13	134	0	0	35	120
North Whitehall Township	80	478	0	0	978	3,584
Salisbury Township	8	514	0	0	101	3,442
Slatington Borough	2	80	0	0	13	87
South Whitehall Township	89	809	0	0	594	2,755
Upper Macungie Township	248	1,145	0	0	747	3,207
Upper Milford Township	3	305	0	0	71	4,562
Upper Saucon Township	22	920	0	1	430	6,954
Washington Township	1	112	0	0	110	1,087
Weisenberg Township	17	164	0	0	377	2,675
Whitehall Township	50	905	0	0	268	1,755
Lehigh County (est. total)	855	13,302	0	5	6,103	50,512
Northampton County						
Allen Township	19	228	0	1	402	2,026
Bangor Borough	0	173	0	0	8	261
Bath Borough	1	94	0	0	24	193
Bethlehem Township	27	1,318	0	3	326	3,428
Bethlehem, City of	14	1,882	0	0	310	3,626
Bushkill Township	19	337	0	0	478	4,318
Chapman Borough	0	6	0	0	2	47
East Allen Township	15	277	0	1	304	2,455
East Bangor Borough	0	28	0	0	0	106

Municipality	Brick and Wood (tons)		Concrete and Steel (tons)		Tree (tons)	
	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year
Easton, City of	0	1,117	0	0	25	997
Forks Township	12	1,030	0	7	156	2,512
Freemansburg Borough	1	76	0	0	8	124
Glendon Borough	0	20	0	0	9	167
Hanover Township	34	765	0	5	306	1,534
Hellertown Borough	0	231	0	0	14	357
Lehigh Township	11	274	0	0	557	3,139
Lower Mt. Bethel Township	0	148	0	0	410	6,225
Lower Nazareth Township	40	592	0	2	278	1,976
Lower Saucon Township	2	675	0	1	126	5,916
Moore Township	13	330	0	0	777	6,128
Nazareth Borough	0	225	0	0	48	366
North Catasauqua Borough	0	72	0	0	16	158
Northampton Borough	4	263	0	0	97	471
Palmer Township	10	1,229	0	7	117	2,113
Pen Argyl Borough	0	100	0	0	2	189
Plainfield Township	7	247	0	0	558	5,338
Portland Borough	0	23	0	0	3	78
Roseto Borough	0	47	0	0	1	117
Stockertown Borough	0	38	0	0	19	236
Tatamy Borough	0	60	0	0	10	115
Upper Mt. Bethel Township	1	218	0	0	250	7,943
Upper Nazareth Township	10	296	0	1	241	1,547
Walnutport Borough	1	43	0	0	26	106
Washington Township	0	174	0	0	65	3,090
West Easton Borough	0	49	0	0	0	68
Williams Township	2	368	0	2	56	4,208
Wilson Borough	0	295	0	0	6	273
Wind Gap Borough	0	67	0	0	11	194
Northampton County (est. total)	243	13,415	0	30	6,046	72,145

Source: HAZUS-MH 2.1

Note: est. = Estimated

4.3.11.5.8 Future Growth and Development

Areas targeted for potential future growth and development in the next five (5) to ten (10) years have been identified across the Lehigh Valley at the municipal level. Refer to the jurisdictional annexes in Volume II of this HMP. Table B.1 in each jurisdictional annex lists the location of the potential new development and its exposure (if any) to known hazard zones. Any areas of growth could be potentially impacted by

the wind hazard because the entire region is exposed and vulnerable to the wind hazard associated with windstorms and tornadoes.

4.3.11.5.9 Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as storms, including those which may bring precipitation, high winds and tornado events. While predicting changes of wind and tornado events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2006).

Since the 1970s, globally there has been an increase in ‘tropical cyclone destructiveness’ as measured by the Power Dissipation Index. This increased tropical cyclone intensity and duration correlates with sea surface temperature. This suggests that future increases of tropical sea surface temperature may lead to future increases in tropical cyclone intensity and duration. However, there is a high level of uncertainty regarding the relationship between climate change and storm events. Future improvements in modeling smaller scale climatic processes can be expected and will lead to improved understanding of how the changing climate will alter temperature, precipitation and storms events in Pennsylvania (Shortle et. al, 2009).

4.3.11.5.10 Additional Data and Next Steps

In time, HAZUS-MH will be released with modules that address straight-line wind and tornado events for the interior U.S. As updated versions of HAZUS-MH are released, the Lehigh Valley can run analyses for an overall picture of the wind damages and debris generated from these tornado events.

Over time, the Lehigh Valley will obtain additional data to support the analysis of this hazard. Data that will support the analysis would include additional detail on past hazard events and impacts, and an updated building inventory to include specific building information such as type of construction and details on protective features (for example, shutters).

4.3.12 Winter Storm

This section provides a profile and vulnerability assessment for the winter storm hazard. Winter storms occur, on average, approximately five times each year in Pennsylvania. From November through March, the State is exposed to winter storms that move up the Atlantic coast or those that sweep in from the west. Every county in the Commonwealth is subject to severe winter storms; however, the northern tier, western counties and mountainous regions tend to experience winter weather more frequently and with greater severity (LVHMP, 2006).

Winter storms have the potential to produce more damage than any other severe weather event, including tornadoes. Winter storms have the potential to cause road closures, especially secondary and farm roads; business losses to commercial centers built in outlying areas due to supply interruption and loss of customers; property losses and roof damages from snow and ice loading and falling trees; utility interruptions; and loss of water supplies (LVHMP, 2006). Flooding can result from winter storm events as well.

Most severe winter storm hazards include heavy snow (snowstorms), blizzards, sleet or freezing rain, ice storms and Nor'easters. Since most extra-tropical cyclones (mid-Atlantic cyclones locally known as Northeasters or Nor'easters), generally take place during the winter weather months (with some events being an exception), these hazards have also been grouped as a type of severe winter weather storm. These types of winter events or conditions are further defined below.

- **Heavy Snow:** According to the National Weather Service (NWS), heavy snow is generally snowfall accumulating to 4 inches or more in depth in 12 hours or less; or snowfall accumulating to six inches or more in depth in 24 hours or less. A snow squall is an intense, but limited duration, period of moderate to heavy snowfall, also known as a snowstorm, accompanied by strong, gusty surface winds and possibly lightning (generally moderate to heavy snow showers) (NWS, 2005). Snowstorms are complex phenomena involving heavy snow and winds, whose impact can be affected by a great many factors, including a region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, and occurrence during the course of the day, weekday versus weekend, and time of season (Kocin and Uccellini, 2011).
- **Blizzard:** Blizzards are characterized by low temperatures, wind gusts of 35 miles per hour (mph) or more and falling and/or blowing snow that reduces visibility to ¼-mile or less for an extended period of time (three or more hours) (NWS, 2005). A severe blizzard is defined as having a wind velocity of 45 mph, temperatures of 10°F or lower, a high density of blowing snow with visibility frequently measured in feet over an extended period of time.
- **Sleet or Freezing Rain:** Sleet is defined as pellets of ice composed of frozen or mostly frozen raindrops or refrozen partially melted snowflakes. These pellets of ice usually bounce after hitting the ground or other hard surfaces. Freezing rain is rain that falls as a liquid but freezes into glaze upon contact with the ground. Both types of precipitation, even in small accumulations, can cause significant hazards to a community (NWS, 2005).
- **Ice storm:** An ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous, and can create extreme hazards to motorists and pedestrians (NWS, 2005).

- Nor'Easter (abbreviation for North Easter): Nor'Easters are named for the strong northeasterly winds that blow in from the ocean ahead of the storm and over coastal areas. They are also referred to as a type of extra-tropical cyclone (mid-latitude storms, or Great Lake storms). A Nor'Easter is a macro-scale extra-tropical storm whose winds come from the northeast, especially in the coastal areas of the northeastern U.S. and Atlantic Canada. Wind gusts associated with Nor'Easters can exceed hurricane forces in intensity. Unlike tropical cyclones that form in the tropics and have warm cores (including tropical depressions, tropical storms and hurricanes), Nor'Easters contain a cold core of low barometric pressure that forms in the mid-latitudes. Their strongest winds are close to the earth's surface and often measure several hundred miles across. Nor'Easters may occur at any time of the year but are more common during fall and winter months (September through April) (NYCOEM, 2008).

Nor'Easters can cause heavy snow, rain, gale force winds and oversized waves (storm surge) that can cause beach erosion, coastal flooding, structural damage, power outages and unsafe human conditions. If a Nor'Easter cyclone stays just offshore, the results are much more devastating than if the cyclone travels up the coast on an inland track. Nor'Easters that stay inland are generally weaker and usually cause strong winds and rain. Those that stay offshore can bring heavy snow, blizzards, ice, strong winds, high waves, and severe beach erosion. In these storms, the warmer air is aloft. Precipitation falling from this warm air moves into the colder air at the surface, causing crippling sleet or freezing rain (McNoldy [Multi-Community Environmental Storm Observatory (MESO)], 1998-2007). While some of the most devastating effects of Nor'Easters are experienced in coastal areas (e.g. beach erosion, coastal flooding), the effects on inland areas, like the Lehigh Valley Planning Area, may include heavy snow, strong winds and blizzards.

4.3.12.1 Location and Extent

Winter storms are regional events, with most events impacting a large area or the entire Commonwealth. In many cases, surrounding states and even the northeast U.S. region are affected by a single winter storm event.

The magnitude, severity, or extent of a winter storm can be classified by meteorological measurements, such as snowfall amounts and rates, wind speeds, temperatures, visibility, storm duration, topography, time of occurrence during the day, and time of season, and by evaluating its societal impacts. The Northeast Snowfall Impact Scale (NESIS) categorizes snowstorms, including Nor'Easter events, in this manner. Unlike the Fujita Scale (tornado) and Saffir-Simpson Scale (hurricanes), there is no widely used scale to classify snowstorms. NESIS was developed by Paul Kocin of The Weather Channel and Louis Uccellini of the NWS to characterize and rank high-impact, northeast snowstorms. These storms have large areas of ten inch snowfall accumulations and greater. NESIS has five ranking categories: Notable (1), Significant (2), Major (3), Crippling (4), and Extreme (5) (Table 4.3.12-1). The index differs from other meteorological indices in that it uses population information in addition to meteorological measurements. Thus, NESIS gives an indication of a storm's societal impacts. This scale was developed because of the impact northeast snowstorms can have on the rest of the country in terms of transportation and economic impact (Kocin and Uccellini, 2011).

Table 4.3.12-1. NESIS Ranking Categories 1 – 5

Category	Description	NESIS Range	Definition
1	Notable	1.0 – 2.49	These storms are notable for their large areas of 4-inch accumulations and small areas of 10-inch snowfall.
2	Significant	2.5 – 3.99	Includes storms that produce significant areas of greater than 10-inch snows while some include small areas of 20-inch snowfalls. A few cases may even include relatively small areas of very heavy snowfall accumulations (greater than 30 inches).
3	Major	4.0 – 5.99	This category encompasses the typical major Northeast snowstorm, with large areas of 10-inch snows (generally between 50 and 150 × 103 mi ² —roughly one to three times the size of New York State with significant areas of 20-inch accumulations.
4	Crippling	6.0 – 9.99	These storms consist of some of the most widespread, heavy snows of the sample and can be best described as crippling to the northeast U.S., with the impact to transportation and the economy felt throughout the United States. These storms encompass huge areas of 10-inch snowfalls, and each case is marked by large areas of 20-inch and greater snowfall accumulations.
5	Extreme	10 +	The storms represent those with the most extreme snowfall distributions, blanketing large areas and populations with snowfalls greater than 10, 20, and 30 inches. These are the only storms in which the 10-inch accumulations exceed 200 × 103 mi ² and affect more than 60 million people.

Source: Kocin and Uccellini, 2004

As shown above, NESIS scores are a function of the area affected by the snowstorm, the amount of snow, and the number of people living in the path of the storm. These numbers are calculated into a raw data number ranking from “1” for an insignificant fall to over “10” for a massive snowstorm. Based on these raw numbers, the storm is placed into its decided category. The largest NESIS values result from storms producing heavy snowfall over large areas that include major metropolitan centers (Enloe, 2007).

4.3.12.2 Range in Magnitude

A winter storm can adversely affect roadways, utilities, businesses, and can cause loss of life, frostbite, and freezing conditions. These storms typically fall into one of the following categories which have been previously defined:

- Heavy snow
- Sleet or freezing rain
- Ice storm
- Blizzard
- Nor’Easter

4.3.12.3 Past Occurrence

Many sources provided historical information regarding previous occurrences and losses associated with winter storm events throughout the Commonwealth of Pennsylvania and the Lehigh Valley. With so many sources reviewed for the purpose of this Plan, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this Plan.

According to the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) storm events database, the Lehigh Valley experienced 219 winter storm events between 1950 and 2012. Total property damages resulting from these winter storm events were estimated at \$43.1 million. This total also includes damages to other counties.

According to the Hazard Research Lab at the University of South Carolina’s Spatial Hazard Events and Losses Database for the U.S. (SHELDUS), between 1960 and 2010, 270 winter storm events occurred within the Lehigh Valley. Losses totaled over \$14.3 million in property damage and over \$5 million in crop damage. However, these numbers may vary due to the database identifying the location of the hazard event in various forms or throughout multiple counties or regions.

Between 1954 and 2012, FEMA declared that the State of Pennsylvania experienced six winter storm-related disasters (DR) or emergencies (EM) classified as one or a combination of the following disaster types: severe winter storms, snowstorms, blizzard, winter storm, severe storm, and snowfall. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations. Of those events, PEMA and other sources indicate that the Lehigh Valley has been declared as a disaster area as a result of four winter storm events (FEMA, 2012; PEMA, 2012).

Based on all sources researched, known winter storm events that have affected the Lehigh Valley are identified in Table 4.3.12-2. With winter storm documentation for the State of Pennsylvania being so extensive, not all sources have been identified or researched. Therefore, Table 4.3.12-2 may not include all events that have occurred throughout the Lehigh Valley.

Table 4.3.12-2. Winter Storm Events between 1993 and 2012 in the Lehigh Valley

Dates of Event	Event Type	FEMA Declaration Number	Counties Designated?	Losses / Impacts	Source(s)
March 13-17, 1993	Severe Snowfall and Winter Storm	EM-3105	Yes	N/A	FEMA
January 4 – February 25, 1994	Winter Storm / Severe Storm	DR-1015	Yes	N/A	FEMA
January 7-8, 1996	Blizzard ("Blizzard of 1996")	DR-1085	Yes	Record breaking snow fell on most of southeastern Pennsylvania. The storm caused a total of 42 deaths and many injuries. One woman died in the City of Allentown. All-time single storm records were set at the Lehigh Valley International Airport (25.6 inches). Snowfall accumulations averaged around two feet in the Lehigh Valley. A state of emergency was declared on January 7 th and was lifted on the 9 th . The snow caused numerous building collapses, with one of the worst at the Penn Crest Gardens Apartments in South Whitehall Township. Residents had to be evacuated from one building after the roof buckled.	FEMA, LVHMP
January 12, 1996				Heavy snow moved into southeastern Pennsylvania with accumulations of four to six inches. Two people in Northampton County died. In Whitehall Township, 60 hockey players were trapped as the roof of the Lehigh Valley ice arena collapsed. Another roof collapsed in the Borough of Coopersburg, causing \$150,000 in damages.	
February 16-17, 2003	Snowstorm ("Presidents Day Storm")	EM-3180	Yes	This was the most powerful storm to affect eastern Pennsylvania since the Blizzard of 1996. A state of emergency was declared on February 17 th . Snow accumulations ranged from 25.5 inches in Williams Township, 22 inches in the Cities of Easton and Allentown and 20 inches at the Lehigh Valley International Airport.	FEMA, LVHMP
February 13-14, 2007	Nor'Easter / Winter Storm	N/A	N/A	Governor Ed Rendell declared a disaster emergency across the entire state on the 15 th . PPL Electric Utilities Corporation reported 1,542 customers were without power for a time during the storm in the Lancaster, Harrisburg and Allentown areas. In Lehigh County, Allentown declared a snow emergency early on the 14 th . The weight of snow and ice brought down the dome over the swimming pool at the West End Racquet and Fitness Club in South Whitehall Township. The Brookside Country Club in Wescosville also reported dome damage as a result of the snow and ice.	NOAA-NCDC, PEMA

SECTION 4.3.12: RISK ASSESSMENT – WINTER STORM

Dates of Event	Event Type	FEMA Declaration Number	Counties Designated?	Losses / Impacts	Source(s)
				<p>In Northampton County, an 83-year-old woman was found dead on the rear porch of her home from hypothermia. In the City of Bethlehem, a pedestrian was hospitalized after a private snowplow operator backed over him. County Emergency Dispatch officials reported about a dozen or so minor vehicle accidents due to the slippery conditions. The weight of snow and ice collapsed the dome covering a soccer field at the Iron Lakes Sports Club in North Catasauqua Borough.</p> <p>Some snow/sleet accumulations included 10.0 inches in Lehigh Township, 8.0 inches in Alburtis Township, 8.0 inches in New Tripoli (Lehigh County), and 7.6 inches at the Lehigh Valley International Airport near Allentown.</p>	
<p>March 16-17, 2007</p>	<p>Nor'Easter</p>	<p>N/A</p>	<p>N/A</p>	<p>A Nor'easter caused heavy snow and sleet to fall across the Lehigh Valley on the 16th into the early morning of the 17th. Accumulations averaged five to nine inches in the Lehigh Valley.</p> <p>In Lehigh County, a tractor-trailer jack-knifed near Pennsylvania State Route 100 at Fogelsville and closed the interstate. Both southbound lanes of the Pennsylvania Turnpike Northeast Extension were closed after two tractor-trailers and a car collided in Lower Milford Township. Many flights at the Lehigh Valley International Airport were delayed, and a few were cancelled. Commuter buses bringing workers home from New York City had long delays. A driver was injured on U.S. Route 22 in Whitehall Township when ice chunks from a tractor-trailer hit their vehicle. In Upper Macungie Township, ice chunks that flew off a Wal-Mart tractor-trailer cracked the windshield and dented the hood of a vehicle on Interstate 78 near the Pennsylvania State Route 100 exit.</p> <p>In Northampton County, a tractor-trailer jack-knifed on the eastbound lanes of Interstate 78 near the Pennsylvania State Route 33 junction. In Moore Township, a school bus collided head-on with a car, injuring both drivers. In Lower Mount Bethel Township, a Jeep Cherokee slid into a home on Pennsylvania State Route 611 and injured the driver. A Ford Explorer driver was injured after the vehicle struck a tree in Wind Gap Borough. Problems on the Lehigh Valley roadways continued long after the snow and sleet ended.</p>	<p>NOAA-NCDC</p>



SECTION 4.3.12: RISK ASSESSMENT – WINTER STORM

Dates of Event	Event Type	FEMA Declaration Number	Counties Designated?	Losses / Impacts	Source(s)
				Snow and sleet totals included 10 inches in Slatington Borough, 8.5 inches at the Lehigh Valley International Airport, and 5.0 inches in the City of Bethlehem.	
December 13, 2007	Wintery Mix	N/A	N/A	This storm produced one to five inches of snow and sleet across eastern Pennsylvania. The combination of snow and ice caused slippery roadways, causing early school and business dismissals in the Lehigh Valley. Snow, sleet and ice accumulations in the Lehigh Valley included 1.2 inches at Trexlertown (Lehigh County); 1.0 inch at the Lehigh Valley International Airport, Tatamy Borough and New Tripoli (Lehigh County), and 0.8 of an inch in Weisenberg Township and Easton. Freezing rain amounts totaled 0.2 inches in the City of Easton.	NOAA-NCDC
February 12-13, 2008	Winter Storm	N/A	N/A	A winter storm brought snow, sleet and freezing rain to eastern Pennsylvania. More freezing rain and sleet fell in the Lehigh Valley than snow. Numerous accidents occurred in the area due to slippery roadways. The winter weather led to power outages due to fallen tree limbs and downed wires. About 50,000 homes and businesses were without power. In the Lehigh Valley, snow and sleet accumulations ranged from two to five inches. Ice accretions averaged between one-quarter and one-half inch with the highest amounts in the Lehigh Valley. Several people were injured due to an accident along Route 309 in Heidelberg Township. In Whitehall Township a large, ice-covered tree fell on Fifth Street, damaging a vehicle. The Lehigh Valley and the Poconos had approximately 7,500 PPL customers without power, with 5,000 in the Allentown area and 1,000 in the City of Bethlehem area. Met-Ed reported 2,068 customers without power in Northampton County. The Lehigh Valley had approximately \$25,000 in property damage. Snow and sleet accumulations in the Lehigh Valley included 4.5 inches in Walnutport Borough and 2.3 inches at the Lehigh Valley International Airport.	NOAA-NCDC
December 19-20, 2009	Nor'Easter	N/A	N/A	A major winter storm affected central and southeast Pennsylvania. Snowfall totals averaged around six inches in the Lehigh Valley. Many municipalities declared state of emergencies.	NOAA-NCDC



SECTION 4.3.12: RISK ASSESSMENT – WINTER STORM

Dates of Event	Event Type	FEMA Declaration Number	Counties Designated?	Losses / Impacts	Source(s)
February 1-2, 2011	Snow / Ice	N/A	N/A	<p>A winter storm brought several inches of sleet and snow to the area, with up to one-half inch of ice in the Lehigh Valley. The ice brought down tree limbs, trees and wires. Nearly 300,000 people were without power. In the Lehigh Valley, numerous car crashes were reported along Route 22, Route 33 and I-78 in Northampton County. In the City of Bethlehem, a 100-foot section of a porch roof collapsed due to the weight of snow and ice.</p> <p>Snow and sleet accumulations in the Lehigh Valley included 2.1 inches at the Lehigh Valley International Airport and 1.0 inch in Easton and Martins Creek (Northampton County). Ice accretions included 0.50 inches in Emmaus Borough, 0.38 inches in Allentown, and 0.25 inches in Bangor Borough. The Lehigh Valley had approximately \$200,000 in property damage.</p>	NOAA-NCDC
October 29, 2011	Heavy Snow	N/A	N/A	<p>Heavy snow fell across most of eastern Pennsylvania in late October. This storm was considered an unprecedented event. It caused widespread power outages and road closures. Nearly one million utility customers were without power and most of it not restored until November 6th. There were eight fatalities due to this event. Snow accumulations averaged between six and 12 inches, with some larger amounts in higher terrains. The hardest hit areas include Lehigh Valley, Berks County and Bucks County. Shelters, warming stations, showers and ice distribution locations were opened in these areas.</p> <p>In Lehigh County, a 60-year-old man died of carbon monoxide poisoning after using a charcoal grill to heat their home in Emmaus. A 17-year-old boy died from an ATV accident in the snow in North Whitehall Township.</p> <p>The Lehigh Valley was one of the hardest hit locations. Some schools and universities were closed through November 2nd. Two-thirds of Emmaus Borough lost power. Boil water advisories and shelters for pets were opened. Leaf collections were suspended. About 6,100 customers still did not have power as of November 3rd.</p> <p>Snowfall totals for Lehigh Valley ranged from 6.5 inches in Nazareth to 9.5 inches in Bushkill Township. At the Lehigh Valley Airport, 6.8 inches of snow was reported which was the heaviest snow to ever fall during the month of October since</p>	NOAA-NCDC



SECTION 4.3.12: RISK ASSESSMENT – WINTER STORM

Dates of Event	Event Type	FEMA Declaration Number	Counties Designated?	Losses / Impacts	Source(s)
				1925.	

Note (1): Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of increased U.S. Inflation Rates.

DR	Federal Disaster Declaration				
EM	Federal Emergency Declaration			N/A	Not applicable/available
FEMA	Federal Emergency Management Agency			NCDC	National Climate Data Center
HMP	Hazard Mitigation Plan			NOAA	National Oceanic Atmospheric Administration
LVHMP	Lehigh Valley Hazard Mitigation Plan			PEMA	Pennsylvania Emergency Management Agency

4.3.12.4 Future Occurrence

Given the history of winter storm events that have impacted the Lehigh Valley, it is apparent that future winter storm events of varying degrees will occur. The facts that the elements required for winter storms exist and that major events have occurred throughout the Lehigh Valley in the past suggest that many people and properties are at risk from the winter storm hazard in the future.

Based on available historical data, the future occurrence of winter storm events can be considered *likely* as defined by the Risk Factor Methodology probability criteria (refer to Section 4.4).

4.3.12.5 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For winter storm events, the entire Lehigh Valley has been identified as the hazard area. Therefore, all assets (population, structures, critical facilities and lifelines), as described in the Regional Profile (Section 2), are vulnerable. The following section includes an evaluation and estimation of the potential impact winter storm events have on the Lehigh Valley including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, health and safety, (2) general building stock, (3) critical facilities (4) economy, (5) environment and (6) future growth and development
- Effect of climate change on vulnerability
- Further data collections that will assist understanding this hazard over time

4.3.12.5.1 Overview of Vulnerability

Winter storms are a concern to the Lehigh Valley because of its location and geographic propensity to experience winter weather more frequently and with greater severity than many other parts of the State. Additionally, winter storms are of significant concern due to the direct and indirect costs associated with these events; delays caused by the storms; and impacts on the people and facilities of the region.

4.3.12.5.2 Data and Methodology

National weather databases, the State HMP and local resources were used to collect and analyze severe winter storm impacts on the Lehigh Valley. The 2010 U.S. Census data and the custom building inventory for the Lehigh Valley was used to support an evaluation of assets exposed to this hazard and the potential impacts associated with this hazard.

4.3.12.5.3 Impact on Life, Health and Safety

According to the NOAA National Severe Storms Laboratory (NSSL), every year, winter weather indirectly and deceptively kills hundreds of people in the U.S., primarily from automobile accidents, overexertion and exposure. Winter storms are often accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, drifting snow and extreme cold temperatures and dangerous wind chill. They are considered deceptive killers because most deaths and other impacts or losses are indirectly related to the storm. People can die in traffic accidents on icy roads, heart attacks while shoveling snow, or of hypothermia from prolonged exposure to cold.

Heavy snow can immobilize a region and paralyze a city, shutting down air and rail transportation, stopping the flow of supplies, and disrupting medical and emergency services. Accumulations of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. Storms near the coast can cause coastal flooding and beach erosion as well as sink ships at sea. In the mountains, heavy snow can lead to avalanches (NSSL, 2006).

Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces (NSSL, 2006).

For the purposes of this Plan, the entire population of the Lehigh Valley is exposed to winter storm events (U.S. Census, 2010). The elderly are considered most susceptible to this hazard due to their increased risk of injuries and death from falls and overexertion and/or hypothermia from attempts to clear snow and ice. In addition, winter storm events can reduce the ability of these populations to access emergency services. Residents with low incomes may not have access to housing or their housing may be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply). Refer to the Regional Profile (Section 2) for population statistics for each participating municipality and a summary of the more vulnerable populations (over the age of 65 and individuals living below the Census poverty threshold).

4.3.12.5.4 Impact on General Building Stock

The entire general building stock inventory in the Lehigh Valley is exposed and vulnerable to the winter storm hazard. In general, structural impacts include damage to roofs and building frames, rather than building content. Current modeling tools are not available to estimate specific losses for this hazard. As an alternate approach, this plan considers percentage damages that could result from winter storm conditions. Table 4.3.12-3 below summarizes percent damages that could result from winter storm conditions on the Lehigh Valley's total general building stock (structure only). Given professional knowledge and the currently available information, the potential losses for this hazard are considered to be overestimated; hence, the following represent conservative estimates for losses associated with severe winter storm events.

SECTION 4.3.12: RISK ASSESSMENT – WINTER STORM

Table 4.3.12-3. General Building Stock Exposure (Structure Only) and Estimated Losses from Winter Storm Events in the Lehigh Valley

Municipality	Total (All Occupancies) RV	1% Damage Loss Estimates	5% Damage Loss Estimates	10% Damage Loss Estimates
Lehigh County				
Alburtis Borough	\$174,822,000	\$1,748,220	\$8,741,100	\$17,482,200
Allentown, City of	\$11,903,318,000	\$119,033,180	\$595,165,900	\$1,190,331,800
Bethlehem, City of	\$2,628,517,000	\$26,285,170	\$131,425,850	\$262,851,700
Catasauqua Borough	\$560,521,000	\$5,605,210	\$28,026,050	\$56,052,100
Coopersburg Borough	\$249,541,000	\$2,495,410	\$12,477,050	\$24,954,100
Coplay Borough	\$254,287,000	\$2,542,870	\$12,714,350	\$25,428,700
Emmaus Borough	\$1,218,443,000	\$12,184,430	\$60,922,150	\$121,844,300
Fountain Hill Borough	\$577,138,000	\$5,771,380	\$28,856,900	\$57,713,800
Hanover Township	\$1,121,295,000	\$11,212,950	\$56,064,750	\$112,129,500
Heidelberg Township	\$332,855,000	\$3,328,550	\$16,642,750	\$33,285,500
Lower Macungie Township	\$3,559,416,000	\$35,594,160	\$177,970,800	\$355,941,600
Lower Milford Township	\$345,853,000	\$3,458,530	\$17,292,650	\$34,585,300
Lowhill Township	\$235,030,000	\$2,350,300	\$11,751,500	\$23,503,000
Lynn Township	\$385,596,000	\$3,855,960	\$19,279,800	\$38,559,600
Macungie Borough	\$322,034,000	\$3,220,340	\$16,101,700	\$32,203,400
North Whitehall Township	\$1,689,865,000	\$16,898,650	\$84,493,250	\$168,986,500
Salisbury Township	\$1,959,935,000	\$19,599,350	\$97,996,750	\$195,993,500
Slatington Borough	\$426,505,000	\$4,265,050	\$21,325,250	\$42,650,500
South Whitehall Township	\$2,828,990,000	\$28,289,900	\$141,449,500	\$282,899,000
Upper Macungie Township	\$5,403,642,000	\$54,036,420	\$270,182,100	\$540,364,200
Upper Milford Township	\$743,671,000	\$7,436,710	\$37,183,550	\$74,367,100
Upper Saucon Township	\$1,886,155,000	\$18,861,550	\$94,307,750	\$188,615,500
Washington Township	\$556,271,000	\$5,562,710	\$27,813,550	\$55,627,100
Weisenberg Township	\$694,670,000	\$6,946,700	\$34,733,500	\$69,467,000
Whitehall Township	\$3,158,161,000	\$31,581,610	\$157,908,050	\$315,816,100
Lehigh County (est. total)	\$43,216,531,000	\$432,165,310	\$2,160,826,550	\$4,321,653,100
Northampton County				
Allen Township	\$449,063,000	\$4,490,630	\$22,453,150	\$44,906,300
Bangor Borough	\$527,429,000	\$5,274,290	\$26,371,450	\$52,742,900
Bath Borough	\$275,179,000	\$2,751,790	\$13,758,950	\$27,517,900
Bethlehem Township	\$3,173,542,000	\$31,735,420	\$158,677,100	\$317,354,200
Bethlehem, City of	\$5,550,240,000	\$55,502,400	\$277,512,000	\$555,024,000
Bushkill Township	\$805,813,000	\$8,058,130	\$40,290,650	\$80,581,300
Chapman Borough	\$19,081,000	\$190,810	\$954,050	\$1,908,100

SECTION 4.3.12: RISK ASSESSMENT – WINTER STORM

Municipality	Total (All Occupancies) RV	1% Damage Loss Estimates	5% Damage Loss Estimates	10% Damage Loss Estimates
East Allen Township	\$596,473,000	\$5,964,730	\$29,823,650	\$59,647,300
East Bangor Borough	\$74,240,000	\$742,400	\$3,712,000	\$7,424,000
Easton, City of	\$2,739,624,000	\$27,396,240	\$136,981,200	\$273,962,400
Forks Township	\$1,804,634,000	\$18,046,340	\$90,231,700	\$180,463,400
Freemansburg Borough	\$213,832,000	\$2,138,320	\$10,691,600	\$21,383,200
Glendon Borough	\$48,844,000	\$488,440	\$2,442,200	\$4,884,400
Hanover Township	\$1,932,002,000	\$19,320,020	\$96,600,100	\$193,200,200
Hellertown Borough	\$531,959,000	\$5,319,590	\$26,597,950	\$53,195,900
Lehigh Township	\$928,266,000	\$9,282,660	\$46,413,300	\$92,826,600
Lower Mt. Bethel Township	\$306,640,000	\$3,066,400	\$15,332,000	\$30,664,000
Lower Nazareth Township	\$1,197,083,000	\$11,970,830	\$59,854,150	\$119,708,300
Lower Saucon Township	\$1,240,742,000	\$12,407,420	\$62,037,100	\$124,074,200
Moore Township	\$778,212,000	\$7,782,120	\$38,910,600	\$77,821,200
Nazareth Borough	\$729,045,000	\$7,290,450	\$36,452,250	\$72,904,500
North Catasauqua Borough	\$232,842,000	\$2,328,420	\$11,642,100	\$23,284,200
Northampton Borough	\$1,068,331,000	\$10,683,310	\$53,416,550	\$106,833,100
Palmer Township	\$2,408,388,000	\$24,083,880	\$120,419,400	\$240,838,800
Pen Argyl Borough	\$372,456,000	\$3,724,560	\$18,622,800	\$37,245,600
Plainfield Township	\$643,358,000	\$6,433,580	\$32,167,900	\$64,335,800
Portland Borough	\$84,500,000	\$845,000	\$4,225,000	\$8,450,000
Roseto Borough	\$161,114,000	\$1,611,140	\$8,055,700	\$16,111,400
Stockertown Borough	\$153,656,000	\$1,536,560	\$7,682,800	\$15,365,600
Tatamy Borough	\$118,758,000	\$1,187,580	\$5,937,900	\$11,875,800
Upper Mt. Bethel Township	\$759,478,000	\$7,594,780	\$37,973,900	\$75,947,800
Upper Nazareth Township	\$631,001,000	\$6,310,010	\$31,550,050	\$63,100,100
Walnutport Borough	\$264,219,000	\$2,642,190	\$13,210,950	\$26,421,900
Washington Township	\$524,741,000	\$5,247,410	\$26,237,050	\$52,474,100
West Easton Borough	\$144,947,000	\$1,449,470	\$7,247,350	\$14,494,700
Williams Township	\$729,593,000	\$7,295,930	\$36,479,650	\$72,959,300
Wilson Borough	\$935,258,000	\$9,352,580	\$46,762,900	\$93,525,800
Wind Gap Borough	\$298,194,000	\$2,981,940	\$14,909,700	\$29,819,400
Northampton County (est. total)	\$33,452,777,000	\$334,527,770	\$1,672,638,850	\$3,345,277,700

Source: HAZUS-MH 2.1

Note (1): The valuation of general building stock and the loss estimates determined in the Lehigh Valley were based on the custom building stock database developed for this plan.

Note (2): Value reflects the replacement cost for building structure.

est. = Estimated; RV = Replacement Value.



A specific area that is vulnerable to the winter storm hazard is the floodplain. At risk general building stock and infrastructure in floodplains are presented in the flood hazard profile (Section 4.3.4). Generally, losses from flooding associated with winter storms should be less than that associated with a 1% or 0.2%-flood. In summary, snow and ice melt can cause both riverine and urban flooding. Estimated losses due to riverine flooding in the Lehigh Valley are discussed in Section 4.3.4.

4.3.12.5.5 Impact on Critical Facilities

Full functionality of critical facilities such as police, fire and medical facilities is essential for response during and after a winter storm event. These critical facility structures are largely constructed of concrete and masonry; therefore, they should only suffer minimal structural damage from severe winter storm events. Because power interruption can occur, backup power is recommended for critical facilities and infrastructure.

4.3.12.5.6 Impact on the Economy

Infrastructure at risk for this hazard includes roadways that could be damaged due to the application of salt and intermittent freezing and warming conditions that can damage roads over time. The cost of snow and ice removal and repair of roads from the freeze/thaw process can drain local financial resources. The potential secondary impacts from winter storms also impact the local economy including loss of utilities; interruption of transportation corridors; and loss of business function.

4.3.12.5.7 Impact on the Environment

Environmental impacts often include damage to trees and shrubs due to heavy snow loading, ice build-up and/or high winds which can break limbs and down large trees. An indirect effect of winter storms is the threat of roadway surfaces with salt, chemicals, and other de-icing materials which can impair adjacent surface and groundwater (PEMA, 2010).

Winter storms have a positive environmental impact; gradual melting of snow and ice provides groundwater recharge. However, abrupt high temperatures following a heavy snowfall can cause snowmelt, rapid surface water runoff and severe flooding (PEMA, 2010).

4.3.12.5.8 Future Growth and Development

Areas targeted for potential future growth and development in the next five (5) to ten (10) years have been identified across the Lehigh Valley at the municipal level. Refer to the jurisdictional annexes in Volume II of this Plan. Table B.1 in each jurisdictional annex lists the location of the potential new development and its exposure (if any) to known hazard zones. For the winter storm hazard, the Lehigh Valley in its entirety has been identified as the hazard area. Therefore, any new development will be exposed to such risks.

4.3.12.5.9 Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such winter storms. While predicting changes of winter storm events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2006).

The climate of Pennsylvania has changed in several ways. Over the past 100 years, annual average temperatures have been rising across the state. Warmer winters have led to a decrease in snow cover and an earlier arrival of spring. Recent analyses based on the Intergovernmental Panel on Climate Change models suggest a decrease in frequency and an increase in intensity of extra-tropical winter cyclones. However based on the methodology used, some models show no significant change in the storm track whereas others indicate a northward displacement of the storm track in the North Atlantic. For the mid-Atlantic region, there is little indication of a change in storm activity or track over Pennsylvania. An overall increase in winter precipitation is anticipated with a decrease in snow and increase in rain during the winter months. There is substantial uncertainty in projections of extra-tropical cyclones for Pennsylvania. With that said, it is anticipated winter storms will continue to pass over Pennsylvania in the future. Future improvements in modeling smaller scale climatic processes can be expected and will lead to improved understanding of how the changing climate will alter temperature, precipitation and storms events in Pennsylvania (Shortle et. al, 2009).

4.3.12.5.10 Additional Data and Next Steps

The assessment above identifies vulnerable populations and economic losses associated with this hazard of concern. Historic data on structural losses to general building stock are not adequate to predict specific losses to this inventory; therefore, the percent of damage assumption methodology was applied. This methodology is based on FEMA's How to Series (FEMA 386-2), Understanding Your Risks, Identifying and Estimating Losses (FEMA, 2001) and FEMA's Using HAZUS-MH for Risk Assessment (FEMA 433) (FEMA, 2004). The collection of additional/actual valuation data for general building stock and critical infrastructure losses would further support future estimates of potential exposure and damage for the general building stock inventory.

4.3.13 Structural Collapse

4.3.13.1 Location and Extent

Based upon building age, construction type, maintenance, and modification, structural collapses could happen anywhere within the limits of the Lehigh Valley. In addition, incidents of structural collapse may be reported as a cascading event following the identification of another incident. For example, the identification of a water main break under a residence may cause the failure of any of the load bearing elements within a structure.

4.3.13.2 Range of Magnitude

A structural collapse is defined by the Occupational Health and Safety Administration (OSHA) as the point when load bearing structural elements fail. Structural collapse severity can range from the single failure of a load-bearing element within or on a structure, weakening it, to the failure of all load-bearing elements within a structure bringing about the complete collapse of the structure.

Following any type of collapse, partial or complete, the development of additional cascading effects must be anticipated. Building construction utilizes load bearing and non-load bearing voids to house transmission lines for gases, liquids, and other products based upon the use of the structure. The failure of any of these elements can create the release of an unwanted material into the environment either from product in use within the building (e.g., natural gas, water, electricity) or used in the building's construction (e.g., sheetrock dust, asbestos or any other building product). Additionally, the reaction of the public, residents, or individuals trapped may create an environment of hysteria creating the possibility of civil unrest.

4.3.13.3 Past Occurrence

Historical records for the Lehigh Valley, submitted annually to the state, note two incidents of structure collapse, not generated as a cascading impact from a separate incident, over the past decade. In 2006, while constructing a new apartment building in Upper Macungie Township, Lehigh County construction crews reported a catastrophic failure of the structure. No injuries resulted from this incident. In 2007, a ceiling within a commercial building in Bangor Township, Northampton County failed, temporarily trapping four individuals.

In addition to stand-alone incidents, some notable structural failures based upon other incidents have caused significant damage within the Lehigh Valley. Lehigh County has been home to notable structural collapses suspected of being generated from incidents such as water main breaks or sinkholes. The most notable of these incidents happened in 1994 in the City of Allentown. A commercial structure valued at over 9 million dollars was impacted by a large sinkhole, which caused the failure of systems within the structure. Following unsuccessful mitigation attempts, the structure was imploded in order to minimize any additional damage to surrounding structures.

Similar to Lehigh County, Northampton County has also been impacted by structural collapses based upon cascading events. In 2008 a large sinkhole at an apartment complex in Hanover Township, Northampton County forced the evacuation of over 40 residents. The incident caused the failure of load bearing walls within the structures, ultimately leading to the demolition of the two buildings. In addition, the City of Easton evacuated an apartment complex in 2004 following the development of a large sinkhole. The structure sustained partial failure of load bearing elements forcing the relocation of 25 residents.

Additional information on land subsidence (sinkhole) frequency can be found in Section 4.3.9.

4.3.13.4 Future Occurrence

Structural collapse within the Lehigh Valley is generally considered as a cascading event following another incident. The regional geography, soil make-up, and age of infrastructure leave it prone to incidents such as land subsidence, which, based upon location can lead to a partial through total structural collapse. Based upon the Risk Factor Methodology Probability Criteria, the likelihood of a structural collapse within the region, due to a non-cascading event, still remains very unlikely.

Table 4.3.13-1. Likelihood of Future Occurrence of Structural Collapse

County	Avg. #/Year	% Probability	Category
Structural Collapse (non-cascading impact)			
Lehigh	<1	10	Very Unlikely
Northampton	<1	10	Very Unlikely
Structural Collapse (cascading event)			
Lehigh	<1	10	Very Unlikely
Northampton	<1	20	Very Unlikely

Source: Pennsylvania Emergency Incident Reporting System (PEIRS); Knowledge Center, County 9-1-1 Databases

4.3.13.5 Vulnerability Assessment

All infrastructure, commercial and industrial businesses, and residential structures within the Lehigh Valley are vulnerable to loss due to structural collapse whether due to a cascading event or a catastrophic structural failure. This vulnerability is compounded due to the ground composition, which is prone to subsidence throughout the region.

4.3.14 Dam Failure

Dams are manmade structures designed to serve a variety of uses, including; water supply, power generation, creation of recreational areas, and flood protection. They are made of concrete, rock, or earth. Failure of these structures may occur due to overtopping (i.e., the level of the water behind the dam exceeds the dam’s height) and erosion of the base, inadequate design and/or maintenance, internal erosion, saturation (for earthen dams), etc. The Pennsylvania Department of Environmental Protection (PADEP) holds responsibility for dam safety. Hazard Potential Category 1 dams are those “where its failure could result in significant loss of life, excessive economic losses, and significant public inconvenience”. Hazard Potential Category 2 dams are those “where its failure could result in the loss of a few lives, appreciable property damage, and short-duration public inconvenience” (PADEP, 2009). Owners of dams classified as Hazard Categories 1 or 2 (i.e., “high-hazard” dams) are required to create an Emergency Action Plan (EAP) that describes the dam, the inundation area if the dam was to catastrophically fail, and procedures for responding to the dam failure (e.g., notification of the vulnerable population).

4.3.14.1 Location and Extent

There are 101 dams in the Lehigh Valley, shown in Figure 4.3.14-1. The vast majority of these dams pose little risk; however, there are eight Hazard Category 1 “high-hazard” dams (all of them earthen) that require EAPs. See Table 4.3.14-1 for classification definitions. Refer to Table 4.3.14-2 for a complete list of dams in the Lehigh Valley.

Table 4.3.14-1. Dam Classification Definition

Size Category		
Category	Impoundment Storage (Acre feet)	Dam Height (Feet)
A	Equal to or greater than 50,000	Equal to or greater than 100
B	Less than 50,000 but greater than 1,000	Less than 100 but greater than 40
C	Equal to or less than 1000	Equal to or less than 40
Hazard Potential Category		
Category	Population at Risk	Economic Loss
1	Substantial (Numerous homes or small businesses or a large business or school).	Excessive such as extensive residential, commercial, or agricultural damage, or substantial public inconvenience.

SECTION 4.3.14: RISK ASSESSMENT – DAM FAILURE

Hazard Potential Category		
Category	Population at Risk	Economic Loss
2	Few (A small number of homes or small businesses.)	Appreciable such as limited residential, commercial, or agricultural damage, or moderate public inconvenience.
3	None expected (no permanent structures for human habitation or employment.)	Significant damage to private or public property and short duration public inconvenience such as damage to storage facilities or loss of critical stream crossings.
4	None expected (no permanent structures for human habitation or employment.)	Minimal damage to private or public property and no significant public inconvenience.

Source: 025 Pa. Code § 105.91. <http://www.pacode.com/secure/data/025/chapter105/s105.91.html>

The high hazard dams are as follows:

- **Hosensack No. 4**: This dam is permitted by a private resident and is located on the Indian Creek in Lower Milford Township, Lehigh County. Classification: C-1.
- **Leaser Lake**: This dam is permitted by the PA Fish & Boat Commission and is located on the Jacksonville Branch of the Ontelaunee Creek in Lynn Township, Lehigh County. Classification: B-1.
- **Cedar Crest Boulevard**: This dam is permitted by South Whitehall Township and is located on a tributary of the Jordan Creek in South Whitehall Township, Lehigh County. Classification: C-1.
- **Erickson Fish Pond**: This dam is permitted by a private resident and is located on a tributary of Tumble Brook in Upper Saucon Township, Lehigh County. Classification: C-1.
- **Rolling Greens**: This dam is permitted by Bethlehem Township and is located on a tributary of Nancy Run in Bethlehem Township, Northampton County. Classification: C-1.
- **Martin’s Creek SES Ash Basin No. 4**: This dam is permitted by PPL Martins Creek, LLC and is located on a tributary of the Oughoughton Creek in Lower Mount Bethel Township, Northampton County. Classification: B-1.
- **West Side Detention**: This dam is permitted by the Borough of Roseto and is located on a tributary of Martins Creek in Roseto Borough, Northampton County. Classification: C-1.
- **Minsi Lake**: This dam is permitted by the PA Fish & Boat Commission and is located on the East Branch Martins Creek in Upper Mount Bethel Township, Northampton County. Classification: B-1.

Table 4.3.14-2. Dams in Lehigh Valley

Dam Name	County	Municipality	Stream	Type	Class	Permittee
Leaser Lake	Lehigh	Lynn Township	Jacksonville Br Ontelaunee Creek	Earth	B-1	PA Fish & Boat Commission
Hosensack No 4	Lehigh	Lower Milford Township	Indian Creek	Earth; Stone; Masonry	C-1	Frank Lunney
Errickson Fish Pond	Lehigh	Upper Saucon Township	Tr Tumble Brook	Earth	C-1	Paul A Bouis
Cedar Crest Boulevard	Lehigh	South Whitehall Township	Tr Jordan Creek	Earth	C-1	South Whitehall Township
Macarthur Towne Centre	Lehigh	Whitehall Township	Tr Lehigh River	Earth	C-3	Mark Development Company
Fogelsville Pond	Lehigh	Upper Macungie Township	Hassen Creek	Masonry	C-3	Upper Macungie Township
Hensingersville	Lehigh	Macungie Borough	East Branch Swope Creek	Earth; Concrete	C-4	Alburtis Borough Authority
Locust Valley Country Club	Lehigh	Upper Saucon Township	Tr Saucon Creek	Unpopulated	C-4	Locust Valley Country Club
Lake Muhlenberg	Lehigh	Allentown City	Cedar Creek	Unpopulated	C-4	City of Allentown
Schmidt	Lehigh	North Whitehall Township	Unnamed	Concrete; Earth	C-4	Paul Schmidt
Paul Krauss	Lehigh	Lynn Township	Tr Switzer Creek	Unpopulated	C-4	Paul Krauss
Detention Pond	Lehigh	Hanover Township	Tr Lehigh River	Earth	C-4	Ms. Deanna L. Brandt
Green Hills Section 5	Lehigh	Upper Macungie Township	Tr Iron Run	Earth	C-4	Fred J. Jandl
West Detention Basin	Lehigh	Upper Macungie Township	Tr Iron Run	Earth	C-4	Jandl Land Company
Coplay Creek	Lehigh	Whitehall Township	Coplay Creek	Concrete; Run of River	C-4	Giant Portland Cement Company
Stabler Basin A	Lehigh	Upper Saucon Township	Tr Saucon Creek	Earth	C-4	Valley Green At Stabler Center Homeowners Associa
Ernst	Lehigh	Washington Township	Unnamed	Earth	C-4	Thomas Ernst
Stabler Basin 1	Lehigh	Upper Saucon Township	Tr Saucon Creek	Earth	C-4	Valley Green At Stabler Center Homeowners Associa
Trexler Park Pond	Lehigh	Allentown City	Little Cedar Creek	Concrete; Earth	C-4	City of Allentown
Furnace Street	Lehigh	Emmaus Borough	Tr Leibert Creek	Earth	C-4	Borough of Emmaus
School Creek	Lehigh	Lynn Township	School Creek	Unpopulated	C-4	James & Pat Hoffman
Giacobbe	Lehigh	Washington Township	Tr Mill Creek	Unpopulated	C-4	F. J. Giacobbe

SECTION 4.3.14: RISK ASSESSMENT – DAM FAILURE

Dam Name	County	Municipality	Stream	Type	Class	Permittee
Pfeiffer Pond	Lehigh	Heidelberg Township	Tr Jordan Creek	Earth	C-4	Karen Pfeiffer
Essroc	Lehigh	Whitehall Township	Coplay Creek		C-4	Essroc Italcementi Group
Spring Mill	Lehigh	Whitehall Township	Spring Creek	Earth; Masonry; Rockfill	C-4	Northampton Borough Municipal Water Authority
Builders Square	Lehigh	South Whitehall Township	Tr Cedar Creek	Earth	C-4	Powerline Associates, L.P.
Mill - Dorney Park	Lehigh	South Whitehall Township	Cedar Creek	Gravity	C-4	Dorney Park/Wildwater Kingdom
Hamilton Street	Lehigh	Allentown City	Lehigh River	Concrete; Gravity	C-4	City of Allentown
Trout Creek Reservoir	Lehigh	Heidelberg Township	Trout Creek	Stone; Masonry; Earth	C-4	Heidelberg Game Protective Association
Mill	Lehigh	Allentown City	Little Lehigh Creek	Concrete	C-4	City of Allentown
Mill	Lehigh	Lower Macungie Township	Little Lehigh Creek	Concrete	C-4	Cordesw & Kimberly K. Snyder Iii
Mill	Lehigh	Lower Macungie Township	Little Lehigh Creek	Concrete	C-4	Mark P. & Ellyn G. Elstein
Mill	Lehigh	Lower Macungie Township	Little Lehigh Creek	Concrete	C-4	John Gallagher And Deana Zosky
Ice	Lehigh	Upper Milford Township	Leibert Creek	Concrete; Gravity	C-4	David & Barbara Bollinger
Jordan Park	Lehigh	Allentown City	Jordan Creek	Stone; Masonry; Run of River	C-4	City of Allentown
Little Lehigh	Lehigh	Allentown City	Little Lehigh Creek	Concrete	C-4	City of Allentown
Mill	Lehigh	Weisenberg Township	Schaefer Run	Earth	C-4	Sue Ubben
Big Bed Slate	Lehigh	Washington Township	Trout Creek	Concrete; Gravity	C-4	Penn Big Bed Slate Co.
Kemmerling	Lehigh	Lynn Township	Ontelaunee Creek	Concrete; Run of River	C-4	Nevin & Helen Kemmerling
Crowley	Lehigh	Weisenberg Township	Lyon Creek	Concrete; Gravity	C-4	Patrick Crowley, Jr.
Kerns	Lehigh	North Whitehall Township	Jordan Creek	Concrete	C-4	Fred Jaendl
Northampton	Lehigh	Whitehall Township	Lehigh River	Concrete	C-4	Whitehall Cement Manufacturing Company
Mill	Lehigh	North Whitehall Township	Coplay Creek	Concrete	C-4	Terry Muth
Wehrs	Lehigh	South Whitehall Township	Jordan Creek	Concrete	C-4	South Whitehall Township
Minsi Lake	Northampton	Upper Mt Bethel Township	East Branch Martins Creek	Earth	B-1	PA Fish & Boat Commission



SECTION 4.3.14: RISK ASSESSMENT – DAM FAILURE

Dam Name	County	Municipality	Stream	Type	Class	Permittee
Martins Creek Ses Ash Basin No 4	Northampton	Lower Mount Bethel Township	Tr Oughoughton Creek	Earth	B-1	Ppl Martins Creek, Llc
Chain	Northampton	Palmer Township	Lehigh River	Stone; Masonry	B-4	Dep
Rolling Greens (Bethlehem Twp Det)	Northampton	Bethlehem Township	Tr Nancy Run	Earth	C-1	Bethlehem Township
West Side Detention	Northampton	Roseto Borough	Tr Martins Creek	Earth	C-1	Borough of Roseto
Palmer Park Mall	Northampton	Palmer Township	Tr Bushkill Creek	Earth	C-3	Palmer Park Mall Venture
Quail Hollow Detention Basin	Northampton	Bethlehem Township	Tr Lehigh River	Earth	C-3	4-L Housing Associates
Echo Lake	Northampton	Upper Mt Bethel Township	Tr Jacoby Creek	Earth; Rockfill	C-3	Echo Lake Development Co Inc
Kings Crossing	Northampton	Bethlehem Township	Tr Lehigh River	Earth	C-3	Bethlehem Township
Upper	Northampton	Easton City	Bushkill Creek	Concrete	C-4	Specialty Minerals, Inc
Emery	Northampton	Portland Borough	Jacoby Creek	Masonry	C-4	M.C. Emery
Wagner Farms Detention Basin	Northampton	Bethlehem Township	Tr Lehigh River	Earth	C-4	Wagner Enterprises, Ltd.
Water Power	Northampton	Palmer Township	Bushkill Creek	Concrete	C-4	Upper Mill LP
Hemlock Brook	Northampton	Upper Mt Bethel Township	Hemlock Brook	Earth	C-4	Garafalo Realty
Lappawinzo	Northampton	Allen Township	Hokendauqua Creek	Stone; Masonry; Run of River	C-4	Lappawinzo Rod And Gun Club
Grays Pond	Northampton	Hellertown Borough	Reservoir Creek	Earth	C-4	Hellertown Borough Authority
Inter-Club	Northampton	Freemansburg Borough	Nancy Run	Unpopulated	C-4	Inter-Club Canal Commission, Inc.
Jacoby Creek	Northampton	Upper Mt Bethel Township	Jacoby Creek	Earth	C-4	Upper Mount Bethel Development Group, Inc.
Ratcliffe	Northampton	Washington Township	Tr Oughoughton Creek	Earth	C-4	Ms. Sheri Lobb
Stephen Demshock	Northampton	Lower Nazareth Township	Tr East Monocacy Creek	Earth	C-4	Stephen Demshock
Penns Farm Detention Basin	Northampton	Bethlehem Township	Tr Nancy Run	Earth	C-4	PennS Farms Condominium Association
Cole	Northampton	Upper Mt Bethel Township	Tr Allegheny Creek	Earth	C-4	Charles Cole
Pond No 2	Northampton	Hanover Township	Tr Monocacy Creek	Earth	C-4	Pointe Associates
Lake Je-Ba-Ru	Northampton	Upper Mt Bethel Township	Jacoby Creek	Earth	C-4	Stabler Development Co.



SECTION 4.3.14: RISK ASSESSMENT – DAM FAILURE

Dam Name	County	Municipality	Stream	Type	Class	Permittee
Rouse And Associates Sdb #1	Northampton	Hanover Township	Tr Monocacy Creek	Earth	C-4	Rouse & Associates
Rouse Detention Basin No. 2	Northampton	Hanover Township	Tr Monocacy Creek	Earth	C-4	Liberty Property Limited Partnership
Lehigh Valley Industrial Park #3	Northampton	Hanover Township	Tr Monocacy Creek	Earth	C-4	Micro Speciality System
Lehigh Valley Industrial Park #4	Northampton	Hanover Township	Tr Monocacy Creek	Earth	C-4	Lehigh Valley Industrial Park
Walnut Hills Detention	Northampton	Bethlehem Township	Tr Lehigh River	Earth	C-4	Sam Calatoni
Delaware Trace Detention Basin	Northampton	East Allen Township	Tr Lehigh River	Earth	C-4	Ronald And Marilyn Bauer
Laneco Plaza Detention Basin	Northampton	Lower Nazareth Township	Tr Shoeneck Creek	Unpopulated	C-4	Laneco Pad Lp
Chrin Brothers	Northampton	Williams Township	Tumble Creek	Earth	C-4	Chrin Brothers, Inc.
Lehigh Canal Lock 41	Northampton	Bethlehem City	Lehigh River Canal	Masonry; Timber Crib	C-4	City of Bethlehem
Schiavone	Northampton	Plainfield Township	Tr Bushkill Creek	Rockfill	C-4	Allen Flory
Water Supply	Northampton	Northampton Borough	Hokendauqua Creek	Gravity	C-4	Horwith Leasing Co. Inc.
Walters Mill Pond	Northampton	Palmer Township	Bushkill Creek	Concrete	C-4	Palmer Township
Upper	Northampton	Easton City	Bushkill Creek	Concrete	C-4	Excalibur Realty Company
Martins Creek Ash Basin No. 1	Northampton	Lower Mount Bethel Township	Oughoughton Creek	Other; Earth	C-4	Ppl Martins Creek, Llc
Dewalt	Northampton	Easton City	Bushkill Creek	Unpopulated	C-4	Scott Dewalt
Lower	Northampton	Easton City	Bushkill Creek	Concrete	C-4	Easton Municipal Authority
Lafayette College	Northampton	Easton City	Bushkill Creek	Unpopulated	C-4	Lafayette College
Mill	Northampton	Lower Saucon Township	Saucon Creek	Unpopulated	C-4	G.A. Keck
Mill	Northampton	Hanover Township	Monocacy Creek	Concrete	C-4	Lee & Sally Snyder
Mill	Northampton	Hanover Township	Monocacy Creek	Concrete	C-4	St. Francis Retreat
Cohen	Northampton	Lower Saucon Township	Black Creek	Earth	C-4	Martin & Susan Cohen
Mill	Northampton	Hanover Township	Monocacy Creek	Concrete	C-4	Leon A.C. & Beverly Isaac
Easton	Northampton	Easton City	Lehigh River	Stone; Masonry	C-4	Dcnr
Field	Northampton	Palmer Township	Bushkill Creek	Concrete	C-4	Richard L. Field
Mill	Northampton	Bushkill Township	Bushkill Creek	Concrete	C-4	Mary Ann Orsinger
Mill	Northampton	Lower Mount Bethel Township	Martins Creek	Concrete; Masonry	C-4	Dina Plebani

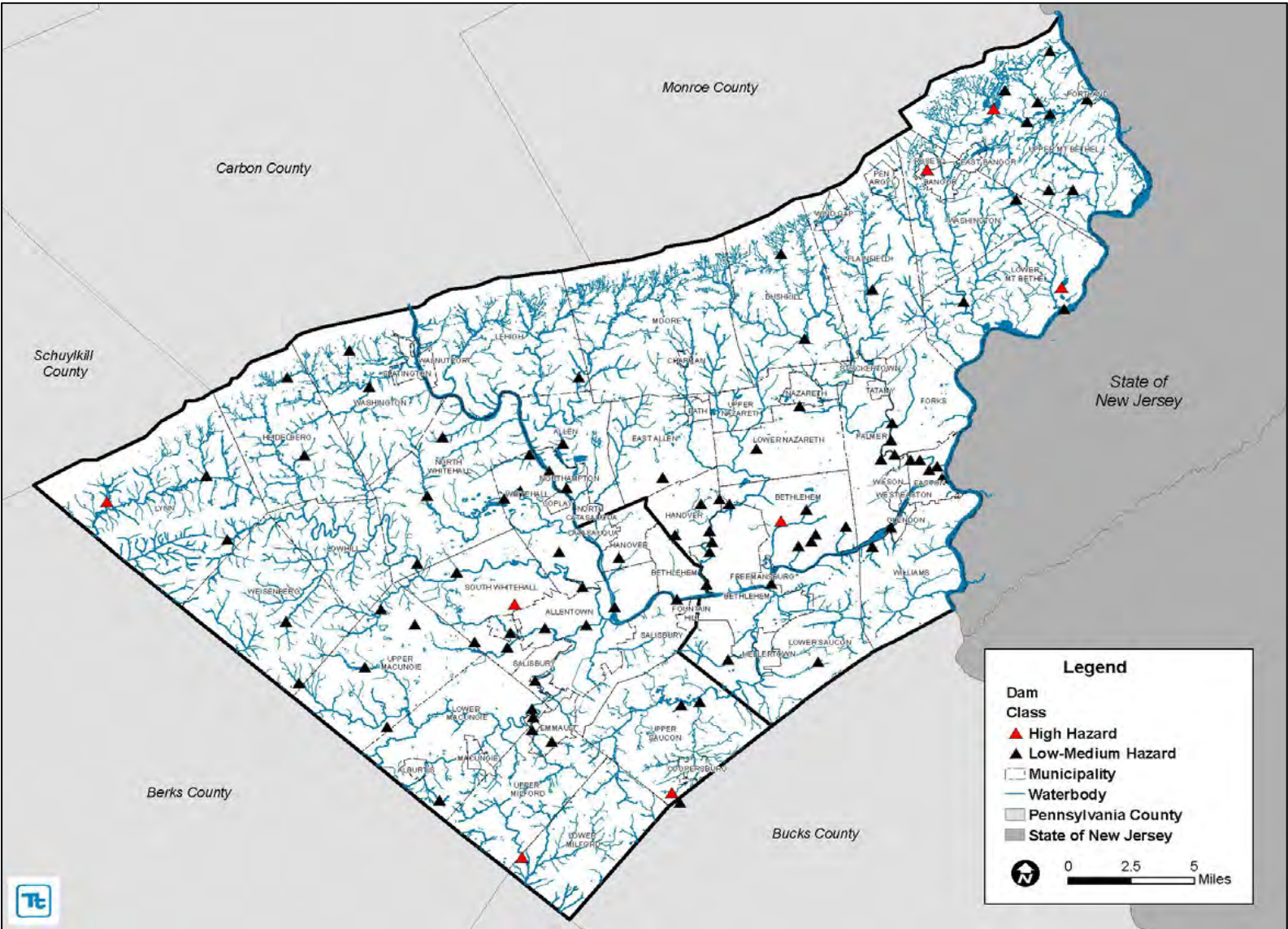


SECTION 4.3.14: RISK ASSESSMENT – DAM FAILURE

Dam Name	County	Municipality	Stream	Type	Class	Permittee
Ice-Fish	Northampton	Upper Mt Bethel Township	Martins Creek	Earth	C-4	Barbara Paul
Illicks Mill	Northampton	Hanover Township	Monocacy Creek	Earth; Stone; Masonry	C-4	City of Bethlehem
Monocacy Creek	Northampton	Bethlehem City	Monocacy Creek	Stone; Masonry	C-4	City of Bethlehem
Minch Spring Run	Northampton	Upper Mt Bethel Township	Minch Spring Run	Stone; Masonry	C-4	Portland Borough Authority
Beersville Grove	Northampton	Moore Township	Tr Hokendauqua Creek	Concrete; Gravity	C-4	Beersville Grove, Inc.
Peppell	Northampton	Bushkill Township	Tr Bushkill Creek	Earth	C-4	James & Virginia Peppell
Mill	Northampton	Hanover Township	Monocacy Creek	Concrete	C-4	Eastlake Montessori Education Center, Inc.

Source: PA DEP Dam Safety

Figure 4.3.14-1. Dams in the Lehigh Valley



Source: PA DEP Dam Safety



4.3.14.2 Range of Magnitude

The impact of dam failures varies by the amount of water being held by the dam. Failures of small dams, such as those created to form a pond or other small water body, may result in a flood of only a few hundred gallons of water, and may not impact any structures or other property. Failures of large dams, such as those created to form large water supply reservoirs or recreational lakes, may result in millions of gallons of water destroying hundreds of structures and potentially killing large numbers of people.

4.3.14.3 Past Occurrence

There have been no recorded dam failures in the Lehigh Valley.

4.3.14.4 Future Occurrence

The likelihood of a dam failure in the Lehigh Valley is extremely difficult to predict. However, the risk of such an event increases for each dam as the dam's age increases and/or frequency of maintenance decreases. Based upon the Risk Factor Methodology Probability Criteria and providing that regular maintenance and inspections of the dams in the Lehigh Valley are performed, dam failures are considered *unlikely* (see Section 4.4 for definition).

4.3.14.5 Vulnerability Assessment

The dam failure hazard is of significance to the Lehigh Valley because there are 101 dams across Lehigh and Northampton Counties, 8 of which are classified as high hazard by the PADEP. The direct and indirect losses associated with dam failures include injury and loss of life, damage to structures and infrastructure, agricultural losses, utility failure (power outages), and stress on community resources.

All population in a dam failure inundation zone is considered exposed and vulnerable. Of the population exposed, the most vulnerable include the economically disadvantaged and the population over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact to their family. The population over the age of 65 is also highly vulnerable because they are more likely to seek or need medical attention which may not be available due to isolation during a flood event and they may have more difficulty evacuating.

There is often limited warning time for dam failure. These events are frequently associated with other natural hazard events such as earthquakes, landslides, or severe weather, which limits their predictability and compounds the hazard. Populations without adequate warning of the event are highly vulnerable to this hazard.

All buildings and infrastructure located in the dam failure inundation zone are considered exposed and vulnerable. Property located closest to the dam inundation zone has the greatest potential to experience the largest, most destructive surge of water. All transportation infrastructure in the dam failure inundation zone is vulnerable to damage. Damage to this infrastructure could cut off evacuation routes, limit emergency access, and create isolation issues. Utilities such as overhead power lines, cable and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation zones.

4.3.15 Environmental Hazard

The Lehigh Valley is home to over 900 identified facilities that utilize, ship, or house chemicals that are considered hazardous in nature. Of the 900 identified, 384 facilities have been identified under the Superfund Amendments and Reauthorization Act (SARA) as exceeding the quantity threshold for reporting.

Product release into the local environment can be generated from a fixed facility or along any location on a route of travel, and may be the result of carelessness, technical failure, external incidents, or an intentional act against the facility/container. The volatility of products being stored or transported, along with the potential impact on a local community, may increase the risk of intentional acts against a facility or transport vehicle. The release of certain products deemed to be hazardous materials can have an immediate adverse impact on the general population ranging from the inconvenience of evacuations to injury and even death. In addition to human impacts, any release can compromise the local environment through the contamination of soil, groundwater, or local flora and fauna.

For the purposes of this document, explosions are included under Environmental Hazard, as all reported and confirmed explosions have been the result of the loss of containment of a hazardous material, thus creating the explosion. According to the National Fire Protection Agency, the definition of explosion is “the sudden conversion of potential energy (chemical or mechanical) into kinetic energy with the production and release of gases under pressure, or the release of gas under pressure. These high-pressure gases then do mechanical work such as moving, changing, or shattering nearby materials.” This pairing of the two hazards is a natural process, as once the explosion occurs the product released is always considered a hazardous material.

4.3.15.1 Location and Extent

Hazardous materials are classified by the Department of Transportation (DOT) into nine classes based on the chemical characteristics producing the risk. The nine classifications are:

- Class 1: Explosives
- Class 2: Gases
- Class 3: Flammable Liquids
- Class 4: Flammable Solids
- Class 5: Oxidizers and organic pesticides
- Class 6: Poisons and etiologic materials
- Class 7: Radioactive materials
- Class 8: Corrosives
- Class 9: Miscellaneous

Within the Lehigh Valley, based on past occurrences, hazardous material releases are accidental and are not considered acts of terrorism or criminal in nature. While past occurrences have not been deemed intentional, the impact from the intentional release of any of these products in large quantity would pose a threat to the local population, economy, and environment resulting in lost revenue, injuries, and deaths.

The Lehigh Valley is home to just over 4,000 miles of roadways including 57 miles of interstate highway, 35 miles of freeways, 188 miles of principal arterials, 223 miles of minor arterials, and over 400 miles of major collectors. With just over 4,000 miles of roadways linking more populated areas with rural communities, the grid work of roadways facilitates the free movement of hazardous materials throughout the region. While permitted, identified hazardous substance travel routes are not maintained by the

county or regional planning entities, the primary roadways being used, as identified within the Lehigh Valley Transportation Plan, are as follows:

- Interstate 78 (I-78)
- US Highway 22 (US22)
- PA-33
- PA-248
- Interstate -476 (I-476)
- PA-309
- PA-378 (LVPC, Date Unknown)

In addition to the major routes of transportation, each fixed facility identified within the Lehigh Valley poses a potential threat to the surrounding community.

Reported explosions within the Lehigh Valley are predominantly related to the release of a confined material evacuating from its containment. The most common reported explosion within the Lehigh Valley is the result of a failure within local infrastructure leading to the expansion and ignition of natural gas. The age of the infrastructure within the Lehigh Valley leaves the region prone to this type of occurrence and is currently being investigated by many federal agencies in an attempt to develop more comprehensive federal guidance.

4.3.15.2 Range of Magnitude

Environmental hazards incidents within the Lehigh Valley range from minor petroleum spills to large facility based incidents that lead to the loss of life, property, environment, and economy. Additionally, the range of explosion related incidents within the region varies from a small incident that has an impact on a residential or smaller type commercial building to a catastrophic failure leading to the loss of life, large amounts of property and economy.

The region has been home to significant hazardous materials releases over the previous decade with the largest environmental hazard incident happening in Lehigh County, Upper Macungie Township in August of 2011. The incident occurred on Interstate 78 near the Pennsylvania Route 100 Interchange. A tractor-trailer was involved in a vehicular collision resulting in the loss of over 7,000 gallons of motor oil, which spilled on the roadway and into the nearby earth and waterways. This incident lasted approximately 18 hours and the impacts from the accident caused Pennsylvania Department of Transportation (PennDOT) to mill and resurface the roadway. In total, the initial response was able to collect just over 4,000 gallons of product, leaving almost 3,000 gallons for the state and environmental cleanup agencies to handle. Additionally, in March of 2009, Wind Gap Borough in Northampton County was impacted by the spill of hydrogen fluoride following a motor vehicle accident. The incident took place on PA Route 33 just south of the Borough of Wind Gap. The truck was carrying over 33,000 pounds of chemical product when it rolled onto its side. The response to this incident included the evacuation of over 5,000 residents and the closure of a major roadway in the Lehigh Valley for hours.

4.3.15.3 Past Occurrence

The Lehigh Valley's location between two major metropolitan areas provides for an increase in transportation of hazardous materials through rail, air, and road. These routes of transportation combined with the large number of fixed facilities and end users of hazardous materials have provided for an incidence of frequent chemical and petroleum product releases with several being deemed as serious. The past decade brought about an increase in incidents based upon the population growth and business development.

SECTION 4.3.15: RISK ASSESSMENT – ENVIRONMENTAL HAZARD

Environmental hazard incidents within the Lehigh Valley occur on a regular basis with the majority being handled by the local responders with guidance from the PADEP. In total, the region reported 1,961 incidents to the Pennsylvania Emergency Management Agency (PEMA) over the last decade.

Table 4.3.15-1 below depicts the number of reported environmental hazards incidents to PEMA. It should be noted that the figures provided below are not a comprehensive listing, as the reporting requirements from the state changed in 2007, allowing state agencies to categorize the incident as something other than “Hazardous Materials.” For instance, a vehicle collision resulting in a spill of petroleum products (e.g., gasoline, motor oil) may be reported as a vehicle accident instead of a hazardous materials release.

Table 4.3.15-1. Reported Release of Hazardous Materials 2001-2011

County	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Lehigh	38	44	42	48	40	40	44	37	352	340	256	1281
Northampton	7	8	10	8	8	15	35	40	89	223	237	680
Total	45	52	52	56	48	55	79	77	441	563	493	1961

Source: Pennsylvania Emergency Incident Reporting System (PEIRS); Knowledge Center, County 9-1-1 Databases

**Due to archiving processes and reporting requirements prior to 2007, databases are not complete and do not accurately represent the total number of reported incidents **

Additionally, the age of infrastructure in the region has led to an increase in reported explosions, primarily based on gas utility failures. These incidents range from simple building property incidents through large scale loss of life, property, economy and environment. In December of 2010, the City of Allentown, in Lehigh County was impacted by a catastrophic failure of a large gas main under a row of residential structures in the 500 Block of North 13th Street. The explosion took the lives of five individuals and destroyed six residential structures. The incident forced the evacuation of hundreds of residential and commercial properties, including a senior living complex on the adjoining block. Since that incident, the Lehigh Valley has been impacted by numerous failures of infrastructure causing smaller explosions with less impact.

The Lehigh Valley was also impacted in 1999 by a large commercial building explosion in Hanover Township, Northampton County, that led to the deaths of 5 employees and to 14 injuries. The incident was caused by the failure of a containment vessel that was in the process of distilling a hazardous material. The explosion damaged numerous buildings within the industrial park and residential structures in the adjacent area. As a result of this incident, the expansion of Local Emergency Planning Committees (LEPC) was established throughout the country. In addition, the Commonwealth of Pennsylvania adopted Act 165, the Hazardous Materials Emergency Planning, and Response Act. These changes in planning were implemented to establish a mechanism to ensure planning, training, and funding within local communities for facilities utilizing hazardous materials (U.S. Chemical Safety and Hazard Investigation Board, 2002).

Table 4.3.15-2 below provides a total number of reportable explosion type incidents within the Lehigh Valley. It should be noted that the figures provided below are not a comprehensive listing, as the explosive event may not be the primary incident. Rather, the incidents may be based on the events that led up to an explosion.

Table 4.3.15-2: Reported Explosion Incidents 2001-2011

County	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Lehigh	0	0	1	0	1	1	0	0	0	1	1	5

SECTION 4.3.15: RISK ASSESSMENT – ENVIRONMENTAL HAZARD

County	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Northampton	0	0	0	1	0	1	1	1	1	3	0	8
Total	0	0	1	1	1	2	1	1	1	4	1	13

Source: PEIRS; Knowledge Center, County 9-1-1 Databases

**Due to archiving processes and reporting requirements prior to 2007, databases are not complete and do not accurately represent the total number of reported incidents **

4.3.15.4 Future Occurrence

Due to the wide scope of definition of environmental hazards, ranging from a small spill to a large release of a highly volatile or toxic hazardous material, incidents can and will happen at any time. Based upon Risk Factor Methodology Probability Criteria, the likelihood of future occurrences within the Lehigh Valley remains at *Highly Likely* (see Table 4.3.15-3). The below table shows the expected number of incidents reported based on an average of the data compiled over the previous decade.

Based upon the Risk Factor Methodology Probability Criteria, using the numbers of reported explosion incidents over the previous decade (shown in Table 4.3.15-2); the likelihood of an explosion incident is considered *Possible* (see Table 4.3.15-3). The projected frequency of these events overall is less than one occurrence reported per year. While the severity of the occurrence is significant, the probability based on historical data is not as significant.

Table 4.3.15-3: Likelihood of Future Occurrence of Environmental / Explosion Hazard

County	Avg. #/Year	% Probability	Category
Environmental Hazards			
Lehigh	128.1	100	Highly Likely
Northampton	68	100	Highly Likely
Explosion			
Lehigh	<1	50	Possible
Northampton	<1	80	Possible

Source: PEIRS; Knowledge Center, County 9-1-1 Databases

**Due to archiving processes and reporting requirements prior to 2007, databases are not complete and do not accurately represent the total number of reported incidents **

4.3.15.5 Vulnerability Assessment

Environmental hazards have the greatest impact on the residential population within the Lehigh Valley. The majority of incidents reported within the Lehigh Valley are the result of motor vehicle incidents or spills within a residential structure.

The economic loss from environmental hazards and explosion incidents ranges from non-recordable to losses exceeding millions of dollars. The impact on the local economy from a single incident is almost impossible to measure due to the complexity of work lost, revenue losses, and loss of future business.

4.3.15.6 Programs to Manage Risk

Facilities that produce, use, or ship hazardous materials within the Commonwealth of Pennsylvania are required to comply with regulations set forth within the federal SARA and the Emergency Planning and Community Right to Know Act (EPCRA), and the Commonwealth of Pennsylvania reporting requirements under the Hazardous Materials Emergency Planning and Response Act (Act 165). Additionally, the established LEPCs are tasked with the development, maintenance and update of all off-

SECTION 4.3.15: RISK ASSESSMENT – ENVIRONMENTAL HAZARD

site emergency response plans for facilities that have Extremely Hazardous Substances (EHS). These plans provide information on the materials, quantities, locations, impacts on the area, and evacuation routes for each facility in an attempt to maintain a safe environment within a jurisdiction.



4.3.16 Fire (Urban/Structural Fire)

4.3.16.1 Location and Extent

Structural fires within the Lehigh Valley have had a detrimental impact on life, property, and the local economy over the past decade. The age of many residential structures within the region combined with changes in building construction and materials has created a threat of fire loss that is occurring on a regular basis. In addition, the advancement of the regional economy has brought in businesses and industry that use the Lehigh Valley for their industrial manufacturing. These business and industrial locations, due to their operations, are prone to a variety of types of fire.

As defined by the National Fire Protection Agency (NFPA), in the *NFPA 901: Standard Classifications for Incident Reporting and Fire Protection Data*, a structure fire is defined as “Any fire inside, on, under, or touching a structure.” This definition includes any mobile living structure such as a mobile or modular residence, but does not include roadworthy vehicles such as recreation vehicles (National Fire Protection Agency, 2011).

4.3.16.2 Range of Magnitude

The severity of structural fires varies due to the losses associated with the incident. The impact to the local economy is minimal with the loss of a residential structure but the loss of a large manufacturing facility that employs a large number of people can be extensive. Likewise, the impact to the local environment from a single residential fire is minimal while the impact from an industrial or commercial fire can take years to measure. Finally, the loss of life due to structural fires appears to be opposite of the previous two impacts. The loss of life during a residential fire is more likely than that of an industrial or commercial building fire. The building composition combined with the hour of the incident combine to increase the loss of life during a residential type fire.

The structural fires within the Lehigh Valley are usually small, and generally affect residential structures. These fires are limited in duration and are generally contained within the local jurisdiction. While the average fire is small in nature, the threat from a large or even catastrophic fire is always present. Many operations within larger industrial and commercial sites within the Lehigh Valley are prone to small fires that if improperly contained can, and do, lead to catastrophic fire losses. Combined with the presence of materials that are volatile in nature, these threats are ever changing and increasing within the region.

In the last ten years, the Lehigh Valley has seen some notable fires. In March of 2008, City of Bethlehem, Northampton County reported a fire loss in a row of joined homes. The fire claimed the life of four juveniles and injured one additional civilian and four emergency workers. This loss of life is noted as the greatest single loss of life from a non-explosion related fire in the past decade.

In addition to the City of Bethlehem fire, Plainfield Township, Northampton County experienced a catastrophic fire within an industrial site. The site provided a scrap recycling service that received and collected materials and through various processes provided the plastics industry with plastic, glass and metal separation and grinding services. In March of 2011, a fire was reported within the structure, which led to a five-county fire response that continued for over 36 hours. Once extinguished, the building and all products on site were deemed a loss, bringing the loss total to an excess of \$9 million dollars.

4.3.16.3 Past Occurrence

Within the Lehigh Valley over the last decade, 1,142 structural fires have been reported to the Pennsylvania Emergency Management Agency (PEMA). While not an all-encompassing listing, these

fires represent the threshold set forth by the state to be a reportable incident. Table 4.3.16-1 shows an annual fire report by county for both Lehigh and Northampton Counties from 2001 - 2011.

Table 4.3.16-1: Reported Structural Fires 2001-2011

County	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Lehigh	9	5	2	2	15	16	19	10	195	194	189	656
Northampton	4	2	0	0	2	7	91	73	90	135	82	486
Total	13	7	2	2	17	23	110	83	285	329	271	1142

Source: Pennsylvania Emergency Incident Reporting System (PEIRS); Knowledge Center, County 9-1-1 Databases (Due to archiving processes and reporting requirements prior to 2007, databases are not complete and do not accurately represent the total number of fires reported)

4.3.16.4 Future Occurrence

Based upon the Risk Factor Methodology Probability Criteria, structural fires are categorized as *Highly Likely*. According to the NFPA 2009 report *A Few Facts at the Household Level*, based on historical data collected, an average household is expected to experience a fire within a structure every 15 years, based on an average expectance of the household to be 78 years. While most of these fires will be considered small and may not cause any significant damage, the possibility of a catastrophic loss due to fire is present (see Table 4.3.16-2).

Table 4.3.16-2: Likelihood of Future Occurrences of Structural Fire

County	Avg. #/Year	% Probability	Category
Lehigh	65.6	100	Highly Likely
Northampton	60.5	100	Highly Likely

** Due to archiving processes and reporting requirement changes prior to 2007, data collected does not fully reflect the number of fires prior to 2007, thus increasing the % Probability and Average Occurrences per year.**

The NFPA reports a decreasing trend in structural fires within the United States over the past 30 years. Based upon public outreach campaigns to promote fire safety awareness and smoke detector use, the agency is reporting a decrease of over 7,000 deaths per year in the 1970's to just under 3,000 deaths in 2010 (NFPA, 2011). Despite the decrease being reported in fire fatalities, the Lehigh Valley remains consistent with the number of fires being reported over the previous five years. The quantity of residential structures within the Lehigh Valley, especially within the City of Easton, City of Bethlehem, and the City of Allentown, combined with a varying range of fire code enforcement equates to a greater probability of loss in the future. In addition, the influx of commercial and industrial sites within the Lehigh Valley also increases the possibility of future commercial and/or industrial fires.

4.3.16.5 Vulnerability Assessment

Structural fires most frequently affect the residential communities within the Lehigh Valley. While the impact of most structural fires is considered minimal due to the availability of support services following a fire, these fires need to be classified as a high threat due to the frequency and potential for injury and loss of life.

Within the Lehigh Valley, as the population density increases, there is a greater probability of structural fires. The increased population combined with the dense building saturation increases the threat from

structural fires, increasing the likelihood of a larger loss. The continued growth within the Lehigh Valley, both commercial and residential, will continue to impact the threat of structural fires in the future.

4.3.17 Levee Failure

Levees and floodwalls are man-made structures designed to protect specific areas from flooding. These structures fail when floodwaters exceed the height of the structure, or when the maximum pressure exerted by the floodwaters against the levee/floodwall exceeds its capability.

4.3.17.1 Location and Extent

There are four US Army Corps of Engineers levees/floodwalls in the Lehigh Valley: Allentown (Sewer Treatment Plant) Levee, Salisbury Levee, Allentown-Jordan Creek Floodwall, and Bethlehem Levee System. Figures 4.3.17-1 to 4.3.17-4 show the locations of these structures (R3Levees, 2009).

In the City of Allentown, there is a 750-foot low levee along the right bank of the River, a concrete floodwall extending 204 feet upstream of the Old Hamilton Street bridge, a short levee spanning 69 feet between the abutment of the Old and New Hamilton Street bridges, a levee extending 1,125 feet connecting with Kline’s Island Levee, and a training dike approximately 1,300 feet long that was constructed around a sharp bend to reduce backwater stages in Little Lehigh Creek. A straightened and deepened main channel, extending 8,280 feet, is another local flood control project within the City. In Salisbury Township, a dike was built along the south side of the Lehigh River to protect the floodplain in the loop of the River (FEMA, 2004).

Figure 4.3.17-1. Allentown Levee

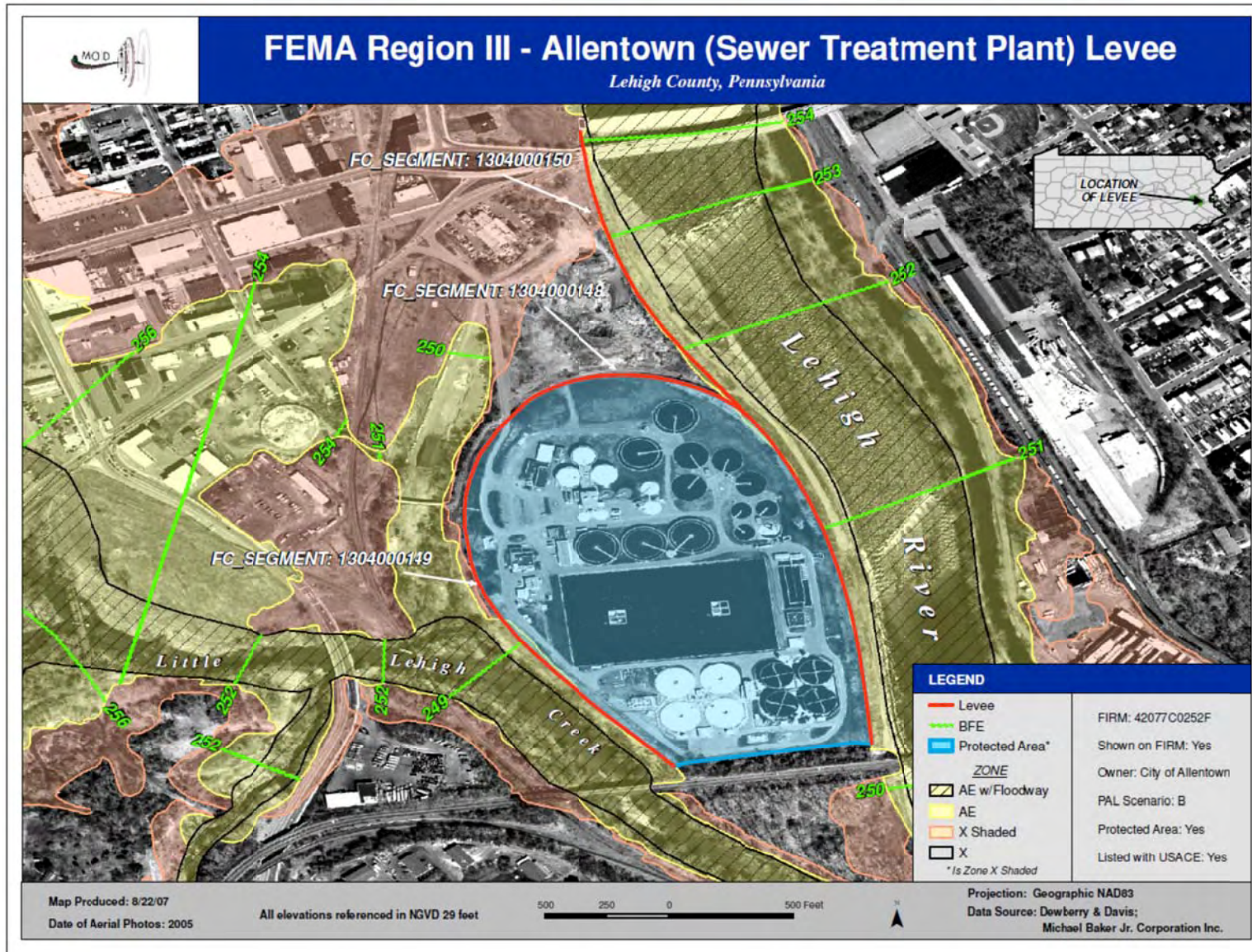


Figure 4.3.17-2. Salisbury Levee

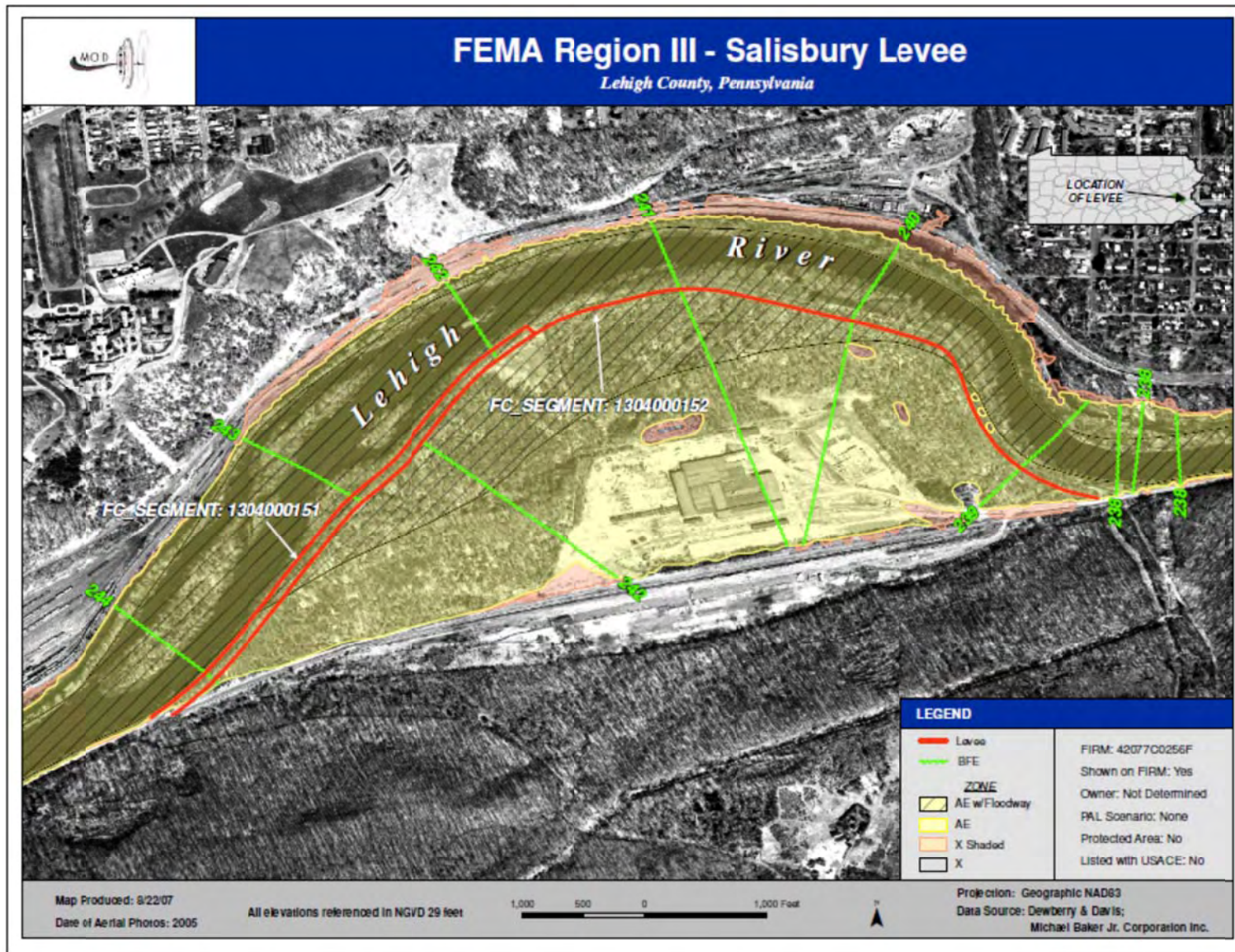


Figure 4.3.1-3. Allentown-Jordan Creek Floodwall

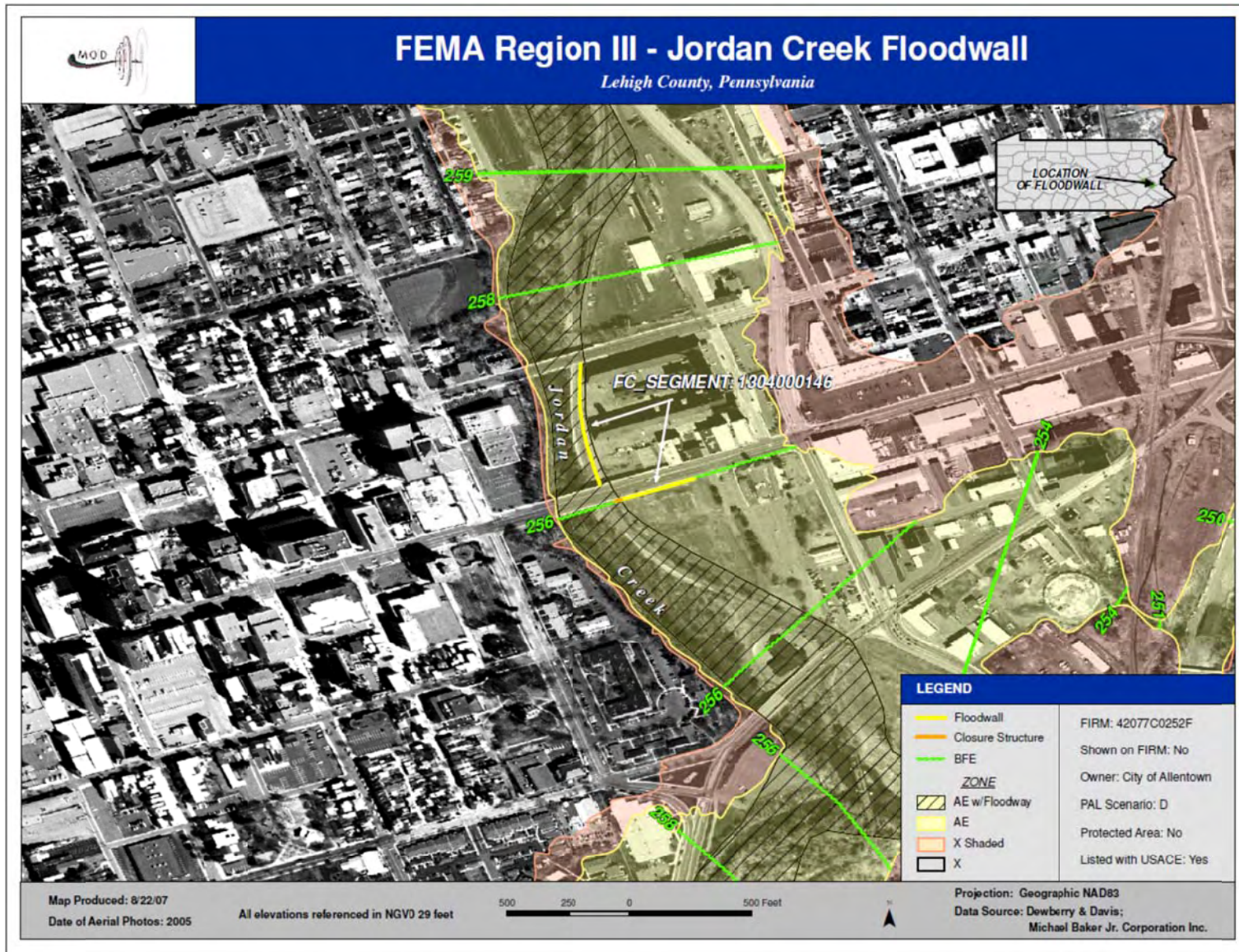
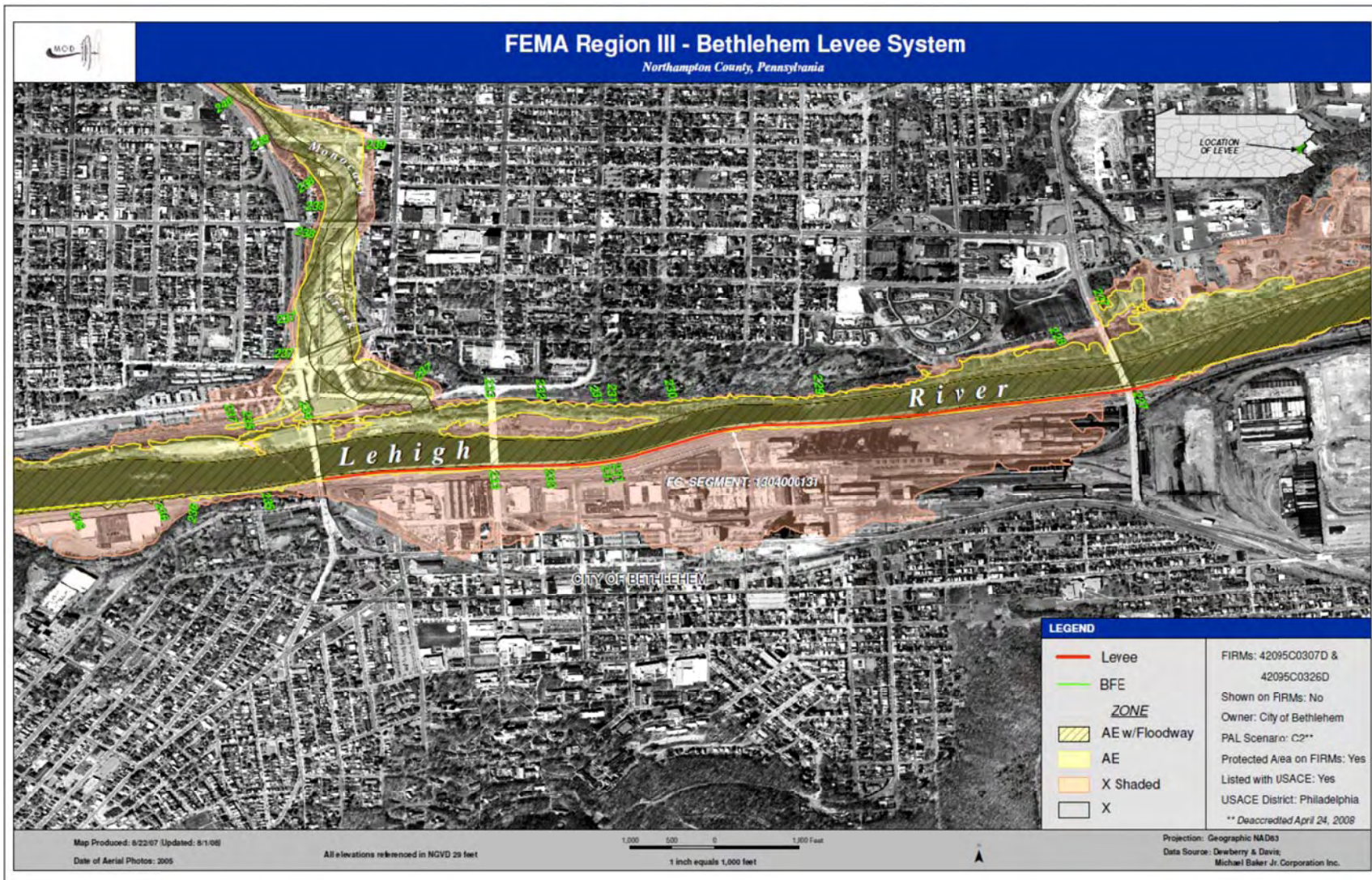


Figure 4.3.1-4. Bethlehem Levee System



4.3.17.2 Range of Magnitude

Failure of the Allentown (Sewer Treatment Plant) Levee or the Salisbury Levee would affect only the individual facilities that they protect- the Allentown Sewer Treatment Plant and the Lehigh County Men’s Community Correction Center, respectively. Flooding of the Allentown Sewer Treatment Plant would affect a large number of people in the area in and around the City of Allentown (Allentown). It would likely result in widespread contamination of the floodwaters and, potentially, the drinking water supply (e.g., if contamination from the sewer plant reached a drinking water system intake). The public may be advised to boil water before using it to drink or cook (i.e., “boil water advisories”). Additional limitations on water usage may also be issued. Flooding of the Men’s Community Correction Center would impact the center’s population of 300 and staff; evacuation of the facility may be necessary.

Neither the Jordan Creek Floodwall nor the Bethlehem Levee System is shown on the official Digital Flood Insurance Rate Maps (DFIRMs). That is, flood zones on the DFIRMs do not account for the levees’ existence. Therefore, if they failed during the 1 percent annual chance flood, the floodwaters would reach the areas shown on the DFIRMs as being within the 1 percent annual chance floodplain. Either of these levees failing is considered a worst-case scenario. See Section 4.3.4 for a description of flood events in the Lehigh Valley.

4.3.17.3 Past Occurrence

There have been no levee failures in the Lehigh Valley.

4.3.17.4 Future Occurrence

The probability of a levee failure in the Lehigh Valley cannot be determined, but based upon the Risk Factor Methodology Probability Criteria, is considered to be *unlikely*. Should the Jordan Creek Floodwall or the Bethlehem Levee System fail during the 1 percent annual chance flood, the floodwaters would reach the areas shown on the DFIRMs as being within the 1 percent annual chance floodplain. See Section 4.3.4 for further discussion of the 1 percent annual chance floodplain.

4.3.17.5 Vulnerability Assessment

The impact of the existence of the Jordan Creek Floodwall and the Bethlehem Levee System is not reflected on the DFIRMs, so the areas, structures, and population vulnerable to the failure of these levees cannot be determined. Failure of these levees during the 1 percent annual chance flood would result in the floodwaters reaching the areas shown on the DFIRMs.

Failure of the Allentown (Sewer Treatment Plant) Levee would result in the inundation and failure of the Allentown Sewer Treatment Plant. Thousands of residences, businesses, and other facilities that depend on that plant for service would be affected, and “boil water advisories” and water usage limitations would likely be imposed.

Failure of the Salisbury Levee would result in the inundation of the Lehigh County Men’s Community Correction Center. Evacuation of the facility’s staff and 300 inmates may be required.

4.3.18 Mass Gathering

4.3.18.1 Location and Extent

The Lehigh Valley is home to numerous regularly scheduled and unscheduled gatherings of large numbers of individuals. A mass gathering of individuals may range from peaceful assembly of populations that join for a common cause, to large groups of people seeking to form a protest against or disrupt any jurisdictional or agency function. The scope of gatherings within the Lehigh Valley varies widely based on the group, intent, and location within the region. Within the region, pre-planned events such as sports gatherings, college ceremonies, and public festivals draw large numbers of individuals that are considered mass gathering events. Additionally, the location of government facilities, new construction, and higher educational institutions within the region may draw the attention of protest organizations looking to voice their message and/or disrupt local operations. These facilities are generally located within the larger, more urban environments found within the City of Allentown, City of Bethlehem, and City of Easton.

4.3.18.2 Range of Magnitude

Mass gatherings range from small groups of individuals joined together with a common purpose to large quantities of individuals intent on disruption of services, access, and/or operations. These gatherings generally range from annual planned events such as jurisdictional festivals, sporting events, and college graduations to peaceful or violent assemblies of large numbers of individuals.

In 2011, Lehigh University rented their facilities out to a company that hosted a rave party for the college students. During the event, a student became ill, followed by numerous others. Local responders quickly arrived and determined the event to be a Mass Casualty Event (MCE). In total 44 students were transported from the event and taken to local hospitals for a variety of injuries and illnesses.

4.3.18.3 Past Occurrence

The Lehigh Valley is home to annual pre-planned events that meet the criteria set forth by the Pennsylvania Department of Health as a mass gathering. The list of events shown in Table 4.3.18-1 is a partial compilation of annual events that draw large numbers of individuals together with peaceful intent. Due to the number of events being hosted by each jurisdiction throughout the Lehigh Valley, a full listing of events is unable to be maintained. The information identified below was provided by the County Emergency Management Agencies, and was noted to be events that require assistance from county and municipal agencies due to location and number of attendees.

Table 4.3.18-1. Mass Gathering Pre-Planned Events

County	Jurisdiction	Event	Date	Estimated Population
Lehigh	Allentown	DCI Eastern Classic	August	Unknown
Lehigh	Allentown	Coca-Cola Stadium	Varies	seating up to 10,000
Lehigh	Allentown	Great Allentown Fair	August	Unknown
Lehigh	Allentown	Mayfair Festival of Arts	Memorial Day Weekend	Unknown
Lehigh	Allentown	Coca-Cola (Iron Pigs)	Up to 88 Games	Seating up to 10,000
Lehigh	Allentown	Ag Hall Events	Year Round	Unknown
Lehigh	Breinigsville	Valley Preferred Cycling Center	Weekly	Up to 2,000
Lehigh	Cementon	Cementon Fair	June	Unknown
Lehigh	Macungie	Paws for Fun Pet Festival	October	Unknown
Lehigh	Macungie	Truck Show	June	Unknown
Lehigh	Macungie	Das Awkscht Fest	August	Unknown
Lehigh	Macungie	Wheels of Time Car Show	August	Unknown
Lehigh	Macungie	Lehigh & Berks County Dog Show	September	Unknown
Lehigh	Schnecksville	Schnecksville Community Fair	June	Unknown
Lehigh	Upper Saucon	2003 US Woman's Open	9-Jun	Unknown
Lehigh	Varies	Lehigh Valley Sportsfest	Varies	Unknown
Northampton	Bethlehem	Musik Fest	August	Unknown
Northampton	Bethlehem	Eagles Football Camp	June	Unknown

Source: Pennsylvania Emergency Incident Reporting System (PEIRS); Knowledge Center, County 9-1-1 Databases

Past occurrences of non-planned gatherings within the Lehigh Valley have been for the most part peaceful, with only one incident being associated with any type of violence. Table 4.3.18-2 below is a list of non-planned mass gatherings of individuals as provided by the County Emergency Management Agencies.

Table 4.3.18-2. Non-planned Mass Gatherings

County	Jurisdiction	Event	Date	Estimated Population
Lehigh	Allentown	Anti-War protestor group at the Courthouse	7-Feb	Unknown
Lehigh	Allentown	Disruption of traffic due to a local march for "Day without immigrants"	6-May	400
Lehigh	Allentown	Occupy Allentown	Fall/Winter 2011	Unknown
Lehigh	North Whitehall	Riot (Large group of juveniles fighting)	7-Jul	30-40
Northampton	Bethlehem	Occupy Bethlehem	Fall/Winter 2011	Unknown

Source: Pennsylvania Emergency Incident Reporting System (PEIRS); Knowledge Center, County 9-1-1 Databases

4.3.18.4 Future Occurrence

Based upon the Risk Factor Methodology Probability Criteria, the likelihood of a pre-planned mass gathering is considered “*Highly Likely*” due to the annual scheduling of jurisdictional events throughout the Lehigh Valley. Mass gathering incidents, or events that are not planned and are based solely on the public uprising, are considered “*Unlikely*” (see Table 4.3.18-3).

Table 4.3.18-3. Likelihood of Future Occurrences of Mass Gathering

County	Avg. #/Year	% Probability	Category
Pre-Planned Events			
Lehigh	15+	100	Highly Likely
Northampton	3+	100	Highly Likely
Non-planned Mass Gathering Incidents			
Lehigh	<1	30%	Unlikely
Northampton	<1	10%	Unlikely

Source: PEIRS; Knowledge Center, County 9-1-1 Databases

4.3.18.5 Vulnerability Assessment

The vulnerability of a jurisdiction to a non-planned mass gathering is difficult to measure due to the unknown target or topic that is causing the group to gather. Past occurrences have led to little if any loss measured by financial or property damage.

Pre-planned events are generally coordinated with local jurisdictions, response agencies, and county agencies to ensure the safety of the jurisdiction, county, and the general public attending. Costs associated with loss due to damage or other adverse incidents during or related to the event are generally covered by the organization hosting the event. Pre-planned or non-planned events may result in road closures, which in turn may delay the provision of emergency services.

4.3.19 Nuclear Incident

4.3.19.1 Location and Extent

Within the Commonwealth of Pennsylvania, there are five nuclear power generation stations. The Limerick Generation Station (LGS) and the Susquehanna Steam Electric Station (SSES) are both located outside the Lehigh Valley, but maintain a 50-mile ingestion exposure pathway that includes parts of the region. LGS is located in central Montgomery County, to the south of the Lehigh Valley, and SSES is located in Luzerne County to the northwest of the Lehigh Valley region. LGS maintains two Mark 2 reactors producing 2,345 MW of electricity while SSES maintains two Boiling Water direct cycle reactors producing 2,600 MW of electricity.

Within the Lehigh Valley, both Lehigh and Northampton Counties maintain the classification of Support County for both the LGS and SSES facilities. The Support County status is reserved for counties that fall within the 50-mile ingestion pathway of the nuclear facility. This classification brings along a variety of responsibilities including planning, training, exercise and facility support. Both Lehigh and Northampton Counties maintain nuclear planning annexes to their emergency operations plan (EOP), train regularly, and complete exercise programs set forth by state and federal entities. Lehigh County, in support of LGS, maintains two reception centers designed to provide residential population monitoring and decontamination. In addition to these two Lehigh County locations, the regional trauma center provides medical decontamination for the general public and emergency workers. These medical services require additional annual training and exercise programs.

4.3.19.2 Range of Magnitude

As per regulations, set forth by the Federal Emergency Management Agency (FEMA) and the Nuclear Regulatory Commission (NRC), all facilities are required to notify jurisdictional agencies of an incident or occurrence within the facility. The Pennsylvania Emergency Management Agency (PEMA), in coordination with the facility owners, has established the following notification levels that are based upon an internal trigger. The Emergency Alert Levels are as follows:

- Unusual Event
- Alert
- Site Area Emergency
- General Emergency

Definitions, as per the NRC, are provided below.

- **Unusual Event** - Under this category, events are in process or have occurred which indicate potential degradation in the level of safety of the plant. No release of radioactive material requiring offsite response or monitoring is expected unless further degradation occurs.
- **Alert** - If an alert is declared, events are in process or have occurred which involve an actual or potential substantial degradation in the level of safety of the plant. Any releases of radioactive material from the plant are expected to be limited to a small fraction of the Environmental Protection Agency (EPA) protective action guides (PAGs).
- **Site Area Emergency** - A site area emergency involves events in process or which have occurred that result in actual or likely major failures of plant functions needed for protection of the public. Any releases of radioactive material are not expected to exceed the EPA PAGs except near the site boundary.

- **General Emergency** - A general emergency involves actual or imminent substantial core damage or melting of reactor fuel with the potential for loss of containment integrity. Radioactive releases during a general emergency can reasonably be expected to exceed the EPA PAGs for more than the immediate site area (USNRC, 2012).

The southern and northern regions of the Lehigh Valley are closest in proximity to the LGS and SSES facilities, but fall well outside the prescribed 10-mile emergency planning zone (EPZ) or evacuation area for either facility. In the event of an incident within either of the locations, the Lehigh Valley would become a temporary staging location for the hundreds of thousands of residents seeking safety outside the 10-mile emergency planning zone. Additionally, jurisdictions found within the 50-mile ingestion exposure pathway could receive deposits of radioactive particles on crops, bodies of water and ground surfaces, rendering local agricultural harvest unusable for consumption by either humans or livestock.

4.3.19.3 Past Occurrence

While no fixed facility nuclear emergencies have occurred in the Lehigh Valley, Pennsylvania is home to the only recorded nuclear emergency in the U.S. In 1979, the Three Mile Island Nuclear Generating Station declared a General Emergency following an internal system failure. The repercussions from this event were swift, with sweeping changes of the NRC oversight to include FEMA for outside support. The growing nuclear power industry immediately reversed course with the number of facilities decreasing over the next decade. In addition, public confidence in the nuclear industry was greatly impacted.

While reports show conflicting information on the medical impact on the residential population following the disaster, fiscal data from the cleanup phase of this incident exceeded \$1 billion.

4.3.19.4 Future Occurrence

Within the United States, the low frequency of fixed facility nuclear incidents that elevate above the Alert Level proves the stability of the industry. Based upon the Risk Factor Methodology Probability Criteria, probability of an incident at the LGS or SSES facilities is classified as *unlikely*. In addition, Pennsylvania Power and Light (PPL), the parent company to LGS and SSES, continues to improve systems within the facility to provide additional safeguards to the jurisdictions that could be impacted by an incident, as outlined by Exelon in October 2011 (Exelon Generation, 2011).

4.3.19.5 Vulnerability Assessment

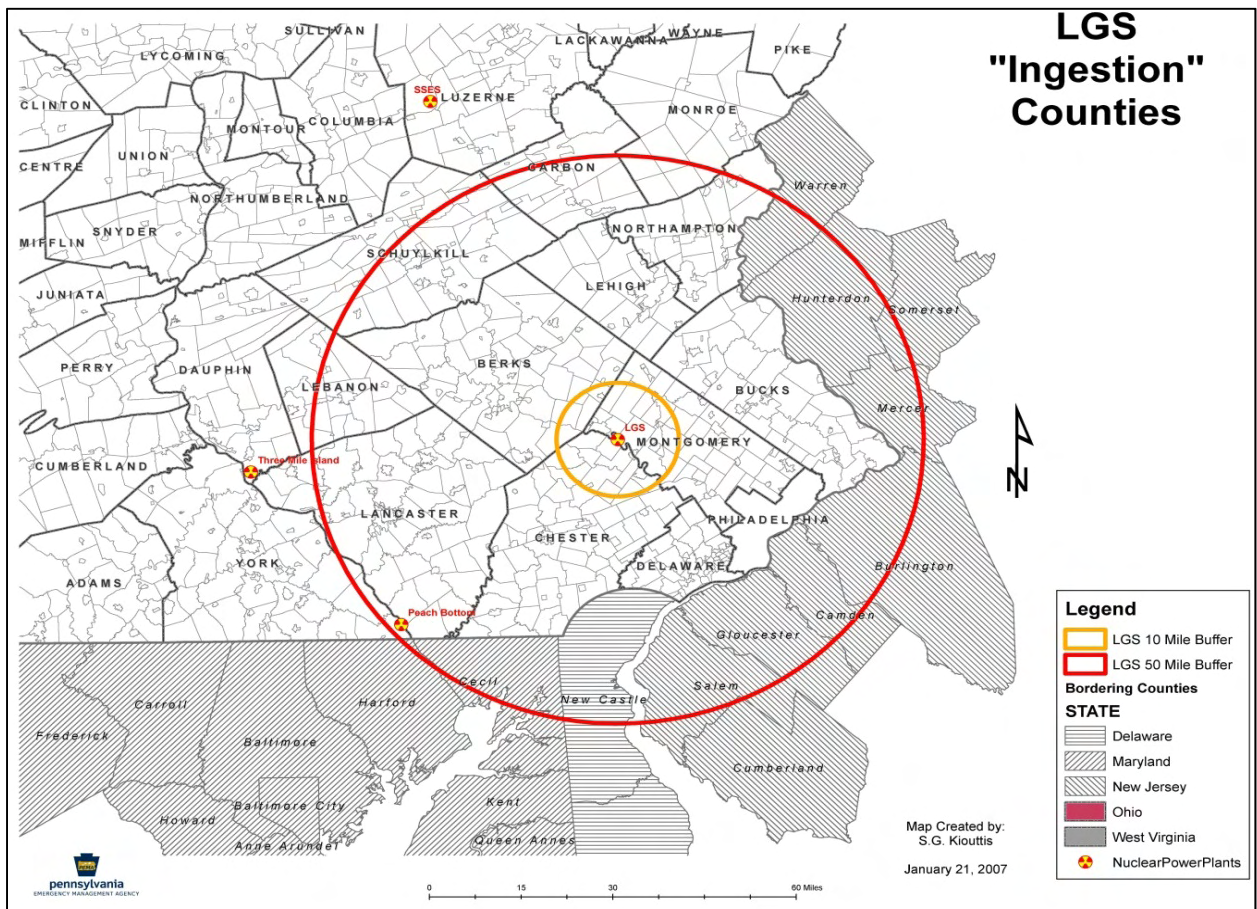
The effects from a radiological incident at a fixed facility will vary based upon the product being released (type of radiation), the quantity released, the current weather conditions, and the time of day. The priority following an incident at any of the facilities within the Commonwealth of Pennsylvania is the life and safety of all individuals within the area impacted. Secondary to health and safety will be the impact on critical infrastructure, environment, property and the economy.

Contamination of agriculture, livestock, and production can lead to the loss of commerce with other regions of the state, country and even the world. The loss of commerce could compound an already struggling Lehigh Valley economy. Recently, many countries halted the importing of products from Japan for fear of contamination following the tsunami-related nuclear incident at the Fukushima Power Plant. This loss in revenue compounded the loss the country and region were already feeling following the initial disaster.

Impacts within the affected area can include loss of utility service, contamination of local crops and livestock, loss of residential property due to measurable quantities of nuclear materials, and increased risk to health and well-being of individuals within the area.

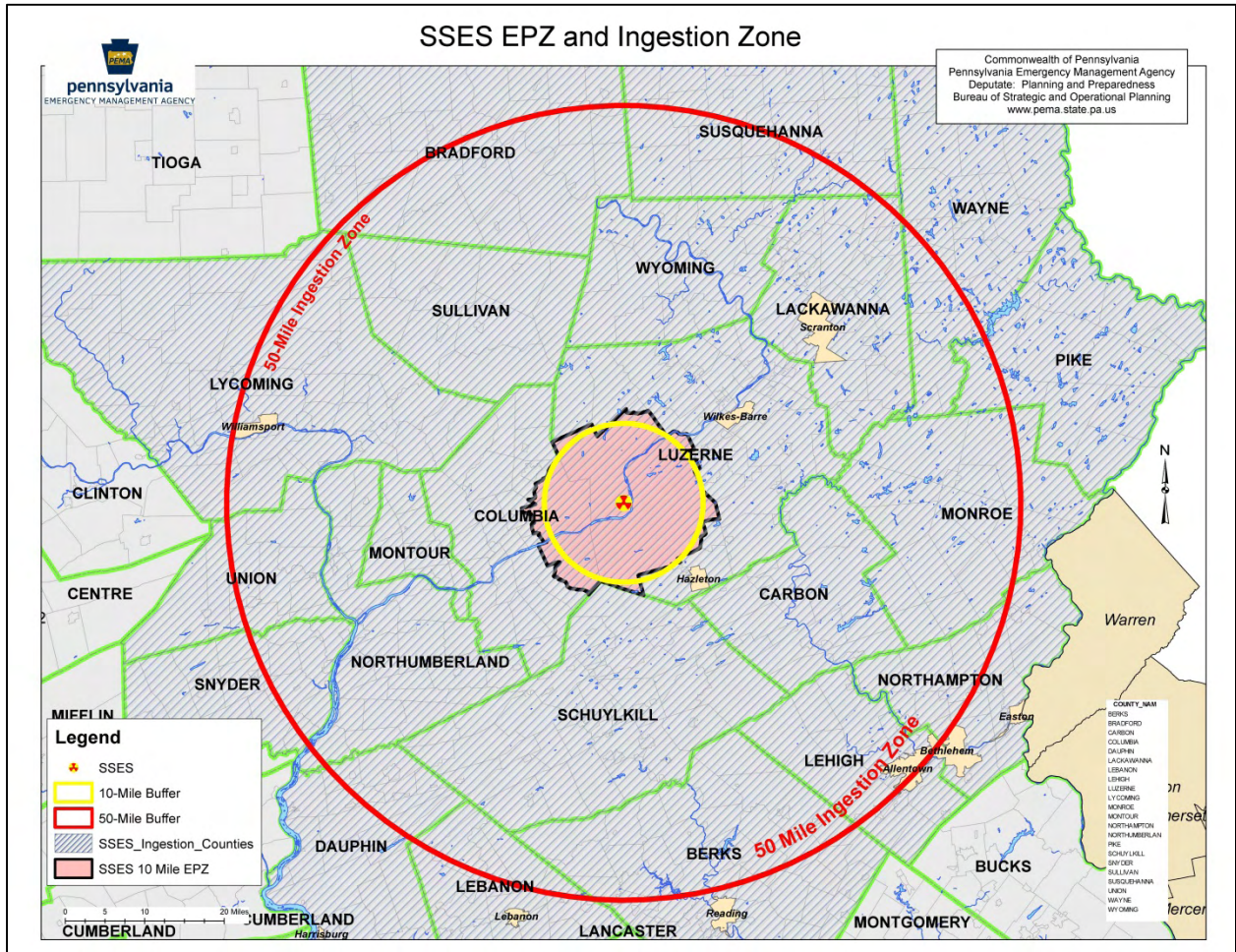
Figure 4.3.19-1 and Figure 4.3.19-2 provide visual representations of the jurisdictions that fall within the 10-mile EPZ and 50-mile ingestion zones. These jurisdictions, due to proximity to LGS and SSES, have the greatest vulnerability to an incident within the facility.

Figure 4.3.19-1. Jurisdictions within 50 Mile Ingestion Zone



Source: Exelon Corporation, LGS Emergency Preparedness Coordinator

Figure 4.3.19-2. SSES EPZ and Ingestion Zone



Source: Pennsylvania Emergency Management Agency

SECTION 4.3.19: RISK ASSESSMENT – NUCLEAR INCIDENT

The following jurisdictions within Lehigh County are found within the 50-mile ingestion zone for the Limerick Generation Station:

- City of Allentown
- City of Bethlehem
- Alburtis Borough
- Emmaus Borough
- Catasauqua Borough
- Coopersburg Borough
- Coplay Borough
- Fountain Hill Borough
- Macungie Borough
- Slatington Borough
- Hanover Township
- Heidelberg Township
- Lower Macungie Township
- Lower Milford Township
- Lowhill Township
- Lynn Township
- North Whitehall Township
- Salisbury Township
- South Whitehall Township
- Upper Macungie Township
- Upper Milford Township
- Upper Saucon Township
- Washington Township
- Weisenberg Township
- Whitehall Township

The following jurisdictions within Northampton County are found within the 50-mile ingestion zone for the Limerick Generation Station:

- City of Bethlehem
- City of Easton
- Bangor Borough
- Bath Borough
- Chapman Borough
- East Bangor Borough
- Freemansburg Borough
- Glendon Borough
- Hellertown Borough
- Nazareth Borough
- North Catasauqua Borough
- Northampton Borough
- Pen Argyl Borough
- Roseto Borough
- Stockertown Borough
- Tatamy Borough
- Walnutport Borough
- West Easton Borough
- Wilson Borough
- Wind Gap Borough
- Allen Township
- Bethlehem Township
- Bushkill Township
- East Allen Township
- Forks Township
- Hanover Township
- Lehigh Township
- Lower Mount Bethel Township
- Lower Nazareth Township
- Lower Saucon Township
- Moore Township
- Palmer Township
- Plainfield Township
- Upper Nazareth Township
- Washington Township
- Williams Township

SECTION 4.3.19: RISK ASSESSMENT – NUCLEAR INCIDENT

The following jurisdictions within Lehigh County are found within the 50-mile ingestion zone for the Susquehanna Steam Electric Station:

- Alburtis Borough
- City of Allentown
- City of Bethlehem
- Catasauqua Borough
- Coplay Borough
- Hanover Township
- Heidelberg Township
- Lowhill Township
- Lower Macungie Township
- Lynn Township
- Macungie Borough
- North Whitehall Township
- Salisbury Township
- Slatington Borough
- South Whitehall Township
- Upper Macungie Township
- Washington Township
- Weisenberg Township
- Whitehall Township

The following Jurisdictions within Northampton County are found within the 50-mile ingestion zone for the Susquehanna Steam Electric Station:

- Allen Township
- Bath Borough
- Bethlehem City
- Bushkill Township
- Chapman Borough
- East Allen Township
- Hanover Township
- Lehigh Township
- Lower Nazareth Township
- Moore Township
- Northampton Borough
- North Catasauqua Borough
- Nazareth Borough
- Pen Argyl Borough
- Plainfield Township
- Upper Nazareth Township
- Walnutport Borough
- Wind Gap Borough

The above listed jurisdictions maintain numerous locations considered critical infrastructure. Within the Lehigh Valley, critical infrastructure can be found within Section 2 of this Plan Update.

In response to the vulnerability, both Lehigh County and Northampton County maintain a radiological emergency response plan. This plan is written in accordance with the regulations set forth by the NRC and PEMA. The plan addresses actions that are to be taken to mitigate and respond to a possible radiological release. In support of the radiological response plan, both Lehigh and Northampton Counties participate in a variety of exercises designed to validate the planning found within the county documents. These exercises run once every two years for support counties within the 10-mile EPZ, with an additional ingestion exercise run every five years for all counties within the 50-mile ingestion zone. In addition to these exercise programs, Lehigh County participates annually in the Medical Service Agreement (MS-1) radiological decontamination-training program.

The MS-1 program provides classroom and practical training to emergency medical services in areas of decontamination and patient handling. Additionally, the MS-1 designated hospitals receive two training sessions focusing in on proper patient management and levels of care. At the completion of these training programs each year, the staff at both the hospital and EMS agency is provided with the opportunity to validate plans, policies, and training levels through a full-scale exercise program. The exercise is federally evaluated once every seven years with the remaining six years being evaluated by PEMA.

4.3.20 Terrorism

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). Terrorism is less about causing physical damage and injuries/fatalities as it is creating fear in the population. This fear may result in a key policy being changed or business operations (e.g., logging) to cease. Terrorism may include the use of weapons of mass destruction (WMD), including chemical, biological, radiological, nuclear, and high-yield explosive weapons; armed attacks; industrial sabotage; cyber terrorism; and other means. There may be significant variation even within these general categories, especially in the areas of chemical and biological weapons.

4.3.20.1 Location and Extent

Terrorism could occur at any location in the Lehigh Valley, depending on the terrorist group’s agenda. Any facility is vulnerable, as terrorists have historically sent chemical or biological agents through the mail. High-risk targets include local, county, state, or federal government facilities; major venues and gathering places; sites with historic, cultural, or other significance; key infrastructure; etc. Damage to or disruption of operations at government facilities could have a profound impact on the Lehigh Valley’s population, even if the terrorism event is relatively small-scale.

4.3.20.2 Range of Magnitude

The magnitude of a terrorism event depends on the scale of the attack, population involved, equipment and other key assets affected, and duration of the incident or exposure to the agent used. In the Lehigh Valley, terrorist attacks could vary from a mere threat to an individual facility to the use of a high-yield explosive or other device in a major urban area. The former is far more common in the Lehigh Valley, with bomb threats being the most prevalent form of terrorism (see Past Occurrence section).

The worst case scenario for a terrorism event in the Lehigh Valley would be a high-yield “dirty bomb” detonating in a major urban area on a weekday. The blast itself would damage buildings and infrastructure, ignite fires, and cause large numbers of casualties and fatalities. Additional individuals, including emergency responders, would then be exposed to radiation for a time after the event.

4.3.20.3 Past Occurrence

The Lehigh Valley has experienced frequent domestic terror threats. Bomb threats, especially school bomb threats, are the most common terrorist event to occur in the Lehigh Valley, with 179 bomb threats reported since 2001. Suspicious devices, packages, substances, etc. together are a close second, with 175 instances since 2001. Table 4.3.20-1 shows the number of terrorist acts in the Lehigh Valley since 2001.

Table 4.3.20-1: Terrorist Events Since 2001

Event	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total	Average
Bomb/Explosives		1		1		1				9	9	21	2
Bomb Threat	29	14	8	8	16	23	27	26	11	11	6	179	16
Suspicious Activity		2	1			2	3	2	2	2	2	16	1
Suspicious Device/ Package/ Substance	73	6	9	4	2	11	5	9	4	8	44	175	16
Threatening/ Barricaded Subject; Hostage situation	2	2	1	1		1	3		3		5	18	2

4.3.20.4 Future Occurrence

The Lehigh Valley does not contain any sites with national symbolism (e.g., the Statue of Liberty), therefore the likelihood of a national-level terrorist attack is *unlikely*. However, based upon the Risk Factor Methodology Probability Criteria the overall likelihood of a localized terrorist attack is *highly likely*. As shown in Table 4.3.20-1, above, the Lehigh Valley can expect almost 20 bomb threats alone each year. Terrorist events in the Lehigh Valley will continue to occur frequently at local schools and government facilities. Lehigh and Northampton Counties have each identified several facilities in the following categories as being vulnerable to terrorism:

- Government facilities
- Major public venues
- Commercial facilities/centers
- Utilities and other critical infrastructure
- Educational facilities
- Tourist attractions

Due to the sensitive nature of this information, specific facility names are not being included in this HMP.

4.3.20.5 Vulnerability Assessment

As stated above, the Lehigh Valley does not have facilities, buildings, or landmarks that are more likely to be targeted than other areas in the country. However, there are several colleges and universities, a major amusement park, and a minor league baseball stadium that could be considered potential targets for local terrorist activity. These facilities, as well as any of the critical infrastructure in the Lehigh Valley, are vulnerable to terrorist attacks. The degree to which they are vulnerable is assessed at the facility level by facility owners and/or local law enforcement.

To reduce their vulnerability to terrorism hazards, Lehigh and Northampton Counties belong to the Northeast Pennsylvania Regional Counterterrorism Task Force (NEPARCTTF), a group of eight counties that collaborate to prevent, protect against, prepare for, respond to, recover from, and mitigate against terrorism and other hazards on a regional level. The NEPARCTTF, like the other regional task forces in Pennsylvania, is funded by the Pennsylvania Emergency Management Agency (PEMA) using the U.S. Department of Homeland Security’s Homeland Security Grant Program’s State Homeland Security Program (SHSP). The counties of the NEPARCTTF, including Lehigh and Northampton Counties, use this funding to conduct emergency planning, training, and exercise activities, and to purchase equipment to reduce the region’s vulnerability to terrorism.

Additionally, the counties may use funding received by the respective counties' Local Emergency Planning Committees (LEPCs) to decrease their vulnerability to chemical hazards, which may be used by terrorists to conduct attacks. LEPCs are bodies of public safety, government, education, and industry representatives that maintain awareness of the chemical hazards in their jurisdictions. They receive fees from chemical facilities and help to administer the counties' chemical preparedness programs through development of off-site emergency response plans and oversight of the counties' hazardous materials response teams (HMRTs). The Lehigh Valley is serviced by the Lehigh County Special Operations Team, with the exception of the City of Allentown, which provides hazardous materials response through the City of Allentown Fire Department. The City of Bethlehem Fire Department also provides hazardous materials response in the City of Bethlehem (PEIRS, 2012).

4.3.21 Transportation Accident

Transportation accidents described herein include incidents involving road, air, and rail travel. Effects of the release of hazardous materials due to any of these accidents are described in the Environmental Hazard profile (Section 4.3.15).

4.3.21.1 Location and Extent

Major roadways in the Lehigh Valley include I-78, I-476, the US-22 corridor, US-222, and PA Routes 29, 33, 100, 143, 145, 309, 329, 378, 863, 873, and 987. The Lehigh Valley has over 4,000 miles of roadways, split as shown in Table 4.3.21-1.

Table 4.3.21-1: Lehigh Valley Transportation Network

Category	Miles
Interstate Highway	57
Freeways/Expressways	35
Principal Arterials	188
Minor Arterials	223
Major Collectors	419
Minor Collectors	106
Local Roads	3,015
Total	4,044

Source: PennDOT, Pennsylvania Highway Statistics, 2010 Highway Data

Transportation accidents can occur at any point along these roadways, with many occurring at the intersection of two or more roadways. A regional study has been conducted to identify high priority traffic safety locations. Table 4.3.21-2 and Figure 4.3.21-1 show these locations (LVPC, 2011).

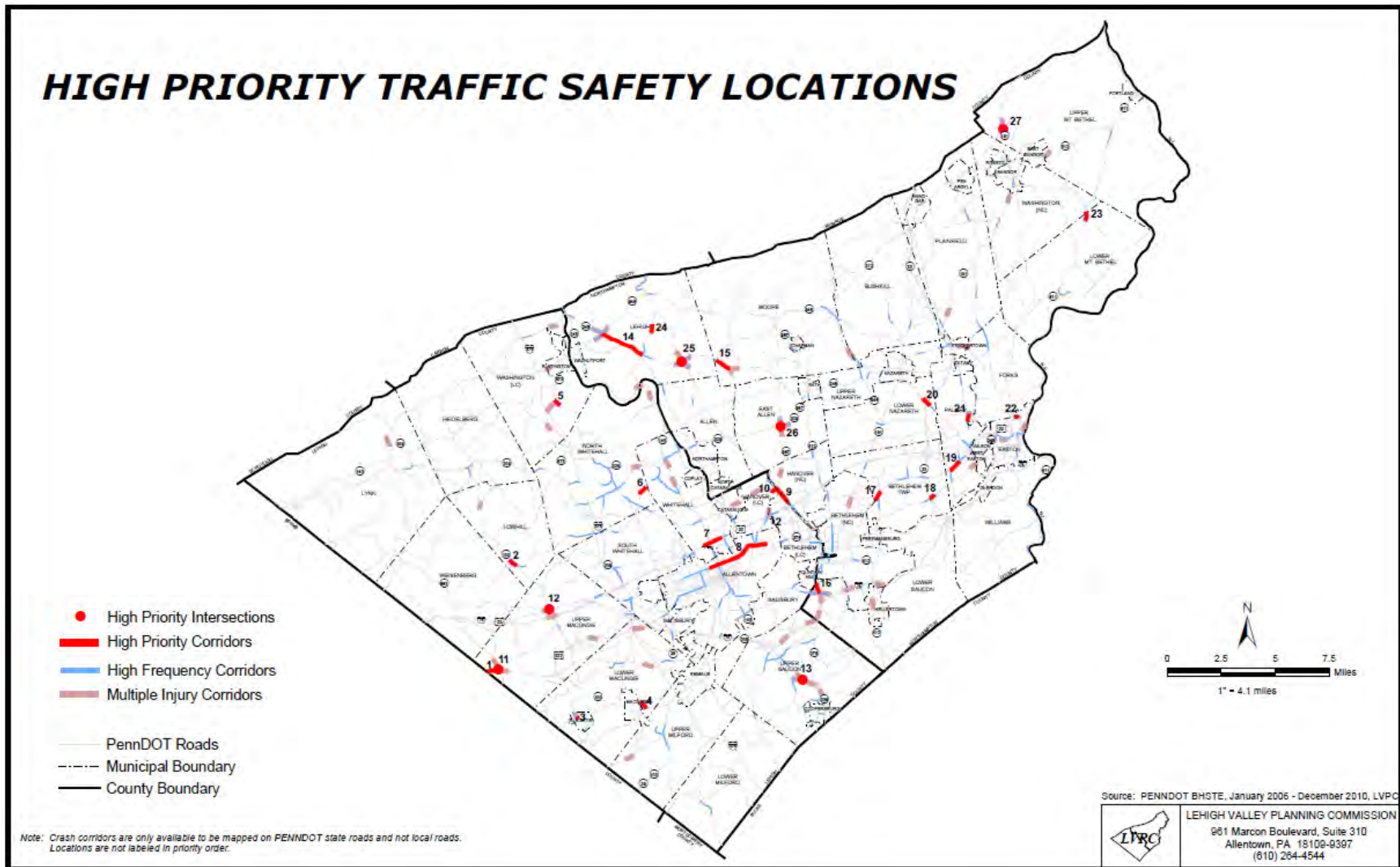
Table 4.3.21-2: High Priority Traffic Safety Locations

Name	From	To	Municipality
LEHIGH COUNTY			
<i>Corridors</i>			
Route 222	Berks County line	Route 863	Upper Macungie Township
Route 100	Windy Road	Kernsville Road	Lowhill Township
North Main Street	East Penn Avenue	East 2 nd Street	Alburtis Borough
Brookside Road	Indian Creek Road	Buckeye Road	Lower Macungie Township
Old Post Road	Route 873	Rip Court	Washington Township (L)
Willow Street	Shelby Drive	Bridge Street	North Whitehall Township
Route 22	Mickley Road	Fullerton Avenue	Whitehall Township
Union Boulevard/Tilghman Street	North Plymouth Street	North 11 th Street	City of Allentown
Schoenersville Road	Industrial Drive	Airport Road	City of Bethlehem/Hanover Township (L)
Airport Road	Grove Road	Schoenersville Road	Hanover Township (L)

SECTION 4.3.21: RISK ASSESSMENT – TRANSPORTATION ACCIDENT

Name	From	To	Municipality
Intersections			
Schantz Road/Route 863			Upper Macungie Township
Route 100/Tilghman Street			Upper Macungie Township
Route 309/Lanark Road			Upper Saucon Township
NORTHAMPTON COUNTY			
Corridors			
Route 248	Blue Mountain Drive	Mountain View Drive	Lehigh Township
Route 248	Valley View Drive	Allen Drive	Moore Township
Route 378	Kohler Drive	Seidersville Road	Lower Saucon Township
Easton Avenue	Butztown Road	5 th Street	Bethlehem Township
Freemansburg Avenue	Route 33	Hope Road	Bethlehem Township
William Penn Highway	Stones Crossing Road	South Greenwood Avenue	Palmer Township
Route 248	Ramp L	Ramp K	Lower Nazareth Township
Tatamy Road	Bushkill Park Drive	Northwood Avenue	Palmer Township
Cattell Street/Knox Avenue	West Lafayette Street	Sullivan Trail	City of Easton
Route 611	Hester Drive	Richmond Road	Lower Mt. Bethel Township/Washington Township (N)
Blue Mountain Drive	Cedar Drive	Wood Drive	Lehigh Township
Intersections			
Route 248/Walnut Drive			Lehigh Township
Route 329/Route 512			East Allen Township
Route 191/Lake Minsi Drive			Upper Mt. Bethel Township

Figure 4.3.21-1: High Priority Traffic Safety Locations



Source: LVPC, 2011



SECTION 4.3.21: RISK ASSESSMENT – TRANSPORTATION ACCIDENT

In addition, in response to the collapse of the I-35W Bridge in Minneapolis in August 2007, PennDOT assessed the structural integrity of all bridges in the Commonwealth. Table 4.3.21-3 shows the total number of bridges in the Lehigh Valley, as well as the number of those that are structurally-deficient (in parentheses). Each structurally-deficient bridge poses a risk for transportation accidents.

Table 4.3.21-3: Bridges in the Lehigh Valley

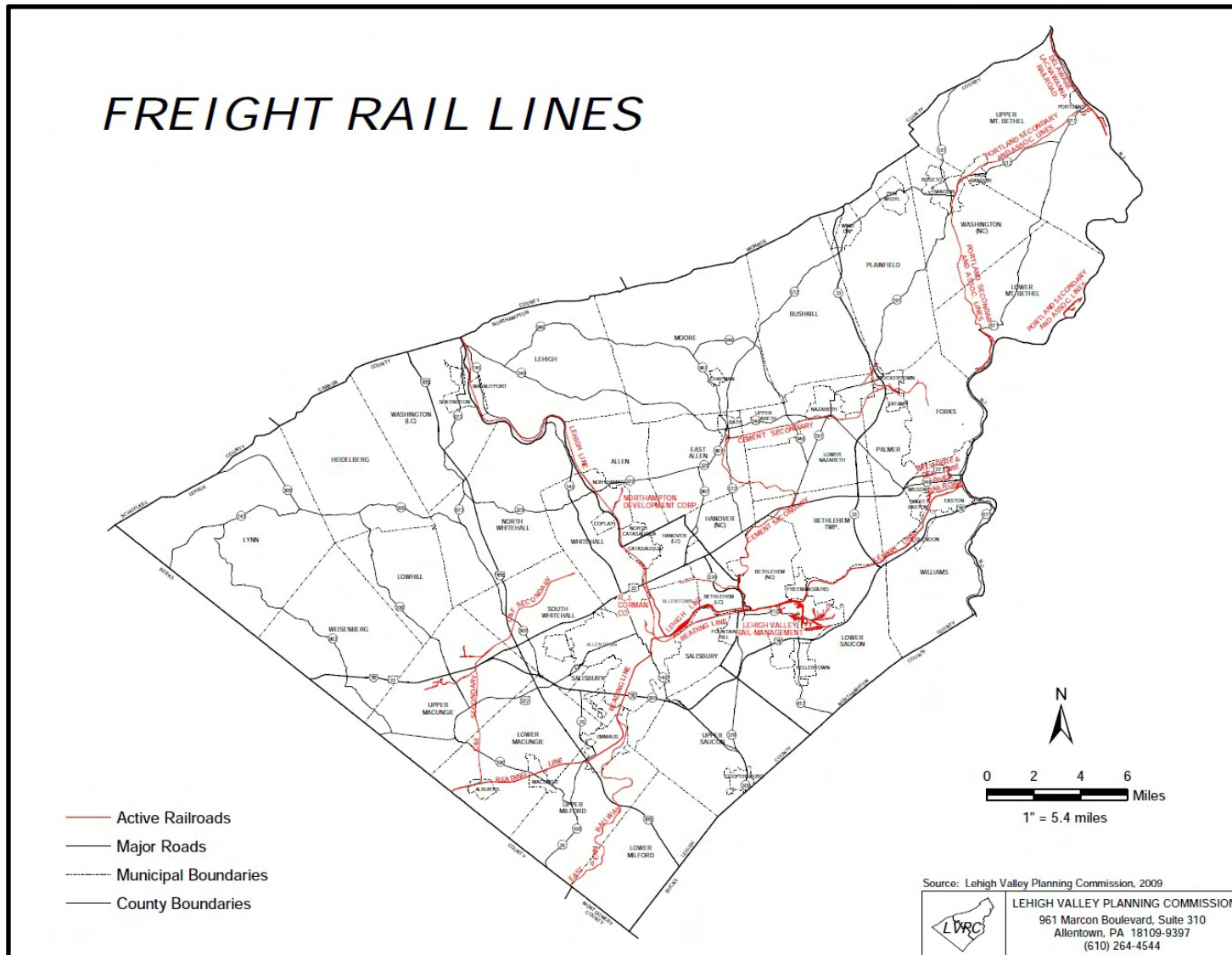
County	On State Roads	On Local Roads
Lehigh	349 (62)	118 (40)
Northampton	310 (63)	131 (24)
Total	659 (125)	249 (64)

Source: PADOT, 2005

As of March 2012, there were 4,813 structurally-deficient bridges throughout Pennsylvania (PADOT, 2005). PennDOT has plans in place to rebuild more than 600 of these by 2014 and beyond. No data regarding the schedule to repair or rebuild the Lehigh Valley's structurally-deficient bridges was available.

No passenger rail service is available in the Lehigh Valley. However, two Class 1 railroads (i.e., large freight railroad companies such as CSX Transportation and Norfolk Southern Railway) and six short line railroads operate within the Lehigh Valley (LVPC, 2010). Figure 4.3.21-2 shows freight rail lines in the Lehigh Valley.

Figure 4.3.21-2: Freight Rail Lines in the Lehigh Valley

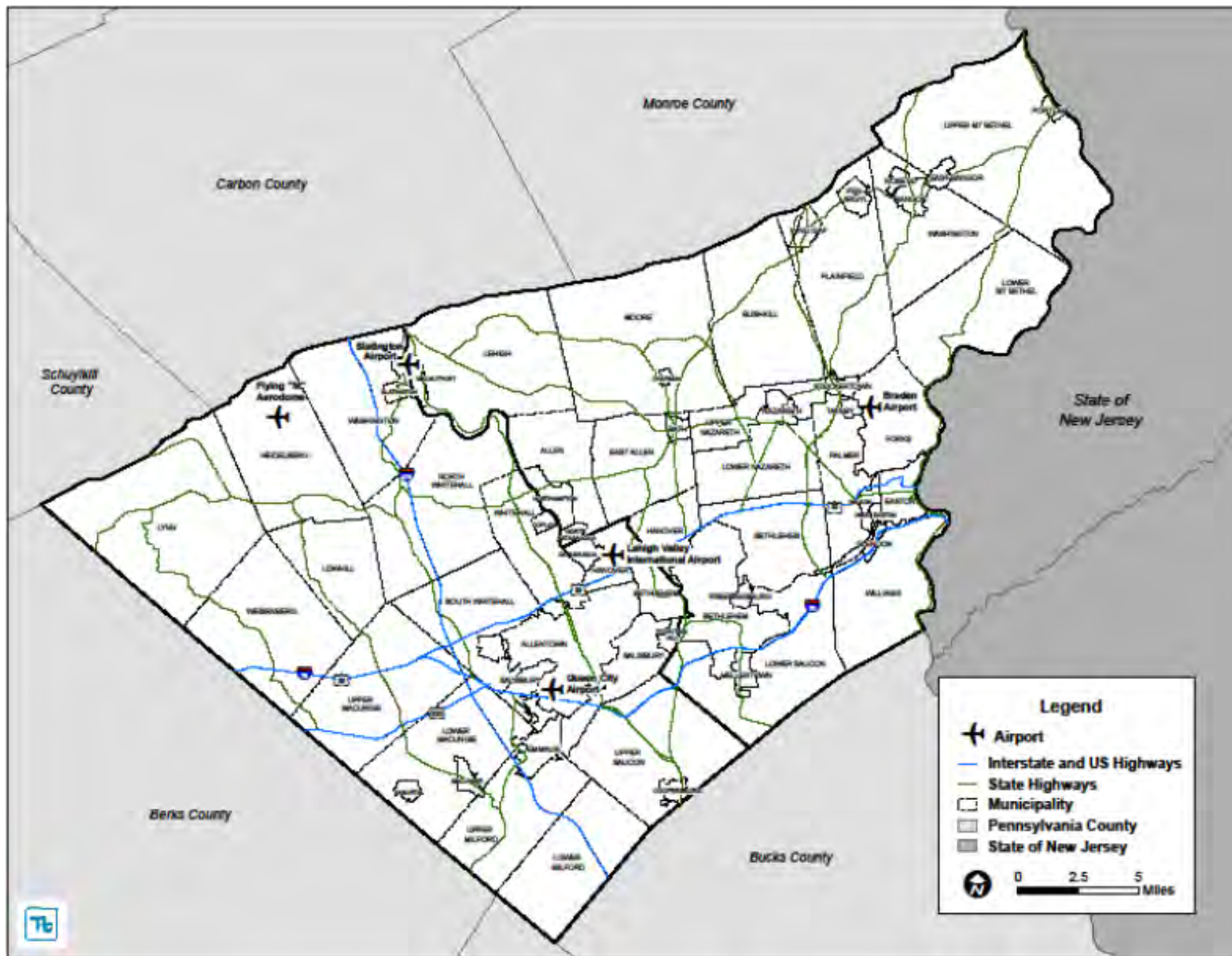


Source: Lehigh Valley Surface Transportation Plan 2011-2030, www.lvpc.org

SECTION 4.3.21: RISK ASSESSMENT – TRANSPORTATION ACCIDENT

There are also several airports in the Lehigh Valley. The most notable is the Lehigh Valley International Airport (LVIA), which provides passenger, cargo, and general aviation services. Other airports in the Lehigh Valley include the Queen City Airport in Allentown, Braden Airpark in Forks Township, the Slatington Airport, and the Flying “M” Aerodrome in Heidelberg Township. Figure 4.3.21-3 shows the locations of these airports. In addition, there are large international airports in Newark, NJ, New York City, NY, and Philadelphia, PA, with associated air traffic patterns in the skies above the Lehigh Valley, which may experience problems in flight and crash in the Lehigh Valley.

Figure 4.3.21-3: Airports in the Lehigh Valley



4.3.21.2 Range of Magnitude

Roadway accidents in the Lehigh Valley range from minor crashes to more serious incidents that involve injuries and/or fatalities, and/or result in the release of hazardous materials (see Section 4.3.15). The Lehigh Valley Planning Commission captured all injuries in the Traffic Safety in the Lehigh Valley 2004-2008 report, but only “major injuries” in the Traffic Safety in the Lehigh Valley 2006-2010 report. Table 4.3.21-4 shows the number of injuries and fatalities from the 54,230 automobile crashes for 2004-2010 (the most current data). Table 4.3.21-5 shows the number of injuries and fatalities of pedestrians from pedestrian/motorist crashes.

Table 4.3.21-4: Injuries and Fatalities from Automobile Crashes

Year	Injuries (Major)	Fatalities
2004	5,969	74
2005	5,865	81
2006	5,949 (198)	71
2007	5,370 (175)	59
2008	4,793 (157)	64
2009	(144)	59
2010	(158)	51
Total	27,946+ (832+)*	459

Sources: Lehigh Valley Planning Commission. *Traffic Safety in the Lehigh Valley 2004-2008*. November 2009; Lehigh Valley Planning Commission. *Traffic Safety in the Lehigh Valley 2006-2010*. December 2011.

Note: * Because of the difference in reported statistics between the two reports covering the time identified, it is not possible to determine exact figures of injuries or major injuries.

Table 4.3.21-5: Injuries and Fatalities of Pedestrians

Year	Injuries (Major)	Fatalities
2004	263	10
2005	266	10
2006	266 (21)	6
2007	240 (10)	7
2008	268 (11)	4
2009	(5)	8
2010	(13)	8
Total	1,303+ (60+)*	53

Sources: Lehigh Valley Planning Commission. *Traffic Safety in the Lehigh Valley 2004-2008*. November 2009; Lehigh Valley Planning Commission. *Traffic Safety in the Lehigh Valley 2006-2010*. December 2011.

Note: * Because of the difference in reported statistics between the two reports covering the time identified, it is not possible to determine exact figures of injuries or major injuries.

Rail accidents fall into three categories (PAHMP, 2010):

- Derailment: an accident in which a train leaves the rails
- Collision: an accident in which a train strikes an object (e.g., another train, vehicle, etc.)
- Other: an accident caused by another reason, such as a fire, explosion, or obstruction of the rails

Rail accidents can vary widely in terms of injuries, fatalities, property damage, and interruption of service, depending on the nature and severity of the accident.

Aircraft accidents can vary from a single-engine aircraft having a “hard landing” and causing damage to the aircraft, to the crash of a small turboprop or jet aircraft, to the crash of a large jet aircraft (e.g., Boeing 727).

The worst-case transportation accident within the Lehigh Valley would be a tractor trailer carrying an extremely hazardous substance (see Section 4.3.15) overturning and suffering a massive release of its cargo on a major roadway; this incident would block traffic on the Lehigh Valley’s major transportation routes, and could threaten the health and safety of individuals on the roadways and in surrounding neighborhoods. In addition, a release could cause the closure of critical facilities in the Lehigh Valley.

4.3.21.3 Past Occurrence

Major accidents are reported by the Lehigh and Northampton County EMA to PEMA. Table 4.3.21-6 shows a summary of these accidents from 2001-2009 (the years for which data is available, 2010-2011 not available). While this reflects the accidents that are reported to the counties and Commonwealth, there are significantly more minor accidents that are not reported. The dramatic increase in accidents from 2006 to 2007 is due to increased reporting of accidents in the state.

Table 4.3.21-6: Summary of Major Accidents

Year	Vehicle Accidents	Bus Accidents	Railroad Incidents	Aircraft Accidents
2001	12	2	2	2
2002	25	1	2	1
2003	26	1	0	0
2004	21	3	3	2
2005	22	10	4	2
2006	35	20	2	0
2007	146	61	4	3
2008	142	40	3	2
2009	102	34	2	1
2010	567			
2011	667			
Total	531+	172+	22+	13+

Source: PEIRS reports 2001-2009; Knowledge Center report 2010-2011

Table 4.3.21-7 summarizes significant transportation accidents in the Lehigh Valley from 2001 through 2011.

Table 4.3.21-7: Accidents of Significance through 2011

Date	Description
3/28/2001	Approximately 40 students were injured when two school busses collided in South Whitehall Township, Lehigh County.
10/28/2003	US-22 was closed in both directions in Bethlehem Township, Northampton County, due to a seven-car accident.
11/9/2004	A school bus in Upper Macungie Township, Lehigh County, carrying 30-40 students was involved in an accident and rolled over. There were several minor injuries on the school bus and the driver of the other car was killed.
6/14/2005	A school bus was involved in an accident in Bethlehem Township, Northampton County. Multiple injuries were reported, and a Level 1 Mass Casualty Incident was declared.
6/23/2005	A single engine aircraft crashed in Moore Township, Northampton County; the pilot was killed.
2/19/2008	A train struck and killed a pedestrian in Emmaus Borough, Lehigh County.
1/10/2009	A train struck a vehicle on PA-100 in Macungie Borough, Lehigh County. Two injuries were reported.
1/26/2009	A student was struck by a school bus in Northampton Borough, Northampton County, and later died from his injuries.

Source: PEIRS reports 2001-2009; Knowledge Center report 2010-2011

4.3.21.4 Future Occurrence

Assuming that transportation accidents are as likely to occur in the future as they have occurred in the past and based on the available data, the Lehigh Valley can expect the following each year:

- Approximately 130 vehicle accidents (the actual number of vehicle accidents in the Lehigh Valley may be much higher, however this figure is based on vehicle accidents captured in PEIRS or Knowledge Center.)
- Approximately 45 bus accidents
- One to two aircraft incidents
- Two to three railroad incidents

Though historical data show two to three railroad incidents each year, the Pennsylvania Department of Transportation’s *Pennsylvania Intercity Passenger and Freight Rail Plan* (February 2010) identifies strategic improvements to Pennsylvania’s rail system, and includes major rail initiatives in the Lehigh Valley. In terms of passenger rail, the plan identifies a possible rail corridor from Harrisburg to New York City through Reading, Allentown, Bethlehem, and Easton. This corridor would also serve to link the individual corridors in eastern Pennsylvania. For rail freight, the Lehigh Valley is part of Norfolk Southern’s Central Corridor, with an intermodal terminal in Bethlehem. When these improvements are made, the Lehigh Valley can expect a major increase in rail traffic, both passenger and freight. All things being equal, increased rail traffic volume will result in an increase in the number of rail accidents.

Based upon the Risk Factor Methodology Probability Criteria, the probability of a transportation accident described above is considered to be *highly likely* (see Table 4.4-1).

4.3.21.5 Vulnerability Assessment

All critical infrastructures in the Lehigh Valley are vulnerable to transportation accidents. This vulnerability is manifested either through direct damage (e.g., a vehicle striking the facility) or through operators being injured or delayed in performing their duties due to congested or closed roadways. In the case of critical transportation infrastructure (e.g., bridges, key highways), the critical infrastructure may be the only property damaged by an accident. In addition, transportation accidents that result in the release of hazardous materials (as discussed in Section 4.3.15) may cause health effects and/or fatalities, depending on the material released.

4.3.22 Utility Interruption

4.3.22.1 Location and Extent

Interruptions in basic utilities (e.g., power, data/telecommunications, water, sewer) can have a detrimental impact on the Lehigh Valley. Utilities that employ above-ground wiring (i.e., power and data/telecommunications) are vulnerable to the effects of other hazards such as high wind, heavy snow, ice, rain, and vehicular accidents.

Utility interruptions occur throughout the Lehigh Valley, but are usually of small scale and short duration. Interruptions are possible anywhere there is utility service. Some utility facilities are especially vulnerable. For instance, water intakes and many water control facilities lie in the 1% annual chance floodplain (National Flood Insurance – Special Flood Hazard Area); a flood of this magnitude may seriously impact water service.

4.3.22.2 Range of Magnitude

No injuries/deaths related to utility interruptions have been reported in the Lehigh Valley, and the total number of people historically affected by these outages is unknown. Generally speaking, the most severe utility interruptions are regional power outages. Regional loss of power affects lighting, HVAC and other support equipment, communications, fire and security systems, and refrigerators, which can, in turn, cause loss of water/sewer service, food spoilage, etc. These effects are especially severe for individuals with functional needs and the elderly.

The Lehigh Valley suffered its worst utility interruption in October 2011, when an early snowstorm dropped 6-10” of wet snow on trees that still had leaves on them, causing historic numbers of tree limbs and wires down, resulting in massive power outages. PPL and FirstEnergy, the two largest electric utilities companies in the Lehigh Valley, reported over 109,000 customers without power for up to a week. Regional shelters and warming stations were opened throughout the Lehigh Valley to care for people without power.

4.3.22.3 Past Occurrence

Table 4.3.22-1 below shows the number of utility interruptions, by type, between 2001 and 2011.

Table 4.3.22-1: Utility Interruptions from 2001-2011

Type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
911 Issue	0	2	0	0	1	2	3	1	3	1	3	16
Gas	22	24	22	24	23	22	32	26	11	5	7	196
Phone	2	0	0	0	1	1	2	3	4	4	1	18
Power	0	2	2	1	0	7	28	18	26	58	50	192
Sewer	NR	NR	NR	2	NR	NR	1	3	NR	2	NR	5
Water	0	0	0	0	1	1	14	14	12	30	23	95
Wires Down	NR	NR	NR	NR	NR	NR	NR	NR	16	20	6	42
Total	2	28	24	25	26	33	79	65	72	120	90	564

Source: Pennsylvania Emergency Incident Reporting System (PEIRS); Knowledge Center
NR: None reported

4.3.22.4 Future Occurrence

Because their causes vary from minor vehicle accidents to severe weather, utility interruptions can happen at any time. Table 4.3.22-2 shows the expected annual number of interruptions and the corresponding likelihood category for each type. Overall, utility interruptions are considered *highly likely* based on the Risk Factor Methodology Probability Criteria.

Table 4.3.22-2: Likelihood of Future Occurrence of Utility Interruptions

Type	Avg. #/Year	% Probability	Category*
911 Issue	1.5	100	Highly Likely
Gas	17.8	100	Highly Likely
Phone	1.6	100	Highly Likely
Power	17.5	100	Highly Likely
Sewer	0.5	50	Likely
Water	8.6	100	Highly Likely
Wires Down**	3.8	100	Highly Likely
Overall	51.3	100	Highly Likely

* See Table 4.4-1 for definitions of each category.

** Some incidents were reported only as “wires down,” which may include power or phone transmission lines.

4.3.22.5 Vulnerability Assessment

Utility interruptions most severely affect individuals with access and functional needs (e.g., children, the elderly, individuals with special medical needs). Special medical equipment will not function without power. Likewise, a loss of air conditioning during periods of extreme heat or the loss of heat during extreme cold can be especially detrimental to those with medical needs, children, and the elderly. A lack of clean, potable water has health implications for all people, and a lack of water supply may also impact the sewer system and the availability of sewer service.

All facilities considered to be critical infrastructure are vulnerable to utility interruptions, especially the loss of power. The establishment of reliable backup power at these facilities is extremely important to continue to provide for the health, safety, and well-being of the Lehigh Valley’s population.

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

4.4 Hazard Risk Ranking

As discussed in Section 4.2, “Hazard Identification”, a comprehensive range of natural and non-natural hazards that pose significant risk to the Lehigh Valley were selected and considered in this plan update. However it is recognized that the communities in the Lehigh Valley have differing levels of exposure and vulnerability to each of these hazards. In order to most effectively and efficiently manage hazard risk, it is important for each community participating in this plan update to recognize those hazards that pose the greatest risk to their community, and direct their attention and resources accordingly.

To this end, a relative hazard risk ranking process was conducted for each county and municipality in the Lehigh Valley using the “Risk Factor” (RF) methodology identified in Section 5 and Appendix 9 of Pennsylvania’s All-Hazard Planning Standard Operating Guide (October 2010). Per this guidance:

“The RF approach produces numerical values that allow identified hazard to be ranked against one another. The RF values are obtained by assigning varying degrees of risk to five categories for each hazard: *probability, impact, spatial extent, warning time* and *duration*.

To calculate the RF value for a given hazard, the assigned risk value for each category is multiplied by the weighting factor. The sum of all five categories equals the final RF value, as demonstrated in the example equation:

Example Equation

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

Hazards identified as high risk have risk factors greater than or equal to 2.5. Risk Factors ranging from 2.0 to 2.4 are considered moderate risk hazards. Hazards with Risk Factors less than 2.0 are considered low risk.”

Table 4.4-1 identifies the five risk assessment categories, the criteria and associated indices used to quantify their risk, and the suggested weighting factor applied to each risk assessment category.

The hazard rankings for all participating jurisdictions can be found in their jurisdictional annexes in Section 9 of this plan update. The hazard risk ranking for Lehigh and Northampton counties is further presented below in Table 4.4-2. It is noted that the relative hazard risk rankings for both Lehigh and Northampton Counties were found to be the same.

Table 4.4-1. Summary of Risk Factor (RF) Approach

Summary of Risk Factor (RF) Approach				
Risk Assessment Category	Degree of Risk			Weight Value
	Level	Criteria	Index	
PROBABILITY <i>What is the likelihood of a hazard event occurring in a given year?</i>	UNLIKELY	LESS THAN 1% ANNUAL PROBABILITY	1	30%
	POSSIBLE	BETWEEN 1 & 10% ANNUAL PROBABILITY	2	
	LIKELY	BETWEEN 10 & 100% ANNUAL PROBABILITY	3	
	HIGHLY LIKELY	100% ANNUAL PROBABILITY	4	
IMPACT <i>In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?</i>	MINOR	VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF CRITICAL FACILITIES.	1	30%
	LIMITED	MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE DAY.	2	
	CRITICAL	MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE WEEK.	3	
	CATASTROPHIC	HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR 30 DAYS OR MORE.	4	
SPATIAL EXTENT <i>How large of an area could be impacted by a hazard event? Are impacts localized or regional?</i>	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 <i>Is there usually some lead time associated with the hazard event? Have warning measures been implemented?</i>	MORE THAN 24 HRS	SELF-DEFINED	1	10%
	12 TO 24 HRS	SELF-DEFINED	2	
	6 TO 12 HRS	SELF-DEFINED	3	
	LESS THAN 6 HRS	SELF-DEFINED	4	
DURATION <i>How long does the hazard event usually last?</i>	LESS THAN 6 HRS	SELF-DEFINED	1	10%
	LESS THAN 24 HRS	SELF-DEFINED	2	
	LESS THAN 1 WEEK	SELF-DEFINED	3	
	MORE THAN 1 WEEK	SELF-DEFINED	4	

Source: Pennsylvania's All-Hazard Planning Standard Operating Guide (October 2010)

SECTION 4.4: HAZARD RISK RANKING

Table 4.4-2. Risk Ranking for Lehigh and Northampton Counties

HAZARD RISK	NATURAL HAZARDS	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
		PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
HIGH	Winter Storm	3	2	4	1	3	2.7
	Flood	3	2	2	3	3	2.5
MODERATE	Radon Exposure	4	1	2	1	4	2.4
	Extreme Temperatures	4	1	2	1	3	2.3
	Drought	2	1	4	1	4	2.2
	Wildfire	3	1	2	3	3	2.2
	Hailstorm	3	1	3	2	1	2.1
	Wind, incl. Tornado	1	3	2	4	1	2.1
	Lightning	4	1	1	2	1	2
LOW	Earthquake	1	1	4	4	1	1.9
	Subsidence / Sinkholes	2	1	1	2	1	1.4
	Landslide	1	1	1	4	1	1.3

HAZARD RISK	MAN-MADE HAZARDS	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
		PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
HIGH	Fire (Urban/Structural)	4	2	1	4	2	2.6
	Environmental Hazard and Explosion	3	2	2	4	3	2.6
	Levee Failure	1	3	3	4	3	2.5
	Utility Interruption	3	1	3	4	3	2.5
MODERATE	Transportation Accident	4	1	1	4	1	2.2
	Dam Failure	1	3	2	4	2	2.2
	Mass Gathering and Civil Disturbance	3	1	1	4	2	2
LOW	Terrorism	1	3	1	4	1	1.9
	Building Collapse	1	3	1	4	1	1.9
	Nuclear Incident	1	1	1	4	2	1.4

SECTION 5: CAPABILITY ASSESSMENT

The capability assessment evaluates the capabilities and resources that are already in place in a community to reduce hazard risks. The capability assessment looks at the resources in place at the municipal, county, state and federal levels. The assessment also identifies where improvements can be made to increase disaster resistance in the community.

To help organize a description of hazard mitigation capabilities or resources, it is useful to first describe the basic approaches available to reduce hazard risks. According to the PEMA Hazard Mitigation Planning guide, there are six general approaches to reducing hazard risks. They include preventive measures, property protection, emergency service measures, structural projects, natural resource protection and public information. A brief description of each according to the PEMA guide is provided below.

- **Preventive measures** keep problems from getting started or getting worse and are typically administered through government programs or regulatory actions that influence the way land is developed and buildings are built. They are particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Examples of preventive measures are planning (including comprehensive planning), open space preservation or regulation (including zoning and building codes).
- **Property protection measures** involve the modification of existing buildings and structures to help them better withstand the forces of a hazard, or removal of the structures from hazardous locations. These measures include property acquisition, relocation of structures, building elevation and floodproofing. Insurance is also considered a property protection measure.
- **Emergency service measures** are taken during a disaster to minimize its impact. They include alert warning systems, monitoring systems, emergency response planning, evacuation and critical facilities protection.
- **Structural projects** are designed to reduce or redirect the impact of natural disasters (especially floods) away from at-risk populations. Examples include reservoirs, levees/floodwalls, channel modifications, storm sewers and diversions.
- **Natural resource protection** preserves or restores natural areas or their natural functions. Examples include wetland protection, riparian buffers, erosion and sediment control and riverine protection.
- **Public information programs** advise property owners, potential property owners and others of hazards and ways to protect people and property from them. Activities can include flood maps and data, library resources, outreach projects, technical assistance, real estate disclosure information and environmental education programs.

Capability assessments document the existing resources available to local communities to reduce hazard risks. Resources can be divided into five categories: human, physical, technical, informational and financial. For each basic capability or approach, there may be one or more of the five resources available to carry out the approach. A brief description of each resource according to the PEMA guide is provided below.

- **Human resources** include local police, fire, ambulance and emergency management and response personnel, local government operation and services, electric, gas and other utility providers that need to function during critical periods in disasters.
- **Physical resources** include the equipment and vehicles (such as emergency response and recovery equipment and vehicles), public lands, facilities and buildings available to the community.
- **Technical/technological resources** include early warning systems, weather alert radios, stream level monitoring gages and 911 communications systems. They also include technical requirements established by law, regulation or ordinance.
- **Informational resources** include materials about disasters and hazard mitigation and planning that is available from a wide variety of sources such as the internet, libraries and state and federal agencies.
- **Financial resources** identify the sources of funding available for hazard mitigation. Most state and federal grant programs require local communities to provide at least part of the necessary project funding in real dollars or through in-kind services. Local communities need to assess their financial capability and resources to implement hazard mitigation action plans.

This section describes and summarizes the federal, state, regional, county and local capabilities to address hazard risk in the Lehigh Valley. The comprehensive Capability Assessment section of the 2006 plan has been incorporated in this section in near totality, and updated as appropriate.

During this plan update process, Lehigh and Northampton counties and all 62 inclusive municipalities were surveyed to provide an updated assessment of their mitigation planning capabilities. Each municipality was provided a Capability Assessment Survey, based on the capability assessment survey provided as Appendix 3 of the Pennsylvania's All-Hazard Mitigation Planning Standard Operating Guide – October, 2010 (PA SOG). This survey was provided to each of the municipal planning points of contact prior to the municipal Kick-Off meetings, at the Kick-Off meetings, and further throughout the planning process as needed to promote broad municipal input.

Completed capability assessment surveys provided by the municipalities may be found in Appendix D.

County and municipal capabilities in the areas of planning and regulatory, administrative and technical, and fiscal may be found in their jurisdictional annexes in Section 9 in Tables E1, E2 and E3. The results of their mitigation capability self-assessment are summarized below in Section 5.8.

5.1 Emergency Management

5.1.1 County Capabilities

The Lehigh Valley is supported by strong regional and county-level emergency management capabilities provided by the Lehigh County Emergency Management Agency and Northampton County Emergency Management Services. As described in the 2006 Lehigh Valley HMP, both Lehigh and Northampton counties continue to operate emergency 9-1-1 call centers, and Emergency Operations Centers (EOCs) during emergencies in their counties. In addition, both counties continue to provide or support emergency service programs and measures including emergency response, public alert and warning systems, emergency communications systems, hazard event monitoring systems, and public information and outreach programs.

In January 2008, Northampton County underwent significant changes to its Emergency Management program and structure when the Northampton County Council approved a resolution to create the Division of Emergency Management Services. This newly established Division essentially combined Emergency Management and E-911 Communications under one operating structure.

9-1-1 Centers

9-1-1 is the telephone number used to report emergencies, wherein there is the presence or potential for an immediate threat to life or property, and response by Police, Fire, and/or Emergency Medical Service Agencies. Examples include a crime which has just occurred or in-progress, odor or presence of fire, a sick or injured person requiring pre-hospital treatment and transportation to a hospital emergency department. The 9-1-1 System maintains the capability to accept calls from hearing or speech impaired callers utilizing a Telecommunications Device for the Deaf (TDD). Each county operates a 9-1-1 Public Safety Answering Point (PSAP), as do the Cities of Allentown and Bethlehem. These four PSAPs would need to coordinate efforts in a regional hazard event. Computerized mapping of streets with address information is critical for emergency response purposes. Opportunities exist to streamline the regional 9-1-1 coordination through development of fully-integrated and consistent mapping and databases.

Emergency Operations Centers (EOC)

In the event of an impending emergency or disaster, both Lehigh and Northampton counties would activate their EOCs. The purpose of the EOC is to manage the emergency response and coordinate the distribution of resources to a disaster incident. Highly trained and experienced personnel staff the EOC when it is activated and becomes operational. Capable individuals having the authority, flexibility, imagination and initiative needed to make command and coordination decisions (relative to their field of expertise) necessary during emergency operations are recruited. EOC staffing includes the following disciplines: Transportation, Firefighting, Communications/RACES, Public Works and Engineering, Emergency Management, Mass Care/Housing and Human Services, Resource Support, Public Health and Medical Services, Urban Search and Rescue, Oil and Hazardous Materials Response, Energy, Public Safety and Security, Long-Term Community Recovery and Mitigation, Agriculture and Natural Resources and External Affairs. When activated, the EOCs are in constant communication with the 9-1-1 centers to ensure coordination of activities. NC EOC includes an Emergency Support Function 16 (ESF 16) Volunteers & Donations Management.

The Lehigh and Northampton County Emergency Management Agency (EMA) capabilities fall under two categories: Emergency Service Measures and Public Information Programs. These capabilities are described below.

Emergency Service Measures

Emergency service measures protect people during and immediately following a disaster.

- Alert Warning System – Emergency Alert System (EAS) – Lehigh County operates as an EAS initiating station, covering Lehigh and Northampton counties. The EAS is an alert system for disseminating emergency information and warnings to the general public within the Counties, utilizing the resources of the Broadcast and Cable Industries. The EAS System allows state and local officials to quickly send out important area specific state and local information and it also recognizes the need to provide emergency information to people whose first language is not English. The EAS system has the capability of providing alerts in the language normally used by the station or cable system such as the Spanish language.

- Monitoring Systems – The counties have several systems they monitor that will disseminate emergency information and warnings. These systems include: SEVAN, Knowledge Center, PA Star System, RACES, IFLOWS, NOAA Weather Radios, and 800 Mhz Statewide Radio.
- SEVAN – The Satellite Emergency Voice Alerting Network – The voice side of the satellite warning system allows PEMA, counties, regional offices and cities to communicate directly in real time regardless of the status of the telephone system. Warning messages are routinely broadcast by PEMA using the system.
- PaSTAR – The Pennsylvania Statewide Telecommunication and Alerting System – A computer network that uses satellite-based technology and the latest computer server and client systems. The system allows data sharing, reporting and textual and graphics communications to flow unimpaired between users connected to the system. At the core of PaSTAR are commercially available computer server and email software packages.
- Knowledge Center – Knowledge Center is a web-based interactive incident management tool used by the Northeast Pennsylvania Regional Counterterrorism Task Force (NEPARCTTF), which includes, Lehigh and Northampton Counties. Knowledge Center provides emergency managers with the ability to gather large quantities of information related to incidents and coordinate that information for either small-scale events with one or two responder agencies or for large-scale events that involve complex, multi-jurisdictional responses comprised of hundreds of agencies from the local, state, and federal government, non-governmental organizations, and the private sector. The system allows for seamless communication with our neighboring jurisdictions, counties and the state about the types of incidents and emergencies we may have in our jurisdiction.
- RACES – The Radio Amateur Civil Emergency Services is a group of amateur radio operators who donate their services in time of natural disaster or emergency. They provide communication to fire, police and other agencies that need assistance.
- IFLOWS – Integrated Flood Observing and Warning System – This system relies on radio reporting rain and stream gauges which provide rainfall and stream level data via radio and satellite to counties, State Emergency Operations Center, PEMA Area Offices and the National Weather Service (NWS) serving Pennsylvania. Actual rainfall is compared with NWS Flash Flood Guidance (FFG), and alarms are triggered at various preset levels related to the FFG. FFG estimates the number of inches of rainfall for given durations required to produce flash flooding in the counties. These estimates are based on current soil moisture conditions. Note, in urban areas, less rainfall is required to produce flash flooding. The IFLOWS computer at the counties and all sites on the satellite network, alarm with both an audible and visual signal when rainfall or stream levels reach levels that can lead to flash flooding.
- NOAA Weather Radio All Hazards (NWR) is a nationwide network of radio stations broadcasting continuous weather information directly from a nearby National Weather Service office. NWR broadcasts National Weather Service warnings, watches, forecasts and other hazard information 24 hours a day. NWR also broadcasts warning and post-event information for all types of hazards – including natural and man-made (such as chemical releases or oil spills) and public safety (such as AMBER alerts or 911 Telephone outages).
- 800 Mhz Radio System – provides two-way voice and data communications for all county and state agencies. The primary function of this system is to provide redundant communications

between the county and the partner agency facilities in the event that the primary means of communication becomes interrupted.

- Emergency Response Planning
- Emergency Operations Plan (EOP) - Lehigh and Northampton counties have prepared EOPs to document the county's emergency preparedness planning. The EOP includes county-specific emergency response procedures during significant emergency events. The counties will typically open the Emergency Operations Centers (EOCs) to coordinate warning, response and recovery actions.
- Mutual Aid Agreements – Lehigh and Northampton counties have formal agreements in place with each other, and with the Pennsylvania counties contiguous to each as a result of the PA Intrastate Mutual Assistance Program. All PA counties are participants in this program.
- The counties also assist in planning for:
 - Lehigh Valley International Airport
 - Lehigh and Northampton County Prisons
 - Local (Municipal) Emergency Operation Plans
 - Medical Facilities
 - Dams
 - Mass Casualty/Fatality Incidents
 - Counterterrorism Preparedness
 - Limerick Nuclear Power Station Evacuation and Sheltering
 - Special Events – i.e. Allentown Fair, MusikFest, Mayfair etc.
 - School Planning
 - Day Care, Group Homes and Special Needs Facilities
 - SARA (Superfund Amendments and Reauthorization Act of 1986) – The Local Emergency Planning Committee program is based upon the 1986 Title III. This legislation requires local planning by businesses and response agencies (such as fire departments and hazardous materials teams) whenever hazardous materials are involved. SARA also requires the establishment of a system in each community, which informs the citizens of chemicals used, manufactured and stored locally.
- Evacuation
 - Northampton County is in the early stages of developing an Evacuation Plan at the county level. Lehigh County has developed an evacuation plan for the County. The plan addresses the following basic scenarios:
 - Evacuation of a large population or geographic area within our regional task force.
 - Mass exodus of population from another area entering our area.
 - How would we or could we act as host for a large influx of evacuees?
 - The counties, in cooperation with the American Red Cross, have designated shelters set up throughout the counties. These shelters may be used during times of emergency and disasters.

Public Information Programs

- Flood Maps/Data – The counties have access to this type of information through their GIS departments, as well as other information that is available through the County Assessment Offices. The following information is available through the County Assessment Offices: County/Municipality Maps, District/Ward Maps, Millage Rate Schedules, Property Assessment Records and Deeds.
- Library Resources – The counties have educational materials available upon request that are used at public speaking events when appropriate. The following educational materials are available, but are not limited to:
 - Various Types of Training Videos
 - Pennsylvania Emergency Preparedness Guides
 - American Red Cross Packets for Flash Flooding, Hurricane, Thunder and Lightning, Tornado, Winter Storms
 - Family Disaster Planning Guides
 - Homeland Security information for Businesses, Family, Individuals, Neighborhoods and Schools
 - Pandemic Brochures
- Outreach Projects
 - Are You Ready? – An in-depth program for Citizen Preparedness (individual, family and community preparedness). Provides a step-by-step approach to disaster preparedness by walking the student through how to get informed about local emergency plans, how to identify hazards that affect their area, and how to develop and maintain an emergency communications plan and disaster supply kit. Other topics covered include evacuation, emergency public shelters, animals in disaster and information specific to people with disabilities. The course also provides in-depth information on specific hazards such as Floods, Tornadoes, Hurricanes, Thunderstorms and Lightning, Winter Storms and Extreme Cold, Extreme Heat, Earthquakes, Volcanoes, Landslide and Debris Flows (Mudslide), Tsunamis, Fires, Wildfires, Hazardous Materials Incidents, Household Chemical Emergencies, Nuclear Power Plant, and Terrorism (Explosion, Biological, Chemical, Nuclear, and Radiological hazards) and includes what to do before, during and after each hazard type.
 - Community Emergency Response Teams (CERT) – Training to educate citizens about disaster preparedness and training in basic disaster response skills, such as fire suppression, Disaster Medical Operations, Light Search and Rescue, Team Organization, Disaster Psychology, and Terrorism Awareness. The goal of this program is for emergency personnel to train members of neighborhoods, community organizations, or workplaces in basic response skills. If a disastrous event overwhelms or delays the community’s professional response, CERT members can assist others by applying the basic response and organizational skills that they learned during training. These skills can help save and sustain lives following a disaster until help arrives.
 - Citizen Corps Council – The mission of the Citizen Corps is to harness the power of every individual through education, training, and volunteer service to make communities safer, stronger, and better prepared to respond to the threats of terrorism, crime, public health issues and disasters of all kinds.

- Emergency Management Courses are provided through the county EMA offices to the Local Coordinators and Elected Officials. The following courses are provided: Duties and Responsibilities of the Local Emergency Management Coordinator (LEMC), Elected Officials Seminar, Initial Damage Assessment, Safe Schools Training, National Incident Management System, Work Environment of the LEMC and numerous FEMA Independent Study Courses.
- Local Emergency Planning Committee (LEPC) – Working closely with the business industry community to form a safety net around the chemical industry to protect the general population from the possible outcome of hazardous material incidents.
 - The LEPC shall have a minimum of seven members, and will include at least one representative of each of the following groups:
 - Group 1 – Elected Official representing local governments within the county
 - Group 2 – Law enforcement, first aid, health, local environmental, hospital and transportation personnel
 - Group 3 – Firefighting personnel
 - Group 4 – Civil Defense and emergency management personnel
 - Group 5 – Broadcast and print media
 - Group 6 – Community groups not affiliated with emergency service groups
 - Group 7 – Owners and Operators of facilities subject to the requirements of SARA Title III
 - Reporting Facilities – Hazardous Chemicals for which facilities are required to have or prepare a Material Safety Data Sheet, the minimum reporting threshold is 10,000 pounds.
 - Planning Facilities – Extremely Hazardous Substances designated under Section 302 of Title III, the reporting threshold is 500 pounds or the threshold planning quantity, whichever is lower.
- Lehigh County has:
 - 102 SARA Planning Facilities
 - 134 SARA Reporting Facilities
- Northampton County has:
 - 37 SARA Planning Facilities
 - 77 SARA Reporting Facilities
- Technical Assistance – The county EMA offices can support local, public and private entities as needed through coordination and provision of information and equipment resources. These include both existing county capabilities, such as County Hazardous Materials Response Team and Technical Rescue Teams, and predetermined private and public resources.
- The Lehigh County Special Operations Team is/has:
 - Greater than 50 active members trained to Operations and Technician level in compliance with OSHA 1910.120.
 - Personal Protective Equipment (PPE) for all levels of Hazmat entry. Level A, B, C.

- SCBA for 16 team members with in suit communications. Dedicated radio frequencies.
 - Monitoring equipment for Radiation, Chemical & Biological Warfare, Mercury and Industrial Toxics available at any time.
 - Spill Containment and Mitigation supplies for spills, large and small.
 - Specialized equipment for tanker and rail car emergencies
 - They hold certifications in the following: Confined Space Rescue Technician, Trench Rescue Technician, Low and High Angle Rope Rescue, Structural Collapse, and Incident Command
 - Medically trained members in CPR, AED, EMT and Paramedic
 - Paramedics trained in Rescue Medicine to aid in the care of Technical Rescue Patients
- Lehigh County provides contractual Hazardous Materials Response Team coverage to Northampton County.

5.1.2 Local Capabilities

According to Pennsylvania Title 35 (Emergency Management Services Code) Chapter 7500:

- Each political subdivision of this Commonwealth is directed and authorized to establish a local emergency management organization in accordance with the plan and program of PEMA. Each local organization shall have responsibility for emergency, response and recovery within the territorial limits of the political subdivision within which it is organized and, in addition, shall conduct such services outside of its jurisdictional limits as may be required under this part.
- Declaration of disaster emergency – A local disaster emergency may be declared by the governing body of a political subdivision upon finding a disaster has occurred or is imminent. The effect of a declaration of a local disaster emergency is to activate the response and recovery aspects of any and all applicable local emergency management plans and to authorize the furnishing of aid and assistance.
- Each local organization of emergency management shall have a coordinator who shall be responsible for the planning, administration and operation of the local organization.
- Each political subdivision shall adopt an Intergovernmental Cooperation agreement with other political subdivisions to:
 - Prepare, maintain and keep current a disaster emergency management plan for the prevention and minimization of injury and damage caused by disaster, prompt and effective response to disaster and disaster emergency relief and recovery in consonance with the Pennsylvania Emergency Management Plan.
 - Establish, equip and staff an emergency operations center, consolidated with warning and communication systems to support government operations in emergencies and provide other essential facilities and equipment for agencies and activities assigned emergency functions.
 - Provide individual and organizational training programs to insure prompt, efficient and effective disaster emergency services.

- Organize, prepare and coordinate all locally available manpower, materials, supplies, equipment, facilities and services necessary for disaster emergency readiness, response and recovery.
 - Adopt and implement precautionary measures to mitigate the anticipated effects of disaster. Execute and enforce such rules and orders as the agency shall adopt and promulgate under the authority of this part.
 - Cooperate and coordinate with any public and private agency or entity in achieving any purpose of this part.
 - Have available for inspection at its emergency operations center all emergency management plans, rules and orders of the Governor and the agency.
 - Provide prompt and accurate information regarding local disaster emergencies to appropriate Commonwealth and local officials and 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.
 - Participate in the program of integrated flood warning systems under section 7313 (6) (relating to powers and duties).
- Direction of disaster emergency management services is the responsibility of the lowest level of government affected. When two or more political subdivisions within a county are affected, the county organization shall exercise responsibility for coordination and support to the area of operations. When two or more counties are involved, coordination shall be provided by PEMA or by area organizations established by PEMA.
 - When all appropriate locally available forces and resources are fully committed by the affected political subdivision, assistance from a higher level of government shall be provided.
 - Local coordinators of emergency management shall develop mutual aid agreements with adjacent political subdivisions for reciprocal emergency assistance. The agreements shall be consistent with the plans and programs of PEMA.

The local municipalities in Lehigh and Northampton counties have the following capabilities:

Mutual Aid Agreements

Lehigh County has formal mutual aid agreements with 19 of its municipalities and the airport authority. Northampton County does not have agreements in place with its municipalities. Mutual Aid is covered under Act 93.

Emergency Operations Centers (EOC)

In the event of an impending emergency or disaster the local EOC may be activated. The purpose of the EOC is to manage the emergency response and coordinate distribution of resources to a disaster incident at the local level.

Emergency Response

Each municipality is responsible to provide emergency response to their municipality in Emergency Medical Services (EMS), Fire and Police. If a municipality does not have one of these providers in their community, they have mutual aid agreements with an adjacent political subdivision to provide such.

In Lehigh County there are:

- 15 EMS Stations
- 44 Fire Companies
- 13 Municipal Police Departments
- 2 State Police Barracks
- City of Allentown 9-1-1
- City of Bethlehem 9-1-1

In Northampton County there are:

- 15 EMS Agencies
- 38 Fire Agencies, 2 Rescue Agencies
- 26 Municipal Police Departments
- 3 School District Police Departments
- 3 College Campus Police Departments
- 2 State Police Barracks
- City of Bethlehem 9-1-1

Monitoring Systems

The municipalities may also be equipped with several systems to monitor emergency information and warnings. They include: Radio Amateur Civil Emergency Services (RACES) and National Oceanic and Atmospheric Administration (NOAA) Weather Radios, and Knowledge Center.

Emergency Response Planning

The municipalities may also assist with planning for:

- Municipal Emergency Operations Plan (EOP)
- Lehigh Valley International Airport
- Medical Facilities
- Dams
- Counterterrorism Preparedness
- Special Events – i.e. Allentown Fair, MusikFest, Mayfair, etc.
- School Planning
- Day Care, Group Homes and Special Needs Facilities
- Evacuation Planning

A summary of existing federal, state, regional and county programs (regulatory and otherwise) to manage specific hazard risks may be found in the hazard profiles in Section 4 of this plan update. While the risk of certain hazards can be addressed at least partially through mitigation, the risks of other hazards (particularly certain non-natural hazards) are primarily managed through the preparedness and response elements of emergency management, or via other regulatory programs at the federal and state levels.

Additional information on county and local emergency management capabilities may be found in the jurisdictional annexes in Section 9.

5.2 Participation in the National Flood Insurance Program

According to FEMA's 2002 *National Flood Insurance Program (NFIP): Program Description*, the U.S. Congress established the NFIP with the passage of the National Flood Insurance Act of 1968. The NFIP is a Federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for state and community floodplain management regulations that reduce future flood damages.

Participation in the NFIP is based on an agreement between communities and the Federal Government. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction and substantial improvements in floodplains, the Federal Government will make flood insurance available within the community as a financial protection against flood losses. This insurance is designed to provide an insurance alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods (FEMA, 2002).

Currently all municipalities in the Lehigh Valley participate in the NFIP, with no municipalities having outstanding sanctions or suspensions. All municipalities have adopted a Flood Damage Prevention Ordinance which is administered locally by their Floodplain Administrator, and make current NFIP Flood Insurance Rate Maps (FIRMs) available for review by the public.

NFIP-participating communities in the Lehigh Valley are required to adopt a Flood Damage Prevention Ordinance, and update this ordinance whenever the regulatory NFIP FIRMs are officially updated. FEMA is currently in the process of developing new FIRM mapping for Northampton County, and once the map update process has been formally completed each community in the county will have to update their ordinance. Both the LVPC and the PA Department of Community and Economic Development (state coordinating agency for the NFIP) provide support to municipalities by providing model Flood Damage Prevention Ordinances.

NFIP-participating communities in the Lehigh Valley are required to make current regulatory NFIP mapping available to their residents for review, and may provide mapping assistance through their floodplain administrators. Typically this mapping is available at the municipal offices in each community.

At the time this plan was written, the Lehigh County FEMA Digitized Flood Insurance Rate Maps (DFIRMs) dated July 2004 and the Northampton County preliminary DFIRMs dated 2011 were used to evaluate exposure and determine potential future losses. The Northampton County 2011 DFIRMs, although considered preliminary, are the best available data and used for this plan update.

Municipal participation in and compliance with the NFIP is supported at the federal level by FEMA Region III and the Insurance Services Organization (ISO), at the state level by the Pennsylvania Department of Environmental Protection (PADEP) and PEMA. Regionally, each County's emergency management department supports flood mitigation efforts as well as associated training and public education and awareness programs.

Flood hazard risk management in the Lehigh Valley is further supported by the LVPC through the Act 167 Stormwater Management Planning program, as detailed and referenced throughout this plan update.

Additional information on the NFIP program and its implementation within the Lehigh Valley may be found in the flood hazard profile (Section 4.3.4).

5.3 Community Rating System (CRS)

In the 1990s, the Flood Insurance Administration (FIA) established the CRS to encourage local governments to increase their standards for floodplain development. The goal of this program is to encourage communities, through flood insurance rate adjustments, to implement standards above and beyond the minimum required in order to:

- Reduce losses from floods
- Facilitate accurate insurance ratings
- Promote public awareness of the availability of flood insurance

CRS is a voluntary program designed to reward participating jurisdictions for their efforts to create more disaster-resistant communities using the principles of sustainable development and management. By enrolling in CRS, municipalities can leverage greater flood protection while receiving flood insurance discounts.

Currently within the Lehigh Valley only Hanover Township in Northampton County participates in the CRS program, with a current rating of 9 (5% discount on flood insurance premiums). Increased participation in the Lehigh Valley will be supported by both Counties as identified in their updated mitigation strategies. Further, certain communities in the Lehigh Valley have identified in their updated mitigation strategies that they plan to apply to the CRS program.

5.4 Planning and Regulatory Capability

While municipalities in Pennsylvania must comply with the minimum regulatory requirements established under the Pennsylvania Municipal Planning Code, they otherwise have considerable latitude in adopting ordinances, policies and programs that can support their ability to manage natural and non-natural hazard risk. Specifically, municipalities can manage these risks through comprehensive land use planning, hazard-specific ordinances (e.g. flood damage prevention, sinkholes, steep slopes), zoning, site-plan approval, and building code.

County and municipal planning and regulatory capabilities may be found in their jurisdictional annexes (Section 9, Table E1).

There is no county zoning ordinance in Lehigh or Northampton counties. Both counties have a subdivision and land development ordinance (SALDO). However, these regulations cover only Slatington Borough in Lehigh County and the Boroughs of West Easton, Glendon, Chapman in Northampton County. Since these municipalities do not have their own SALDO in place, the LVPC has the authority to enforce the county regulations in these communities. (LVHMP 2012)

The LVPC has prepared a number of planning documents that are used during project review and informational resources that are available for public use, including the “Comprehensive Plan – The Lehigh Valley...2030”, Act 167 Stormwater Management Plans, water supply and wellhead protection plans, as well as model regulations/ordinances for floodplain management, steep slopes, and wetland and riparian buffers. Further, the LVPC supports open space and natural resource planning in the Lehigh Valley.

5.4.1 Comprehensive Plan, The Lehigh Valley...2030

The Lehigh Valley comprehensive plan was prepared by the LVPC and adopted by Lehigh and Northampton counties in June 2005. The purpose of the plan is to guide the orderly growth in the Lehigh Valley while promoting the conservation of farmland and natural resources including streams and floodplains, riparian buffers, wetlands, important natural areas, steep slopes and woodlands. Figure 2-6 in Section 2 of this plan shows the recommended General Land Use Plan for the Lehigh Valley. The figure identifies four broad categories of land use: natural resources, farmland preservation, and urban and rural development. The county plan recommends that new growth should not locate in areas recommended for natural resource or farmland protection. Higher density residential growth, industrial and business expansion should take place in the recommended urban areas. Areas recommended for rural development should be planned for low density and low intensity uses. The county plan identifies goals, policies and a number of implementation strategies for a variety of topics including land use, housing, natural resources, farmland preservation, economic development, transportation, community utilities (water, wastewater and stormwater), parks and recreation and historic preservation. The LVPC will comment on these issues during project reviews, however, the comments are advisory. Although the Pennsylvania Municipalities Planning Code requires that municipal plans be in accord with the county plan, the code provides no measures for assuring that this occurs. Most municipalities have adopted their own comprehensive plan as shown in the following table.

Table 5-1. Development Ordinances and Regulations Adopted by Municipalities (as of March 2012)

Municipalities	Comprehensive Plan		Zoning Ordinance		Subdivision Regulations	
	First Adopted	Latest Revision	First Adopted	Latest Revision	First Adopted	Latest Revision
LEHIGH COUNTY						
Alburtis	1974	2005	1961	1991	1960	1976
Allentown	1945	2009	1948	2010	1924	1987
Bethlehem*						
Catasauqua	1963	1999	1962	2004	1962	1973
Coopersburg	—	—	1961	2005	1957	2007
Coplay	2010	—	1969	2012	1982	—
Emmaus	1957	2005	1957	2005	1956	1976
Fountain Hill	1977	2007	1948	2008	1974	1995
Hanover Twp.	1964	1995	1963	1996	1961	1978
Heidelberg Twp.	1971	2005	1972	2010	1971	2010
Lower Macungie Twp.	1972	2005	1961	1998	1965	1998
Lower Milford Twp.	1968	2005	1967	2009	1964	1997
Lowhill Twp.	1971	2005	1972	—	1971	—
Lynn Twp.	1968	2005	1968	1982	1968	1980
Macungie	1966	2005	1966	2001	1964	2008
North Whitehall Twp.	1969	2009	1969	2002	1964	1999
Salisbury Twp.	1969	1992	1960	1993	1960	1997
Slatington	1981	2005	1982	1988	—	—
South Whitehall Twp.	1969	2009	1962	2010	1968	2010
Upper Macungie Twp.	1972	2007	1961	1994	1964	2011
Upper Milford Twp.	1963	2005	1963	2010	1962	2010
Upper Saucon Twp.	1971	1985	1959	2009	1963	2011
Washington Twp.	1964	2005	1968	2009	1963	2010
Weisenberg Twp.	1971	2005	1972	1993	1971	2000
Whitehall Twp.	1972	2005	1962	2006	1968	1999
NORTHAMPTON COUNTY						
Allen Twp.	1969	1999	1969	2000	1968	2001
Bangor	1968	2005	1967	1992	1968	—
Bath	1978	2006	1978	2011	1976	2011
Bethlehem	1960	2009	1926	2006	1975	1975
Bethlehem Twp.	1964	2004	1962	1997	1960	1989
Bushkill Twp.	1967	2006	1966	1994	1973	1994
Chapman	2006	—	—	—	—	—
East Allen Twp.	1970	2009	1970	1983	1971	1984
East Bangor	2006	—	2005	—	2009	—
Easton	1913	1997	1928	2007	1946	2007
Forks Twp.	1968	2010	1956	2006	1962	2007
Freemansburg	1969	—	1950	2009	2009	—
Glendon	—	—	1950	1987	—	—
Hanover Twp.	1972	2004	1963	1978	1963	1973
Hellertown	1969	2009	1968	2002	1969	1986
Lehigh Twp.	1968	1999	1968	2002	1968	1980
Lower Mt. Bethel Twp.	1971	2007	1972	—	1971	1990
Lower Nazareth Twp.	1962	2006	1966	2001	1963	2005
Lower Saucon Twp.	1964	2009	1963	2002	1958	2003
Moore Twp.	1973	2006	1973	2011	1965	2005
Nazareth	1969	2006	1969	1988	1986	1989
Northampton	1972	2005	1960	1999	1974	1993
North Catasauqua	—	—	1955	1995	1996	—
Palmer Twp.	1963	2003	1950	2002	1955	2002
Pen Argyl	1968	2004	1969	1997	1969	2007
Plainfield Twp.	1971	2004	1971	1993	1959	1991
Portland	1966	—	1966	—	1973	—
Roseto	1982	2005	1984	—	1979	1995
Stockertown	1972	2010	1973	2005	1970	2002
Tatamy	1965	2006	1964	1991	1964	1992
Upper Mt. Bethel Twp.	1967	2001	1977	2004	1973	2001
Upper Nazareth Twp.	1968	2006	1969	2007	1967	2005
Walnutport	1975	2008	1977	2008	2004	—
Washington Twp.	1969	2006	1979	1997	1973	1995
West Easton	—	—	1952	1992	—	—
Williams Twp.	1969	2000	1957	1990	1969	1997
Wilson	1962	—	1959	1994	1975	1995
Wind Gap	1968	2004	1968	1993	1968	2004

*Bethlehem City information is listed under Northampton County.

Note: Includes recodifications

Source: Lehigh Valley Planning Commission.

5.4.2 Stormwater Management Planning

In 1978, the Pennsylvania General Assembly passed the Stormwater Management Act, Act 167 of 1978. Act 167 requires counties to prepare stormwater management plans on a watershed-by-watershed basis. The plans must be developed in consultation with the affected municipalities. Standards for control of runoff from new development are a required component of each plan and are based on a detailed hydrologic assessment. A key objective of each plan is to coordinate the stormwater management decisions of the watershed municipalities. Implementation of each plan is through mandatory municipal adoption of ordinance provisions consistent with the plan. The LVPC provides an advisory engineering review of the stormwater aspects of subdivision proposals to assist in creating consistent implementation throughout each watershed. The municipalities have the authority to enforce the ordinance provisions. Within Lehigh and Northampton counties, the LVPC prepares plans on behalf of both counties. The state has designated 16 Act 167 study areas within the region. Figure 2-3 in Section 2 (Regional Profile) displays the location of the designated watersheds in the Lehigh Valley, while Table 2-1 lists the municipalities by watershed.

Until 2004, stormwater planning dealt solely with runoff quantity and not quality. To comply with requirements of the National Pollutant Discharge Elimination System (NPDES) regulations from the Environmental Protection Agency, 59 of the 62 municipalities in the Lehigh Valley must adopt and implement an ordinance to reduce or prevent the discharge of pollutants into receiving waters. The LVPC has updated all Act 167 plans to include water quality provisions.

Plans prepared under Act 167 will not resolve all drainage issues. A key goal of the planning process is to maintain existing peak runoff rates throughout a watershed as land development continues to take place. This process does not solve existing flooding problems although it should prevent these problems from getting worse. Correction of existing flooding problems is the responsibility of the municipalities.

5.4.3 Water Supply Planning

The LVPC has prepared a number of water supply planning documents including the 1995 Water Supply and Sewage Facilities Plan and 2000 Supplement, Wellhead Protection Demonstration Project, Water Supply/Wellhead Protection Plan, Wellhead Protection Implementation Program, Water Supply Assessment Report and the model Small Water System and draft Water Withdrawal ordinances. These documents provide the basis for the goals, policies and implementation strategies in the county comprehensive plan.

The Water Supply and Sewage Facilities Plan and Supplement identify issues and concerns related to water supply planning in the Lehigh Valley. Community and central water systems are identified as well as existing service areas, water source(s), source yield, treated storage and usage. The 1995 plan provides more detailed water supply planning policies and implementation strategies than the county comprehensive plan.

The Water Supply/Wellhead Protection Plan evaluates the viability of each community and central water system to provide for customer needs through 2010. The plan provides recommendations for each system. A general recommendation of the plan is the acquisition of the central systems by community systems to improve reliability, minimize the costs of needed improvements and enhance the viability of long-term water service to the central system customers. The purpose of the wellhead protection plans is to protect community and central water supply wells from pollutants. This would be accomplished through an ordinance designed to regulate land use activities within defined critical recharge areas surrounding water supply wells. A model ordinance was created as part of the work for municipalities to consider for

adoption. The LVPC worked with 12 municipalities to protect two water supply wells in each municipality. There were three municipalities that adopted the wellhead protection ordinance including Upper Mt. Bethel and Washington (N) townships and the Borough of Catasauqua.

In 2002, the LVPC completed a Water Supply Assessment Report of the Lehigh Valley's water resources to identify current and future well water users of all types through 2030 and groundwater availability during normal and drought conditions. From the available data, it was found that well water demand should not exceed groundwater supply during normal and drought conditions through 2030 on a watershed by watershed basis. One of the main findings of the assessment was the lack of up-to-date, reliable data on water usage and groundwater recharge. In 2009, the State released an updated State Water plan that began the process of updating this data.

The LVPC small water system ordinance is designed to regulate the creation of new central water systems and the expansion of existing small systems to ensure long-term, safe, reliable water supply. It is available for use by municipalities. The LVPC draft water withdrawal ordinance is designed to regulate new or expanded water withdrawals to ensure continuous water availability and prevent adverse impacts on existing users. The ordinance would impact proposals of 10,000 to 100,000 gallons per day which are less than that regulated by the Delaware River Basin Commission (DRBC). The DRBC has broad regulatory authority over water withdrawals. The ordinance is available for use by municipalities but they should be aware of the DRBC authority and the potential legal limitations of the draft ordinance.

5.4.4 Natural Resource Planning

The LVPC has prepared several documents related to natural resource planning. These documents include Minimizing Sinkhole Occurrences, a natural resources plan that is part of the two county comprehensive plan and a Natural Areas Inventory of Lehigh and Northampton Counties. These documents provide the basis for some of the policies and implementation strategies in the county comprehensive plan. Additional documents include the Monocacy Creek Erosion Restoration Plan and the Flood Recovery and Flood Mitigation Study.

Minimizing Sinkhole Occurrences (1988) provides a general understanding of sinkholes and how they can form. The document provides recommended ordinance provisions for municipal consideration to minimize the potential for sinkhole occurrence as it relates to new development. 47 of the 62 municipalities in Lehigh and Northampton counties are underlain entirely or in part by carbonate bedrock. Figure 2-5 in Section 2 (Regional Profile) identifies areas of carbonate geology in the Lehigh Valley. Sinkholes can occur in areas that have carbonate bedrock. There are 18 municipalities within the two counties that have adopted carbonate bedrock standards. These municipalities are listed below along with the year of ordinance adoption in parentheses.

- Upper Saucon Township, Lehigh County (1986)
- Lower Saucon Township, Northampton County (1988)
- Forks Township, Northampton County (1989)
- Lower Mt. Bethel Township, Northampton County (1990)
- Emmaus Borough, Lehigh County (1994)
- Bethlehem Township, Northampton County (1997)
- Lower Macungie Township, Lehigh County (1998)
- East Allen Township, Northampton County (1999)
- North Whitehall Township, Lehigh County (1999)
- Whitehall Township, Lehigh County (1999)
- Weisenberg Township, Lehigh County (2000)

- Upper Macungie Township, Lehigh County (2001)
- Stockertown Borough, Northampton County (2002)
- Lower Nazareth Township, Northampton County (2003)
- Palmer Township, Northampton County (2003)
- Upper Nazareth Township, Northampton County (2004)
- Tatamy Borough, Northampton County (2005)
- Macungie Borough, Lehigh County (2008)

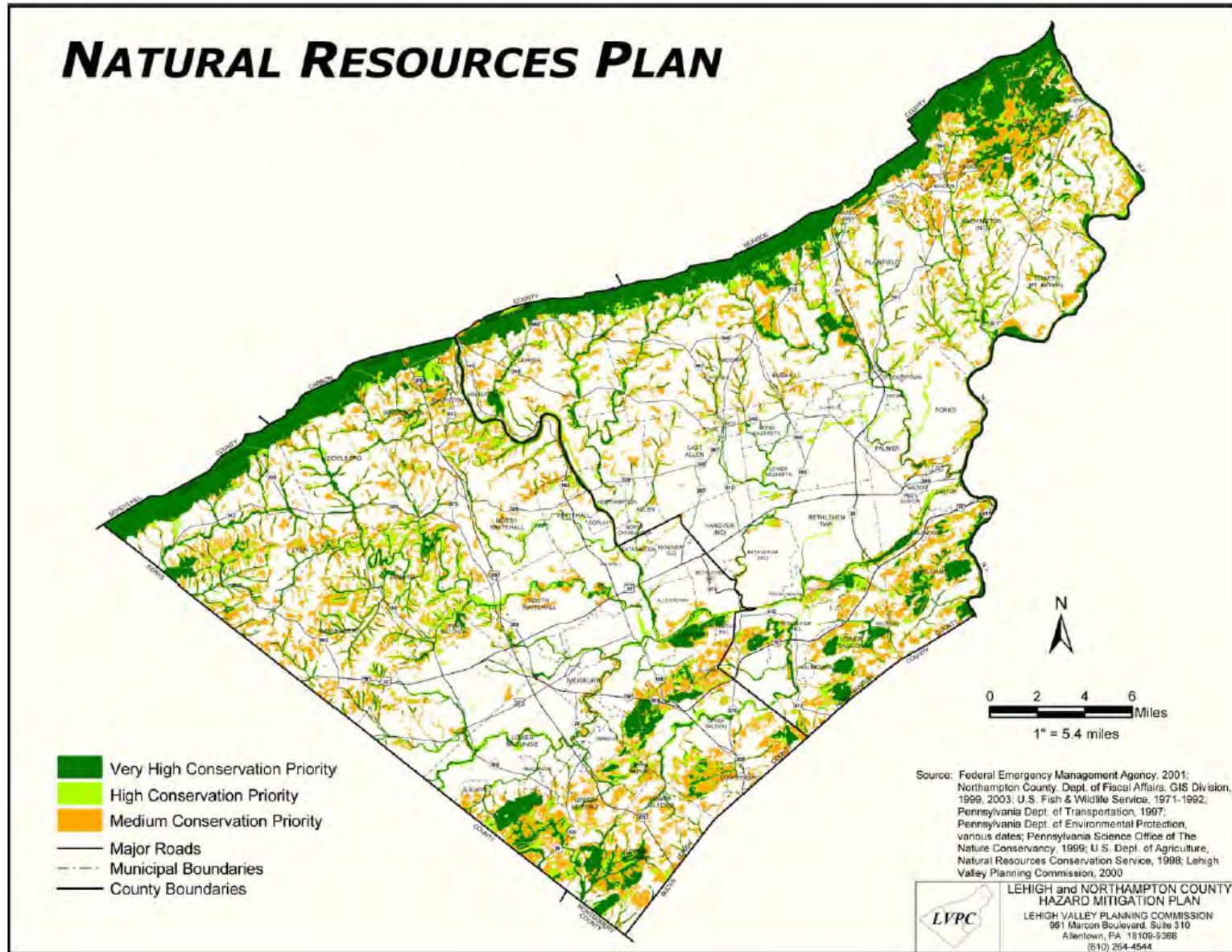
Further, it is noted that the boroughs of Glendon and West Easton are covered under the Northampton County Subdivision and Land Development Ordinance carbonate geology provisions.

The Natural Areas Inventory was prepared by The Nature Conservancy for the LVPC in 1999 and updated in 2005. The Inventory is currently being updated by the Western Pennsylvania Conservancy and is to be completed in 2013. This document identifies plant and animal species of concern and both outstanding natural communities and geologic features requiring protection in the Lehigh Valley. Lehigh and Northampton counties have many significant natural resources that are worthy of protection. Figure 5-1 provides a Natural Resources Plan map prepared by the Lehigh Valley Planning Commission as part of the county comprehensive plan. The map identifies major conservation areas based on steep slope areas, stream quality, floodplains, wetlands, hydric soils, carbonate geology, woodlands and important natural areas (identified in the Natural Areas Inventory). The map shows areas considered very high conservation priority, high conservation priority and medium conservation priority. Very high priority areas are based on areas with the greatest combination of important natural resources. These areas should be given first consideration for public and private conservation acquisition programs.

In 2003, the LVPC prepared the Monocacy Creek Erosion Restoration Plan to identify measures to minimize future stormwater erosion risks in the watershed. A key part of the project was to define the relative risk of erosion for agricultural properties throughout the watershed. The LVPC GIS was used to define natural site characteristics and upslope development characteristics that combine to enhance erosion risk. Existing erosion problems were also identified through field surveys. The restoration plan includes recommendations to remediate the existing problems and to minimize future problems. For existing problem sites, it is recommended that the county conservation districts and the Natural Resources Conservation Service (NRCS) conduct a detailed assessment of the existing erosion sites and identify appropriate solutions. Minimizing future problems is accomplished by the county conservation districts and NRCS using the erosion risk mapping to ensure that areas susceptible to erosion have appropriate preventive measures installed.

The purpose of the Flood Recovery and Flood Mitigation Study was to evaluate the extent of flood damage in Lehigh and Northampton counties due to the January 1996 flooding. The focus of the study was on commercial/industrial development. Possible mitigation measures were developed for high priority areas and the document was provided to the appropriate municipalities for their information and use.

Figure 5-1. Natural Resources Plan



5.4.5 Open Space Planning

The LVPC has prepared several plans with the goal of preserving open space in the Lehigh Valley for recreational and environmental purposes. These plans include the Regional Recreation and Open Space Plan: 1980 Update, the South Mountain Study (1977), and the Northampton County Parks - 2010 and Lehigh County Parks - 2005 plans. The LVPC will comment on open space issues identified in these plans during project reviews.

The LVPC completed a greenways plan for the Lehigh Valley in 2007. A greenway is a corridor of open space. The plan identifies four types of greenways that include conservation, cultural/recreational, conservation/cultural and scenic. The plan evaluates how local ordinances may protect greenways.

5.4.6 Informational Resources

The LVPC has a variety of informational resources available to the public. Many of the publications discussed previously are available for review by the public at the LVPC office. The LVPC recently released an updated version of its GIS data disc covering Lehigh and Northampton counties which is available on CD-ROM. The layers include floodplains, geology, natural areas, parks, wetlands and woodlands, among others. Copies of the floodplain mapping and flood studies prepared by FEMA for both counties are available for public review at the LVPC office. The floodplain mapping currently in effect in Lehigh and Northampton Counties is dated July 16, 2004 and April 6, 2001, respectively. FEMA prepared preliminary mapping for Northampton County dated December 14, 2011, however it has not been finalized at the time of this report. The LVPC also responds to floodplain information requests from the public. The LVPC Local Government Academy has sponsored seminars related to stormwater management, floodplain issues, model environmental ordinances, Growing Greener-Conservation by Design, and basic courses in subdivision review and zoning and a basic course for planning commissioners. The LVPC has also prepared water supply brochures that are available to the public on water conservation and groundwater/wellhead protection.

It is noted that both counties, and many of the municipalities, have identified specific mitigation initiatives in this plan update to help build and enhance mitigation-related planning and regulatory capabilities in the Lehigh Valley.

5.5 Administrative and Technical Capability

Specific administrative and technical capabilities at the county and local levels are identified in each jurisdiction's annex in Section 9, Table E2, of this plan update.

Municipalities are further supported by county, regional, state and federal administrative and technical capabilities. With regard to hazard mitigation, the majority of such support agencies and resources have been included within this plan update process, and identified and referenced throughout the plan update.

It is noted that both counties, and many of the municipalities, have identified specific mitigation initiatives in this plan update to help build and enhance mitigation-related administrative and technical capabilities in the Lehigh Valley.

5.6 Fiscal Capability

Mitigation projects and initiatives are largely or entirely dependent on available funding. As such, it is critical to identify all available sources of funding at the local, county, regional, state and federal level to support implementation of the mitigation strategies identified in this plan update.

Jurisdictions fund mitigation projects through existing local budgets, local appropriations (including referendums and bonding), and through a myriad of federal and state loan and grant programs.

Federal mitigation grant funding (Stafford Act 404 and 406) is available to all communities with a current hazard mitigation plan (this plan); however most of these grants require a “local share” in the range of 10-25% of the total grant amount.

5.6.1 Capital Improvement Planning

Both counties and many of the municipalities in the Lehigh Valley have capital improvements plans, identifying specific capital projects to be funded and completed according to a defined schedule. Some of these projects involve improvements to facilities and infrastructure that provide hazard mitigation benefits. As such, during this update process, the counties and municipalities have been encouraged to consider the mitigation benefits associated with their known or anticipated capital projects as a way to help prioritize their execution and to develop awareness that mitigation grants may be available to help fund such projects.

5.6.2 Federal Hazard Mitigation Funding Opportunities

Hazard Mitigation Grant Program (HMGP)

The HMGP is a post-disaster mitigation program. It is made available to states by FEMA after each Federal disaster declaration. The HMGP can provide up to 75% funding for hazard mitigation measures. The HMGP can be used to fund cost-effective projects that will protect public or private property in an area covered by a federal disaster declaration or that will reduce the likely damage from future disasters. Examples of projects include acquisition and demolition of structures in hazard prone areas, floodproofing or elevation to reduce future damage, minor structural improvements and development of state or local standards. Projects must fit into an overall mitigation strategy for the area identified as part of a local planning effort. All applicants must have a FEMA-approved Hazard Mitigation Plan. Applicants who are eligible for the HMGP are state and local governments, certain nonprofit organizations or institutions that perform essential government services, and Indian tribes and authorized tribal organizations. Individuals or homeowners cannot apply directly for the HMGP; a local government must apply on their behalf. Applications are submitted to PEMA and placed in rank order for available funding and submitted to FEMA for final approval. Eligible projects not selected for funding are placed in an inactive status and may be considered as additional HMGP funding becomes available.

Flood Mitigation Assistance (FMA) Program

FMA provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. The FMA is funded annually; no federal disaster declaration is required. Only NFIP insured homes and businesses are eligible for mitigation in this program. Funding for FMA is very limited and, as with the HMGP, individuals cannot apply directly for the program. Applications must come from local governments or other eligible organizations. The federal cost share for an FMA project is 75%. At least 25% of the total eligible costs must be provided by a non-federal source. Of this 25%, no more than

half can be provided as in-kind contributions from third parties. At minimum, a FEMA-approved local flood mitigation plan is required before a project can be approved. FMA funds are distributed from FEMA to the state. PEMA serves as the grantee and program administrator for FMA.

Pre-Disaster Mitigation (PDM) Program

The PDM program is an annually funded, nationwide, competitive grant program. No disaster declaration is required. Federal funds will cover 75% of a project's cost up to \$3 million. As with the HMGP and FMA, a FEMA-approved local Hazard Mitigation Plan is required to be approved for funding under the PDM program.

Repetitive Flood Claims (RFC) Program

The RFC program is an annually funded, nationwide mitigation grant program with the goal of reducing flood damages to individual properties for which one or more claim payments for losses have been made under flood insurance coverage, and will result in the greatest amount of savings to the National Flood Insurance Fund (NFIF) in the shortest period of time. RFC funding is available for property acquisition and structure demolition or relocation, structural elevations, and minor localized flood reduction projects. Federal funding covers 100% of the project costs.

Severe Repetitive Loss (SRL) Program

The SRL program is an annually funded, nationwide mitigation grant program with the goal of reducing flood damages to residential properties that have experienced severe repetitive losses under flood insurance coverage, and as such, will result in the greatest amount of savings to the NFIF in the shortest period of time. An SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- (a) That has at least four NFIP claim payments (including building and contents) over \$5,000 each, and the cumulative amount of such claims payments exceeds \$20,000; or
- (b) For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

For both (a) and (b) above, at least two of the referenced claims must have occurred within any ten-year period, and must be greater than 10 days apart.

SRL funding is available for property acquisition and structure demolition or relocation, structural elevations, and minor localized flood reduction projects. Federal funding covers 75% of the project costs (90% if the community has a repetitive loss strategy).

5.6.3 Federal Disaster Assistance Programs

Following a disaster, various types of assistance may be made available by local, state and federal governments. The types and levels of disaster assistance depend on the severity of the damage and the declarations that result from the disaster event. Among the general types of assistance that may be provided should the President of the United States declare the event a major disaster are the following:

- Individual Assistance – provides help for homeowners, renters, businesses and some non-profit entities after disasters occur. This program is largely funded by the U.S. Small Business Administration. For homeowners and renters, those who suffered uninsured or underinsured losses may be eligible for a Home Disaster Loan to repair or replace damaged real estate or

personal property. Renters are eligible for loans to cover personal property losses. Individuals may borrow up to \$200,000 to repair or replace real estate, \$40,000 to cover losses to personal property and an additional 20% for mitigation. For businesses, loans may be made to repair or replace disaster damages to property owned by the business, including real estate, machinery and equipment, inventory and supplies. Businesses of any size are eligible. Non-profit organizations such as charities, churches, private universities, etc. are also eligible. An Economic Injury Disaster Loan provides necessary working capital until normal operations resume after a physical disaster. These loans are restricted, by law, to small businesses only.

- Public Assistance – provides cost reimbursement aid to local governments (state, county, local, municipal authorities and school districts) and certain non-profit agencies that were involved in disaster response and recovery programs or that suffered loss or damage to facilities or property used to deliver government-like services. This program is largely funded by FEMA with both local and state matching contributions required.

5.6.4 Other Potential Funding Sources

Community Development Block Grants (CDBG)

CDBG are federal funds intended to provide low and moderate-income households with viable communities, including decent housing, a suitable living environment, and expanded economic opportunities. Eligible activities include community facilities and improvements, roads and infrastructure, housing rehabilitation and preservation, development activities, public services, economic development, planning, and administration. Public improvements may include flood and drainage improvements. In limited instances, and during the times of “urgent need” (e.g. post disaster) as defined by the CDBG National Objectives, CDBG funding may be used to acquire a property located in a floodplain that was severely damaged by a recent flood, demolish a structure severely damaged by an earthquake, or repair a public facility severely damaged by a hazard event.

The County of Northampton’s Consolidated Plan, covering Fiscal Years 2012-2017, has identified housing and community development needs and developed specific goals and objectives to address those needs over a five-year period. This Plan allows the County to receive federal housing and community development funds as a direct Entitlement from the U.S. Department of Housing and Urban Development (HUD). Under this Plan, it is stipulated that the Northampton County Department of Community and Economic Development (NCD CED) will administer the community development programs for all municipalities in Northampton County, except the Cities of Bethlehem and Easton which are separate Entitlements under the CDBG program. The County is a direct entitlement of CDBG funds only. Other HUD funding sources covered by Consolidated Plans, such as HOME or Emergency Solutions Grants, must be received through the Commonwealth’s competitive process.

Specific fiscal capabilities at the county and local levels are identified in each jurisdiction’s annex in Section 9, Table E3, of this plan update. While most of the identified fiscal capabilities are available to all of the municipalities in the Lehigh Valley, the extent to which communities have leveraged these funding sources varies widely, and it is logical to expect that communities that are familiar with accessing specific grant programs will continue to consider and pursue those sources as appropriate.

It is noted that known, targeted and potential funding sources are identified for each project/initiative in the mitigation strategies summarized in each jurisdictional annex in Section 9.

5.7 Political Capability

With respect to hazard mitigation, political capability speaks to a jurisdiction’s ability, will and commitment to supporting risk management activities and programs within all aspects of their community’s governance. This may be evidenced through the adoption and appropriate enforcement of mitigation-related ordinances and plans (zoning, comprehensive planning, site-plan review, building code, higher regulatory standards), appropriate and critical mitigation-related outreach to vulnerable property owners and the public in general, an appropriate dedication of resources (administrative, technical, fiscal) to implement identified priority mitigation projects/actions, and the integration and coordination of the findings and recommendations of this plan update within other complementary and supportive plans and programs.

Strong political capabilities are built over time; they are not necessarily transferred from one elected official to the next. Communities that have had to repeatedly face hazard events and their impacts tend to be those that build and maintain greater mitigation capabilities, and this is certainly the case with political (including public) will. Through this mitigation planning, update and implementation process, FEMA and the state are promoting efforts to build political and popular support to improve the management of hazard risk at the local level.

The Capability Assessment surveys provided to each jurisdiction for completion included an assessment of local political capability, where the respondent was asked to rate their community’s political capability to effect and support hazard mitigation on a scale ranging from “5 – Very Willing” to “0 – Unwilling to Adopt Policies/Programs”. Completed capability assessment worksheets returned from communities may be found in Appendix D. By its very nature, an assessment of political capabilities tends to be highly subjective, and any such local assessment provided by a community should not necessarily be considered statistically valid or reflective of the opinions of others in the community. As such, no summary of jurisdictional responses with respect to local political capability assessments is provided. Alternatively, as described in the following section, a self-assessment of municipal capabilities, including community political capability, is provided in Table 5-2.

5.8 Self-Assessment

Via the Capability Assessment surveys, all participating jurisdictions were further asked to provide a self-assessment of their jurisdiction’s capability in the areas of Planning and Regulatory Capability, Administrative and Technical Capability, Fiscal Capability, Community Political Capability, and Community Resiliency Capability. Respondents evaluated their degree of capability in these areas as “Limited”, “Moderate” or “High”. The summary results from those communities providing completed capability self-assessment worksheets are provided in Table 5-2.

Table 5-2. Capability Self-Assessment Matrix

Municipality	Capability Category				
	Planning and Regulatory Capability	Administrative and Technical Capability	Fiscal Capability	Community Political Capability	Community Resiliency Capability
Lehigh County					
Alburtis Borough	Moderate	Moderate	Limited	Moderate	Moderate
Allentown, City of	High	High	Moderate	High	High
Bethlehem, City of	High	High	Moderate	High	High

SECTION 5: CAPABILITY ASSESSMENT

Municipality	Capability Category				
	Planning and Regulatory Capability	Administrative and Technical Capability	Fiscal Capability	Community Political Capability	Community Resiliency Capability
Catasauqua Borough	High	Moderate	Limited	Moderate	Moderate
Coopersburg Borough	Moderate	High	Limited	Moderate	Limited
Coplay Borough	Moderate	Moderate	Moderate	Moderate	Moderate
Emmaus Borough	High	High	Moderate	Moderate	Moderate
Fountain Hill Borough	Moderate	Moderate	Moderate	Moderate	Moderate
Hanover Township	High	High	High	High	High
Heidelberg Township	Moderate	Moderate	Moderate	Moderate	Moderate
Lower Macungie Township	High	High	Moderate	Moderate	Moderate
Lower Milford Township	High	High	Limited	High	Limited
Lowhill Township					
Lynn Township	Limited	Moderate	Limited	Limited	Limited
Macungie Borough	Limited	Limited	Limited	Limited	Limited
North Whitehall Township					
Salisbury Township					
Slatington Borough	Moderate	Moderate	Limited	Moderate	Limited
South Whitehall Township	High	High	High	High	High
Upper Macungie Township	High	High	Moderate	Moderate	High
Upper Milford Township	Moderate	Moderate	Moderate	Moderate	High
Upper Saucon Township					
Washington Township	Moderate	Moderate	Moderate	Moderate	Moderate
Weisenberg Township					
Whitehall Township	High	High	High	High	Moderate
Lehigh County					
Northampton County					
Allen Township					
Bangor Borough	Moderate	Moderate/High	Moderate	High	Moderate
Bath Borough	Moderate	Moderate	Limited	High	High
Bethlehem Township	Moderate	Moderate	Moderate	Moderate	Moderate
Bethlehem, City of	High	High	Moderate	High	High
Bushkill Township	Moderate	High	High	High	High
Chapman Borough					
East Allen Township	Moderate	Moderate	Limited	Limited	Limited
East Bangor Borough					
Easton, City of	High	High	High	High	High
Forks Township					
Freemansburg Borough					
Glendon Borough					
Hanover Township					
Hellertown Borough	High	Moderate	Limited	Moderate	Moderate

SECTION 5: CAPABILITY ASSESSMENT

Municipality	Capability Category				
	Planning and Regulatory Capability	Administrative and Technical Capability	Fiscal Capability	Community Political Capability	Community Resiliency Capability
Lehigh Township	Moderate	Moderate	Limited	Moderate	Moderate
Lower Mt. Bethel Township					
Lower Nazareth Township					
Lower Saucon Township					
Moore Township					
Nazareth Borough					
North Catasauqua Borough					
Northampton Borough	Limited	Moderate	Limited	Limited	Moderate
Palmer Township	Moderate	High	Limited	Moderate	Moderate
Pen Argyl Borough	Limited	Limited	Limited	Moderate	Moderate
Plainfield Township	Moderate	Moderate	Limited	Moderate	Moderate
Portland Borough	Moderate	Moderate	Moderate	Moderate	Moderate
Roseto Borough					
Stockertown Borough	High	High	Limited	Limited	Moderate
Tatamy Borough	Limited	Limited	Limited	Limited	Limited
Upper Mt. Bethel Township	High	High	Limited	High	High
Upper Nazareth Township					
Walnutport Borough	Limited	Limited	Limited	Moderate	Moderate
Washington Township	Moderate	Moderate	Limited	Moderate	Moderate
West Easton Borough					
Williams Township	Moderate	Moderate	Moderate	Moderate	Moderate
Wilson Borough					
Wind Gap Borough					
Northampton County					

5.9 Capability Assessment Recommendations

It is well recognized that a jurisdiction’s ability to effectively manage natural hazard risk is directly related to their level of hazard mitigation capabilities. Both counties and all communities in the Lehigh Valley have identified specific actions to improve these capabilities, as identified in their jurisdictional annexes in Section 9.

SECTION 6: MITIGATION STRATEGY

This section describes the process by which the Lehigh Valley Steering Committee and municipal planning partnership performed the update to the county and local mitigation strategies. This update focused on improving the county and local mitigation strategies, and so addressed the updating of mitigation strategies from the outset of the planning process. Throughout the planning process, both counties and all municipalities were encouraged to thoroughly consider their natural and non-natural hazard risks and vulnerabilities, and to identify appropriate projects or initiatives to mitigate those risks.

This section includes:

- (1) Review and Update of Hazard Mitigation Goals
- (2) Update of Municipal Mitigation Strategies
- (3) Update of County-Level Mitigation Strategies
- (4) Mitigation Strategy Prioritization and Implementation

6.1 Review and Update of Hazard Mitigation Goals

As part of the plan update process, the Steering Committee and all participating municipalities were tasked with review of the hazard mitigation planning goals identified in the 2006 plan. Steering Committee members were tasked with this review at the outset of the process, as part of an overall review of the 2006 plan and associated FEMA plan review crosswalk to determine those areas that needed specific updating. To facilitate the municipal review process, a mitigation planning Goals Review Worksheet was developed and distributed to all participating municipalities. This worksheet, based on the Goal and Objective Review Worksheet sample provided in Appendix 8 of Pennsylvania's All-Hazard Planning Standard Operating Guide (October 2010), further included a description and purpose of hazard mitigation planning goals and objectives, the need for these goals to complement and support the goals of other associated state, regional and local planning mechanisms, and identified the mitigation goals in the Commonwealth of Pennsylvania Standard 2010 All-Hazard Mitigation Plan.

While conducting the review process, participating municipalities were asked to consider the following questions:

- Do the goals identified in the previously approved plan reflect the updated risk assessment?
- Did the goals identified in the previously approved plan lead to mitigation projects and/or changes in policy that helped the jurisdiction(s) to reduce vulnerability?
- Do the goals identified in the previously approved plan support any changes in mitigation priorities?
- Are goals identified in the updated Local Mitigation Plan reflective of current State goals?

For each goal in the 2006 plan, the worksheet asked the respondent to indicate:

- Keep/Still Applies (Yes/No, if "No", then indicate reason)
- Modify as Follows
- Supported Local Risk Reduction (Yes/No)

Further, respondents were provided the opportunity to identify new/additional goals and/or objectives. Completed worksheets submitted by the municipalities may be found in Appendix D.

Throughout the planning process, the relevance of the original goals continued to be evaluated for possible amendment based on input from the counties and municipalities; a consideration of the updated risk assessment results; review of relevant authorities, policies, and programs; and alignment with the mitigation goals in the Commonwealth of Pennsylvania Standard 2010 All-Hazard Mitigation Plan, identified as:

1. Protect lives, property, environmental quality, and resources of the Commonwealth, including Repetitive Loss (RL) and Severe Repetitive Loss (SRL) properties.
2. Enhance consistent coordination, collaboration, and communications among stakeholders.
3. Provide a framework for active hazard mitigation planning and implementation.
4. Build legislative support and secure funding for mitigation efforts.
5. Increase awareness, understanding, and preparedness across all sectors.

Subsequent to this review process, the goals of the 2006 plan remain unchanged, with the exception of the addition of “non-natural hazards” (noted in brackets below), as they were found to embody the overarching needs and concerns of the counties and participating municipalities in addressing natural and non-natural hazard risk reduction, and are in-line with the State mitigation goals.

Goal 1: To minimize the risk to human life associated with natural [and non-natural] hazards.

Goal 2: To promote hazard avoidance, especially in floodplains, by removing high-risk and repetitive loss structures and through restrictions on future development.

Goal 3: To reduce the damages from natural [and non-natural] hazards to existing and future public and private assets including structures, critical facilities and infrastructure.

Goal 4: To protect and restore existing natural resources including wetlands, floodplains and riparian buffers.

Goal 5: To develop, prioritize and implement cost-effective, long term actions that will reduce the impacts of natural [and non-natural] hazards.

Goal 6: To recommend local regulations to reduce the impacts of natural [and non-natural] hazards.

Goal 7: To enhance planning and emergency response efforts among federal, state, county and local emergency management personnel to protect public health and safety.

Goal 8: To promote public awareness on both the potential impacts of natural [and non-natural] hazards and actions to reduce those impacts.

6.2 Update of Municipal Mitigation Strategies

In the 2006 Lehigh Valley HMP, participating municipalities were asked to identify mitigation projects within their communities. In Lehigh County, 10 municipalities recommended a total 103 projects, while in Northampton County, 26 municipalities recommended a total of 106 projects.

To evaluate progress on local mitigation actions, each community with actions in the 2006 plan was provided with a Mitigation Action Plan Review Worksheet, based on the Action Plan Review Worksheet sample provided in Appendix 8 of Pennsylvania's All-Hazard Planning Standard Operating Guide (October 2010). Each municipal worksheet was pre-populated with those actions identified for their community in the 2006 plan. For each action, the respondents were asked to indicate the status of each action ("No Progress/Unknown", "In Progress/Not Yet Complete", "Continuous", "Completed", "Discontinued"), and provide review comments on each.

Completed Mitigation Action Plan Review Worksheets submitted by the municipalities may be found in Appendix D. Local mitigation actions identified as "Complete", as well as certain "Continuous" (ongoing) actions, are identified in the jurisdictional annexes found in Section 9, Table F1, of this plan. Actions identified as "Discontinued" have been removed from this plan update.

Those local actions that municipalities identified as "No Progress/Unknown", "In Progress/Not Yet Complete" or "Continuous" have been carried forward in their local updated mitigation strategy identified in the jurisdictional annexes found in Section 9, Table F3, of this plan update. Municipalities were asked to provide further details on these projects to help better define the projects, identify benefits and costs, and improve implementation, and were provided with a "Mitigation Project Capture Worksheet" to help survey communities for this information.

At the Kick-Off and subsequent planning meetings, all participating municipalities were provided a survey ("Municipal Information Worksheet") to further assist in identifying mitigation activities completed, ongoing and potential/proposed. Completed Municipal Information Worksheets submitted by the municipalities may be found in Appendix D.

As new additional potential mitigation actions, projects or initiatives became evident during the plan update process, including as part of the risk assessment update and as identified through the public and stakeholder outreach process (see Section 3), communities were made aware of these either through direct communication (email, phone) or via their draft municipal annexes.

As ongoing or uncompleted activities from the 2006 plan, or potential new initiatives were identified, municipalities were provided with "Project Capture Worksheets" to facilitate the gathering of additional information on each potential project, including additional project description, estimated cost, potential benefits, responsible agency/department, and timeline.

Jurisdictional Annexes:

A major change in the format of this plan update was the incorporation of jurisdictional annexes. Each jurisdiction participating in this update (both counties and all municipalities) has assisted in the authoring of their own annex or chapter to this plan update, included in Section 9. One of the key elements of each annex is the updated jurisdictional mitigation strategy.

Each municipality was asked to attend at least one of the three Jurisdictional Annex Workshops held during April and May, 2012. At these workshops, municipalities were provided with their draft annex,

annex completion instructions, and various resources to assist and support the development of their annexes including:

- Electronic copies of the updated draft hazard profiles.
- Mitigation Strategy Ideas (organized by hazard) excerpted from Appendix 10 of Pennsylvania's All-Hazard Planning Standard Operating Guide (October 2010).
- Excerpts of the relevant Act 167 Stormwater Management Plan covering their community, specifically those sections pertaining to existing storm drainage problem areas, significant obstructions, and existing and proposed flood control projects.

To help support the selection of an appropriate, risk-based mitigation strategy, each annex provided a summary of hazard vulnerabilities identified during the plan update process, either directly by municipal representatives, through review of available county and local plans and reports, and through the hazard profiling and vulnerability assessment process.

Annexes were pre-populated with both specific mitigation actions identified during the course of the plan update, as well as general ("common") initiatives developed during the planning process and included for municipal consideration.

Specific mitigation actions included in the draft municipal annexes included:

- Those being carried forward from the 2006 plan;
- Those specifically identified by the jurisdiction during the course of the planning process;
- Those identified in other relevant county and local plans and reports (e.g. Act 167 Stormwater Management Plans, Capital Plans, local engineering studies);
- Those identified during the public and stakeholder outreach process, including the Stakeholder Outreach Workshops (see Section 3);
- Those that became evident through the updated hazard profiling and risk/vulnerability assessment effort.

Each draft jurisdictional annex was also pre-populated with a suite of "general" or "common" mitigation initiatives for their consideration and inclusion as appropriate. Throughout the plan update process, and in consideration of federal and state mitigation guidance, the Steering Committee recognized that all municipalities would benefit from the inclusion of certain mitigation initiatives. These include initiatives to address vulnerable public and private properties, including RL and SRL properties; initiatives to support continued and enhanced participation in the NFIP; improved public education and awareness programs; initiatives to build greater local mitigation capabilities; and a commitment to implement and maintain the plan.

All municipalities were asked to thoroughly review these "general" initiatives, and include, amend or delete them as they found appropriate for their jurisdiction.

From May through September 2012, members of the Steering Committee and contract consultant worked directly with each jurisdiction (phone, email, local support meetings) to assist with the development and update of their annex and include mitigation strategies, focusing on identifying well-defined, implementable projects with a careful consideration of benefits (risk reduction, losses avoided), costs, and possible funding sources (including mitigation grant programs).

Further, concerted efforts were made to assure that municipalities develop updated mitigation strategies that included activities and initiatives covering the range of mitigation action types described in FEMA guidance (FEMA 386-3), including:

- 1. Prevention:** Government, administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, floodplain local laws, capital improvement programs, open space preservation, and storm water management regulations.
- 2. Property Protection:** Actions that involve (1) modification of existing buildings or structures to protect them from a hazard or (2) removal of the structures from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, storm shutters, and shatter-resistant glass.
- 3. Public Education and Awareness:** Actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.
- 4. Natural Resource Protection:** Actions that minimize hazard loss and also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- 5. Emergency Services:** Actions that protect people and property, during and immediately following, a disaster or hazard event. Services include warning systems, emergency response services, and the protection of essential facilities.
- 6. Structural Projects:** Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include dams, setback levees, floodwalls, retaining walls, and safe rooms.

6.3 Update of County-Level Mitigation Strategies

In the 2006 Lehigh Valley HMP, Lehigh and Northampton counties identified fifteen (15) county-level actions/initiatives to support an improved understanding of hazard risk and vulnerability, and enhance mitigation capabilities. Progress on the 2006 county-level mitigation actions was evaluated during the 2008 formal plan review, and again during this update process.

The update of the county-level mitigation strategies included a review of progress on the actions/initiatives identified in the 2006 HMP, using a process similar to that used to review municipal mitigation strategy progress. Both counties and the LVPC, via their various representatives on the Steering Committee, were provided with a Mitigation Action Plan Review Worksheet identifying all of the county-level actions/initiatives from the 2006 plan, including any progress as identified in the 2008 Progress Report. For each action, the respondents were asked to indicate the status of each action (“No Progress/Unknown”, “In Progress/Not Yet Complete”, “Continuous”, “Completed”, “Discontinued”), and provide review comments on each.

Completed Mitigation Action Plan Review Worksheets submitted by both counties are provided in Appendix D. Projects/initiatives identified as “Complete”, as well as certain “Continuous” (ongoing)

actions, are identified in subsection F1 of the county annexes found in Section 9 of this plan update. Actions identified as “Discontinued” have been removed from this plan update. Those actions the counties have identified as “No Progress/Unknown”, “In Progress/Not Yet Complete” or “Continuous” have been carried forward in the updated mitigation strategies identified in Table F3 of the county annexes found in Section 9 of this plan update.

Throughout the course of the plan update process, additional regional and county-level mitigation actions have been identified. These were identified through:

- Review of the results and findings of the updated risk assessment;
- Review of available regional and county plans, reports and studies;
- Direct input from regional and county agencies, including emergency services, public works/facilities, health/human services, and community and economic development;
- Input received through the stakeholder outreach process, including the Stakeholder Outreach Workshops.

6.4 Mitigation Strategy Prioritization and Implementation

Section 201.6.c.3iii of 44CFR requires the prioritization of the action plan to emphasize the extent to which benefits are maximized according to a cost/benefit review of the proposed projects and their associated costs. This allows the jurisdictions to select the most cost-effective actions for implementation first, not only to use resources efficiently, but to make a realistic start toward mitigating risks.

Mitigation benefits are future damages and losses that would be eliminated and/or reduced by implementing the proposed mitigation project, and include physical damage to structures and infrastructure, loss of service or function, emergency management costs, etc. Particularly for physical (“shovel-in-the-ground”) mitigation projects, jurisdictions were encouraged to identify and/or estimate both project costs as well as anticipated benefits. Where exact project benefits and costs were not available, ranges were identified (high, medium, low) for each allowing at least a qualitative evaluation of project cost-effectiveness.

Municipal and county-level mitigation actions were evaluated and prioritized primarily using the PA STEEL methodology defined in Pennsylvania’s All-Hazard Planning Standard Operating Guide (October 2010), pages 36-37 and Appendix 12, “Mitigation Strategy Action Evaluation”. Each jurisdictional annex in Section 9 contains a completed PA STEEL action evaluation table (Table G) for those actions identified in their updated mitigation strategies (Table F.3).

The PA STEEL methodology provides a uniform approach the counties and jurisdictions can use to consider, in a systematic way, the **Political, Administrative, Social, Technical, Economic, Environmental, and Legal** (PA STEEL) opportunities and constraints of implementing a particular mitigation action in your jurisdiction. The following provides a brief discussion of each of the PA STEEL evaluation criteria, excerpted from the FEMA 386 mitigation planning guidance:

Political: Understanding how your current community and state political leadership feels about issues related to the environment, economic development, safety, and emergency management will provide valuable insight into the level of political support you will have for mitigation activities and programs. Proposed mitigation objectives sometimes fail because of a lack of political acceptability.

Administrative: Under this part of the evaluation criteria, you will examine the anticipated staffing, funding, and maintenance requirements for the mitigation action to determine if the jurisdiction has the

personnel and administrative capabilities necessary to implement the action or whether outside help will be necessary.

Social: The public must support the overall implementation strategy and specific mitigation actions. Therefore, the projects will have to be evaluated in terms of community acceptance.

Technical: It is important to determine if the proposed action is technically feasible, will help to reduce losses in the long term, and has minimal secondary impacts. Here, you will determine whether the alternative action is a whole or partial solution, or not a solution at all.

Economic: Every local, state, and tribal government experiences budget constraints at one time or another. Cost-effective mitigation actions that can be funded in current or upcoming budget cycles are much more likely to be implemented than mitigation actions requiring general obligation bonds or other instruments that would incur long-term debt to a community. States and local communities with tight budgets or budget shortfalls may be more willing to undertake a mitigation initiative if it can be funded, at least in part, by outside sources. “Big ticket” mitigation actions, such as large-scale acquisition and relocation, are often considered for implementation in a post-disaster scenario when additional federal and state funding for mitigation is available. Economic considerations must include the present economic base and projected growth.

Environmental: Impact on the environment is an important consideration because of public desire for sustainable and environmentally healthy communities and the many statutory considerations, such as the National Environmental Policy Act (NEPA), to keep in mind when using federal funds. You will need to evaluate whether, when implementing mitigation actions, there would be negative consequences to environmental assets such as threatened and endangered species, wetlands, and other protected natural resources.

Legal: Without the appropriate legal authority, the action cannot lawfully be undertaken. When considering this criterion, you will determine whether your jurisdiction has the legal authority at the state, tribal, or local level to implement the action, or whether the jurisdiction must pass new laws or regulations. Each level of government operates under a specific source of delegated authority. As a general rule, most local governments operate under enabling legislation that gives them the power to engage in different activities. You should identify the unit of government undertaking the mitigation action, and include an analysis of the interrelationships between local, regional, state, and federal governments. Legal authority is likely to have a significant role later in the process when your state, tribe, or community will have to determine how mitigation activities can best be carried out, and to what extent mitigation policies and programs can be enforced.

Per the PEMA SOG, the mitigation strategy evaluation through the PA STEEL methodology also summarizes the feasibility factors for each action and summarizes the factors with benefits and costs weighed more heavily and, therefore given greater priority. Using cost-benefit weighted prioritization, mitigation actions which receive twenty or more favorable ratings are considered high priority actions. Mitigation actions which receive six or more unfavorable ratings are expected to be more difficult to accomplish compared to other mitigation actions. These are not considered low priority, particularly since they will likely need more attention than other actions. However, barriers to implementation including political, financial, time, etc., increase their costs and therefore reduce overall benefits.

However, other factors beyond the PA STEEL numeric rankings may have been considered during project prioritization. For example, a project might be assigned a medium priority because of the uncertainty of a funding source. This priority could be changed to high once a funding source has been identified such as a grant.

The annexes in Section 9, Volume II of this plan update present the updated mitigation strategies identified by both counties and all participating municipalities, including:

- Mitigation actions for individual and multiple hazards;
- Identification of the mitigation action type;
- Department or agency primarily responsible for project initiation and/or implementation;
- Estimated cost for the mitigation action, and identification of known or potential sources of funding;
- Implementation schedule;
- Implementation priority.

Specific mitigation actions were identified to prevent future losses; however, current funding is not identified for all of these actions at present. The two counties and participating municipalities in the Lehigh Valley have limited resources to take on new responsibilities or projects. The implementation of these mitigation actions is dependent on the approval of the local elected governing body and the ability of the jurisdiction to obtain funding from local or outside sources.

In general, mitigation actions ranked as high priorities will be addressed first. However, medium or even low priority mitigation actions will be considered for concurrent implementation. Therefore, the ranking levels should be considered as a first-cut, preliminary ranking and will evolve based on prevailing priorities and decisions of local governments, the public, PEMA and FEMA as the plan update is implemented.

Plan revisions to reflect changes in priorities (FEMA Requirement 201.6(d)(3):

Prioritization in the 2006 plan was limited to flood projects, using a High, Medium, Low system as follows:

- High Priority: Public Infrastructure/Critical Facilities
- Medium Priority: Acquisitions and Floodproofing/Elevation
- Low Priority: Storm Drainage Improvements

As detailed above, the 2013 update has added the PA STEEL criteria to help enhance the prioritization of projects, particularly new projects identified during the update process. In general, the prioritization of 2006 flood projects being carried forward into this update has remained the same, as the prioritization system used for flood projects in the 2006 plan is still believed to be valid for the two counties and the inclusive municipalities. However, the PA STEEL criteria has been applied by plan participants to all projects in this update (Table F3 in each annex), allowing a broader range of prioritization criteria to be applied including technological, social, environmental and economic criteria. Changes in priorities by the participating jurisdictions have been accommodated through the addition of the PA STEEL criteria to the 2006 prioritization system.

Further, the mitigation goals established in the 2006 plan were reviewed by the Steering Committee, and were determined to remain valid with minor modifications (the addition of “non-natural hazards”). As such they continue to reflect the overarching priorities driving mitigation in the Lehigh Valley.

SECTION 7: PLAN MAINTENANCE PROCEDURES

This section describes the system that Lehigh and Northampton counties and all participating jurisdictions have established to monitor, evaluate, and update the mitigation plan; implement the mitigation plan through existing programs; and solicit continued public involvement for plan maintenance.

7.1 Monitoring, Evaluating and Updating the Plan

This section presents the procedures for monitoring, evaluating, and updating the plan.

The Lehigh Valley Hazard Mitigation Steering Committee (“Steering Committee”) intends to remain intact as the organization responsible for monitoring, evaluating and updating this plan. Ms. Angel Gillette, the Northampton County Emergency Management Services (NCEMS) Hazard Mitigation and Disaster Recovery Manager, shall continue to act as the coordinator for the Steering Committee. Each participating jurisdiction is expected to maintain a municipal hazard mitigation representative to support their jurisdiction’s input to the monitoring, evaluation and updating responsibilities identified in this section. Table 7-1 identifies the representation on the Steering Committee as of the date of this plan update. Ongoing municipal hazard mitigation planning points of contact are identified in each jurisdiction’s annex (Section 9).

Table 7-1. Lehigh Valley Hazard Mitigation Plan Update Steering Committee Membership

Name	Title	Department / Agency
Angel Gillette, CEM	Manager, Hazard Mitigation and Disaster Recovery	Northampton County Emergency Management Services
Robert Mateff, ENP	Director/Coordinator	Northampton County Emergency Management Services
William Hillanbrand, MA	Emergency Management Planning Manager	Northampton County Emergency Management Services
Nick Tylenda	Deputy Director	Northampton County Emergency Management Services
Todd Weaver, ENP	Deputy Director for Systems Management	Northampton County Emergency Management Services
Tanya Hook	County Mitigation Lead – Community Outreach Coordinator	Lehigh County Emergency Management Agency
Thomas Nervine	Director	Lehigh County Emergency Management Agency
Nicole Burton	Administrative Assistant	Lehigh County Emergency Management Agency
David Fenton	Operations and Training Coordinator	Lehigh County Emergency Management Agency
Geoffrey Reese, PE	Assistant Director	Lehigh Valley Planning Commission
Susan Rockwell	Senior Environmental Planner	Lehigh Valley Planning Commission

It is recognized that individual commitments change over time, and it shall be the responsibility of each jurisdiction and its representatives to inform the NCEMS Hazard Mitigation and Disaster Recovery Manager of any changes in representation by formal letter. The NCEMS Hazard Mitigation and Disaster Recovery Manager shall maintain the current membership of the Steering Committee and municipal representatives on the Lehigh Valley Hazard Mitigation Plan public website at http://www.nc911.org/html/hazard_mitigation.html.

7.1.1 Monitoring and Evaluating

The NCEMS Hazard Mitigation and Disaster Recovery Manager shall be responsible for monitoring progress on, and evaluating the effectiveness of the plan update, and documenting this with the Pennsylvania Emergency Management Agency (PEMA) and the Federal Emergency Management Agency (FEMA) Region III. The evaluation of the plan update is an assessment of whether the planning process and actions have been effective, if the plan goals are being reached, and whether changes are needed. These evaluations will assess whether:

- Mitigation goals address current and expected conditions;
- The nature or magnitude of the risks has changed;
- Current resources are appropriate for implementing the plan and if different or additional resources are now available;
- Actions were cost effective;
- Schedules and budgets are feasible;
- Implementation problems, such as technical, political, legal or coordination issues with other agencies exist;
- Outcomes have occurred as expected;
- Changes in municipal resources impacted plan implementation (for example, funding, personnel, and equipment);
- New agencies/departments/staff should be included, including other local governments as defined under 44 CFR 201.6;
- Documentation of hazard events that occurred during the previous year.

Finally, the Steering Committee will evaluate how other programs and policies have conflicted or augmented planned or implemented measures, and shall identify policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions (see the “Implementation of Mitigation Plan through Existing Programs” subsection later in this section).

7.1.2 Annual Plan Review

Monitoring of plan progress and evaluating effectiveness shall be accomplished through an annual plan review process, initiated by the NCEMS Hazard Mitigation and Disaster Recovery Manager and working directly with each participating jurisdiction.

The annual plan review process shall begin in May of each year, timed to coincide with the annual FEMA Hazard Mitigation Assistance (HMA) program announcement. At this time, the NCEMS Hazard Mitigation and Disaster Recovery Manager shall call a meeting of the Steering Committee to discuss how to conduct the annual review and reporting process for the year. At this meeting, the Steering Committee shall determine the method by which county departments and agencies and municipalities will be

surveyed for information to go into the annual review and report, and set a schedule and assign responsibilities to complete the review and reporting process.

While the actual methods and tools for this review and reporting will be established by the Steering Committee each year, it is anticipated that the process will include the following:

- Preparing and distributing a county department/agency progress survey (one for each county) to identify progress on county-level mitigation actions, and identify new actions and initiatives to be added to the county strategies;
- Preparing an annual municipal mitigation progress reporting form for distribution to all municipalities ahead of an annual meeting of the planning partnership;
- Inviting the planning partnership to the annual meeting, and providing the municipal mitigation progress reporting form;
- Conducting an annual meeting of the municipal planning partnership, at which the following will be discussed:
 - Mitigation progress and activity at the county and regional level;
 - How to complete the municipal mitigation progress reporting form, and schedule for completion;
 - Adding and/or eliminating mitigation projects/activities/initiatives from the local mitigation action plans;
 - Mitigation successes, problems, concerns and issues regarding plan implementation at the local level;
 - Mitigation resources available, including upcoming and potential training programs;
 - Annual HMA grant program (process to apply, schedule, etc.);
- Preparing and submitting an annual progress report to PEMA and FEMA Region III.

For county-level activity, the Lehigh County Emergency Management Agency (LCEMA) and NCEMS shall task their county department and agency representatives to collect and process information on mitigation activity and progress from their respective departments and agencies. At the municipal level, the Steering Committee shall collect and compile municipal survey forms, information provided at the annual plan review meeting with the communities, and conduct phone calls and meetings with persons responsible for initiating and/or overseeing the mitigation projects to obtain progress information. Copies of any grant applications filed on behalf of any of the participating jurisdictions shall be provided to the Steering Committee. Further, the representatives shall obtain from their municipal supervisor/administrator or clerk any public comments made on the plan update and provide to the Steering Committee for inclusion in the annual report.

Through this process, the Steering Committee and municipal representatives shall be expected to document, as needed and appropriate:

- Hazard events and losses occurring in their jurisdiction including their nature and extent and the effects that hazard mitigation actions have had on impacts and losses;
- Progress on the implementation of mitigation actions, including efforts to obtain outside funding for mitigation actions;
- Any obstacles or impediments to the implementation of actions;
- Additional mitigation actions believed to be appropriate and feasible;
- Public and stakeholder input and comment on the plan update.

The NCEMS Hazard Mitigation and Disaster Recovery Manager shall be responsible for preparing an Annual HMP Progress Report, based on the local annual progress reports provided by each jurisdiction, information presented at the annual Steering Committee meeting, and other information as appropriate and relevant. While the main purposes of this report are to document progress on plan implementation at the county and local level, and to formally document updates to the county and local mitigation strategies, these annual reports will provide data for the five-year update of this plan and will assist in pinpointing implementation challenges. By monitoring the implementation of the plan on an annual basis, the Steering Committee will be able to assess which projects are completed, which are no longer feasible, and what projects may require additional funding.

The Annual HMP Progress Report shall be posted on the Lehigh Valley Hazard Mitigation Plan public website at http://www.nc911.org/html/hazard_mitigation.html to keep the public apprised of the plan's implementation. This report will also be provided to any community participating in the Community Rating System (CRS) program to meet CRS Activity 510 and annual CRS recertification requirements. To meet this recertification timeline, the Steering Committee will strive to complete the review process and prepare an Annual HMP Progress Report by the end of October.

Post-Disaster:

After a declared disaster or major hazard event in the Lehigh Valley, the NCEMS Hazard Mitigation and Disaster Recovery Manager and Steering Committee may elect to meet with the municipal planning partnership to:

- Discuss ongoing recovery and public assistance efforts;
- Discuss data and information collection on the disaster;
- Evaluate the effectiveness of mitigation projects completed in the county and municipalities;
- Identify specific areas of vulnerability evident in the wake of the disaster;
- Identify potential mitigation actions and opportunities to address new areas of vulnerability;
- Discuss current or anticipated grant opportunities (e.g. HMGP) in the wake of the disaster.

7.1.3 Plan Maintenance and Updating

44 CFR 201.6.d.3 requires that local hazard mitigation plans be reviewed, revised as appropriate, and resubmitted for approval in order to remain eligible for benefits awarded under DMA 2000. It is the intent of the Steering Committee to update this plan on a five year cycle from the date of adoption (to be formally established by FEMA). Ongoing maintenance and updating of the plan shall be the responsibility of the NCEMS Hazard Mitigation and Disaster Recovery Manager, working with the Steering Committee and municipal planning partners.

To facilitate the update process, the NCEMS Hazard Mitigation and Disaster Recovery Manager, with support of the Steering Committee, shall use the **third** annual plan review process to develop and commence the implementation of a detailed plan update program. The NCEMS Hazard Mitigation and Disaster Recovery Manager shall invite representatives from PEMA and FEMA Region III to this meeting to provide guidance on plan update procedures. This program shall, at a minimum, establish who shall be responsible for managing and completing the plan update effort, what needs to be included in the updated plan, and a detailed timeline with milestones to assure that the update is completed according to regulatory requirements. At this meeting, the Steering Committee shall determine what resources will be needed to complete the update. The NCEMS Hazard Mitigation and Disaster Recovery Manager shall be responsible for assuring that needed resources are secured.

Following each five year update, the updated plan will be distributed for public comment. After all comments are addressed, the plan will be revised and distributed to all municipal planning partners, the Pennsylvania State Hazard Mitigation Officer, and FEMA Region III.

7.2 Implementation of Mitigation Plan through Existing Programs

The two counties and participating jurisdictions have provided a listing of related programs, through which mitigation planning may be implemented, in the local capability assessments provided in each jurisdictional annex (Volume II, Section 9). In addition, a full discussion on relevant federal, state, regional, county and local plans and programs is provided in Section 5, “Capability Assessment.”

It is the intention of the Steering Committee and participating jurisdictions to incorporate mitigation planning as an integral component of daily government operations. Steering Committee members will work with local government officials to integrate hazard mitigation goals and actions into the general operations of government and partner organizations. Further, the sample adoption resolution (Appendix F) includes a resolution item stating the intent of the local governing body to incorporate mitigation planning as an integral component of government and partner operations. By doing so, the Steering Committee anticipates that:

- 1) Hazard mitigation planning will be formally recognized as an integral part of overall emergency management efforts;
- 2) This plan update and other planning documents and programs will become mutually supportive efforts that work in concert to meet the goals and needs of the county and municipalities;
- 3) Duplication of effort can be minimized.

The information on hazard, risk, vulnerability and mitigation contained in this plan update is based on the best science, data and technology available at the time of the plan update’s preparation. It is recognized by all participating jurisdictions that this information can be invaluable in making decisions under other planning programs, such as comprehensive, long-term community recovery plans, watershed management plans, capital improvement, and emergency management plans.

Section 3.6 “Integration/Coordination with Existing Plans and Programs” identified how existing plans and programs have been integrated into this updated plan. The following identifies how this plan will continue to promote and effect that coordination during the implementation of this updated plan.

7.2.1 Emergency Management Plans and Programs:

The LCEMA and NCEMS and municipalities in the Lehigh Valley recognize that the findings and recommendations of this plan update need to be incorporated into their emergency planning, preparedness, response and recovery programs and operations.

The HAZUS-MH datasets and projects developed for this plan update shall be provided to the two counties for their use in ongoing and future emergency management planning, preparedness, response and recovery programs and activities. It is noted that the flood depth grids created for this update provide critical information about not only the locations of flood inundation, but the depth of inundation at a high level of resolution (10-foot grid cells). This process could be expanded to provide flood depth grid maps for varying levels of flooding (return periods), allowing emergency managers to better plan for

evacuations, road closures and detours, and emergency access. Further, the HAZUS models and results may support other emergency response and recovery programs such as sheltering, debris management and risk communication.

Public education and outreach to improve personal preparedness, and promote an awareness of mitigation opportunities and personal protection through risk insurance, have been incorporated in specific county and local initiatives.

7.2.2 Comprehensive Planning and Land Use Regulation:

The availability of model ordinances (e.g. floodplain management, sinkholes, steep slopes) developed by the Lehigh Valley Planning Commission (LVPC) to address the specific risks and regulatory frameworks of the Lehigh Valley, was presented to the planning partnership during the planning process, discussed at the Jurisdictional Annex Workshops, and included in mitigation strategy identification/development resources provided to the plan participants.

It was the intention that through this planning process, municipalities shall incorporate the findings and recommendations of this plan update into future local planning efforts, and into the overall execution of their land-use planning process (e.g. site plan review, permitting, code enforcement). Known or anticipated future development in the Lehigh Valley was identified at the county and local level, including the identification of known hazard risks and risk zones, within the jurisdictional annexes (Section 9).

7.2.3 Act 167 Stormwater Management Plans:

The LVPC provided Act 167 Stormwater Management Plans for the entire Lehigh Valley. Information that was incorporated into this plan update includes general watershed information, identification of floodprone areas and known restrictions, and potential mitigation projects. At the Jurisdictional Annex Workshops, all municipalities were provided excerpts (hard copy and on CD) of the salient portions of the Act 167 Stormwater Management Plans for their watershed for their review and use as they were developing their jurisdictional annexes.

In 2007, the LVPC secured a 5-year bi-county contract from the Pennsylvania Department of Environmental Protection (PADEP) to update existing Act 167 plans. The LVPC began work under the contract, however due to lack of funding PADEP terminated all Act 167 contracts in 2010. LVPC work on these plan updates is deferred until funding is restored.

7.2.4 National Flood Insurance Program (NFIP) and the Community Rating System (CRS):

FEMA Region III provided NFIP policy, claims and repetitive loss data for the entire Lehigh Valley. This data was incorporated in the flood hazard profiling and risk assessment (Section 4), as well as into the municipal annexes in Section 9. All municipalities were encouraged to include mitigation initiatives that specify continued and enhanced participation in the NFIP, and address their flood vulnerable structures and infrastructure, including Repetitive Loss (RL) and Severe Repetitive Loss (SRL) properties.

Both counties and all municipalities have identified public outreach initiatives that include increasing public awareness of and participation in the NFIP. Further, both counties have identified that they will be hosting a hazard insurance forum with major regional insurers to better understand hazard insurance issues (requirements, availability, limitations, costs, etc.) and thus be better able to inform the public.

As updated NFIP mapping is adopted in the Lehigh Valley, communities will need to adopt this mapping, update their NFIP Flood Damage Prevention Ordinances, and assist their residents with issues such as Letters of Map Amendment (LOMAs). FEMA Region III and the State NFIP Coordinator's office provide support for these efforts, in addition to the LVPC who prepared a model Floodplain Ordinance for use by Lehigh Valley communities.

Currently within the Lehigh Valley only Hanover Township in Northampton County participates in the CRS program, with a current rating of 9 (5% discount on flood insurance premiums). Northampton County Emergency Management Services sponsored a CRS workshop in May 2012 to inform the communities of the programs and encourage participation. Increased participation in the Lehigh Valley will continue to be supported by both Counties as identified in their updated mitigation strategies. Further, certain communities in the Lehigh Valley have identified in their updated mitigation strategies that they plan to apply to the CRS program.

7.2.5 FEMA Unified Hazard Mitigation Assistance (Unified HMA) Grant Programs:

As the counties and municipalities updated their mitigation strategies, potentially mitigation grant eligible projects have been indicated as such when identifying the potential funding source. LCEMA and NCEMS will continue to inform their inclusive municipalities as mitigation grant opportunities are announced by PEMA, and provide assistance as feasible and appropriate with the grant application process.

7.2.6 Capital Improvement Planning:

Both counties and many of the municipalities in the Lehigh Valley have capital improvements plans, identifying specific capital projects to be funded and completed according to a defined schedule. Some of these projects involve improvements to facilities and infrastructure that provide hazard mitigation benefits. As such, during this update process, the counties and municipalities have been encouraged to consider the mitigation benefits associated with their known or anticipated capital projects as a way to help prioritize their execution and to develop awareness that mitigation grants may be available to help fund such projects.

7.2.7 Housing and Urban Development (HUD) and Community Development Block Grant (CDBG) Funding:

HUD and CDBG funding may be available and used to support certain types of mitigation activities in the Lehigh Valley, including as identified in the 2012-2017 Northampton County Consolidated Plan.

During the annual plan evaluation process, the Steering Committee will identify additional policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions, and include these findings and recommendations in the Annual HMP Progress Report.

7.3 Continued Public Involvement

Both counties and all participating municipalities have identified continued public outreach as high priority initiatives in their mitigation strategies (Section 9). Under these initiatives, the planning partnership will continue to maintain and provide links to the plan update's hazard mitigation webpage, continue to provide ongoing media releases and other public notifications regarding where the public can review the plan update and provide ongoing input, and may include public meetings to further promote awareness of the plan update.

Full copies of the plan update shall continue to be made available in hard-copy for review during normal business hours at the following locations:

Lehigh County Emergency Management Agency
640 W. Hamilton Street, 8th Floor
Allentown, PA 18101

Northampton County Emergency Mangement Services
100 Gracedale Road
Nazareth, PA 18064

Lehigh Valley Planning Commission
961 Marcon Boulevard, Suite 310
Allentown, PA 18109

Municipalities are asked to make available hard-copy excerpts of the plan update at their municipal building (e.g. clerk's office), including at a minimum the Introduction, applicable County annex and applicable municipal annex to the plan. Municipalities and the Steering Committee shall be responsible for receiving, tracking, and filing public comments regarding this plan update.

The public will have an opportunity to comment on the plan update as part of the annual plan review process and during the five-year plan update. Annual progress reports will be posted on the Lehigh Valley Hazard Mitigation Plan public website at http://www.nc911.org/html/hazard_mitigation.html. NCEMS will maintain this website, posting the annual progress reports and maintaining an active link to collect public comments.

The NCEMS Hazard Mitigation and Disaster Recovery Manager and Steering Committee are responsible for coordinating the collection and review of public comment, and ensuring their incorporation in the five-year plan update as appropriate.

Municipal mitigation planning representatives shall be responsible to assure that:

- Public comment and input on the plan update, and hazard mitigation in general, are recorded and addressed, as appropriate. Opportunity to comment on the plan update will be provided directly on the project web site.
- Copies of the latest approved plan (or draft in the case that the five year update effort is underway) are available for review at their municipal offices along with forms and instructions to facilitate public input and comment on the plan.

SECTION 7: PLAN MAINTENANCE PROCEDURES

- Appropriate local links to the Lehigh Valley Hazard Mitigation Plan website are maintained. The website will be maintained throughout the course of the project, and during the plan update implementation phase.
- Public notices are made as appropriate to inform the public of the availability of the plan update, particularly during plan update cycles.

The NCEMS Hazard Mitigation and Disaster Recovery Manager shall be responsible to assure that:

- Public comment and input on the plan, and hazard mitigation in general, are recorded and addressed, as appropriate.
- The Lehigh Valley Hazard Mitigation Plan website is maintained and updated as appropriate.
- All public and stakeholder comments received are document and maintained.
- Copies of the latest approved plan (or draft in the case that the five-year update effort is underway) are available for review at the locations identified above, along with instructions to facilitate public input and comment on the plan.
- Public notices, including media releases, are made as appropriate to inform the public of the availability of the plan, particularly during plan update cycles.

SECTION 8: PLAN ADOPTION

8.1 OVERVIEW

This section contains information regarding adoption of the plan update by Lehigh and Northampton counties and each participating municipality.

8.1.1 PLAN ADOPTION BY LOCAL GOVERNING BODIES

Adoption by the local governing bodies demonstrates the commitment of Lehigh and Northampton counties and each participating municipality to fulfill the mitigation goals and objectives outlined in the plan update. Adoption legitimizes the plan update and authorizes responsible agencies to execute their responsibilities. In order for this multi-jurisdictional plan to be approved, each jurisdiction included in the plan update must have its governing body adopt the plan update upon conditional approval by the Federal Emergency Management Agency (FEMA), even when a cross-jurisdiction agency has the authority to prepare such plans in the name of the respective jurisdictions.

Each participating jurisdiction will proceed with formal adoption proceedings when FEMA provides conditional approval of this plan update. A draft adoption resolution template is provided in Appendix F, and will be forwarded to each jurisdiction upon FEMA's conditional approval of this plan update. Each participating jurisdiction understands that a conditional approval of the plan update will be provided for those municipalities that meet the planning requirements with the exception of the adoption requirement as stated above.

Following adoption or formal action on the plan update, each participating jurisdiction must submit a copy of the resolution or other legal instrument showing formal adoption (acceptance) of the plan update to their respective county emergency management contact for this plan update. These will then be submitted to PEMA and forwarded to FEMA. Each participating jurisdiction understands that PEMA and/or FEMA will transmit acknowledgement of verification of formal plan adoption and the official approval of the plan to the mitigation plan coordinator.

In addition to being required by DMA 2000, adoption of the plan is necessary because:

- It lends authority to the plan to serve as a guiding document for all local and state government officials;
- It gives legal status to the plan in the event it is challenged in court;
- It certifies the program and grant administrators that the plan's recommendations have been properly considered and approved by the governing authority and jurisdictions' citizens; and
- It helps to ensure the continuity of mitigation programs and policies over time because elected officials, staff, and other community decision-makers can refer to the official document when making decisions about the community's future.

Source: FEMA. 2003. "How to Series"-*Bringing the Plan to Life* (FEMA 386-4).

9.1 LEHIGH AND NORTHAMPTON COUNTIES

This section presents the county-level annex for Lehigh and Northampton Counties.

A. HAZARD MITIGATION PLAN POINTS OF CONTACT

Lehigh County		Northampton County	
Primary Point of Contact		Primary Point of Contact	
Name Title/ Department Address Telephone Fax Email	Tanya Hook County Mitigation Lead LC Emergency Management Agency 640 W. Hamilton St., 8 th Flr., Allentown 610-782-4604 tanyahook@lehighcounty.org	Name Title/ Department Address Telephone Fax Email	Angel Gillette Mgr., Hazard Mit. and Dis. Recovery NC Emergency Management Services 100 Gracedale Avenue, Nazareth 610-746-3194 610-746-3199 agillette@ncem-pa.org
Alternate Point of Contact		Alternate Point of Contact	
Name Title/ Department Address Telephone Fax Email		Name Title/ Department Address Telephone Fax Email	

B. REGIONAL PROFILE

Please refer to Section 2 of this plan for details on population, location, climate, history, growth, and development in the Lehigh Valley.

B.1 Known or Anticipated Future Development

Please refer to the Regional Profile (Section 2) and the municipal annexes (Section 9) of this plan for known and anticipated future development in the Lehigh Valley.

C. NATURAL HAZARD EVENT HISTORY SPECIFIC TO THE REGION

Please refer to the Past Occurrence section of the appropriate hazard profiles in Section 4.3 of this plan.

SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

D. HAZARD RISK/VULNERABILITY RISK RANKING

The following relative ranking of natural and non-natural hazard risks in the Lehigh Valley was developed using PEMA’s Risk Factor methodology described in Section 4, “Risk Assessment”.

HAZARD RISK	NATURAL HAZARDS	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
		PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
HIGH	Winter Storm	3	2	4	1	3	2.7
	Flood	3	2	2	3	3	2.5
MODERATE	Radon Exposure	4	1	2	1	4	2.4
	Extreme Temperatures	4	1	2	1	3	2.3
	Drought	2	1	4	1	4	2.2
	Wildfire	3	1	2	3	3	2.2
	Hailstorm	3	1	3	2	1	2.1
	Wind, incl. Tornado	1	3	2	4	1	2.1
	Lightning	4	1	1	2	1	2
LOW	Earthquake	1	1	4	4	1	1.9
	Subsidence / Sinkholes	2	1	1	2	1	1.4
	Landslide	1	1	1	4	1	1.3

HAZARD RISK	MAN-MADE HAZARDS	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
		PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
HIGH	Fire (Urban/Structural)	4	2	1	4	2	2.6
	Environmental Hazard and Explosion	3	2	2	4	3	2.6
	Levee Failure	1	3	3	4	3	2.5
	Utility Interruption	3	1	3	4	3	2.5
MODERATE	Transportation Accident	4	1	1	4	1	2.2
	Dam Failure	1	3	2	4	2	2.2
	Mass Gathering and Civil Disturbance	3	1	1	4	2	2
LOW	Terrorism	1	3	1	4	1	1.9
	Building Collapse	1	3	1	4	1	1.9
	Nuclear Incident	1	1	1	4	2	1.4



E. CAPABILITY ASSESSMENT

Please refer to Section 5 of this plan for a complete discussion on the regional hazard mitigation capabilities within the Lehigh Valley.

F. MITIGATION STRATEGY

F.1 Past Mitigation Activities/Efforts

The following summarizes progress on the mitigation strategy identified by Lehigh and Northampton Counties in the 2006 plan.

Hazard Identification Actions:

Action #1: County EMAs coordinate with FEMA to accurately locate all repetitive loss properties in the Lehigh Valley. Year 4 (2011)

Disposition for 2012 Update: Complete

2008 Status: The LVPC obtained updated data on repetitive loss properties since April 30, 2004. There are currently 330 properties identified as repetitive loss properties in Lehigh and Northampton counties. The LVPC has mapped these properties; however, 29 of the properties could not be located. The LVPC also obtained data on severe repetitive loss properties. There are 42 severe repetitive loss properties in the two counties. The properties have been mapped; however, four of the properties could not be located.

2012 Status: Complete. Tetra Tech has been provided NFIP policy, claims and Repetitive Loss/Severe Repetitive Loss data from FEMA Region III, current to December 31, 2011. This data was geo-coded by FEMA, and has been used within the flood profiling and risk assessment work for this plan update.

Vulnerability Assessment Actions:

Action #2: Lehigh and Northampton County GIS departments map building footprints to better evaluate structures at risk from flooding. Year 3 (2010)

Disposition for 2012 Update: Complete

2008 Status: The Lehigh County GIS department has begun the process of mapping building footprints. All condominiums and mobile homes for the entire county have been mapped. The City of Allentown has completed mapping for the city and the mapping will be incorporated into the county mapping. The county will proceed municipality by municipality until the mapping for all other structures is complete. There is not a scheduled completion date. Northampton County EMAs are in the process of coordinating with the county GIS department to create floodplain building footprints.

2012 Status: The Lehigh County GIS Department has completed the process of mapping building footprints for the entire county. They are now in the process of updating the files to include pictures from the 2011 aerial flight.

Action #3: County EMAs investigate the implementation of the FEMA HAZUS software in plan updates to better define potential losses from flooding, hurricanes and earthquakes. Year 4 (2011)

Disposition for 2012 Update: Complete

2008 Status: No progress

2012 Status: HAZUS-MH has been used extensively in the development of the 2012 LV HMP Update. All data sets and HAZUS-MH projects shall be provided to the counties at the end of the project for their longterm use.

Action #4: County EMAs refine the critical facilities mapping from assessment data to include only properties that actually represent critical facilities for emergency management purposes. Year 2 (2009)

Disposition for 2012 Update: Complete

2008 Status: Lehigh County is updating their rosters and SARA facilities. Northampton County is reassessing their critical facilities inventory.

2012 Status: Tetra Tech worked with both county's EM and GIS departments to develop an updated critical facility inventory to support the risk assessment effort for this plan update. This dataset shall be provided to both counties at the end of the project.

Action #5: County EMAs encourage property owners in carbonate bedrock areas to obtain sinkhole insurance. Year 1 (2008)

Disposition for 2012 Update: Ongoing; carried forward in 2012 update

2008 Status: Lehigh County – no progress. Northampton County anticipates working on this item in the near future.

2012 Status: Lehigh and Northampton Counties anticipate offering an insurance informational meeting to the public in the upcoming year to encourage homeowners to obtain sinkhole and flood insurance.

Action #6: County EMAs work with the Pennsylvania State University Agricultural Extension Office to develop economic loss data due to droughts. Year 4 (2011)

Disposition for 2012 Update: Discontinued

2008 Status: No progress.

2012 Status: No progress.

Action #7: Municipalities adopt floodplain regulations that prohibit new development and structures in the 100-year floodplain and adopt carbonate bedrock standards to minimize sinkhole occurrences to reduce hazard impacts on new development. Year 1 (2008)

Disposition for 2012 Update: Ongoing; carried forward in 2012 update

2008 Status: The first in the series of model ordinances, floodplain regulation, was released in September 2007 by the LVPC. The model regulations were designed to be more effective at preventing flood damage and to better deal with the redevelopment of existing properties that have been subject to repeated flooding. The regulations exceed the National Flood Insurance Program minimum requirements.

2012 Status: During 2009, the LVPC held workshops for municipalities to discuss the floodplain ordinance as well as other model ordinances related to natural features preservation including steep slopes and woodlands. The steep slopes ordinance was released in November 2008, and the woodlands ordinance was released in March 2009. The LVPC also created a model ordinance on conservation subdivisions (released in November 2010). The LVPC continues to promote all the model ordinances which are available on the LVPC website (www.lvpc.org).

Capability Assessment Actions:

Action #8: County EMAs, in conjunction with the regional Counterterrorism Task Force, implement a Reverse Notification System; also known as Interactive Communication Notification System. Year 1(2008)

Disposition for 2012 Update: Complete

2008 Status: Lehigh County purchased the Reverse 9-1-1 System and is in the process of implementation. Northampton County purchased a Reverse Notification System, and it was implemented in October 2007. The county is working on guidelines for its use. The county updated the subscriber database with phone records and county shape file updates (new parcels). These are done biannually. They also added contours to the map updates.

2012 Status: Lehigh County has completed the installation and has tested the Reverse 9-1-1 System, which was funded by the Regional Counter-Terrorism Taskforce. The County is working on guidelines for its use. Further, the County is encouraging residents to register their cell phone numbers and emails.

Action #9: Lehigh County EMA provides National Oceanic and Atmospheric weather radios for needed facilities to alert them of warnings and post-event information. Northampton County EMA explores providing weather radios for needed facilities. Year 1 (2008)

Disposition for 2012 Update: Complete

2008 Status: Lehigh County purchased and distributed the radios in the fall of 2007 to local coordinators. School districts received radios from another source. Northampton County is still in the exploratory stage.

2012 Status: Lehigh County has not expanded upon the Weather Radio Distribution Program, however a small number of radios have been exchanged due to them being broken. Each spring the facilities which received these radios, participate in the Annual Statewide Severe Weather Exercise. During the exercise, schools, hospitals, nursing homes and day-cares are notified of a severe weather event, and are asked to

practice getting students, residents and patients to a safe location in emergency situation, thus enacting and testing their emergency response plans.

Action #10: County EMAs pursue implementation of stream/river gauges – pursue participation in the Integrated Flood Observing and Warning System by installation, maintenance and monitoring of additional rainfall/stream/river gauges throughout both counties to provide additional rainfall and stream level data, to allow the counties to disseminate necessary alerts. Year 2 (2009)

Disposition for 2012 Update: Ongoing

2008 Status: Lehigh County – no progress. Northampton County did receive quotes, but it is very expensive. The county is exploring grant programs as a viable option. They are also exploring the use of a Weather Bug Tool that can be put on a computer desktop and customized by specific county location. It is noted that United States Representative Charlie Dent secured funding for an enhanced flood warning system for the Delaware River Basin. It is not clear how this might benefit the two counties.

2012 Status: Lehigh County has explored the implementation of stream/river gauges, however the system is very costly, and we currently do not have the funds for this program. The county hopes to work with the National Weather Service in the near future to develop an Acquisition Plan to implement this project in the future.

Action #11: County EMAs will work to create formal agreements between the counties and all municipalities to provide mutual aid in the event of a hazard event. Northampton County EMAs will work to create a formal agreement with Warren and Hunterdon counties in New Jersey. Year 1 (2008)

Disposition for 2012 Update: Complete

2008 Status: Lehigh County – no information. Northampton County began working on this earlier this year. By law, the proposed Intrastate Mutual Aid legislation will require agreements. The county will create the agreements. The goal is to complete them by Spring 2009. The county has not approached Warren or Hunterdon counties yet. They will check to see if an agreement is needed.

2012 Status: Mutual Aid Agreements exist between the Pennsylvania Counties, as a result of the PA Intrastate Mutual Assistance Program. All PA counties are participants in this program.

Action #12: County EMAs encourage Lehigh County, Northampton County, Allentown and Bethlehem 9-1-1 operations to fully integrate mapping and databases to streamline coordination during regional hazard events. Year 2 (2009)

Disposition for 2012 Update: Complete

2008 Status: For both Lehigh and Northampton counties, the Northeast Pennsylvania Emergency Response Group (Counterterrorism Task Force), through a GIS committee, is spearheading an effort among eight counties, including Lehigh and Northampton, to work with 9-1-1 centers to integrate data.

Action #13: County EMA offices will recruit individuals for the following [programs]: Year 2 (2009)

- **Citizen Corps Council**
- **Are You Ready?**
- **Community Emergency Response Team (CERT)**

Disposition for 2012 Update: Ongoing

2008 Status: Lehigh County has an active, 24-member Citizen Corps Council. There were 3,543 preparedness packets distributed to schools, businesses, SARA facilities, multi-cultural centers, day cares, nursing homes, and churches. There have been 21 outreach programs held over the past year and a half. The county has held three CERT training sessions over the past year and has added 34 members to the team. The City of Allentown Volunteer Medical Reserve Corps (AVMRC) is an integral part of the Lehigh County Citizen Corps Council. AVMRC currently has 58 active members. The Lehigh County Citizen Corps Council is currently planning the First Annual Volunteer Skills Training Day for all CERT and Allentown and Bethlehem MRC members. Several events and programs are planned throughout the Lehigh Valley to promote preparedness during the Fifth National Preparedness Month (September 2008). Northampton County established a Citizen Corp Council in May 2008. The county has also integrated with the Medical Reserve Corps in the City of Bethlehem to get access to 105 persons. The county is exploring the establishment of CERT and Teen CERT programs.

2012 Status: Lehigh County has a very active 22-member Citizen Corps Council. The Council continues to oversee Community Emergency Preparedness Campaigns and Programs, which include: Community Emergency Response Team (CERT) Trainings, Outreach Programs, annual participation in the National Preparedness Month (NPM) Campaigns and Advanced Training Opportunities for volunteers. The City of Allentown Volunteer Medical Reserve Corps (AVMRC) and the City of Bethlehem Medical Reserve Corps continue to be active members on the Citizen Corps Council, and their volunteers participate in activities, drills and training events along with the County CERT Members. There have been 49 Community Outreach Events, 38 “Are You Ready?” programs, 12 CERT classes, 36 Training Opportunities, and 3 CERT Rodeo/Exercises over the past 4 years. CERT volunteers assisted with the 3 large-scale H1N1 Clinics, which were held in 2009 and 2010. In 2011 CERT members assisted with the shelters that were opened as a result of Hurricane Irene, Tropical Storm Lee and the October Snow Storm. The Citizen Corps Council is currently developing a planning calendar for CERT Training, Advanced Skills Training and a CERT/MRC Rodeo for the fall/winter 2012. We will also be participating/hosting several events and programs during the Annual National Preparedness Month (September 2012).

Action #14: County EMAs will look at identifying and partnering with owners/operators of critical facilities as necessary to provide adequate planning and protection. Year 3 (2010)

Disposition for 2012 Update: Ongoing

2008 Status: Lehigh County – no progress. Northampton County is updating their critical facilities inventory. It is noted that in February 2008, State Senator Lisa Boscola secured \$100,000 for the establishment of the Lehigh Valley Emergency Web Network by Active Data Exchange, a local Bethlehem firm. The network provides the public in the area with information during emergency situations. Both counties are contributors to the network.

Action #15: Municipalities adopt ordinance provisions to protect natural resources including wetlands and riparian buffers to preserve their flood mitigation benefits. Year 1 (2008)

Disposition for 2012 Update: Ongoing

2008 Status: The LVPC has prepared a model ordinance on riparian and wetland buffers. The LVPC released the ordinance at the monthly meeting in July 2008. It is noted that a bill introduced by State Representative Bob Freeman was signed into law June 11, 2008 by Governor Ed Rendell related to the protection of the Appalachian Trail. Act 24 requires municipalities to adopt zoning laws to preserve and protect this natural resource. Municipalities are required to implement and enforce these zoning provisions.

2012 Status: During 2009, the LVPC held workshops for municipalities to discuss the riparian and wetland buffers ordinance as well as other model ordinances related to natural features preservation. In January 2011, the LVPC updated the riparian and wetland buffers model ordinance. The model ordinance was updated to provide a discussion on the DEP riparian buffer regulations passed in November 2010 and how they relate to the LVPC model ordinance. The LVPC continues to promote the model ordinances which are available on the LVPC website (www.lvpc.org).

F.2 Hazard Vulnerabilities Identified

Please refer to the hazard profiles in Section 4.3 of this plan for information on hazard vulnerabilities identified within the Lehigh Valley.

F.3 Hazard Mitigation Strategy

Note some of the identified mitigation initiatives in Table F are dependent upon available funding (grants and local match availability) and may be modified or omitted at any time based on the occurrence of new hazard events and changes in county priorities.

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
Prevention and Planning									
1	Maintain a centralized library of all data, information and documents compiled, developed and used for the 2012 LV HMP update process, including HAZUS-MH datasets and projects (HPR files). This data shall be used to support plan implementation and future updates, and may be used to support other emergency management and planning functions. Note: This is part of the ongoing 2006 Initiative #14 – see also #3 below.	N/A	All Hazards	Lehigh and Northampton County EMAs; County GIS Departments	Medium - Improved understanding of hazard risk; improved support to future planning efforts including regulatory updates of this plan support of other mitigation, preparedness and response activities.	Low	County Budgets	Short (2012/3)	High
2	As resources and training opportunities permit, County EMAs to install HAZUS-HM and train staff in its use.	N/A	All Hazards	Lehigh and Northampton County EMAs; County GIS Departments	Medium - Improved understanding of hazard risk; improved support to future planning efforts including regulatory updates of this plan support of other mitigation, preparedness and response activities.	Medium	County Budgets	Long-term DOF	Medium



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
3	Lehigh County to continue to work on enhancing their critical facility inventory, specifically with respect to attribution (e.g. names of facilities, type of construction, etc.) Note: This is part of the ongoing 2006 Initiative #14 – see also #1 above.	N/A	All Hazards	Lehigh County EMA and GIS departments	Medium - Improved understanding of hazard risk; improved support to future planning efforts including regulatory updates of this plan support of other mitigation, preparedness and response activities.	Low- Medium	County Budgets	Short (2013)	High
4	Support Lehigh Valley communities with ongoing compliance and enhanced participation in the National Flood Insurance Program (NFIP), specifically through the county-level initiatives identified below.	Both	Flood; Severe Storm	LVPC and Lehigh and Northampton County EMAs working with LV municipalities; supported by PADEP, PEMA, FEMA Region III, ISO	High - Reduced flood risk	Low-Medium	County Budgets	Ongoing	High
5	Continue to promote and assist municipalities with adopting additional and higher regulatory standards by providing model ordinances (e.g. model floodplain management and flood damage ordinances, including increased freeboard and cumulative substantial damages / improvements; carbonate bedrock standards; steep slopes; vegetation management; riparian and wetland buffers), and assisting with local adoption of these ordinances. The LVPC model floodplain regulations are designed to be more effective at preventing flood damage and to better deal with the redevelopment of existing properties that have been subject to repeated flooding, and exceed the National Flood Insurance Program minimum requirements. Note: This is part of the ongoing 2006 Initiative #7.								
	See above	New	Flood; Severe Storm; Severe Winter Storm; Subsidence/Sinkholes; Landslide; Drought	LVPC with support from municipalities and their NFIP FPA, FEMA Region III, ISO, PADEP and PEMA; DRBC	High	Low-Medium	County and LVPC Budgets	Ongoing	High



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
6	Continue to support Lehigh Valley municipalities with the adoption of carbonate bedrock standards to minimize sinkhole occurrences to reduce hazard impacts on new development. Note: This is part of ongoing 2006 Initiative #7.	New	Subsidence\Sinkholes	LVPC supporting local municipalities	High	Low	LVPC Budget	Ongoing	High
7	Improve communication and coordination with the Councils of Governments to promote and support local mitigation efforts.	N/A	All Hazards	Lehigh and Northampton County EMAs, and NC DCED	Medium	Low	County Budgets	Short	High
8	Expand support of communities and property owners / developers to understand current and developing flood mapping and NFIP compliance issues.	N/A	Flood; Severe Storm	Lehigh and Northampton County EMAs, NC DCED	Medium	Low	County Budgets	Ongoing	High
9	Continue to promote and support municipal participation in available Hazard Mitigation Assistance (HMA) grant funding opportunities to mitigate floodprone structures and infrastructure, including RL/SRL outreach.	Existing	Flood; Severe Storm	Lehigh and Northampton County EMAs, working with support from municipal NFIP FPAs. Support provided by PEMA, FEMA Region III, PADEP.	High	Medium	County Budget	Ongoing	High



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
10	Support and facilitate public education and outreach on the NFIP program (see related Public Education and Outreach initiatives)	Existing	Flood; Severe Storm	Lehigh and Northampton County EMAs with support from FEMA Region II, ISO, PADEP and PEMA	Medium	Low	County Budget	Ongoing	High
11	Continue to support and facilitate FEMA floodplain study/remapping and Risk MAP programs	N/A	Flood; Severe Storm; Land Subsidence/Sinkholes; Wildfire	Lehigh and Northampton County EMAs, LVPC with support from municipal NFIP FPA, FEMA Region III, ISO, PADEP and PEMA; DRBC	Medium	Medium-Low	County Budget	Ongoing	High
12	Promote and facilitate continued education and training programs for municipal NFIP floodplain managers and other county and local personnel involved in flood and hazard risk management by advertising and/or facilitating training and certification programs offered by PEMA, PADEP, ASFPM. Such training and certification programs include NFIP 101, Certified Floodplain Manager (CFM) certification through the Association of State Floodplain Managers, FEMA Benefit-Costs Analysis (BCA), NIFP Community Rating System (CRS).								
	See above	N/A	Flood; Severe Storm	Lehigh and Northampton County EMAs, LVPC with support from municipal NFIP FPA, FEMA Region III, ISO, PADEP and PEMA	Medium	Medium-Low	County Budget	Ongoing – To hold a CFM training and certification course in 2012/3	High
13	Promote and support municipal participation in the Community Rating System (CRS) program to better manage flood risk and reduce flood insurance premiums.	N/A	Flood; Severe Storm	Lehigh and Northampton County EMAs, LVPC with support from municipal NFIP FPA, FEMA Region III, ISO, PADEP and PEMA	Medium	Medium-Low	County Budget	Ongoing	High



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
14	Assist municipalities with NFIP Community Assistance Visits (CAVs)	N/A	Flood; Severe Storm	Lehigh and Northampton County EMAs with support from municipal NFIP FPA, FEMA Region III, ISO, PADEP and PEMA	Medium	Medium-Low	County and Municipal Budgets	Ongoing	High
Integrate/coordinate the findings and recommendations of this HMP within the following regional, county and local planning and regulatory mechanisms:									
15a	The "Lehigh Valley Comprehensive Plan...2030"	N/A	All Hazards	LVPC, working with both counties and municipalities	Medium (Reduced hazard vulnerability through integration of plans)	Medium	LVPC Budget	Pending funding	High
15b	Local Comprehensive / Master Plans	N/A	All Hazards	LVPC working with municipalities	Medium (Reduced hazard vulnerability through integration of plans)	Medium	LVPC, county and local budgets	Ongoing	High
15c	Capital Improvement Plans	N/A	All Hazards	County and Municipalities	High (leveraging of available funding to implement mitigation actions)	Low	Local and County funding; matching with available State and Federal sources	Ongoing	High
15d	Watershed and Stream Corridor Management Plans	N/A	Flood; Severe Storm	LVPC working with municipalities	Medium (Reduced hazard vulnerability through integration of plans)	Medium	LVPC, county and local budgets	Ongoing	High
15e	Comprehensive Emergency Management Plans	N/A	All Hazards	Lehigh and Northampton County EMAs	Medium (Reduced hazard vulnerability through	Low	County and Local Budgets	Ongoing	High



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
					integration of plans)				
15f	Act 167 Stormwater Management Plans	N/A	Flood; Severe Storm	LVPC working with municipalities	Medium (Reduced hazard vulnerability through integration of plans)	Medium - High	State funding (suspended)	Pending reinstatement of state funding	High
15g	HUD/CDBG Action Plan(s) – maintain CDBG action plans to support mitigation	Existing	Flood; Severe Storm	NC DCED	High (leveraging of available funding to implement mitigation actions)	Medium	County for maintenance of Action Plans	Ongoing	High
16	Lead and support the implementation, monitoring, maintenance, and update of this Plan, as defined in Section 7.0.	N/A	All Hazards	NC EMS (through the Hazard Mitigation Planning Coordinator) working along with the LV HMP Steering Committee, participating jurisdictions, PEMA, FEMA Region III	High	Low – High (for 5-year update)	County and Local Budgets, FEMA Mitigation Grant Funding for 5-year update	Ongoing	High
17	Continue to provide representation on and support of local and regional flood and watershed committees, commissions and task forces (e.g. Delaware River Basin Commission). Petition DRBC to include LV emergency management representation on their Hazards Committee.	N/A	All Hazards (DRBC includes a Hazards Committee)	Lehigh and Northampton County EMAs, LVPC	Medium - High	Low - Medium	Agency Budget	Ongoing	High



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
18	Lehigh County to continue participation in, and Northampton County to complete their current efforts to join, the NOAA "Storm Ready" program to enhance County/community resilience to severe storms. "Storm Ready" communities are better prepared to save lives from the onslaught of severe weather through advanced planning, education and awareness. Participation in the NOAA "Storm Ready" program includes providing information on the "Storm Ready" program, facilitating public outreach and awareness programs, and supporting community storm risk reduction activities as appropriate. Specific actions addressed by "Storm Ready" participation include establishing a 24 hour Warning Point, increase number of ways EOC receives NWS warnings, increase number of ways to disseminate warnings, monitoring hydro-meteorological data, providing annual weather safety talks, train weather spotters, create a formal hazardous weather plan, host annual visits by NWS to communities, etc.								
	See above.	N/A	Flood; Severe Storm; Severe Winter Storm	Lehigh and Northampton County EMAs; support from NWS, PEMA, FEMA, PADEP	Medium	Low-Medium	County Budget	Lehigh County – ongoing; Northampton County to join in 2012/3	High
	Continue to participate in and support the USACE Silver Jackets program, which provides tools and resources in support of public and stakeholder outreach on flood risk management, and an online database to assist in the mitigation grant application process.	N/A	Flood; Severe Storm	NC EMS working with USACE and the PA Silver Jackets team	Medium – High	Low - Medium	Agency Budgets	Ongoing	High
Property Protection									
19	Support communities in the Lehigh Valley with mitigation for all structures located in hazard prone areas (e.g. acquisition, relocation, elevation). Specific support activities shall include: <ul style="list-style-type: none"> • Forwarding grant program announcements provided by PEMA and/or FEMA to appropriate municipal representatives in a timely manner. • Posting and maintaining grant announcements and associated documents, forms, etc. on the LV HMP webpage. • Supporting PEMA and or FEMA-sponsored public outreach for available grant opportunities, to include but not be limited to, outreach to NFIP Repetitive Loss and Severe Repetitive Loss property owners. • Providing municipalities with grant application support. 								
	See above	Existing	All Hazards	Lehigh and Northampton County EMAs; support from PEMA and FEMA Region III	High (reduced risk for vulnerable structures)	Medium	County Budget	Ongoing	High



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
20	Continue to identify vulnerable county-owned structures and infrastructure, develop and prioritize appropriate mitigation projects, and implement projects as funding is appropriated.	Existing	All Hazards	Lehigh and Northampton County EMAs; working with county departments and agencies with critical facilities and infrastructure	High (reduced risk for vulnerable structures)	Medium – High	County Budget	Ongoing	Medium
21	Work with utility companies and owners/operators of critical facilities to identify and underground important utility lines (esp. those serving critical facilities). Identify and explore potential funding programs, including public / private partnerships, to implement utility hardening projects.	Existing	Severe Storm; Severe Winter Storm	County EMAs and DPWs, working with utilities and owners/operators of critical facilities	High	Medium (identification of projects); High (implementation)	County Budgets to identify; Implementation TBD	Ongoing	Medium
Public Education and Awareness									
	Develop a program to improve the quality and consistency of public education and outreach for natural hazard preparedness and mitigation. Specific activities and aspects of this include the following activities and initiatives.								
22	Leverage existing regional and local meetings and media outlets (local websites, newsletters, email “blasts” and mailings) to promote awareness and understanding of personal preparedness and mitigation activities.	N/A	All Hazards	Lehigh and Northampton County EMAs, working with municipalities	Increased public understanding of hazard preparedness and risk reduction measures	Low	County and Local Budgets	Ongoing	High
23	Maintain the Northampton County Emergency Management Services hazard mitigation webpage; Lehigh County	N/A	All Hazards	Lehigh and Northampton County EMAs, working with municipalities	Increased public understanding of hazard preparedness and risk	Low - Medium	County and Local Budgets	Ongoing	High



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
	to maintain a link to this page on their Emergency Management website. Promote public attention through periodic County homepage announcements and other available media. Advise municipalities to maintain links to the County Emergency Management and HMP websites on their websites.				reduction measures				
24	Continue to participate in and support the USACE Silver Jackets program, which provides tools and resources in support of public and stakeholder outreach on flood risk management, and an online database to assist in the mitigation grant program application process.	N/A	Flood; Severe Storm	NC EMS working with USACE and the PA Silver Jackets team	Medium – High	Low - Medium	Agency Budgets	Ongoing	High
25	Improve public understanding of disaster preparedness and what to do during an emergency, including personal preparedness, available notification/warning services, and incoming and outgoing evacuation routes. Indicate locations of shelters and tips for staying at home. Provide advisories to avoid road travel combined with safe travel tips. Provide information on hazards of unheated houses, guidance on the use of	N/A	All Hazards	County EMAs, working with local EM, police, fire and LEPCs	Medium (increased personal preparedness. life safety)	Low - Medium	County and local budgets, PEMA	Ongoing	High



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
	portable and standby generators, fire hazards associated with space heaters, protecting plumbing during a winter storm, and coping with power failures.								
26	Expand information on emergency service for special needs populations to cover all of the Lehigh Valley.	N/A	All Hazards	Lehigh and Northampton County EMAs, County Human Services	Medium (life safety)	Low-Medium	County Budgets	Ongoing	High
27	Coordinate and facilitate a bi-county hazards insurance summit with appropriate local insurance carriers/companies to promote a stronger regional understanding of hazard insurance needs and options available to public and private property owners. This summit shall address all types of hazard insurance including flood, sinkhole, earthquake, hurricane/high wind, and sump pump failure. Develop and distribute public informational material and distribute through the public outreach program(s) identified above. Note: This is part of ongoing 2006 Initiative #5.	N/A	Earthquake; Flood; Hailstorm; Landslide; Lightning Strike; Subsidence/Sinkholes; Wind; Winter Storm	Lehigh and Northampton County EMAs with support of other county stakeholders; regional insurance carriers	Medium – Increased understanding and awareness of insurance needs and limitations	Low	County Budgets	Short	High



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
28	Incorporate the public education, awareness, preparedness and personal mitigation information provided by Pennsylvania Power and Light (PPL).	N/A	Severe Storm, Severe Winter Storm, Urban/Structural Fire, Environmental/Explosion, Utility Interruption	Lehigh and Northampton County EMAs	Medium - High	Low	County Budgets	Short	High
Natural Resource Protection									
29	LVPC to continue to support municipal adoption of higher regulatory standards, specifically in the area of floodplain management, riparian and wetland buffers, steep slopes, carbonate bedrock, and other zoning laws to protect natural resources that provide natural hazard protection. Note: This is a continuation of Initiative #15 from the 2006 plan.	N/A	Flood, Landslide, Subsidence/Sinkholes	LVPC; working with municipalities	High	Low	LVPC and municipal budgets	Ongoing	High
30	Work with utilities to enhance programs to keep trees from threatening lives, property, and public infrastructure during storm events, including tree trimming and removal programs.	Existing	Severe Storm, Severe Winter Storms	County EMAs and DPWs, Utilities	Protection of electric infrastructure; life-safety.	Medium - High	Current funding sources	Ongoing	Medium



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
Emergency Services									
31	Implement the Lehigh Countywide Generator Project, funded through 2008 LPDM. Provide grant administration and technical support, as needed, to those Lehigh County municipalities awarded funding under this grant. Funding for generators has been awarded for the following sites (note: this is part of the implementation of 2006 Initiative #14): <ul style="list-style-type: none"> • Macungie Well #1/Public Works Building – 301 South Church Street, Macungie Borough • Neffs Volunteer Fire Company – 3755 Park Avenue, Neffs, North Whitehall Township • City of Allentown Fire Station – 164 West Susquehanna Avenue, Allentown • Lower Macungie Township Public Works Facility – 5536 Indian Creek Road, Lower Macungie Township • Whitehall Township Authority – 1901 Schadt Avenue, Whitehall Township • Lehigh County Maintenance Facility – 260 South Cedarbrook Road, Allentown • Police Station – 941 Long Street, Fountain Hill Borough • Fountain Hill Borough – Duplex Grinder Pump Station 								
	See above.	Existing	All Hazards	Lehigh County EMA, working with municipalities	Medium – High (continued operation of critical facilities during power outages)	Low – Medium (local share of LPDM grant)	2008 LPDM grant; local budgets for match	Ongoing	High
32	Implement the Northampton Countywide Generator Project, funded through 2008 LPDM. Provide grant administration and technical support, as needed, to those municipalities awarded funding under this grant. Funding for generators have been awarded for the following sites (note: this is part of the implementation of 2006 Initiative #14): <ul style="list-style-type: none"> • Portland Borough Authority, Well #3 • East Bangor Municipal Authority, Well #34 • Hellertown Borough Authority, Well #1 • Portland Borough Authority, Well #4 • Township of Bethlehem • Lehigh Township Municipal Authority (Danielsville and Pennsville) • Borough of Northampton Sewage Pump 								
	See above.	Existing	All Hazards	Northampton County Emergency Management Services, working with municipalities	Medium – High (continued operation of critical facilities during power outages)	Low – Medium (local share of LPDM grant)	2008 LPDM grant; local budgets for match	Ongoing	High



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
33	Improve communication and coordination between NC DCED, NC Department of Human Services (NC DHS), NC EMS, LC EMA and the Lehigh Valley Disaster Relief Task Force, particularly to support response and post-disaster recovery efforts (human services, small business recovery assistance, donations management).	N/A	All Hazards	NCEMS, LCEMA, NC DCED, NC DHS; working with the Lehigh Valley Disaster Relief Task Force	Medium – High (improved coordination, efficiency and effectiveness of county agencies and departments to assist residents and businesses during disaster response and recovery)	Medium	Local Budgets	Short	Medium
34	Develop a long-term recovery liaison position to support the above initiative.	N/A	All Hazards	NCEMS, LCEMA, NC DCED, NC DHS; working with the Lehigh Valley Disaster Relief Task Force and other departments	Medium – High (as in Initiative #33 above)	Medium-High	County Budgets	Short	Medium
35	Northampton County to maintain and train (through ESF-16 and the Regional Catastrophic Planning Task force), and Lehigh County to establish and participate in training, a donations / volunteer management program to improve the receipt and allocation of donations (e.g. equipment, supplies, water, food, clothes), and the deployment of volunteer resources during disaster recovery. This may include identifying and training volunteers to manage the program, and establishing donation / volunteer management center(s).								
	See above.	N/A	All Hazards	NCEMS, LCEMA, NC DCED, NC DHS; working with the Lehigh Valley Disaster Relief Task Force	Medium – High (improved coordination, efficiency and effectiveness of county agencies and departments to assist residents and businesses during disaster response and recovery)	Medium-High	County Budgets; supported by Federal and State EM funding as available	Ongoing	High



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
36	<p>County EMAs to continue to pursue implementation of stream/river gauges – pursue participation in the Integrated Flood Observing and Warning System by installation, maintenance and monitoring of additional rainfall/stream/river gauges throughout both counties to provide additional rainfall and stream level data, to allow the counties to disseminate necessary alerts. Both counties have explored implementation of gaging systems, however these systems are expensive and outside funding would be needed support implementation. Both counties intend to continue to explore funding sources, including working with the National Weather Service to develop an acquisition plan, to support project implementation.</p> <p>This is the continued implementation of Initiative #10 from the 2006 plan.</p>								
	See above	N/A	Flood	County EMAs, working with USGS, National Weather Service, Delaware River Basin Commission and other regional flood stakeholders	Medium – High Improved flood forecasting and warning supporting emergency management flood response	High	County budgets to support pursuit of funding for project implementation	Ongoing	High
37	<p>County EMAs to continue their efforts to recruit individuals for the following programs:</p> <ul style="list-style-type: none"> - Citizen Corps Council - Are You Ready? - Community Emergency Response Team (CERT) <p>This is a continuation of Action #13 from the 2006 plan.</p>	N/A	All Hazards	Lehigh County EMA	Medium (increased emergency preparedness, response and recovery capabilities)	Medium	County budgets	Ongoing	High
38	<p>County EMAs to continue their efforts at identifying and partnering with owners/operators of critical facilities as necessary to provide adequate planning and protection.</p> <p>This is a continuation of Action #14 from the 2006 Plan.</p>	Existing	All Hazards	Lehigh and Northampton County EMAs	Medium (protection of critical facilities)	Low	County budgets	Ongoing	High



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
39	Research the NFPA “Firewise” program to identify what elements would benefit the LV and how they would be managed and implemented in the LV.	N/A	Wildfire	Lehigh and Northampton County EMAs, working with local fire departments and the NFPA	Medium (increased management of wildfire risk)	Low - Medium	County Budgets	Short	Medium
40	Develop evacuation plans, routes, policies, and procedures for the full range of contingencies and geographic areas of the Lehigh Valley.	N/A	All Hazards	Lehigh and Northampton County EMAs	High (life safety)	Medium - High	County Budgets	Short	Medium
41	Develop county-level debris management plans for the Lehigh Valley.	N/A	Flood; Severe Storm; Severe Winter Storm	Lehigh and Northampton County EMAs	Medium (improved recovery, reduced loss of services)	Medium	County budgets; FEMA EMPG	Longterm	Low - Medium
42	Identify areas and specific residents who would need evacuation assistance, including residents who lack transportation, and develop evacuation assistance plans.	N/A	All Hazards	Lehigh and Northampton County EMAs, working with Human Services and municipalities	Medium – High (life safety)	Low - Medium	County budgets; FEMA EMPG	Short	Medium - High
43	Improve coordination and cooperation with colleges and universities in the Lehigh Valley to address their emergency management and service’s needs, including mass gathering/civil disturbance risks.	N/A	All Hazards, spec. Mass Gathering/ Civil Disturbance	Lehigh and Northampton County EMAs working with college and university emergency services	Medium (improved emergency management capabilities)	Low	Local Budgets	Ongoing	High



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

Initiative #	Mitigation Initiative	Applies to New and/or Existing Structures*	Hazard(s) Addressed	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority
Structural Projects									
44	Implement the Lower Milford Township Creek Stabilization Project, funding through the 2008 LPDM. This project proposes to stabilize a section of Hosensak Creek that is threatening Shutlz Bridge Road near its intersection with Buchman Road, through the installation of 19 inches of rip-rap. Provide grant administration and technical support as needed.								
	See above.	Existing	Flood; Severe Storm	Lehigh County agencies, working with Lower Milford Township	High	High	2008 LPDM, county and local for local match	Longterm	High
45	Continue to design replacement bridges to the new standards.	Existing	Flood; Severe Storm	Northampton County DPW	High (reduced vulnerability to critical infrastructure)	High	FEMA Mitigation Grant Programs; County budget for local share	Ongoing	High

Notes:

*Does this mitigation initiative reduce the effects of hazards on new and/or existing buildings and/or infrastructure? Not applicable (NA) is inserted if this does not apply.

Costs:

Where actual project costs have been reasonably estimated:

Low = < \$10,000

Medium = \$10,000 to \$100,000

High = > \$100,000

Where actual project costs cannot reasonably be established at this time:

Low = Possible to fund under existing budget. Project is part of, or can be part of an existing on-going program.

Medium = Could budget for under existing work-plan, but would require a reapportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.

High = Would require an increase in revenue via an alternative source (i.e., bonds, grants, fee increases) to implement. Existing funding levels are not adequate to cover the costs of the proposed project.

Potential FEMA HMA Funding Sources:

PDM = Pre-Disaster Mitigation Grant Program

FMA = Flood Mitigation Assistance Grant Program

RFC = Repetitive Flood Claims Grant Program

SRL = Severe Repetitive Loss Grant Program

HMGP = Hazard Mitigation Grant Program

Timeline:

Short = 1 to 5 years. Long Term= 5 years or greater. OG = On-going program. DOF = Depending on funding.



F. ANALYSIS OF MITIGATION ACTIONS

Municipal mitigation actions were evaluated and prioritized primarily using the PA STEEL methodology discussed in Section 6 of this plan. Per the cost-benefit weighted PA STEEL methodology, those actions receiving 20 or more favorable ratings were generally considered high-priority actions. However, other factors beyond the PA STEEL numeric ranking may have been considered by the municipality during project prioritization. For example, a project might be assigned a medium priority because of the uncertainty of a funding source, and could be changed to high once a funding source has been identified such as a grant.

Mitigation Action		PA STEEL CRITERIA CONSIDERATIONS																				Results			
		(+) Favorable						(-) Less favorable						(N) Not Applicable											
		P Political			A Administrative			S Social		T Technical		E Economic			E Environmental				L Legal			SUMMARY (EQUAL WEIGHTING)	SUMMARY (BENEFITS & COSTS PRIORITIZED)		
Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action (x3)	Cost of Action (x3)	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HAZMAT / Waste Site	Consistent w/ Community Environmental Goals	Consistent w/ Federal Laws	State Authority	Existing Local Authority			Potential Legal Challenge	
1	Centralized data library of LVHMP	+	+	+	+	+	+	+	+	N	+	+	+	N	+	N	N	N	N	+	N	+	+	16 (+) 0 (-) 7 (N)	20 (+) 0 (-) 7 (N)
2	Incorporate HAZUS and train staff	+	+	-	+	+	-	-	-	+	+	+	+	+	+	N	N	+	+	+	+	-	16 (+) 5 (-) 2 (N)	20 (+) 5 (-) 2 (N)	
3	Enhance critical facility inventory	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	+	N	+	N	+	+	19 (+) 0 (-) 3 (N)	23 (+) 0 (-) 3 (N)	



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

4	Compliance and participation in NFIP Program	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	N	+	+	N	+	-	19 (+) 2 (-) 2 (N)	23 (+) 2 (-) 2 (N)
5	Assist municipalities with regulatory requirement and ordinances	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	N	N	N	N	N	+	+	17 (+) 0 (-) 6 (N)	21 (+) 0 (-) 6 (N)
6	Assist municipalities with carbonate bedrock standards	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	N	N	N	N	N	+	+	17 (+) 0 (-) 6 (N)	21 (+) 0 (-) 6 (N)
7	Improve communication with Councils of Governments	+	+	-	+	+	-	-	-	+	+	+	+	+	+	+	N	N	+	+	+	+	-	16 (+) 5 (-) 2 (N)	20 (+) 5 (-) 2 (N)	
8	Support understanding of flood mapping and NFIP compliance	+	+	-	N	-	+	N	N	N	N	+	+	N	+	N	N	N	N	N	N	+	N	7(+) 2(-) 14(N)	11(+) 2(-) 14(N)	
9	Support HMA grant assistance	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	+	N	+	N	+	+	19 (+) 0 (-) 3 (N)	23 (+) 0 (-) 3 (N)	
10	Support NFIP public outreach	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	N	N	N	+	N	+	+	18 (+) 1 (-) 4 (N)	22 (+) 4 (-) 4 (N)	
11	Support FEMA remapping and Risk Map programs	+	+	-	N	-	+	N	N	N	N	+	+	N	+	N	N	N	N	N	N	+	N	7(+) 2(-) 14(N)	11(+) 2(-) 14(N)	
12	Facilitate training for floodplain managers	+	+	-	+	+	-	-	-	+	+	+	+	+	+	+	N	N	+	+	+	+	-	16 (+) 5 (-) 2 (N)	20 (+) 5 (-) 2 (N)	



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

13	Support CRS	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	N	N	N	N	+	+	17 (+) 0 (-) 6 (N)	21 (+) 0 (-) 6 (N)
14	Support NFIP CAV's	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	N	+	+	N	+	-	19 (+) 2 (-) 2 (N)	23 (+) 2 (-) 2 (N)
15a	Integrate HMP with LV Comprehensive Plan	+	+	+	+	+	-	+	+	+	N	N	+	+	+	+	N	N	N	N	+	N	+	-	14 (+) 2 (-) 7 (N)	18 (+) 2 (-) 7 (N)
15b	Integrate HMP with local Comprehensive and Master Plans	+	+	+	+	+	-	+	+	+	N	N	+	+	+	+	N	N	N	N	+	N	+	-	14 (+) 2 (-) 7 (N)	18 (+) 2 (-) 7 (N)
15c	Integrate HMP with Capital Improvement Plans	+	+	+	+	+	-	+	+	+	N	N	+	+	+	+	N	N	N	N	+	N	+	-	14 (+) 2 (-) 7 (N)	18 (+) 2 (-) 7 (N)
15d	Integrate HMP with Watershed and Stream Corridor Management Plans	+	+	+	+	+	-	+	+	+	N	N	+	+	+	+	N	N	N	N	+	N	+	-	14 (+) 2 (-) 7 (N)	18 (+) 2 (-) 7 (N)
15e	Integrate HMP with Emergency Management Plans	+	+	+	+	+	-	+	+	+	N	N	+	+	+	+	N	N	N	N	+	N	+	-	14 (+) 2 (-) 7 (N)	18 (+) 2 (-) 7 (N)
15f	Integrate HMP with Act Stormwater Management Plans	+	+	+	+	+	-	+	+	+	N	N	+	+	+	+	N	N	N	N	+	N	+	-	14 (+) 2 (-) 7 (N)	18 (+) 2 (-) 7 (N)
15g	Integrate HMP with HUD/CDBG	+	+	+	+	+	-	+	+	+	N	N	+	+	+	+	N	N	N	N	+	N	+	-	14 (+) 2 (-) 7 (N)	18 (+) 2 (-) 7 (N)



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

16	Lead and support maintenance of this Plan	+	+	+	+	+	+	+	+	+	N	+	+	+	N	+	N	N	N	N	+	N	+	+	16 (+) 0 (-) 7 (N)	20 (+) 0 (-) 7 (N)
17	Provide representation and support of local watershed communities	+	+	-	+	-	+	+	+	+	+	N	+	+	N	+	N	N	N	N	+	N	+	+	14+ 2- 7N	20+ 2- 7N
18	Continue participation in Storm Ready	+	+	-	N	+	+	N	N	+	+	N	+	+	N	+	N	N	N	N	+	N	+	N	11+ 1- 11N	17+ 1- 11N
19	Support communities with FEMA grant programs	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	N	+	+	N	+	-	19 (+) 2 (-) 2 (N)	23 (+) 2 (-) 2 (N)	
20	Identify county owned vulnerable infrastructure	+	+	-	+	+	-	-	-	+	+	+	+	+	+	+	N	N	+	+	+	+	-	16 (+) 5 (-) 2 (N)	20 (+) 5 (-) 2 (N)	
21	Coordinate with Private sector regarding underground utilities	+	+	+	+	+	-	+	+	+	N	N	+	+	+	+	N	N	N	N	+	N	+	-	14 (+) 2 (-) 7 (N)	18 (+) 2 (-) 7 (N)
22	Promote awareness of personal preparedness and mitigation	+	+	-	N	-	+	N	N	N	N	N	+	+	N	+	N	N	N	N	N	N	+	N	7(+) 2(-) 14(N)	11(+) 2(-) 14(N)
23	Webpage public attention and announcement	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	+	N	+	+	+	+	20 (+) 0 (-) 3 (N)	24 (+) 0 (-) 3 (N)	
24	Participate in USACE Silver Jackets program	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	N	+	+	N	+	-	19 (+) 2 (-) 2 (N)	23 (+) 2 (-) 2 (N)	
25	Improve public understanding of disaster preparedness	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	+	N	+	+	+	+	20 (+) 0 (-) 3 (N)	24 (+) 0 (-) 3 (N)	



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

26	Expand emergency service for special needs populations	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	N	N	N	+	N	+	+	18 (+) 1 (-) 4 (N)	22 (+) 4 (-) 4 (N)
27	Coordinate bi-county insurance summit to include public information material	+	+	+	+	+	+	+	+	+	N	+	+	+	N	+	N	N	N	N	+	N	+	+	16 (+) 0 (-) 7 (N)	20 (+) 0 (-) 7 (N)
28	Incorporate PPL public information listings	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	+	N	+	N	+	+	19 (+) 0 (-) 3 (N)	23 (+) 0 (-) 3 (N)	
29	Support higher regulatory floodplain standards	+	+	-	+	+	-	-	-	+	+	+	+	+	+	+	N	N	+	+	+	+	-	16 (+) 5 (-) 2 (N)	20 (+) 5 (-) 2 (N)	
30	Coordinate with Utilities ref. threatening trees during events	+	-	-	-	-	-	+	-	+	+	-	+	-	-	-	+	N	N	+	+	N	+	-	9(+) 11(-) 3(N)	11(+) 13(-) 3(N)
31	Implement county wide generator project phase One	+	+	-	N	+	+	N	N	+	+	N	+	+	N	+	N	N	N	N	+	N	+	N	11+ 1- 11N	17+ 1- 11N
32	Implement county wide generator project phase Two	+	+	-	N	+	+	N	N	+	+	N	+	+	N	+	N	N	N	N	+	N	+	N	11+ 1- 11N	17+ 1- 11N
33	Improve coordination and communication to support response and post disaster recovery	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	N	N	N	+	N	+	+	18 (+) 1 (-) 4 (N)	22 (+) 4 (-) 4 (N)



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

34	Develop a long term recovery liaison	+	+	+	+	+	-	+	+	+	N	N	+	+	+	+	N	N	N	N	+	N	+	-	14 (+) 2 (-) 7 (N)	18 (+) 2 (-) 7 (N)
35	Train Regional Catastrophic Task Force and volunteer resources	+	N	+	+	-	+	+	+	+	+	N	+	+	N	+	-	-	+	N	N	N	+	+	14(+) 3(-) 6(N)	20(+) 3(-) 6(N)
36	Participate in Integrated Flood Observing and Warning System and monitoring gauges	+	+	-	+	-	+	+	+	+	+	N	+	+	N	+	N	N	N	N	+	N	+	+	14+ 2- 7N	20+ 2- 7N
37	Continue to support Citizen Corps, CERT and Are You Ready programs	+	+	+	+	+	+	+	+	+	N	+	+	+	N	+	N	N	N	N	+	N	+	+	16 (+) 0 (-) 7 (N)	20 (+) 0 (-) 7 (N)
38	Support critical facility owners with planning and protection	+	+	+	+	+	-	+	+	+	N	N	+	+	+	+	N	N	N	N	+	N	+	-	14 (+) 2 (-) 7 (N)	18 (+) 2 (-) 7 (N)
39	Research NFPA Firewise program	+	N	+	+	-	+	+	+	+	+	N	+	+	N	+	-	-	+	N	N	N	+	+	14(+) 3(-) 6(N)	20(+) 3(-) 6(N)
40	Develop and publicize evacuation plans and routes	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	+	N	+	+	+	+	20 (+) 0 (-) 3 (N)	24 (+) 0 (-) 3 (N)
41	Develop county wide debris management plans	+	+	-	N	-	+	N	N	N	N	N	+	+	N	+	N	N	N	N	N	N	+	N	7(+) 2(-) 14(N)	11(+) 2(-) 14(N)



SECTION 9.1: LEHIGH AND NORTHAMPTON COUNTIES

42	Identify residents in need of evacuation assistance	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	+	N	+	+	+	+	20 (+) 0 (-) 3 (N)	24 (+) 0 (-) 3 (N)
43	Improve coordination and coordination of colleges and universities regarding needs	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	N	+	+	N	+	-	19 (+) 2 (-) 2 (N)	23 (+) 2 (-) 2 (N)
44	Implement the Lower Milford Creek Stabilization Project	+	+	+	N	+	+	+	+	+	+	+	+	+	+	+	N	N	+	+	+	+	-	19(+) 1(-) 3(N)	23(+) 1(-) 3(N)	
45	Design replacement bridges to new standards	+	+	+	+	-	+	+	+	+	+	N	+	+	N	+	-	-	N	-	+	N	+	-	14(+) 5(-) 4(N)	18(+) 5(-) 4(N)



9.2 ALBURTIS BOROUGH

This section presents the jurisdictional annex for Alburdis Borough.

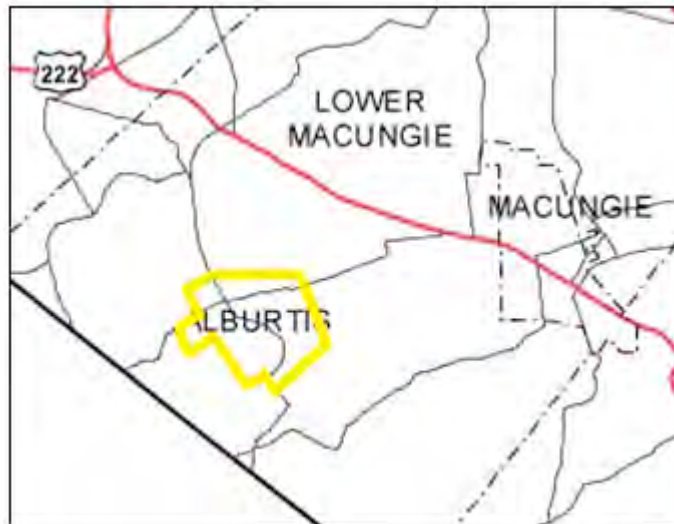
A. HAZARD MITIGATION PLAN POINT OF CONTACT

Primary Point of Contact		Alternate Point of Contact	
<u>Name</u>	Sharon Trexler	<u>Name</u>	
<u>Title/</u>	Executive Secretary	<u>Title/</u>	
<u>Department</u>		<u>Department</u>	
<u>Address</u>	260 Franklin St, PO Box 435, Alburdis, PA 18011	<u>Address</u>	
<u>Telephone</u>	610-966-4777	<u>Telephone</u>	
<u>Fax</u>	610-965-5517	<u>Fax</u>	
<u>Email</u>	sharon@alburdis.org	<u>Email</u>	

B. MUNICIPAL PROFILE

Alburdis Borough is located in the south-western part of Lehigh County. It encompasses an area of 0.7 square miles and has a population of 2,361 (2010 Census). As shown in Figure 1, the borough is located within the boundaries of Lower Macungie Township, which borders Berks County to the southwest; Upper Milford Township (Lehigh County) to the south; Salisbury Township and South Whitehall Township (both Lehigh County) to the east and northeast; and Upper Macungie Township (Lehigh County) to the northwest. Macungie Borough is also located partially within Lower Macungie Township, just to the east of Alburdis Borough.

Figure 1



(Source: <http://www.lvpc.org/pdf/maps/baseMap-LehighNorthamptonCounties.pdf>)

The Swabia Creek, a tributary of the Little Lehigh Creek running through Berks and Lehigh Counties, traverses the borough. Swabia creek runs north to Alburdis through Lock Ridge Park, and then turns east, running roughly parallel to the Norfolk Southern Rail tracks.

D. HAZARD RISK/VULNERABILITY RISK RANKING

The following relative ranking of natural and non-natural hazard risks in this municipality was developed using PEMA’s Risk Factor methodology described in Section 4, “Risk Assessment”

HAZARD RISK	NATURAL HAZARDS	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
		PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
HIGH	Winter Storm	3	2	4	1	3	2.7
	Flood	3	2	2	3	3	2.5
MODERATE	Subsidence / Sinkholes	2	3	3	2	1	2.4
	Radon Exposure	4	1	2	1	4	2.4
	Extreme Temperatures	4	1	2	1	3	2.3
	Drought	2	1	4	1	4	2.2
	Wildfire	3	1	2	3	3	2.2
	Hailstorm	3	1	3	2	1	2.1
	Wind, incl. Tornado	1	3	2	4	1	2.1
	Lightning	4	1	1	2	1	2
LOW	Earthquake	1	1	4	4	1	1.9
	Landslide	1	1	1	4	1	1.3

HAZARD RISK	MAN-MADE HAZARDS	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
		PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
HIGH	Fire (Urban / Structural)	4	2	1	4	2	2.6
	Env. Hazard and Explosion	3	2	2	4	3	2.6
	Utility Interruption	3	1	3	4	3	2.5
MOD-ERATE	Transportation Accident	4	1	1	4	1	2.2
	Mass Gathering and Civil Disturbance	3	1	1	4	2	2
LOW	Terrorism	1	3	1	4	1	1.9
	Building Collapse	1	3	1	4	1	1.9
	Dam Failure	1	2	2	4	2	1.9
	Nuclear Incident	1	1	1	4	2	1.4
	Levee Failure	0	0	0	0	0	0

E. CAPABILITY ASSESSMENT

This section identifies the following capabilities of the local jurisdiction:

- Planning and Regulatory Capability
- Administrative and Technical Capability
- Fiscal Capability
- Community Classifications

E.1 Planning and Regulatory Capability

Tool / Program	Status			Dept./Agency Responsible	Effect on Loss Reduction: + Support O Neutral - Hinder	Change Since Last Plan: + Positive - Negative	Comments
	In Place	Date Adopted or Updated	Under Development				
Hazard Mitigation Plan	X	7/2006		Lehigh County			
Emergency Operations Plan	X	1/1/08					
Disaster Recovery Plan							
Evacuation Plan							
Continuity of Operations Plan							
NFIP							
NFIP – Community Rating System							
Floodplain Regulations (spec. NFIP Flood Damage Prevention Ordinance)							
Floodplain Management Plan							
Zoning Regulations	X	7/25/12					
Subdivision Regulations							
Comprehensive Land Use Plan (or General, Master or Growth Mgt. Plan)	X	2004		Southwestern Lehigh County Comprehensive Plan Committee	+		Includes recommendations on the adoption of carbonate bedrock standards.
Open Space Management Plan (or Parks/Rec or Greenways Plan)							

SECTION 9.2: ALBURTIS BOROUGH

Tool / Program	Status			Dept./Agency Responsible	Effect on Loss Reduction: + Support O Neutral - Hinder	Change Since Last Plan: + Positive - Negative	Comments
	In Place	Date Adopted or Updated	Under Development				
Stormwater Management Plan / Ordinance							
Natural Resource Protection Plan							
Capital Improvement Plan							
Economic Development Plan							
Historic Preservation Plan							
Farmland Preservation							
Building Code	X						
Fire Code							
Firewise							
Storm Ready	X	2012		Lehigh County			
Other							

E.2 Administrative and Technical Capability

Staff/Personnel Resources	Yes	No	Department/Agency	Comments
Planners (with land use / land development knowledge)	X		Planning Commission	
Planners or engineers (with natural and/or human caused hazards knowledge)				
Engineers or professionals trained in building and/or infrastructure construction practices (includes building inspectors)	X			Barry Isett & Associates
Emergency Manager				
NFIP Floodplain Administrator				
Land Surveyors	X			Keystone Consulting
Scientists or staff familiar with the hazards of the community				
Personnel skilled in Geographic Information Systems (GIS) and/or FEMA's HAZUS program	X		Zoning	
Grant writers or fiscal staff to handle large/complex grants				
Staff with expertise or training in Benefit-Cost Analysis				
Other				

E.3 Fiscal Capability

Financial Resources	Yes	No	Department/Agency	Comments
Capital Improvement Programming				
Community Development Block Grants (CDBG)	X		Executive Secretary – BBRP	
Special Purpose Taxes				
Gas / Electric Utility Fees				
Water / Sewer Fees	X		Executive Secretary	
Stormwater Utility Fees				
Development Impact Fees				
General Obligation, Revenue, and/or Special Tax Bonds				
Partnering Arrangements or Intergovernmental Agreements				
Other				

E.4 Community Classifications

Program	Classification	Date Classified
Community Rating System (CRS)	NP	N/A
Building Code Effectiveness Grading Schedule (BCEGS)	TBD	TBD
Public Protection	TBD	TBD
Storm Ready	Lehigh County	TBD
Firewise	NP	N/A

N/A = Not applicable. NP = Not participating. TBD = To Be Determined

The classifications listed above relate to the community's effectiveness in providing services that may impact its vulnerability to the natural hazards identified. These classifications can be viewed as a gauge of the community's capabilities in all phases of emergency management (preparedness, response, recovery and mitigation) and are used as an underwriting parameter for determining the costs of various forms of insurance. The CRS class applies to flood insurance while the BCEGS and Public Protection classifications apply to standard property insurance. CRS classifications range on a scale of 1 to 10 with class one (1) being the best possible classification, and class 10 representing no classification benefit. Firewise classifications include a higher classification when the subject property is located beyond 1000 feet of a creditable fire hydrant and is within 5 road miles of a recognized Fire Station. Storm Ready communities are better prepared to save lives from the onslaught of severe weather through advanced planning, education and awareness.

Criteria for classification credits are outlined in the following documents:

- The Community Rating System Coordinators Manual
- The Building Code Effectiveness Grading Schedule
- The ISO Mitigation online ISO's Public Protection website at <http://www.isomitigation.com/ppc/0000/ppc0001.html>
- The National Weather Service Storm Ready website at <http://www.weather.gov/stormready/howto.htm>
- The National Firewise Communities website at <http://firewise.org/>

F. MITIGATION STRATEGY

F.1 Past Mitigation Activities/Efforts

- Drainage improvement on West Penn Avenue

F.2 Hazard Vulnerabilities Identified

It is estimated that in Alburdis Borough, 5 residents live within the 1% annual chance flood area (NFIP Special Flood Hazard Area). Of the municipality's total land area, 6.2% is located within the 1% annual chance flood area. \$341,863 (0.1%) of the municipality's general building stock replacement cost value (structure and contents) is located within the 1% annual chance flood area.

There are 1 NFIP policies in the community. While there are 22 parcels located within the 1% annual chance flood area, there are no policies issued to property owners in the 1% annual chance flood area.

FEMA has identified no Repetitive Loss (RL) or Severe Repetitive Loss (SRL) properties in the municipality.

HAZUS-MH estimates that for a 1% annual chance flood, \$164,000 (0.1%) of the municipality's general building stock replacement cost value (structure and contents) will be damaged, 35 people may be displaced, 9 people may seek short-term sheltering, and an estimated 4 tons of debris could be generated.

The following vulnerabilities have been identified by the community, within the risk assessment, or in other plan, reports and documents (e.g. FEMA Flood Insurance Studies, Act 167 Stormwater Management Plans):

- Drainage improvement on West Penn Avenue

Please refer to the Hazard Profiles for additional vulnerability information relevant to this jurisdiction.

F.3 Hazard Mitigation Strategy

Note some of the identified mitigation initiatives in Table F are dependent upon available funding (grants and local match availability) and may be modified or omitted at any time based on the occurrence of new hazard events and changes in municipal priorities.

Action No.	Action	Mitigation Technique Category	Hazard(s) Addressed	Priority (H/M/L)	Estimated Cost	Potential Funding Sources	Lead Agency / Department	Implementation Schedule	Applies to New and/or Existing Structures*
1	Maintain fleet of vehicles and equipment for emergency response.	Emergency Services	All	High	Medium	Borough budget; available public protection and emergency services grant programs	Borough	Ongoing	N/A
2	Work with electric utility to improve primary and secondary line clearing.	Property Protection	Severe Storms; Wind and Winter Weather	High	Medium	Borough Budget	Borough working with electric utilities	Short	Existing
3	Drainage improvement on West Penn Avenue	Property Protection	Flood	High	High	Borough Budget	FEMA Mitigation Grants and local budget	Long	New & Existing
4	Continue to support the implementation, monitoring, maintenance, and updating of this Plan, as defined in Section 7.0	All Categories	All Hazards	High	Low – High (for 5-year update)	Local Budget, possibly FEMA Mitigation Grant Funding for 5-year update	Municipality (via mitigation planning point of contacts) with support from Planning Partners (through their Points of Contact), PEMA	Ongoing	New & Existing
5	Complete the ongoing updates of the Comprehensive Emergency	Emergency Services	All Hazards	High	Low	Local Budget	Municipality with support from PEMA	Ongoing	New & Existing

Action No.	Action	Mitigation Technique Category	Hazard(s) Addressed	Priority (H/M/L)	Estimated Cost	Potential Funding Sources	Lead Agency / Department	Implementation Schedule	Applies to New and/or Existing Structures*
	Management Plans								
6	Work with regional agencies (i.e. County and PEMA) to help develop damage assessment capabilities at the local level through such things as training programs, certification of qualified individuals (e.g. code officials, floodplain managers, engineers).	Public Education and Awareness, Emergency Services	All Hazards	Medium	Medium	Local budget, FEMA HMA and HLS grant programs	Municipality with support from County, PEMA	Short – Long-term DOF	NA

Notes:

*Does this mitigation initiative reduce the effects of hazards on new and/or existing buildings and/or infrastructure? Not applicable (NA) is inserted if this does not apply.

Costs:

Where actual project costs have been reasonably estimated:

Low = < \$10,000

Medium = \$10,000 to \$100,000

High = > \$100,000

Where actual project costs cannot reasonably be established at this time:

Low = Possible to fund under existing budget. Project is part of, or can be part of an existing on-going program.

Medium = Could budget for under existing work-plan, but would require a reapportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.

High = Would require an increase in revenue via an alternative source (i.e., bonds, grants, fee increases) to implement. Existing funding levels are not adequate to cover the costs of the proposed project.

Potential FEMA HMA Funding Sources:

PDM = Pre-Disaster Mitigation Grant Program

FMA = Flood Mitigation Assistance Grant Program

RFC = Repetitive Flood Claims Grant Program

SRL = Severe Repetitive Loss Grant Program

HMGP = Hazard Mitigation Grant Program

Timeline:

Short = 1 to 5 years. Long Term= 5 years or greater. OG = On-going program.

DOF = Depending on funding.

G. ANALYSIS OF MITIGATION ACTIONS

Municipal mitigation actions were evaluated and prioritized primarily using the PA STEEL methodology discussed in Section 6 of this plan. Per the cost-benefit weighted PA STEEL methodology, those actions receiving 20 or more favorable ratings were generally considered high-priority actions. However, other factors beyond the PA STEEL numeric ranking may have been considered by the municipality during project prioritization. For example, a project might be assigned a medium priority because of the uncertainty of a funding source, and could be changed to high once a funding source has been identified such as a grant.

Mitigation Action		PA STEEL CRITERIA CONSIDERATIONS																				Results			
		(+) Favorable						(-) Less favorable						(N) Not Applicable											
		P Political			A Administrative			S Social		T Technical			E Economic			E Environmental					L Legal			SUMMARY (EQUAL WEIGHTING)	SUMMARY (BENEFITS & COSTS PRIORITIZED)
Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action (x3)	Cost of Action (x3)	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HAZMAT / Waste Site	Consistent w/ Community Environmental Goals	Consistent w/ Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge			
1	Maintain adequate fleet of vehicles and equipment to handle anticipated emergency response	+	+	+	-	-	+	+	+	+	+	+	+	+	-	+	+	+	N	+	N	+	+	18 (+) 3 (-) 2 (N)	22 (+) 3 (-) 2 (N)
2	Work with local electric utilities to improve line clearing during severe	+	+	+	-	-	-	+	-	+	+	+	+	+	-	+	+	+	+	+	N	+	+	17 (+) 5 (-) 1 (N)	21 (+) 5 (-) 1 (N)



H. FUTURE NEEDS TO BETTER UNDERSTAND RISK/VULNERABILITY

A more detailed flood loss analysis could be conducted on a structural level (versus the Census block analysis conducted for the HMP). The location of each building, details regarding the building (see additional data needed below) and the assessed or fair market value could be included in HAZUS-MH. The FEMA DFIRM boundaries, FEMA Flood Insurance Study detailed studies, base flood elevations and available Light Detection and Ranging (LiDAR) data or digital elevation models (DEM) could be used to generate a more accurate flood depth grid and then integrated into the HAZUS model. The flood depth-damage functions could be updated using the U.S. Army Corps of Engineer damage functions for residential building stock to better correlate HAZUS-MH results with FEMA benefit-cost analysis models. HAZUS-MH would then estimate more accurate potential losses per structure.

Additional data needed to perform the analysis described above:

- Specific building information – first-floor elevation (elevation certificates), number of stories, foundation type, basement, square footage, occupancy type, year built, type of construction etc.
- Assessed or fair market value of structure
- LiDAR or high resolution DEM

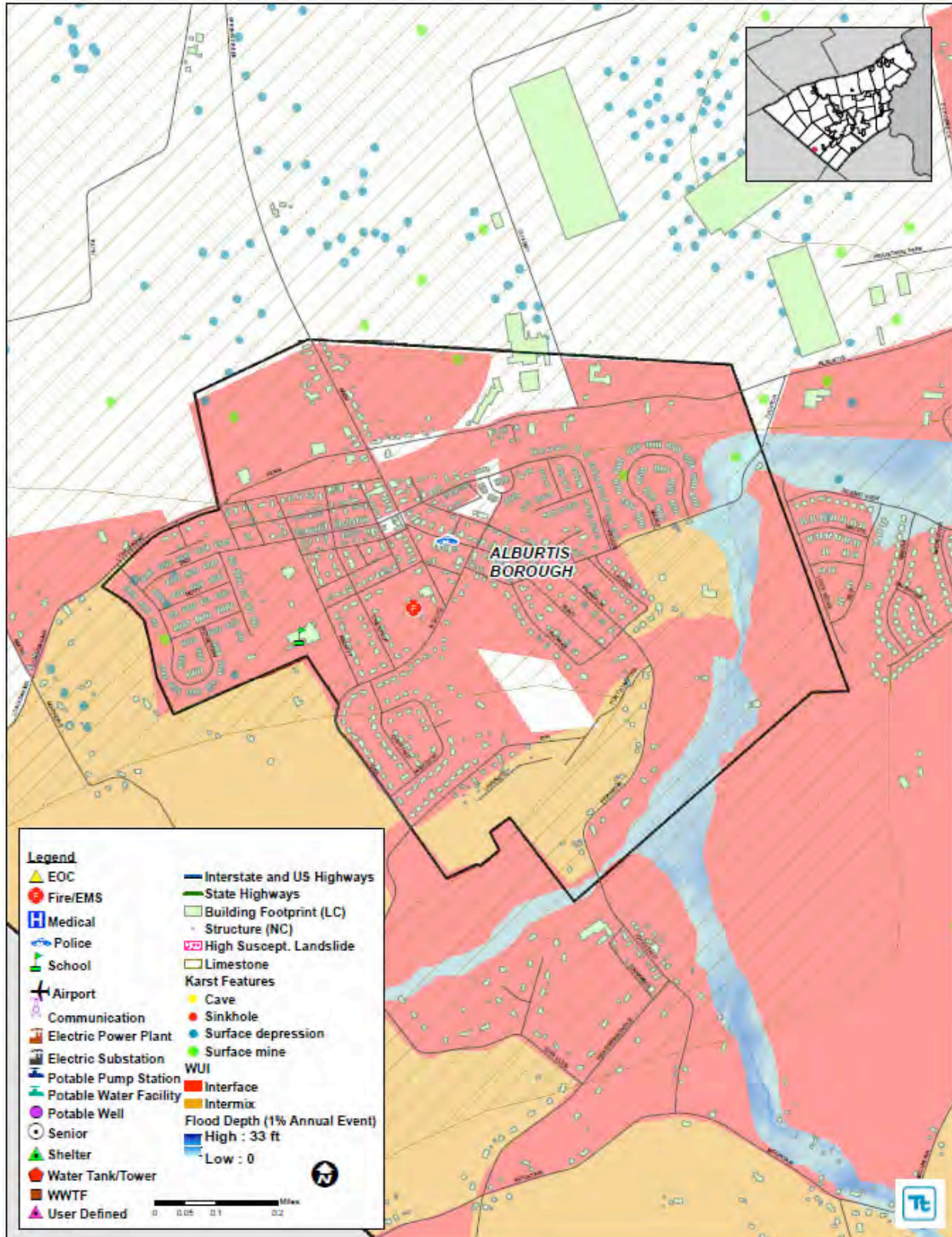
Regional risk maps are provided in the hazard profiles within Section 4, Volume I of this Plan.

I. HAZARD AREA EXTENT AND LOCATION

A hazard area extent and location map has been generated and is provided below for Alburdis Borough to illustrate the probable areas impacted within Alburdis Borough. This map is based on the best available data at the time of the preparation of this Plan, and is considered to be adequate for planning purposes. Maps have only been generated for those hazards that can be clearly identified using mapping techniques and technologies, and for which Alburdis Borough has significant exposure. The Planning Area maps are provided in the hazard profiles within Section 4, Volume I of this Plan.

J. ADDITIONAL COMMENTS

No additional comments at this time.



ABE MSA	Allentown-Bethlehem-Easton Metropolitan Statistical Area
ASFPM	Association of State Floodplain Managers
BCA	Benefit Cost Analysis
BFE	Base Flood Elevation
CDC	Center of Disease Control
CEMP	Comprehensive Emergency Management Program
CFR	Code of Federal Regulations
CRREL	Cold Regions Research and Engineering Laboratory
CRS	Community Rating System
DEM	Digital Elevation Model
DFIRMs	Digital Flood Insurance Rate Maps
DI s	Damage Indicators
DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000
DOD	Degrees of Damage
EFS	Enhanced Fujita Scale
DPW	Department of Public Works
DR	Disaster Declarations
EM	Emergency Management
EMS	Emergency Management Services
EOC	Emergency Operation Center
EOP	Emergency Operation Plan
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FD	Fire Department
FEMA	Federal Emergency Management Agency
FIA	Flood Insurance Administration
FIRM	Flood Insurance Rate Map
FIT	Flood Information Tool
FIS	Flood Insurance Study
FM	Fuel Moisture
FY	Fiscal Year
GIS	Geographic Information System
HAZUS	Hazards U.S.

HAZUS-MH	Hazards U.S. Multi-Hazard
HAZMAT	Hazardous Materials
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
ICLR	Institute for Catastrophic Loss Reduction
IT	Information Technology
LCEMA	Lehigh County Emergency Management Agency
LGS	Limerick Generation Station
LVPC	Lehigh Valley Planning Commission
Mi	Mile
MGD	Million Gallons per Day
Mph	Miles per Hour
MRP	Mean Return Period
N/A	Not Applicable
NA	Not Available
NCDC	National Climate Data Center
NCDCED	Northampton County Department of Community and Economic Development
NCDPW	Northampton County Department of Public Works
NCEMS	Northampton County Emergency Management Services
NFDRS	National Fire Danger Rating System
NEHRP	National Earthquake Hazard Reduction Program
NESEC	Northeast States Emergency Consortium
NESIS	Northeast Snowfall Impact Scale
NFIP	National Flood Insurance Program
NGDC	National Geophysical Data Center
NHC	National Hurricane Center
NID	National Inventory of Dams
NIMS	National Incident Management System
NLCD	National Land Cover Dataset
NOAA	National Oceanic and Atmospheric Administration
NPDP	National Performance of Dams Program
NRCS	Natural Resource Conservation Service
NRC	Nuclear Regulatory Commission

NSSL	National Severe Storms Library
NVRC	Northern Virginia Regional Commission
NWS	National Weather Service
%	Percent
%g	Percent Acceleration Force of Gravity
PADCNR	Pennsylvania Department of Conservation and Natural Resources
PADEP	Pennsylvania Department of Environmental Protection
PD	Police Department
PDM	Pre-Disaster Mitigation Program
PDSI	Palmer Drought Severity Index
PEMA	Pennsylvania Emergency Management Agency
PennDOT	Pennsylvania Department of Transportation
PGA	Peak Ground Acceleration
Pop.	Population
PPL	Pennsylvania Power and Light
OSHA	Occupational Health and Safety Administration
RLP	Repetitive Loss of Property
RCV	Replacement Cost Value
Q3	Quality 3
SHELDUS	Spatial Hazard Events and Losses Database for United States
SPC	Storm Prediction Center
Sq. Mi.	Square mile
SRL	Severe Repetitive Loss
SSES	Susquehanna Steam Electric Station
SWOO	Strengths, Weaknesses, Obstacles and Opportunities
TBD	To Be Determined
TRI	Toxic Release Inventory
TSTM	Thunderstorm
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USD	U.S. Dollar
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service

USGS	U.S. Geological Survey
WCI	Wind Chill Index
WCT	Wind Chill Temperatures
WFAS	Wildland Fire Assessment
WIMS	Weather Information Management System
WMA	Watershed Management Area
WUI	Wildland/Urban Interface
WWTP	Wastewater Treatment Plant

This resource defines terms that are used in or support the risk assessment document. These definitions were based on terms defined in documents included in the reference section, with modifications as appropriate to address the Lehigh Valley specific definitions and requirements.

100-year flood – A flood that has a 1-percent chance of being equaled or exceeded in any given year. This flood event is also referred to as the base flood. The term "100-year flood" can be misleading; it is not the flood that will occur once every 100 years. Rather, it is the flood elevation that has a 1- percent chance of being equaled or exceeded each year. Therefore, the 100-year flood could occur more than once in a relatively short period of time. The 100-year flood, which is the standard used by most federal and state agencies, is used by the National Flood Insurance Program (NFIP) as the standard for floodplain management to determine the need for flood insurance.

500-year flood – A flood that has a 0.2-percent chance of being equaled or exceeded in any one year.

Aggregate Data – Data gathered together across an area or region (for example, census tract or census block data).

Annualized Loss – The estimated long-term value of losses from potential future hazard occurrences of a particular type in any given single year in a specified geographic area. In other words, the average annual loss that is likely to be incurred each year based on frequency of occurrence and loss estimates. Note that the loss in any given year can be substantially higher or lower than the estimated annualized loss.

Annualized Loss Ratio – Represents the annualized loss estimate as a fraction of the replacement value of the local building inventory. This ratio is calculated using the following formula: Annualized Loss Ratio = Annualized Losses / Exposure at Risk. The annualized loss ratio gauges the relationship between average annualized loss and building value at risk. This ratio can be used as a measure of relative risk between hazards as well as across different geographic units

Asset – Any man-made or natural feature that has value, including but not limited to people, buildings, infrastructure (such as bridges, roads, and sewer and water systems), and lifelines (such as electricity and communication resources or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks).

At-Risk – Exposure values that include the entire building inventory value in census blocks that lie within or border the inundation areas or any area potentially exposed to a hazard based on location.

Base Flood – Flood that has a 1-percent probability of being equaled or exceeded in any given year. It is also known as the 100-year flood.

Base Flood Elevation (BFE) – Elevation of the base flood in relation to a specified datum, such as the National Geodetic Vertical Datum of 1929. The BFE is used as the standard for the National Flood Insurance Program.

Benefit – Net project outcomes, usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of conducting a benefit-cost analysis of proposed mitigation measures, benefits are limited to specific, measurable, risk reduction factors, including a reduction in expected property losses (building, content, and function) and protection of human life.

Benefit-cost analysis (BCA) – Benefit-cost analysis is a systematic, quantitative method of comparing the projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.

Blizzard – Characterized by low temperatures, wind gusts of 35 mph or more and falling and/or blowing snow that reduces visibility to 0.25 miles or less for an extended period of time (three or more hours).

Building – A structure that is walled and roofed, principally aboveground and permanently fixed to a site. The term includes a manufactured home on a permanent foundation on which the wheels and axles carry no weight.

Building Codes – Regulations that set forth standards and requirements for construction, maintenance, operation, occupancy, use, or appearance of buildings, premises, and dwelling units. Building codes can include standards for structures to withstand natural disasters.

Buildup Index – Cumulative numerical index derived from daily weather data, presumably indicates the moisture content in medium-drying forest fuels.

Capability Assessment – An assessment that provides a description and analysis of a community or state's current capacity to address the threats associated with hazards. The capability assessment attempts to identify and evaluate existing policies, regulations, programs, and practices that positively or negatively affect the community or state's vulnerability to hazards or specific threats.

Climate – The meteorological elements, including temperature, precipitation, and wind, that characterizes the general conditions of the atmosphere over a period of time (typically 30-years) for a particular region.

Community Rating System (CRS) – CRS is a program that provides incentives for National Flood Insurance Program communities to complete activities that reduce flood hazard risk. When the community completes specific activities, the insurance premiums of these policyholders in communities are reduced.

Comprehensive Plan – A document, also known as a “general plan”, covering the entire geographic area of a community and expressing community goals and objectives. The plan lays out the vision, policies, and strategies for the future of the community, including all of the physical elements that will determine the community's future development. This plan can discuss the community's desired physical development, desired rate and quantity of growth, community character, transportation services, location of growth, and siting of public facilities and transportation. In most states, the comprehensive plan has no authority in and of itself, but serves as a guide for community decision-making.

Critical Facility – Facilities that are critical to the health and welfare of the population and that are especially important following a hazard. Critical facilities include essential facilities, transportation systems, lifeline utility systems, high-potential loss facilities, and hazardous material facilities. As defined for the Lehigh Valley risk assessment, this category includes police stations, fire and/or EMS stations, major medical care facilities and emergency communications.

Dam Failure – A partial or complete breach in a dam, which impacts its integrity. Dam failures occur for a number of reasons such as flash flooding, inadequate size of spillways, mechanical failure of valves and other equipment, rodent activities in earthen dams, freezing and thawing cycles, earthquakes, and intentional destruction.

Debris – The scattered remains of assets broken or destroyed during the occurrence of a hazard. Debris caused by a wind or water hazard event can cause additional damage to other assets.

Digital Elevation Model (DEM) – U.S. Geological Survey (USGS) Digital Elevation Model (DEM) data files that are digital representations of cartographic information in a raster form. DEMs include a sampled array of elevations for a number of ground positions at regularly spaced intervals. These digital cartographic/geographic data files are produced by USGS as part of the National Mapping Program.

Digital Flood Insurance Rate Maps (DFIRMs) – These maps are used to calculate the cost insurance premiums, establish flood risk zones and base flood elevations to mitigate against potential future flood damages to properties.

Displacement Time – After a hazard occurs, the average time (in days) that a building’s occupants must operate from a temporary location while repairs are made to the original building due to damages resulting from the hazard.

Disaster Mitigation Act of 2000 (DMA 2000) – Law that requires and rewards local and state pre-disaster planning, promotes sustainability as a strategy for disaster resistance, and is intended to integrate state and local planning with the aim of strengthening state-wide mitigation planning.

Drought - A drought is a significant deficit in moisture availability due to lower than normal rainfall.

Duration – The length of time a hazard occurs.

Earthquake – A sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of earth’s tectonic plates.

Essential Facility – A facility that is important to ensure a full recovery of a community or state following the occurrence of a hazard. These facilities can include: government facilities, major employers, banks, schools, and certain commercial establishments (such as grocery stores, hardware stores, and gas stations). For the Lehigh Valley risk assessment, this category was defined to include schools, colleges, shelters, adult living and adult care facilities, medical facilities and health clinics, hospitals.

Exposure – The number and dollar value of assets that are considered to be at risk during the occurrence of a specific hazard.

Extent – The size of an area affected by a hazard or the occurrence of a hazard.

Extra Tropical Cyclone – A group of cyclones defined as synoptic scale, low pressure, weather systems that occur in the middle latitudes of the Earth. These storms have neither tropical nor polar characteristics and are connected with fronts and horizontal gradients in temperature and dew point otherwise known as “baroclinic zones”. These cyclones produce impacts ranging from cloudiness and mild showers to heavy gales and thunderstorms.

Federal Emergency Management Agency (FEMA) – Independent agency (now part of the Department of Homeland Security) created in 1978 to provide a single point of accountability for all federal activities related to disaster mitigation and emergency preparedness, response, and recovery.

Flash Flood – A flood occurring with little or no warning where water levels rise at an extremely fast rate.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas resulting from (1) the overflow of inland or tidal waters, (2) the unusual and rapid accumulation or runoff of surface waters from any source, or (3) mudflows or the sudden collapse of shoreline land.

Flood Depth – Height of the flood water surface above the ground surface.

Flood Elevation – Height of the water surface above an established datum (for example, the National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or mean sea level).

Flood Hazard Area – Area shown to be inundated by a flood of a given magnitude on a map.

Flood Information Tool (FIT) – Hazard U.S. Multi-Hazard (HAZUS-MH)- related tool designed to process and convert locally available flood information to data that can be used by the HAZUS-MH Flood Module. The FIT is a system of instructions, tutorials and geographic information system (GIS) analysis scripts. When provided with user-supplied inputs (such as ground elevations, flood elevations, and floodplain boundary information), the FIT calculates flood depth and elevation for river and coastal flood hazards.

Flood Insurance Rate Map (FIRM) – Map of a community, prepared by the FEMA that shows both the special flood hazard areas and the risk premium zones applicable to the community.

Flood Insurance Study (FIS) – A study that provides an examination, evaluation, and determination of flood hazards and, if appropriate, corresponding water surface elevations in a community or communities.

Flood Mitigation Assistance (FMA) Program – A program created as a part of the National Flood Insurance Report Act of 1994. FMA provides funding to assist communities and states in implementing actions that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other NFIP insurance structures, with a focus on repetitive loss properties.

Floodplain – Any land area, including a watercourse, susceptible to partial or complete inundation by water from any source.

Flood Polygon – A geographic information system vector file outlining the area exposed to the flood hazard. HAZUS-MH generates this polygon at the end of the flood computations in order to analyze the inventory at risk.

Freezing Rain – Rain that falls as a liquid but freezes into glaze upon contact with the ground.

Frequency – A measure of how often events of a particular magnitude are expected to occur. Frequency describes how often a hazard of a specific magnitude, duration, and/or extent typically occurs, on average. Statistically, a hazard with a 100-year recurrence interval is expected to occur once every 100 years on average, and would have a 1-percent chance of happening in any given year. The reliability of this information varies depending on the kind of hazard being considered.

Fujita Scale of Tornado Intensity – Rates tornadoes with numeric values from F0 to F5 based on tornado wind speed and damage sustained. An F0 (wind speed less than 73 mph) indicates minimal damage such as broken tree limbs or signs, while an F5 (wind speeds of 261 to 318 mpg) indicated severe damage sustained.

Geology – The scientific study of the earth, including its composition, structure, physical properties, and history.

Goals – General guidelines that explain what you want to achieve. They are usually broad policy-type statements, long term in nature, and represent global visions.

Geographic Information Systems (GIS) – A computer software application that relates data regarding physical and other features on the earth to a database to be used for mapping and analysis.

GIS Shape Files – A type of GIS vector file developed by ESRI for their ArcView software. This type of file contains a table and a graphic. The records in the table are linked to corresponding objects in the graphic.

Ground Failure – Ground failure is the term used to describe zones of ground cracking, fissuring, and localized horizontal and vertical permanent ground displacement that may be caused by surface rupture along faults; secondary movement on shallow faults; shaking-induced compaction of natural deposits in sedimentary basins and river valleys; liquefaction of loose, sandy sediment; landslides; and land subsidence and sinkholes.

Hailstorm – Storm associated with spherical balls of ice. Hail is a product of thunderstorms or intense showers. It is generally white and translucent, consisting of liquid or snow particles encased with layers of ice. Hail is formed within the higher reaches of a well-developed thunderstorm. When hailstones become too heavy to be caught in an updraft back into the clouds of the thunderstorm (hailstones can be caught in numerous updrafts adding a coating of ice to the original frozen droplet of rain each time), they fall as hail and a hailstorm ensues.

Hazard – A source of potential danger or an adverse condition that can cause harm to people or cause property damage. For this risk assessment, priority hazards were identified and selected for the pilot project effort. A natural hazard is a hazard that occurs naturally (such as flood, wind, and earthquake). A man-made hazard is one that is caused by humans (for example, a terrorist act or a hazardous material spill). Hazards are of concern if they have the potential to harm people or property.

Hazards of Interest – A comprehensive listing of hazards that may affect an area.

Hazards of Concern – Those hazards that have been analytically determined to pose significant risk in an area, and thus the focus of the particular mitigation plan for that area (a subset of the Hazards of Interest).

Hazard Identification – The process of identifying hazards that threaten an area.

Hazardous Material Facilities – Facilities housing industrial and hazardous materials, such as corrosives, explosives, flammable materials, radioactive materials, and toxins.

Hazard Mitigation – Sustained actions taken to reduce or eliminate the long-term risk and effects that can result from the occurrence of a specific hazard. For example, building a retaining wall can protect an area from flooding.

Hazard Mitigation Grant Program (HMGP) – Authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster.

Hazard Mitigation Plan – A collaborative document in which hazards affecting the community are identified, vulnerability to hazards assessed, and consensus reached on how to minimize or eliminate the effects of these hazards.

Hazard Profile – A description of the physical characteristics of a hazard, including a determination of various descriptors including magnitude, duration, frequency, probability, and extent. In most cases, a community can most easily use these descriptors when they are recorded and displayed as maps.

Hazard Risk Gauge – The graphic icon used during the initial planning process to convey the relative risk of a given hazard in the study area. The scale ranges from green indicating relatively low or no risk to red indicating severe risk.

Hazards U.S. (HAZUS) – A GIS-based nationally standardized earthquake loss estimation tool developed by FEMA. HAZUS was replaced by HAZUS-MH (see below) in 2003.

Hazards U.S. – Multi-Hazard (HAZUS-MH) – A GIS-based nationally standardized earthquake, flood, and wind loss estimation tool developed by FEMA. The purpose of this pilot project is to demonstrate and implement the use of HAZUS-MH to support risk assessments

HAZUS-MH Risk Assessment Methodology – This analysis uses the HAZUS-MH modules (earthquake, wind--hurricane and flood) to analyze potential damages and losses. For this pilot project risk assessment, the flood and hurricane hazards were evaluated using this methodology.

HAZUS-MH-Driven Risk Assessment Methodology – This analysis involves using inventory data in HAZUS-MH combined with knowledge such as (1) information about potentially exposed areas, (2) expected impacts, and (3) data regarding likelihood of occurrence for hazards. For this risk assessment, a HAZUS-Driven Risk Assessment Methodology could not be used to estimate losses associated with any hazards because of a lack of adequate data. However, the methodology was used, based on more limited data to estimate exposure for the dam failure, urban fire, fuel pipeline breach, and HazMat release hazards.

Heavy Snow – Snowfall accumulating to 4” or more in depth in 12 hours or less; or snowfall accumulating to 6” or more in depth in 24 hours or less.

High Potential Loss Facilities – Facilities that would have a high loss associated with them, such as nuclear power plants, dams, and military installations.

Hurricane – An intense tropical cyclone, formed in the atmosphere over warm ocean areas, in which wind speeds reach 74 miles-per-hour or more and blow in a large spiral around a relatively calm center or "eye." Hurricanes develop over the North Atlantic Ocean, northeast Pacific Ocean, or the South Pacific Ocean (east of 160°E longitude). Hurricane circulation is counter-clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere.

Hydraulics – That branch of science, or of engineering, which addresses fluids (especially, water) in motion, its action in rivers and canals, the works and machinery for conducting or raising it, its use as a prime mover, and other fluid-related areas.

Hydrology – The science of dealing with the waters of the earth (for example, a flood discharge estimate is developed through conduct of a hydrologic study).

Infrastructure – The public services of a community that have a direct impact on the quality of life. Infrastructure includes communication technology such as phone lines or Internet access, vital services such as public water supplies and sewer treatment facilities, transportation system (such as airports, heliports; highways, bridges, tunnels, roadbeds, overpasses, railways, bridges, rail yards, depots; and waterways, canals, locks, seaports, ferries, harbors, dry docks, piers and regional dams).

Ice Jam – An accumulation of ice in a river that acts as a natural dam and can flood low-lying areas upstream. They occur when warm temperatures and heavy rains cause rapid snow melt.

Ice Storm – Term used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication.

Intensity – A measure of the effects of a hazard occurring at a particular place.

Inventory – The assets identified in a study region. It includes assets that can be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

Land Subsidence - Land subsidence can be defined as the sudden sinking or gradual downward settling of the earth's surface with little or no horizontal motion, owing to the subsurface movement of earth materials.

Level 1 Analysis – A HAZUS-MH analysis that yields a rough estimate or preliminary analysis based on the nationwide default database included in HAZUS-MH. A Level 1 analysis is a great way to begin the risk assessment process and prioritize high-risk communities without collecting or using local data.

Level 2 Analysis – A HAZUS-MH analysis that requires the input of additional or refined data and hazard maps that will produce more accurate risk and loss estimates. Assistance from local emergency management personnel, city planners, GIS professionals, and others may be necessary for this level of analysis.

Level 3 Analysis – A HAZUS-MH analysis that yields the most accurate estimate of loss and typically requires the involvement of technical experts such as structural and geotechnical engineers who can modify loss parameters based on the specific conditions of a community. This level analysis will allow users to supply their own techniques to study special conditions such as dam breaks and tsunamis. Engineering and other expertise is needed at this level.

Lifelines – Critical facilities that include utility systems (potable water, wastewater, oil, natural gas, electric power facilities and communication systems) and transportation systems (airways, bridges, roads, tunnels and waterways).

Lightning – A visible electrical discharge produced by a thunderstorm. The discharge may occur within or between clouds or between a rain cloud and the ground.

Loss Estimation – The process of assigning hazard-related damage and loss estimates to inventory, infrastructure, lifelines, and population data. HAZUS-MH can estimate the economic and social loss for specific hazard occurrences. Loss estimation is essential to decision making at all levels of government and provides a basis for developing mitigation plans and policies. It also supports planning for emergency preparedness, response, and recovery.

Lowest Floor – Under the NFIP, the lowest floor of the lowest enclosed area (including basement) of a structure. For the HAZUS-MH flood model, this information can be used to assist in assessing the damage to buildings.

Magnitude – A measure of the strength of a hazard occurrence. The magnitude (also referred to as severity) of a given hazard occurrence is usually determined using technical measures specific to the hazard. For example, ranges of wind speeds are used to categorize tornados.

Major Disaster Declarations – Post-disaster status requested by a state’s governor when local and state resources are not sufficient to meet disaster needs. It is based on the damage assessment, and an agreement to commit state funds and resources to the long-term recovery. The event must be clearly more than the state or local government can handle alone.

Mean Return Period (MRP) – The average period of time, in years, between occurrences of a particular hazard (equal to the inverse of the annual frequency of exceedance).

Mitigation Actions – Specific actions that help you achieve your goals and objectives.

Mitigation Goals – General guidelines that explain what you want to achieve. They are usually broad policy-type statements, long term, and represent global visions.

Mitigation Objectives – Strategies or implementation steps to attain the identified goals. Unlike goals, objectives are specific and measurable.

Mitigation Plan – A plan that documents the process used for a systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards typically present in a state or community. The plan includes a description of actions to minimize future vulnerability to hazards. This plan should be developed with local experts and significant community involvement.

National Flood Insurance Program (NFIP) – Federal program created by Congress in 1968 that makes flood insurance available in communities that enact minimum floodplain management regulations in 44 Code of Federal Regulations (CFR) §60.3.

Nor’Easter – Named for the strong northeasterly winds blowing in ahead of the storm, are also referred to as a type of extra-tropical cyclones (mid-latitude storms, or Great Lake storms). A Nor’Easter is a macro-scale extra-tropical storm whose winds come from the northeast, especially in the coastal areas of the Northeastern U.S. and Atlantic Canada.

Objectives – Objectives define strategies or implementation steps to attain the identified goals. Unlike goals, objectives are specific and measurable.

Occupancy Classes – Categories of buildings used by HAZUS-MH (for example, commercial, residential, industrial, government, and “other”).

Ordinance – A term for a law or regulation adopted by local government.

Outflow – Associated with coastal hazards and follows water inundation creating strong currents that rip at structures and pound them with debris, and erode beaches and coastal structures.

Palmer Drought Severity Index (PDSI) - PDSI provides soil moisture information for evaluating the scope, severity, and frequency of prolonged periods of abnormally dry or wet weather. The tool is

frequently used to indicate the availability of irrigation water supplies, reservoir levels, range conditions, amount of stock water, and forest fire potential. The PDSI is a notably ineffective tool for short-term drought monitoring forecasts; however it is the most effective for determining long-term droughts, and as such is most frequently used to delineate disaster areas.

Parametric Model – A model relating to or including the evaluation of parameters. For example, HAZUS-MH uses parametric models that address different parameters for hazards such as earthquake, flood and wind (hurricane). For example, parameters considered for the earthquake hazard include soil type, peak ground acceleration, building construction type and other parameters.

Planimetric – Maps that indicate only man-made features like buildings.

Planning – The act or process of making or carrying out plans; the establishment of goals, policies and procedures for a social or economic unit.

Post-disaster mitigation – Mitigation actions taken after a disaster has occurred, usually during recovery and reconstruction.

Presidential Disaster Declaration – A post-disaster status that puts into motion long-term federal recovery programs, some of which are matched by state programs, and designed to help disaster victims, businesses, and public entities in the areas of human services, public assistance (infrastructure support), and hazard mitigation. If declared, funding comes from the President’s Disaster Relief Fund and disaster aid programs of other participating federal agencies.

Preparedness – Actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Priority Hazards – Hazards considered most likely to impact a community based on frequency, severity, or other factors such as public perception. These are identified using available data and local knowledge.

Provided Data – The databases included in the HAZUS-MH software that allow users to run a preliminary analysis without collecting or using local data.

Probability – A statistical measure of the likelihood that a hazard event will occur.

Public Education and Outreach Programs – Any campaign to make the public more aware of hazard mitigation and mitigation programs, including hazard information centers, mailings, public meetings, etc.

Q3 Flood Zone Data – FEMA flood data that delineate the 100- and 500-year flood boundaries. The Q3 Flood Data are digital representations of certain features of FEMA’s Flood Insurance Rate Map (FIRM) product, intended for use with desktop mapping and GIS technology.

Radon - Radon is a cancer-causing natural radioactive gas that one cannot 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.

Recovery – The actions taken by an individual or community after a catastrophic event to restore order and lifelines in the community.

Regulation – Most states have granted local jurisdictions broad regulatory powers to enable the enactment and enforcement of ordinances that deal with public health, safety, and welfare. These include

building codes, building inspections, zoning, floodplain and subdivision ordinances, and growth management initiatives.

Recurrence Interval – The average time between the occurrences of hazardous events of similar size in a given location. This interval is based on the probability that the given event will be equaled or exceeded in any given year.

Repetitive Loss Property – A property that is currently insured for which two or more National Flood Insurance Program losses (occurring more than ten days apart) of at least \$1,000 each have been paid within any 10-year period since 1978.

Replacement Value – The cost of rebuilding a structure. This cost is usually expressed in terms of cost per square foot and reflects the present-day cost of labor and materials to construct a building of a particular size, type and quality.

Resolutions – Expressions of a governing body’s opinion, will, or intention that can be executive or administrative in nature. Most planning documents must undergo a council resolution, which must be supported in an official vote by a majority of representatives to be adopted. Other methods of making a statement or announcement about a particular issue or topic include proclamations or declarations.

Resources – Resources include the people, materials, technologies, money, etc., required to implement strategies or processes. The costs of these resources are often included in a budget.

Risk – The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate or low likelihood of sustaining damage above a particular threshold due to occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment – A methodology used to assess potential exposure and estimated losses associated with priority hazards. The risk assessment process includes four steps: (1) identifying hazards, (2) profiling hazards, (3) conducting an inventory of assets, and (4) estimating losses. This pilot project report documents this process for selected hazards addressed as part of the pilot project.

Risk Factors – Characteristics of a hazard that contribute to the severity of potential losses in the study area.

Riverine – Of or produced by a river (for example, a riverine flood is one that is caused by a river overflowing its banks).

Saffir-Simpson Scale – This scale categorizes or rates hurricanes from 1 (Minimal) to 5 (Catastrophic) based on their intensity. It is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the shape of the coastline, in the landfill region.

Scale – A proportion used in determining a dimensional relationship; the ratio of the distance between two points on a map and the actual distance between the two points on the earth’s surface.

Scour – Removal of soil or fill material by the flow of floodwaters. This term is frequently used to describe storm-induced, localized, conical erosion around pilings and other foundation supports where the obstruction of flow increases turbulence.

Sinkholes – Sinkholes are a natural and common geologic feature in areas with underlying limestone, carbonate rock, salt beds, or other rocks that are soluble in water. Over periods of time measured in thousands of years, the carbonate bedrock can be dissolved through acidic rain water moving in fractures or cracks in the bedrock. This creates larger openings in the rock through which water and overlying soil materials will travel. Over time, the deposited soils compromise the strength of the bedrock, until it is unable to support the land surface above, and a collapse or sinkhole occurs.

Special Flood Hazard Area (SFHA) – An area within a floodplain having a 1-percent or greater chance of flood occurrence in any given year (that is, the 100-year or base flood zone); represented on FIRMS as darkly shaded areas with zone designations that include the letter “A” or “V.”

Stafford Act – The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law (PL) 100-107 was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, PL 93-288. The Stafford Act is the statutory authority for most Federal disaster response activities, especially as they pertain to FEMA and its programs.

Stakeholder – Stakeholders are individuals or groups, including businesses, private organizations, and citizens, that will be affected in any way by an action or policy.

State Hazard Mitigation Officer (SHMO) – The representative of state government who is the primary point of contact with FEMA, other state and Federal agencies, and local units of government in the planning and implementation of pre- and post-disaster mitigation activities.

Structure – Something constructed (for example, a residential or commercial building).

Structural Collapse - A structural collapse is defined by the Occupational Health and Safety Administration (OSHA) as the point when load bearing structural elements fail. Structural collapse severity can range from the single failure a load-bearing element within or on a structure, weakening it, through to the failure of all load-bearing elements within a structure bringing about the complete collapse of the structure.

Study Area – The geographic unit for which data are collected and analyzed. A study area can be any combination of states, counties, cities, census tracts, or census blocks. The study area definition depends on the purpose of the loss study and in many cases will follow political boundaries or jurisdictions such as city limits.

Substantial Damage – Damage of any origin sustained by a structure in a SFHA, for which the cost of restoring the structure to its pre-hazard event condition would equal or exceed 50 percent of its pre-hazard event market value.

Terrorism - 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). Terrorism is less about causing physical damage and injuries/fatalities as it is creating fear in the population. This fear may result in a key policy being changed or business operations (e.g., logging) to cease. Terrorism may include the use of weapons of mass destruction (WMD), including chemical, biological, radiological, nuclear, and high-yield explosive weapons; armed attacks; industrial sabotage; cyberterrorism; and other means.

Thunderstorm – A local storm produced by a cumulonimbus cloud and accompanied by lightning and thunder. It forms from a combination of moisture, rapidly rising warm air and a force capable of lifting air

such a warm and cold front, a sea breeze, or a mountain.

Topographic – Map that shows natural features and indicate the physical shape of the land using contour lines based on land elevation. These maps also can include man-made features (such as buildings and roads).

Tornado – A violently rotating column of air extending from a thunderstorm to the ground.

Transportation Systems – One of the lifeline system categories. This category includes: airways (airports, heliports, highways), bridges, tunnels, roadbeds, overpasses, transfer centers; railways (tracks, tunnels, bridges, rail yards, depots), and waterways (canals, locks, seaports, ferries, harbors, dry docks, piers).

Tropical Cyclone – A generic term for a cyclonic, low-pressure system over tropical or sub-tropical waters containing a warm core of low barometric pressure which typically produces heavy rainfall, powerful winds and storm surge.

Tropical Depression – An organized system of clouds and thunderstorms with a defined surface circulation and maximum sustained winds of less than 38 mph. It has no “eye”(the calm area in the center of the storm) and does not typically have the organization or the spiral shape of more powerful storms.

Tropical Storm – An organized system of strong thunderstorms with a defined surface circulation and maximum sustained wind between 39 to 73 mph.

Urban-Wildland Interface Fire – An urban-wildland interface fire is a wildfire in a geographical area where structures and other human development meet or intermingle with wildland or vegetative fuels.

Utility Systems – One of the lifeline systems categories. This category includes potable water, wastewater, oil, natural gas, electric power facilities and communication systems.

Vulnerability – Description of how exposed or susceptible an asset is to damage. This value depends on an asset’s construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. If an electric substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Often, indirect affects can be much more widespread and damaging than direct affects.

Vulnerability Assessment – Evaluation of the extent of injury and damage that may result from a hazard event of a given intensity in a given area. The vulnerability assessment should address impacts of hazard occurrences on the existing and future built environment.

Watershed – Area of land that drains down gradient (from areas of higher land to areas of lower land) to the lowest point; a common drainage basin. The water moves through a network of drainage pathways, both underground and on the surface. Generally, these pathways converge into streams and rivers, which become progressively larger as the water moves downstream, eventually reaching an estuary, lake, or ocean.

Wildfire – An uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures.

Wildland Fire - A wildland fire is a wildfire in an area in which development is essentially nonexistent, except for roads, railroads, power lines, and similar facilities.

Wildland Fire Assessment (WFAS) - The WFAS is an internet-based information system maintained at the National Interagency Fire Center (NIFC) in Boise, Idaho that provides a national view of weather and fire potential, including national fires danger, weather maps and satellite-derived “Greenness” maps. Each day during the fire season, national maps of selected fire weather and fire danger components of the National Fire Danger Rating System (NFDRS) are produced by the WFAS.

Wildland/Urban Interface (WUI) - WUI is the area where houses and wildland vegetation coincide. The WUI is divided into two categories: intermix and interface. Intermix WUI are areas where housing and vegetation ‘intermingle’. Intermix areas have more than one house per 40 acres and have more than 50-percent vegetation. Interface WUI are areas with housing in the vicinity of contiguous wildland vegetation. Interface areas have more than one house per 40 acres, have less than 50-percent vegetation, and are within 1.5 miles of an area over 1,235 acres that is more than 75-percent vegetated.

Wind Chill Index (WCI) – The temperature your body feels when the air temperature is combined with the wind speed. It is based on the rate of heat loss from exposed skin caused by the effects of wind and cold.

Zone – A geographical area shown on a National FIRM that reflects the severity or type of flooding in the area.

Zoning Ordinance – Designation of allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.

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LOCAL MITIGATION PLAN REVIEW TOOL

The *Local Mitigation Plan Review Tool* demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to the community.

- The Regulation Checklist provides a summary of FEMA’s evaluation of whether the Plan has addressed all requirements.
- The Plan Assessment identifies the plan’s strengths as well as documents areas for future improvement.
- The Multi-jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of the each Element of the Plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference this *Local Mitigation Plan Review Guide* when completing the *Local Mitigation Plan Review Tool*.

Jurisdiction:	Title of Plan:	Date of Plan:
Local Point of Contact:		Address:
Title:		
Agency:		
Phone Number:		
		E-Mail:

State Reviewer:	Title:	Date:
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FEMA Reviewer:	Title:	Date:
Date Received in FEMA Region (insert #)		
Plan Not Approved		
Plan Approvable Pending Adoption		
Plan Approved		

**SECTION 1:
REGULATION CHECKLIST**

INSTRUCTIONS: The Regulation Checklist must be completed by FEMA. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been ‘Met’ or ‘Not Met.’ The ‘Required Revisions’ summary at the bottom of each Element must be completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is ‘Not Met.’ Sub-elements should be referenced in each summary by using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each Element and sub-element are described in detail in this *Plan Review Guide* in Section 4, Regulation Checklist.

1. REGULATION CHECKLIST		Location in Plan (section and/or page number)	Met	Not Met
Regulation (44 CFR 201.6 Local Mitigation Plans)				
ELEMENT A. PLANNING PROCESS				
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Section 3; Appendices C and D			
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	Section 3.4; Appendix E			
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Section 3.5; Appendix E			
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Sections 3.6, 4.1 and 4.3; Appendix A (References)			
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Section 7.3			
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Section 7			
ELEMENT A: REQUIRED REVISIONS				

1. REGULATION CHECKLIST		Location in Plan (section and/or page number)	Met	Not Met
Regulation (44 CFR 201.6 Local Mitigation Plans)				
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT				
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Section 4; Section 9 (Jurisdictional Annexes) – Subsections F2 and I			
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	Section 4.3 (Hazard Profiles); Section 9 (Jurisdictional Annexes) – Subsection C			
B3. Is there a description of each identified hazard’s impact on the community as well as an overall summary of the community’s vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	Section 4.3 (Hazard Profiles); Section 9 (Jurisdictional Annexes) – Subsections C, D, F.2			
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	Section 4.3.4 (Flood Hazard Profile); Section 9 (Jurisdictional Annexes) – Subsections F.2 and F.3			
<u>ELEMENT B: REQUIRED REVISIONS</u>				
ELEMENT C. MITIGATION STRATEGY				
C1. Does the plan document each jurisdiction’s existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	Section 5; Section 7.2; Section 9 (Jurisdictional Annexes) – Subsections E.1 to E.4			
C2. Does the Plan address each jurisdiction’s participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Section 4.3.4 (Flood Hazard Profile); Section 9 (Jurisdictional Annexes) – Subsections E.1, E.2, E.4, F.2, F.3			
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Section 6.1			

1. REGULATION CHECKLIST		Location in Plan (section and/or page number)	Met	Not Met
Regulation (44 CFR 201.6 Local Mitigation Plans)				
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	Sections 6.2 and 6.3; Section 9 (Jurisdictional Annexes) – Subsection F.3			
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Section 6.4; Section 9 (Jurisdictional Annexes) – Subsection G			
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	Section 5; Section 7.2; Section 9 (Jurisdictional Annexes) – Subsection F.3			
<u>ELEMENT C: REQUIRED REVISIONS</u>				
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)				
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Section 2 (pg. 2-17 to 2-21); Section 9 (Jurisdictional Annexes) – Subsections B.1 and F.3			
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Sections 6.2 and 6.3; Section 9 (Jurisdictional Annexes) – Subsection F.1			
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Section 6.4; Section 9 (Jurisdictional Annexes) – Subsections F.3 and G			
<u>ELEMENT D: REQUIRED REVISIONS</u>				
ELEMENT E. PLAN ADOPTION				
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	Section 7			
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	Section 7			

1. REGULATION CHECKLIST		Location in Plan (section and/or page number)	Met	Not Met
Regulation (44 CFR 201.6 Local Mitigation Plans)				
<u>ELEMENT E: REQUIRED REVISIONS</u>				
ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)				
F1.				
F2.				
<u>ELEMENT F: REQUIRED REVISIONS</u>				

SECTION 2: PLAN ASSESSMENT

INSTRUCTIONS: The purpose of the Plan Assessment is to offer the local community more comprehensive feedback to the community on the quality and utility of the plan in a narrative format. The audience for the Plan Assessment is not only the plan developer/local community planner, but also elected officials, local departments and agencies, and others involved in implementing the Local Mitigation Plan. The Plan Assessment must be completed by FEMA. The Assessment is an opportunity for FEMA to provide feedback and information to the community on: 1) suggested improvements to the Plan; 2) specific sections in the Plan where the community has gone above and beyond minimum requirements; 3) recommendations for plan implementation; and 4) ongoing partnership(s) and information on other FEMA programs, specifically RiskMAP and Hazard Mitigation Assistance programs. The Plan Assessment is divided into two sections:

1. Plan Strengths and Opportunities for Improvement
2. Resources for Implementing Your Approved Plan

Plan Strengths and Opportunities for Improvement is organized according to the plan Elements listed in the Regulation Checklist. Each Element includes a series of italicized bulleted items that are suggested topics for consideration while evaluating plans, but it is not intended to be a comprehensive list. FEMA Mitigation Planners are not required to answer each bullet item, and should use them as a guide to paraphrase their own written assessment (2-3 sentences) of each Element.

The Plan Assessment must not reiterate the required revisions from the Regulation Checklist or be regulatory in nature, and should be open-ended and to provide the community with suggestions for improvements or recommended revisions. The recommended revisions are suggestions for improvement and are not required to be made for the Plan to meet Federal regulatory requirements. The italicized text should be deleted once FEMA has added comments regarding strengths of the plan and potential improvements for future plan revisions. It is recommended that the Plan Assessment be a short synopsis of the overall strengths and weaknesses of the Plan (no longer than two pages), rather than a complete recap section by section.

Resources for Implementing Your Approved Plan provides a place for FEMA to offer information, data sources and general suggestions on the overall plan implementation and maintenance process. Information on other possible sources of assistance including, but not limited to, existing publications, grant funding or training opportunities, can be provided. States may add state and local resources, if available.

A. Plan Strengths and Opportunities for Improvement

This section provides a discussion of the strengths of the plan document and identifies areas where these could be improved beyond minimum requirements.

Element A: Planning Process

How does the Plan go above and beyond minimum requirements to document the planning process with respect to:

- *Involvement of stakeholders (elected officials/decision makers, plan implementers, business owners, academic institutions, utility companies, water/sanitation districts, etc.);*
- *Involvement of Planning, Emergency Management, Public Works Departments or other planning agencies (i.e., regional planning councils);*
- *Diverse methods of participation (meetings, surveys, online, etc.); and*
- *Reflective of an open and inclusive public involvement process.*

Element B: Hazard Identification and Risk Assessment

In addition to the requirements listed in the Regulation Checklist, 44 CFR 201.6 Local Mitigation Plans identifies additional elements that should be included as part of a plan's risk assessment. The plan should describe vulnerability in terms of:

- 1) *A general description of land uses and future development trends within the community so that mitigation options can be considered in future land use decisions;*
- 2) *The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas; and*
- 3) *A description of potential dollar losses to vulnerable structures, and a description of the methodology used to prepare the estimate.*

How does the Plan go above and beyond minimum requirements to document the Hazard Identification and Risk Assessment with respect to:

- *Use of best available data (flood maps, HAZUS, flood studies) to describe significant hazards;*
- *Communication of risk on people, property, and infrastructure to the public (through tables, charts, maps, photos, etc.);*
- *Incorporation of techniques and methodologies to estimate dollar losses to vulnerable structures;*
- *Incorporation of Risk MAP products (i.e., depth grids, Flood Risk Report, Changes Since Last FIRM, Areas of Mitigation Interest, etc.); and*
- *Identification of any data gaps that can be filled as new data became available.*

Element C: Mitigation Strategy

How does the Plan go above and beyond minimum requirements to document the Mitigation Strategy with respect to:

- *Key problems identified in, and linkages to, the vulnerability assessment;*
- *Serving as a blueprint for reducing potential losses identified in the Hazard Identification and Risk Assessment;*
- *Plan content flow from the risk assessment (problem identification) to goal setting to mitigation action development;*
- *An understanding of mitigation principles (diversity of actions that include structural projects, preventative measures, outreach activities, property protection measures, post-disaster actions, etc);*
- *Specific mitigation actions for each participating jurisdictions that reflects their unique risks and capabilities;*
- *Integration of mitigation actions with existing local authorities, policies, programs, and resources; and*
- *Discussion of existing programs (including the NFIP), plans, and policies that could be used to implement mitigation, as well as document past projects.*

Element D: Plan Update, Evaluation, and Implementation (Plan Updates Only)

How does the Plan go above and beyond minimum requirements to document the 5-year Evaluation and Implementation measures with respect to:

- *Status of previously recommended mitigation actions;*
- *Identification of barriers or obstacles to successful implementation or completion of mitigation actions, along with possible solutions for overcoming risk;*
- *Documentation of annual reviews and committee involvement;*
- *Identification of a lead person to take ownership of, and champion the Plan;*
- *Reducing risks from natural hazards and serving as a guide for decisions makers as they commit resources to reducing the effects of natural hazards;*
- *An approach to evaluating future conditions (i.e. socio-economic, environmental, demographic, change in built environment etc.);*
- *Discussion of how changing conditions and opportunities could impact community resilience in the long term; and*
- *Discussion of how the mitigation goals and actions support the long-term community vision for increased resilience.*

B. Resources for Implementing Your Approved Plan

Ideas may be offered on moving the mitigation plan forward and continuing the relationship with key mitigation stakeholders such as the following:

- *What FEMA assistance (funding) programs are available (for example, Hazard Mitigation Assistance (HMA)) to the jurisdiction(s) to assist with implementing the mitigation actions?*
- *What other Federal programs (National Flood Insurance Program (NFIP), Community Rating System (CRS), Risk MAP, etc.) may provide assistance for mitigation activities?*
- *What publications, technical guidance or other resources are available to the jurisdiction(s) relevant to the identified mitigation actions?*
- *Are there upcoming trainings/workshops (Benefit-Cost Analysis (BCA), HMA, etc.) to assist the jurisdictions(s)?*
- *What mitigation actions can be funded by other Federal agencies (for example, U.S. Forest Service, National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA) Smart Growth, Housing and Urban Development (HUD) Sustainable Communities, etc.) and/or state and local agencies?*

**SECTION 3:
MULTI-JURISDICTION SUMMARY SHEET (OPTIONAL)**

INSTRUCTIONS: For multi-jurisdictional plans, a Multi-jurisdiction Summary Spreadsheet may be completed by listing each participating jurisdiction, which required Elements for each jurisdiction were ‘Met’ or ‘Not Met,’ and when the adoption resolutions were received. This Summary Sheet does not imply that a mini-plan be developed for each jurisdiction; it should be used as an optional worksheet to ensure that each jurisdiction participating in the Plan has been documented and has met the requirements for those Elements (A through E).

MULTI-JURISDICTION SUMMARY SHEET												
#	Jurisdiction Name	Jurisdiction Type (city/borough/ township/ village, etc.)	Plan POC	Mailing Address	Email	Phone	Requirements Met (Y/N)					
							A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Requirements
1												
2												
3												
4												
5												
6												
7												
8												
9												

MULTI-JURISDICTION SUMMARY SHEET

#	Jurisdiction Name	Jurisdiction Type (city/borough/ township/ village, etc.)	Plan POC	Mailing Address	Email	Phone	Requirements Met (Y/N)					
							A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Requirements
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												

APPENDIX F: SAMPLE RESOLUTION OF PLAN ADOPTION

This appendix includes an example resolution as provided in the Pennsylvania's All-Hazard Mitigation Planning – Standard Operating Guide (Appendix 15), to be submitted by each participating jurisdiction authorizing adoption of the Lehigh Valley Hazard Mitigation Plan Update.



<County Name> <Year> Hazard Mitigation Plan
Municipal Adoption Resolution

Resolution No. _____

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

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

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

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

WHEREAS, the <County Name> <Year> Hazard Mitigation Plan has been developed by the <Name of County Department> and the <Name of County Department> in cooperation with other county departments, and officials and citizens of <Borough/Township of Municipality Name>, and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the <County Name> <Year> Hazard Mitigation Plan, and

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

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

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

ADOPTED, this _____ day of _____, <Year>

ATTEST:

<MUNICIPALITY>

By _____

By _____

By _____

This appendix includes the loss estimation results for the HAZUS-MH Earthquake critical facility vulnerability assessment modeling, as follows:

- Table G-1 Estimated Damage and Loss of Functionality for Critical Facilities in the Lehigh Valley for the 500-Year MRP Earthquake Event
- Table G-2 Estimated Damage and Loss of Functionality for Critical Facilities in the Lehigh Valley for the 2,500-Year MRP Earthquake Event
- Table G-3. Estimated Utility Impacts in the Lehigh Valley from the 500-year MRP Earthquake Event
- Table G-4. Estimated Utility Impacts in the Lehigh Valley from the 2,500-year MRP Earthquake Event

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Table G-1. Estimated Damage and Loss of Functionality for Critical Facilities in the Lehigh Valley for the 500-Year MRP Earthquake Event

Name	Municipality	Type	500-Year								
			Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Lehigh County											
ALBURTIS FIRE CO	Alburtis (B)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
ALBURTIS ELEMENTARY SCHOOL	Alburtis (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Allentown Fire Department	Allentown (C)	Fire	88.8	7.3	3.2	0.5	0.1	88.8	96.0	96.1	99.3
St. Luke's Hospital Allentown	Allentown (C)	Medical	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Lehigh Valley Hospital - 17th & Chew	Allentown (C)	Medical	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Sacred Heart Hospital	Allentown (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
OCASIO RAYMOND S & BERTHA L	Allentown (C)	Daycare	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
WESCOSVILLE FIRE COMPANY	Allentown (C)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
WESTERN SALISBURY FIRE CO	Allentown (C)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
CETRONIA FIRE COMPANY	Allentown (C)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
WOODLAWN FIRE CO #1	Allentown (C)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
COMM FIRE CO #1 S WH TWP	Allentown (C)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
WOODLAWN FIRE CO #1	Allentown (C)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
W SALISBURY VOL FIRE CO#3	Allentown (C)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
CITY OF ALLENTOWN	Allentown (C)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
CITY OF ALLENTOWN	Allentown (C)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
CITY OF ALLENTOWN	Allentown (C)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
CITY OF ALLENTOWN	Allentown (C)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
CITY OF ALLENTOWN	Allentown (C)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
CITY OF ALLENTOWN	Allentown (C)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
SALISBURY TWP	Allentown (C)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
SALISBURY TWP SCHOOL AUTH	Allentown (C)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
SALISBURY FIRE CO #1	Allentown (C)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
HANOVER TOWNSHIP	Allentown (C)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
LEHIGH COUNTY HUMANE SOC	Allentown (C)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
CITY OF ALLENTOWN	Allentown (C)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
CITY OF ALLENTOWN	Allentown (C)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
CITY OF ALLENTOWN	Allentown (C)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
COMMONWEALTH OF PA	Allentown (C)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
COMMONWEALTH OF PA	Allentown (C)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
CITY OF ALLENTOWN	Allentown (C)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
COMMONWEALTH OF PA	Allentown (C)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
COMMONWEALTH OF PA	Allentown (C)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
COMMONWEALTH OF PA	Allentown (C)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			UNION TERRACE ELEMENTARY SCHOOL	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1
WILLIAM ALLEN HIGH SCHOOL	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
ST CATHERINE OF SIENA	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
ST CATHERINE OF SIENA	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
RAUB MIDDLE SCHOOL	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
WILLIAM ALLEN HIGH SCHOOL	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
WILLIAM ALLEN HIGH SCHOOL	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
LEHIGH PARKWAY ELEMENTARY SCHOOL	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
LINCOLN ELEMENTARY SCHOOL	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
MUHLENBERG ELEMENTARY SCHOOL	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
JACKSON ELEMENTARY SCHOOL	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
TREXLER MIDDLE SCHOOL	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
ST FRANCIS OF ASSISI	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
MCKINLEY ELEMENTARY SCHOOL	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
CLEVELAND ELEMENTARY SCHOOL	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
WASHINGTON ELEMENTARY SCHOOL	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
CENTRAL ELEMENTARY SCHOOL	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
JEFFERSON ELEMENTARY SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
SOUTH MOUNTAIN MIDDLE SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
ROOSEVELT ELEMENTARY SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
WILSON EARLY CHILDHOOD CENTER	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
WILEY HOUSE	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
ROBERTO CLEMENTE CHARTER SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
ALLENTOWN CENTRAL CATHOLIC HIGH SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
SACRED HEART ELEMENTARY SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
ALLENTOWN CENTRAL CATHOLIC HIGH SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
SHERIDAN ELEMENTARY SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
HOLY SPIRIT SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
HARRISON-MORTON MIDDLE SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
MOSSER ELEMENTARY SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
DIERUFF HIGH SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
RITTER ELEMENTARY SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
LEHIGH VALLEY CHRISTIAN HIGH SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
MIDWAY MANOR EARLY EDUCATION CENTER	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
KINGS WAY ACADEMY	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
THE LUTHERAN ACADEMY	Allentown (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
ST PAULS SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
MERCY DAY SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
OUR LADY HELP OF CHRISTIANS SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
HOLY SPIRIT ELEMENTARY SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
HIRAM DODD ELEMENTARY SCHOOL	Allentown (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
SALISBURY HOUSE OF NORTHEAST PA INC	Allentown (C)	Senior	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
United States Congressman Office	Bethlehem (C)	Federal Buildings	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
CITY OF BETHLEHEM	Bethlehem (C)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
CITY OF BETHLEHEM	Bethlehem (C)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Cantelmi Funeral Home P.C.	Bethlehem (C)	Funeral Homes	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
ARC of the Greater Lehigh Valley	Bethlehem (C)	Healthcare Educational	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
USGS Lehigh River Gauge at Bethlehem, PA	Bethlehem (C)	Lehigh	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Homewood Suites By Hilton	Bethlehem (C)	Lodging (Hotels)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Lehigh Valley Hospital - Muhlenberg	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
CITY OF BETHLEHEM	Bethlehem (C)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
COUNTY OF LEHIGH	Bethlehem (C)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Morning Call	Bethlehem (C)	Print Media	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			Notre Dame of Bethlehem	Bethlehem (C)	Religious (Churches)	98.6	1.3	0.1	0	0	98.5
REGIONAL ACADEMIC STANDARDS ACADEMY	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
CENTENNIAL SCHOOL	Bethlehem (C)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
CLEARVIEW ELEMENTARY SCHOOL	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
JAMES BUCHANAN ELEMENTARY SCHOOL	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
WILEY HOUSE	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
CALYPSO ELEMENTARY SCHOOL	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
NITSCHMANN MIDDLE SCHOOL	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
VITALISTIC THERAPEUTIC SCHOOL	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
CENTRAL CHRISTIAN ACADEMY	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
NOTRE DAME SCHOOL	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
ST SIMON & JUDE SCHOOL	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
CORROCHER JOHN C & ARLANA L	Catasauqua (B)	Daycare	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
SOUTHWARK HOSE CO #9	Catasauqua (B)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
EAST END FIRE CO	Catasauqua (B)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
BORO OF CATASAUQUA	Catasauqua (B)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
ST MARYS CATHOLIC SCHOOL	Catasauqua (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
LINCOLN MIDDLE SCHOOL	Catasauqua (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
CATASAUQUA HIGH SCHOOL	Catasauqua (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
SHECKLER ELEMENTARY SCHOOL	Catasauqua (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
COOPERSBURG FIRE CO	Coopersburg (B)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
U S POSTAL SERVICE	Coopersburg (B)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
LIBERTY BELL ELEMENTARY SCHOOL	Coopersburg (B)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
BORO OF COPLAY	Coplay (B)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
BORO OF EMMAUS	Emmaus (B)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
CITIZENS FIRE CO	Emmaus (B)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
CITIZENS FIRE CO	Emmaus (B)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
BORO OF EMMAUS	Emmaus (B)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
BORO OF EMMAUS	Emmaus (B)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
EMMAUS HIGH SCHOOL	Emmaus (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
EMMAUS HIGH SCHOOL	Emmaus (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			JEFFERSON ELEMENTARY SCHOOL	Emmaus (B)	School	59.1	39.5	1.2	0.1	0	59.1
LINCOLN ELEMENTARY SCHOOL	Emmaus (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
ST ANNES PAROCHIAL SCHOOL	Emmaus (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
FOUNTAIN HILL HOSE CO 1	Fountain Hill (B)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
BORO OF FOUNTAIN HILL	Fountain Hill (B)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
St. Luke's Hospital - Bethlehem	Fountain Hill (B)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
FOUNTAIN HILL ELEMENTARY SCHOOL	Fountain Hill (B)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
HOLY CHILD SCHOOL	Fountain Hill (B)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
HANOVER TOWNSHIP	Hanover (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
GOODWILL FIRE CO	Heidelberg (T)	Fire	60.1	38.6	1.1	0.1	0	60.1	97.8	98.7	99.8
HEIDELBERG TWP	Heidelberg (T)	Municipal	98.7	1.2	0.1	0	0	98.6	99.8	99.8	99.9
COMMONWEALTH OF PA	Heidelberg (T)	Municipal	98.7	1.2	0.1	0	0	98.6	99.8	99.8	99.9
NORTHWESTERN LEHIGH HIGH SCHOOL	Heidelberg (T)	School	60.1	38.6	1.1	0.1	0	60.1	97.8	98.7	99.8
NORTHWESTERN LEHIGH MIDDLE SCHOOL	Heidelberg (T)	School	60.1	38.6	1.1	0.1	0	60.1	97.8	98.7	99.8
RITTER DEAN L & MARYBETH A	Heidelberg (T)	Senior	98.7	1.2	0.1	0	0	98.6	99.8	99.8	99.9
LOWER MACUNGIE TWP	Lower Macungie (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			THE HILLSIDE SCHOOL	Lower Macungie (T)	School	59.1	39.5	1.2	0.1	0	59.1
LOWER MACUNGIE MIDDLE SCHOOL	Lower Macungie (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
LOWER MACUNGIE ELEMENTARY SCHOOL	Lower Macungie (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
WESCOSVILLE ELEMENTARY SCHOOL	Lower Macungie (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
EYER MIDDLE SCHOOL	Lower Macungie (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
SHOEMAKER ELEMENTARY SCHOOL	Lower Macungie (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
MACUNGIE ELEMENTARY SCHOOL	Lower Macungie (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Legacy Oaks at Lehigh Valley	Lower Macungie (T)	Senior	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Traditions at Wild Cherry Knoll	Lower Macungie (T)	Senior	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Four Seasons at Farmington	Lower Macungie (T)	Senior	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
LOWER MILFORD TWP FIRE CO #1	Lower Milford (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
PENNA DEPT OF TRANSPORTATION	Lower Milford (T)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
LOWER MILFORD ELEMENTARY SCHOOL	Lower Milford (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
COMMUNITY FIRE CO OF NEW TRIPOLI	Lynn (T)	Fire	60.1	38.6	1.1	0.1	0	60.1	97.8	98.7	99.8
NEW TRIPOLI FIRE CO	Lynn (T)	Fire	60.1	38.6	1.1	0.1	0	60.1	97.8	98.7	99.8
LYNNPORT COMM FIRE CO #1	Lynn (T)	Fire	60.1	38.6	1.1	0.1	0	60.1	97.8	98.7	99.8
LYNN TOWNSHIP	Lynn (T)	Municipal	98.7	1.2	0.1	0	0	98.6	99.8	99.8	99.9
NORTHWESTERN LEHIGH ELEMENTARY SCHOOL	Lynn (T)	School	60.1	38.6	1.1	0.1	0	60.1	97.8	98.7	99.8
MACUNGIE FIRE CO #1	Macungie (B)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
TRI-CLOVER FIRE CO	North Whitehall (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
TRI-CLOVER FIRE CO	North Whitehall (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			LAURY'S STATION VOLUNTEER FIRE CO #1	North Whitehall (T)	Fire	59.1	39.5	1.2	0.1	0	59.1
NEFFS VOLUNTEER FIRE COMPANY	North Whitehall (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
NORTH WHITEHALL TWP	North Whitehall (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
COUNTY OF LEHIGH	North Whitehall (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
KERNSVILLE ELEMENTARY SCHOOL	North Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
LEHIGH CAREER & TECHNICAL INSTITUTE	North Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
SCHNECKSVILLE ELEMENTARY SCHOOL	North Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
IRONTON ELEMENTARY SCHOOL	North Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
COUNTY OF LEHIGH	Salisbury (T)	County Buildings	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Lehigh Valley Hospital - Cedar Crest	Salisbury (T)	Medical	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
SALISBURY MIDDLE SCHOOL	Salisbury (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
WESTERN SALISBURY ELEMENTARY SCHOOL	Salisbury (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
THE SWAIN SCHOOL	Salisbury (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
SALISBURY HIGH SCHOOL	Salisbury (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
HARRY S TRUMAN ELEMENTARY SCHOOL	Salisbury (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
WILEY HOUSE	Salisbury (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
WILEY HOUSE	Salisbury (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
LEHIGH CHRISTIAN ACADEMY	Salisbury (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
ST THOMAS MORE	Salisbury (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
BORO OF SLATINGTON	Slatington (B)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
BORO OF SLATINGTON	Slatington (B)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
BORO OF SLATINGTON	Slatington (B)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
BORO OF SLATINGTON	Slatington (B)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
SLATINGTON ELEMENTARY SCHOOL	Slatington (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
NORTHERN LEHIGH HIGH SCHOOL	Slatington (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
NORTHERN LEHIGH MIDDLE SCHOOL	Slatington (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			ST JOHN NEUMANN REGIONAL SCHOOL	Slatington (B)	School	59.1	39.5	1.2	0.1	0	59.1
Westfield Hospital	South Whitehall (T)	Medical	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
CITY OF ALLENTOWN	South Whitehall (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
ST JOSEPH THE WORKER ELEMENTARY SCHOOL	South Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
PARKWAY MANOR ELEMENTARY SCHOOL	South Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
SPRINGHOUSE MIDDLE SCHOOL	South Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
OREFIELD MIDDLE SCHOOL	South Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
PARKLAND HIGH SCHOOL	South Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
CETRONIA ELEMENTARY SCHOOL	South Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
KRATZER ELEMENTARY SCHOOL	South Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
JEWISH DAY SCHOOL	South Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
JEWISH DAY SCHOOL	South Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
JEWISH DAY SCHOOL	South Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
ALLENTOWN CHRISTIAN SCHOOL	South Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
DATZYK MONTESSORI SCHOOL	South Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
FOGELSVILLE VOL FIRE CO	Upper Macungie (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
UPPER MACUNGIE TWP	Upper Macungie (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
TREXLERTOWN GOOD WILL FIRE CO #1	Upper Macungie (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
COMMONWEALTH OF PA	Upper Macungie (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
CITY OF ALLENTOWN	Upper Macungie (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
CITY OF ALLENTOWN	Upper Macungie (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
CITY OF ALLENTOWN	Upper Macungie (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
FOGELSVILLE ELEMENTARY SCHOOL	Upper Macungie (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
FRED J JAINDL ELEMENTARY SCHOOL	Upper Macungie (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
UPPER MILFORD WESTERN DIST FIRE CO 1	Upper Milford (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
EMMAUS BAPTIST ACADEMY	Upper Milford (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
SOUTH MOUNTAIN AREA MEDIC V INC	Upper Saucon (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
UPPER SAUCON TWP	Upper Saucon (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
UPPER SAUCON TWP VOLUNTEER FIRE CO 1	Upper Saucon (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
HOPEWELL ELEMENTARY SCHOOL	Upper Saucon (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
SOUTHERN LEHIGH MIDDLE SCHOOL	Upper Saucon (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
SOUTHERN LEHIGH HIGH SCHOOL	Upper Saucon (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
ASSUMPTION BVM SCHOOL	Upper Saucon (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
ST MICHAELS SCHOOL	Upper Saucon (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
FRIEDENS FIRE COMPANY	Washington (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
EMERALD STAR HOSE COMPANY #1	Washington (T)	Fire	60.1	38.6	1.1	0.1	0	60.1	97.8	98.7	99.8
CITIZENS FIRE CO	Washington (T)	Fire	60.1	38.6	1.1	0.1	0	60.1	97.8	98.7	99.8
WASHINGTON TWP	Washington (T)	Municipal	98.7	1.2	0.1	0	0	98.6	99.8	99.8	99.9
WASHINGTON TWP	Washington (T)	Municipal	98.7	1.2	0.1	0	0	98.6	99.8	99.8	99.9
PETERS ELEMENTARY SCHOOL	Washington (T)	School	60.1	38.6	1.1	0.1	0	60.1	97.8	98.7	99.8
WEISENBERG TWP	Weisenberg (T)	Fire	60.1	38.6	1.1	0.1	0	60.1	97.8	98.7	99.8

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
WEISENBERG ELEMENTARY SCHOOL	Weisenberg (T)	School	60.1	38.6	1.1	0.1	0	60.1	97.8	98.7	99.8
EGYPT FIRE CO #1	Whitehall (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
W CATASAUQUA FIRE CO	Whitehall (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
HOKENDAUQUA FIRE CO #1	Whitehall (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
LAUREL FIRE CO #1 INC	Whitehall (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
LAUREL FIRE CO #1	Whitehall (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
FULLERTON FIRE CO #1	Whitehall (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
WHITEHALL TWP	Whitehall (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
LEHIGH VALLEY 7TH DAY ADVENTIST SCHOOL	Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
WHITEHALL-COPLAY HIGH SCHOOL	Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
WHITEHALL-COPLAY MIDDLE SCHOOL	Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
STECKEL ELEMENTARY SCHOOL	Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
GOCKLEY ELEMENTARY SCHOOL	Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
CHRIST THE KING SCHOOL	Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
ST STEPHENS SCHOOL	Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
ST ELIZABETH SCHOOL	Whitehall (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Briarwood Commons	Whitehall (T)	Senior	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Willow Green	Allen (T)	Adult Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Zion's Stone Cemetery	Allen (T)	Cemeteries	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Thrash Family Day Care	Allen (T)	Child Day Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Childhood Dreams Daycare	Allen (T)	Child Day Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
ALLEN TWP FIRE CO	Allen (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Allen Township	Allen (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Lehigh Valley Lutheran School	Allen (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Learning Locomotion	Bangor (B)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
BANGOR FIRE DEPT - LIBERTY	Bangor (B)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
BANGOR FIRE DEPT - RESCUE	Bangor (B)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
BANGOR FIRE DEPT - SECOND WARD	Bangor (B)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
BLUE VALLEY RESCUE	Bangor (B)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Gaffney Funeral Home	Bangor (B)	Funeral Homes	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Fiore Funeral Home	Bangor (B)	Funeral Homes	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
District Court 03-3-03	Bangor (B)	Judicial Buildings (Courthouses)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Bangor Public Library	Bangor (B)	Libraries	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
147 N 11TH ST	Bangor (B)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
129 N 11TH ST	Bangor (B)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
BANGOR DENTAL ASSO.	Bangor (B)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Bangor Borough	Bangor (B)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
BANGOR PD	Bangor (B)	Police	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Pius X High School	Bangor (B)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
United States Post Office	Bangor (B)	USPS Mail Centers (Post Offices)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
ALEXANDRIA MANOR	Bath (B)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Sacred Heart Parish's Cemetery	Bath (B)	Cemeteries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Learn-N-Play Daycare	Bath (B)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Mid-County Senior Center	Bath (B)	Community Organization Facilities	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
BATH BORO FIRE FIGHTERS AMBULANCE	Bath (B)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
BATH BORO FIRE FIGHTERS	Bath (B)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Bartholomew Funeral Home	Bath (B)	Funeral Homes	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Bath Drug	Bath (B)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Bath Borough	Bath (B)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
COLONIAL REGIONAL PD	Bath (B)	Police	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Christ Church United Church of Christ	Bath (B)	Religious (Church)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
George Wolf Elementary School	Bath (B)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Sacred Heart Elementary School	Bath (B)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Saint John's Lutheran Church	Bath (B)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Christ Church United Church of Christ	Bath (B)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
United States Post Office	Bath (B)	USPS Mail Centers (Post Offices)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
111 W 4TH ST	Bethlehem (C)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
L V COMM HEALTH CNTR	Bethlehem (C)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Moravian Village of Bethlehem	Bethlehem (C)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
NURSING HOME	Bethlehem (C)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
KIRKLAND VILLAGE (EASTWOOD)	Bethlehem (C)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
ALEXANDRIA LIVING	Bethlehem (C)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Moravian Village	Bethlehem (C)	Adult Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Northampton County Area Agency on Aging	Bethlehem (C)	Adult Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Salisbury Behavioral Health	Bethlehem (C)	Adult Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Atria Bethlehem	Bethlehem (C)	Adult Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Stabler Arena	Bethlehem (C)	Arenas (Stadiums)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Murray H. Goodman Stadium	Bethlehem (C)	Arenas (Stadiums)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Leeman-Turner Arena at Grace Hall	Bethlehem (C)	Arenas (Stadiums)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Abbe Hall LLC	Bethlehem (C)	Assisted Living	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Bethlehem Manor	Bethlehem (C)	Assisted Living	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Christ Lutheran Church of Lower Saucon	Bethlehem (C)	Cemeteries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Holy Ghost Cemetery	Bethlehem (C)	Cemeteries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Union Cemetery	Bethlehem (C)	Cemeteries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Nisky Hill Cemetery	Bethlehem (C)	Cemeteries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Fairview Cemetery	Bethlehem (C)	Cemeteries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Bethlehem Memorial Park Cemetery	Bethlehem (C)	Cemeteries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Memorial Park Cemetery	Bethlehem (C)	Cemeteries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Holy Saviour Cemetery	Bethlehem (C)	Cemeteries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
St. Thomas UCC Cemetery	Bethlehem (C)	Cemeteries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Lehigh University Child Care	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Millie's Creative Child Care	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Head Start of the LV - St. Peter's	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Lehigh Valley Child Care Campus Center	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Donegan Childcare	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Happy Faces Day Care	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Head Start of the Lehigh Valley - Unita*	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Bethlehem YMCA Child Care	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Head Start of the Lehigh Valley - Salem	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Kindercare Campus	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Thomas Jefferson Child Care	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Lehigh Valley Child Care at Fowler Cent*	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
William Penn Child Care	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Giggles Kid's Club	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Lincoln Child Day Care	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Blake Messman's Daycare	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Stefko Child Care Center	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
First Presbyterian Church	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Gaidula's Family Child Care	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Spring Garden Child Care	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Spark Child Care	Bethlehem (C)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Northampton County - Bechtel Building	Bethlehem (C)	County Buildings	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
United States SS Administration	Bethlehem (C)	Federal Buildings	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
United States Internal Revenue Service	Bethlehem (C)	Federal Buildings	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
John Herron Funeral Home	Bethlehem (C)	Funeral Homes	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Long Funeral Home	Bethlehem (C)	Funeral Homes	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Snyder-Hinkle Lunsford Funeral Home	Bethlehem (C)	Funeral Homes	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Valley Eye Surgical Center	Bethlehem (C)	Health Practitioner (Physician)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
American Heart Association	Bethlehem (C)	Healthcare Educational	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Lehigh Valley Industrial Park Inc.	Bethlehem (C)	Industrial Assets	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
District Court 03-2-10	Bethlehem (C)	Judicial Buildings (Courthouses)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
District Court 03-2-01	Bethlehem (C)	Judicial Buildings (Courthouses)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
District Court 03-2-11	Bethlehem (C)	Judicial Buildings (Courthouses)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
District Court 03-1-04	Bethlehem (C)	Judicial Buildings (Courthouses)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Bethlehem Area Public Library	Bethlehem (C)	Libraries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Bethlehem Area Public Library	Bethlehem (C)	Libraries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Holiday Inn Express Hotel & Suites	Bethlehem (C)	Lodging (Hotels)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Comfort Suites	Bethlehem (C)	Lodging (Hotels)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Hotel Bethlehem	Bethlehem (C)	Lodging (Hotels)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
ST LUKES UNION STATION	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
ST LUKES PHYSICAL THERAPY	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
2223 LINDEN ST	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
DENTIST OFFICE	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
1458 STEFKO BLVD	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
NEW ST. MEDICAL CNT	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
1313 CENTER ST	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Quest Diagnostic Inc.	Bethlehem (C)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Quest Diagnostics Inc.	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Superior Cardiac Imaging Mobile Svcs	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Baxter Healthcare	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Bio Med Sciences Inc.	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
C & S Medical Supply Inc.	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Hess Healthcare Services	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Orasure Technologies Inc.	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Sun Inn Preservation Association	Bethlehem (C)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Sun Inn Preservation Association	Bethlehem (C)	Medical Supplies	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Northampton Community College	Bethlehem (C)	Morgues	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Bethlehem City	Bethlehem (C)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
National Museum of Industrial History	Bethlehem (C)	Museums	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Historic Bethlehem Partnership	Bethlehem (C)	Museums	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Historic Bethlehem Partnership	Bethlehem (C)	Museums	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Historic Bethlehem Partnership	Bethlehem (C)	Museums	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Connell Funeral Home, Inc.	Bethlehem (C)	Funeral	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Pearson Funeral Home, Inc.	Bethlehem (C)	Funeral	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
USGS Monocacy Creek Gauge at Bethlehem,*	Bethlehem (C)	USGS	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Zoellner Arts Center - Lehigh University	Bethlehem (C)	Performing Arts (Theaters)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Bethlehem Press	Bethlehem (C)	Print Media	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
City of Bethlehem Health Bureau	Bethlehem (C)	Public Health	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			Fritz Memorial United Methodist Church	Bethlehem (C)	Religious (Church)	98.5	1.4	0.1	0	0	98.5
Trinity Episcopal Church	Bethlehem (C)	Religious (Church)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
First Presbyterian Church	Bethlehem (C)	Religious (Church)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Wesley United Methodist Church	Bethlehem (C)	Religious (Church)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Ben Franklin Technology Center	Bethlehem (C)	Research and Development	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Spring Garden Children's Center	Bethlehem (C)	School	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Liberty Senior High School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Gateway School of the Lehigh Valley	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Moravian College-South	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
St. Anne's School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Edgeboro School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Moravian College-North	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Marvine Elementary School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Lincoln Elementary School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Spring Garden Elementary School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Bethlehem Catholic High School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Thomas Jefferson Elementary School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Governor Wolf Elementary School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
East Hills Middle School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Holy Infancy School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Lehigh University	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Lehigh University	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Lehigh University	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Lehigh University	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Lehigh University	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Lehigh University	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Lehigh University	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Broughal Middle School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Donegan Elementary School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
STS Cyril & Methodius Parochial School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Northeast Middle School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
William Penn Elementary School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			Lehigh University - Saucon Field Complex	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1
Moravian Academy Lower School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Moravian Academy Middle School	Bethlehem (C)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Fritz Memorial United Methodist Church	Bethlehem (C)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Saint Peter's Lutheran Church	Bethlehem (C)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Saints Cyril and Methodius Roman Cathol*	Bethlehem (C)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Holy Infancy Roman Catholic Church	Bethlehem (C)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Saint John's Windish Evangelical Church	Bethlehem (C)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Zion First Hungarian Lutheran Church	Bethlehem (C)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Concordia Lutheran Church	Bethlehem (C)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Trinity Episcopal Church	Bethlehem (C)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Christ Church- United Church of Christ	Bethlehem (C)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
First Presbyterian Church	Bethlehem (C)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Holy Cross Evangelical Lutheran Church	Bethlehem (C)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Wesley United Methodist Church	Bethlehem (C)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Bethlehem Township's Coolidge Building	Bethlehem (C)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Bethlehem Township Community Center	Bethlehem (C)	Shelter	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Saint Mark's Evangelical Lutheran Church	Bethlehem (C)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
First United Church of Christ	Bethlehem (C)	Shelter	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Ebenezer Bible Fellowship Church	Bethlehem (C)	Shelter	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
133rd State Legislative District	Bethlehem (C)	State Buildings	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
18th State Senatorial District	Bethlehem (C)	State Buildings	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
135th State Legislative District	Bethlehem (C)	State Buildings	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
United States Post Office	Bethlehem (C)	USPS Mail Centers (Post Offices)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
United States Post Office	Bethlehem (C)	USPS Mail Centers (Post Offices)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
MANOR CARE	Bethlehem (T)	Adult Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			BLDG 1 & 2 COUNTRY MEADOWS BET	Bethlehem (T)	Adult Care	98.4	1.4	0.1	0	0	98.4
Country Meadows	Bethlehem (T)	Adult Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Animal Therapy Center	Bethlehem (T)	Animal Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Caring Connection	Bethlehem (T)	Assisted Living	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
St. John's Lutheran of Farmersville	Bethlehem (T)	Cemeteries	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Northampton Memorial Shrine Inc.	Bethlehem (T)	Cemeteries	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Precious Ones Day Care	Bethlehem (T)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Miller Heights Child Care	Bethlehem (T)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Chapel Family Child Care	Bethlehem (T)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Farmersville Child Care	Bethlehem (T)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Lehigh Valley Child Care Stone's Crossi*	Bethlehem (T)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Bethlehem Township Coolidge Building	Bethlehem (T)	Community Organization Facilities	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Bethlehem Township Community Center	Bethlehem (T)	Community Organization Facilities	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Federal Express - Freight	Bethlehem (T)	Courier Centers	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
United Parcel Service	Bethlehem (T)	Courier Centers	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
BETHLEHEM TWP EMS	Bethlehem (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
NANCY RUN FIRE DEPT	Bethlehem (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
BETHLEHEM TWP FIRE CO	Bethlehem (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Northampton Country Club	Bethlehem (T)	Golf Courses	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Green Pond Country Club	Bethlehem (T)	Golf Courses	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Courtyard by Marriott - Bethlehem	Bethlehem (T)	Lodging (Hotels)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Marriott Courtyard Bethlehem	Bethlehem (T)	Lodging (Hotels)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Comfort Inn	Bethlehem (T)	Lodging (Hotels)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
ST LUKES RIVERSIDE	Bethlehem (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
DUNKIN DONUT/ MINI MART	Bethlehem (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
COORDINATED HEALTH SERVICES	Bethlehem (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Health Network Laboratories	Bethlehem (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
St. Lukes Hospital	Bethlehem (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Digirad Imaging Solutions	Bethlehem (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Invatec	Bethlehem (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Cummings Veterinary Hospital, LLC	Bethlehem (T)	Medical	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Bethlehem Township	Bethlehem (T)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
BETHLEHEM TWP PD	Bethlehem (T)	Police	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Freedom High School	Bethlehem (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Freedom High School	Bethlehem (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Bethlehem Area Vocational Tech School	Bethlehem (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Our Lady of Perpetual Church and School	Bethlehem (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Moravian Academy	Bethlehem (T)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Northampton County Area Comm College	Bethlehem (T)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Northampton County Area Comm College	Bethlehem (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Miller Heights Elementary School	Bethlehem (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Farmersville Elementary School	Bethlehem (T)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Notre Dame High School	Bethlehem (T)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
First Church of Christ	Bethlehem (T)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Bethlehem Township Municipal Bldg	Bethlehem (T)	Shelter	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Lehigh Valley Friends Meetinghouse	Bethlehem (T)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
United States Post Office	Bethlehem (T)	USPS Mail Centers (Post Offices)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Lehigh River Boat Access Ramp	Bethlehem (T)	Waterways	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Holy Cross Day Care Center	Bushkill (T)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Little Buddies Childcare and Preschool	Bushkill (T)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
BUSHKILL TWP EMS	Bushkill (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
BUSHKILL TWP FIRE CO	Bushkill (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Sullivan Trail Golf Course	Bushkill (T)	Golf Courses	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Bushkill Township	Bushkill (T)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Jacobsburg Historical Society	Bushkill (T)	Museums	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
BUSHKILL TWP PD	Bushkill (T)	Police	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Bushkill Elementary School	Bushkill (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Jacobsburg EE Center Bureau State Parks	Bushkill (T)	State Buildings	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Catasauqua High School	Catasauqua (B)	Shelter	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Chapman Borough	Chapman (B)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
St. Peter's UCC Cemetery	East Allen (T)	Cemeteries	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
EAST ALLEN TWP AMBULANCE CORPS	East Allen (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
EAST ALLEN TWP FIRE CO	East Allen (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
BATH COMMUNITY MED	East Allen (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Health Network Laboratories	East Allen (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
East Allen Township	East Allen (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
16th State Senatorial District	East Allen (T)	State Buildings	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
138th State Legislative District	East Allen (T)	State Buildings	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
EAST BANGOR FIRE CO	East Bangor (B)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
East Bangor Borough	East Bangor (B)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
EAST BANGOR PD	East Bangor (B)	Police	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
1PRAXIS NURSING HOME	Easton (C)	Adult Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
1EASTON NURSING CENT	Easton (C)	Adult Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
EASTON HOME/PRESBY SENIORS	Easton (C)	Adult Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Salisbury Behavioral Health	Easton (C)	Adult Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Fisher Stadium	Easton (C)	Arenas (Stadiums)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Shiloh Manor Inc.	Easton (C)	Assisted Living	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Easton - Phillipsburg Toll Bridge	Easton (C)	Bridges	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Hays Cemetery	Easton (C)	Cemeteries	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Dutchman Cemetery	Easton (C)	Cemeteries	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Easton Cemetery Company	Easton (C)	Cemeteries	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Easton Heights Cemetery Company	Easton (C)	Cemeteries	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Head Start of the LV - Easton Paul's	Easton (C)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Pride and Joy Educational Day Care	Easton (C)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			Family YMCA of Easton	Easton (C)	Child Day Care	98.4	1.5	0.1	0	0	98.3
Head Start of the LV - Our Lady of Mercy	Easton (C)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
All My Children Daycare	Easton (C)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Olivet Wee Care Daycare and Nursery	Easton (C)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
ACJC Day Care Center	Easton (C)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Head Start of the LV - Northampton Stre*	Easton (C)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Angel's Daycare Center	Easton (C)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Third Street Alliance for Women & Child*	Easton (C)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Trinity Child Care	Easton (C)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Family YMCA of Easton	Easton (C)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Lafayette Early Learning Center	Easton (C)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Lehigh Valley Child Care March School	Easton (C)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Creative Learning Center	Easton (C)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
NORTHAMPTON CTY DOMESTIC RELATIONS	Easton (C)	County Building	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
NORTHAMPTON CTY CORONER OFFICE	Easton (C)	County Building	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
NH Cty Courthouse & Gov Center	Easton (C)	County Building	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Northampton County - Archives Building	Easton (C)	County Buildings	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Northampton County Prison - Work Release	Easton (C)	County Buildings	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Northampton County Juvenile Detention	Easton (C)	County Buildings	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			Northampton County - Governor Wolf Bldg	Easton (C)	County Buildings	98.4	1.5	0.1	0	0	98.3
United States SS Administration	Easton (C)	Federal Buildings	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
United States National Park Service	Easton (C)	Federal Buildings	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
EASTON EMERGENCY SQUAD	Easton (C)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
EASTON CITY FIRE DEPT - CENTRAL	Easton (C)	Fire	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
EASTON CITY FIRE DEPT - COLLEGE HILL	Easton (C)	Fire	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
EASTON CITY FIRE DEPT - SOUTH SIDE	Easton (C)	Fire	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
PA WATER RECUE	Easton (C)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Morello Funeral Home	Easton (C)	Funeral Homes	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Northampton County Courthouse	Easton (C)	Judicial Buildings (Courthouses)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
District Court 03-2-05	Easton (C)	Judicial Buildings (Courthouses)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Easton Area Public Library	Easton (C)	Libraries	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Quality Inn	Easton (C)	Lodging (Hotels)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
412 MONROE ST	Easton (C)	Medical	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
EASTON CHIROPRACTIC	Easton (C)	Medical	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
Lou Reda Productions	Easton (C)	Motion Picture and Sound	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Easton City	Easton (C)	Municipal	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
DAR Parsons Taylor House	Easton (C)	Museums	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Binney & Smith Crayola Crayon Tours	Easton (C)	Museums	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Hugh Moore Park & Museum	Easton (C)	Museums	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
National Canal Museum	Easton (C)	Museums	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
NC Historical & Genealogical Society	Easton (C)	Museums	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Bachmann Publick House	Easton (C)	Museums	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
USGS Lehigh River Gauge at Easton, PA	Easton (C)	USGS	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Ashton Funeral Home, Inc.	Easton (C)	Funeral	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			USGS Delaware River Gauge Phillipsburg,*	Easton (C)	USGS	98.4	1.5	0.1	0	0	98.3
State Theatre Center for the Arts	Easton (C)	Performing Arts (Theaters)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
NORTHAMPTON COUNTY SHERIFF DEPT	Easton (C)	Police	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
EASTON CITY PD	Easton (C)	Police	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
Easton Irregular	Easton (C)	Print Media	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Express Times	Easton (C)	Print Media	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
NORTHAMPTON COUNTY PRISON	Easton (C)	PRISON	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Northampton County Prison	Easton (C)	Prisons	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Pennsylvania Department of Health	Easton (C)	Public Health	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
River of God Fellowship Church	Easton (C)	Religious (Church)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
St. Paul Lutheran Church	Easton (C)	Religious (Church)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Greater Shiloh Church	Easton (C)	Religious (Church)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
St. Anthony's Youth Center	Easton (C)	Religious (Church)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Christ Lutheran Church	Easton (C)	Religious (Church)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
St. Bernard's Oratory	Easton (C)	Religious (Church)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
St. John's Evangelical Lutheran Church	Easton (C)	Religious (Church)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Olivet United Presbyterian Church	Easton (C)	Religious (Church)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
First Evangelical Congregational Church	Easton (C)	Religious (Church)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Trinity Episcopal Church	Easton (C)	Religious (Church)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
First Moravian Church	Easton (C)	Religious (Church)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
First Presbyterian Church	Easton (C)	Religious (Church)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Easton Catholic and EC-ST Joseph ES	Easton (C)	School	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
March Elementary School	Easton (C)	School	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Cheston Elementary School	Easton (C)	School	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
Cheston Elementary School	Easton (C)	School	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
Cheston Elementary School	Easton (C)	School	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
Cheston Elementary School	Easton (C)	School	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
Cheston Elementary School	Easton (C)	School	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
Lafayette College	Easton (C)	School	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
Lafayette College	Easton (C)	School	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
Easton Area Middle School	Easton (C)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Saint John's Evangelical Lutheran Church	Easton (C)	Shelter	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Saint John's United Church of Christ	Easton (C)	Shelter	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Christ Evangelical Congregational Church*	Easton (C)	Shelter	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
River of God Fellowship Church	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Holy Ghost Ukrainian Catholic Church	Easton (C)	Shelter	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
New Life Presbyterian Church	Easton (C)	Shelter	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Saint Paul's Lutheran Church	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Shiloh Baptist Church-Enrichment Center	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Memorial United Church of Christ	Easton (C)	Shelter	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Saint Anthony's Youth Center	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Faith Unity Church	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Saint Bernard's Roman Catholic Church	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Christ Lutheran Church	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Saint John's Evangelical Lutheran Church	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Church of God by Faith Inc.	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Our Lady of Lebanon Church	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Second Baptist Church	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Olivet United Presbyterian Church	Easton (C)	Shelter	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
First Evangelical Congregational Church	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
First United Church of Christ	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Church of The Nazarene	Easton (C)	Shelter	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
First Moravian Church	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
First Presbyterian Church	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Saint Paul's Third Lutheran Church	Easton (C)	Shelter	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Arndt's Lutheran Church	Easton (C)	Shelter	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Faith Lutheran Church	Easton (C)	Shelter	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
136th State Legislative District	Easton (C)	State Buildings	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Northampton County Archives	Easton (C)	Storage and Preservation (Archive)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
United States Post Office	Easton (C)	USPS Mail Centers (Post Offices)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Easton (Lehigh River) Boat Access Ramp	Easton (C)	Waterways	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Easton (Delaware River) Boat Access Ramp	Easton (C)	Waterways	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
VILLAGE AT SULLIVAN TRAIL	Forks (T)	Adult Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
The Village at Upstream Farm	Forks (T)	Adult Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Riverview Estates	Forks (T)	Adult Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Jacob's Farm	Forks (T)	Adult Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Thoreau Veterinary Hospital	Forks (T)	Animal Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Easton Animal Hospital	Forks (T)	Animal Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Family YMCA of Easton	Forks (T)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Family YMCA of Easton	Forks (T)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Lehigh Valley Child Care at Forks School	Forks (T)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Goddard School	Forks (T)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Home Sweet Home	Forks (T)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Lehigh Valley Child Care Great Beginnin*	Forks (T)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Tech Tyke Center	Forks (T)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Forks Township Community Center	Forks (T)	Community Organization Facilities	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
FORKS TWP EMS	Forks (T)	Fire	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
FORKS TWP FIRE DEPT	Forks (T)	Fire	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
MEDIC 9 - SOUTH	Forks (T)	Fire	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Riverview Golf & Country Club	Forks (T)	Golf Courses	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Quest Diagnostics Inc.	Forks (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Forks Township	Forks (T)	Municipal	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Binney & Smith	Forks (T)	Museums	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
PA Army Natl Guard - Easton Ctr	Forks (T)	National Guard Facilities	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Majestic Athletic, Ltd.	Forks (T)	Northampton	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
FORKS TWP PD	Forks (T)	Police	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
Faith Lutheran Church	Forks (T)	Religious (Church)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Forks Elementary School	Forks (T)	School	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
Paxinosa ES and Shawnee Intermediate	Forks (T)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Career Institute of Technology	Forks (T)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Freemansburg Child Care	Freemansburg (B)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Pembroke Pee Wee's Child Care	Freemansburg (B)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
FREEMANSBURG FIRE	Freemansburg (B)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Freemansburg Borough	Freemansburg (B)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
FREEMANSBURG PD	Freemansburg (B)	Police	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Freemansburg Elementary School	Freemansburg (B)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Glendon Borough	Glendon (B)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
USGS Lehigh River Gauge at Glendon, PA	Glendon (B)	USGS	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
SR QUARTERS AT MUHLE	Hanover (T)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Hanover Glen	Hanover (T)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Traditions of America at Hanover	Hanover (T)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Atria Bethlehem	Hanover (T)	Assisted Living	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Miller Keystone Blood Center	Hanover (T)	Blood	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Asa Packer Child Care	Hanover (T)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Hanover Child Care	Hanover (T)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Federal Express	Hanover (T)	Courier Centers	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
HANOVER TWP EMS	Hanover (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
HANOVER TWP FIRE	Hanover (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Visiting Nurse Association	Hanover (T)	Healthcare and Public Health - Other	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Holiday Inn Express Hotels & Suites	Hanover (T)	Lodging (Hotels)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Hampton Inn & Suites	Hanover (T)	Lodging (Hotels)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Best Western Conference Center	Hanover (T)	Lodging (Hotels)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
ST. LUKES NORTH	Hanover (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
52 HIGHLAND AVE	Hanover (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
CAMPBELL MEDICAL CEN	Hanover (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Radiology & MRI of Bethlehem	Hanover (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
St. Lukes Hospital	Hanover (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Boas Surgical Inc.	Hanover (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Helping Hands Medical Supply	Hanover (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Homestar Medical Equip & Infusion Center	Hanover (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Lincare	Hanover (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Miller Keystone Blood Center	Hanover (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Visiting Nurse Association	Hanover (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Hanover (N) Township	Hanover (T)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Holy Cross Evangelical Lutheran Church	Hanover (T)	Religious (Church)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Lehigh Valley Friends Meetinghouse	Hanover (T)	Religious (Church)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Asa Packer Elementary School	Hanover (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Hanover Elementary School	Hanover (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Triangle Tech	Hanover (T)	Specialized Education	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Division of Long Term Care - Dept Health	Hanover (T)	State Buildings	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Department of Environmental Protection	Hanover (T)	State Buildings	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			SAUCON VALLEY MANOR/SENIORLIVI	Hellertown (B)	Adult Care	98.5	1.4	0.1	0	0	98.5
Hellertown Union Cemetery	Hellertown (B)	Cemeteries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Christ Lutheran Center	Hellertown (B)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Saucon Valley Community Center	Hellertown (B)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Society of Little Learners Child Care	Hellertown (B)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Saucon Valley Community Center	Hellertown (B)	Community Organization Facilities	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
DEWEY FIRE COMPANY AMBULANCE	Hellertown (B)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
METRO EMS	Hellertown (B)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
DEWEY FIRE COMPANY	Hellertown (B)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Heintzelman Funeral Home	Hellertown (B)	Funeral Homes	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Silver Creek Country Club	Hellertown (B)	Golf Courses	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Hellertown Area Library	Hellertown (B)	Libraries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
SAUCON VALLEY FAMILY PRACTICE	Hellertown (B)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Quest Diagnostics Inc.	Hellertown (B)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
St. Lukes Hospital	Hellertown (B)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Yeagers Pharmacy	Hellertown (B)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Hellertown Borough	Hellertown (B)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
HELLERTOWN PD	Hellertown (B)	Police	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
United States Post Office	Hellertown (B)	USPS Mail Centers (Post Offices)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Saint Theresa School	Hellertown (B)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
CHANDLER III	Lehigh (T)	Adult Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
PERSONAL CARE HOME	Lehigh (T)	Adult Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Liza's House Personal Care Home	Lehigh (T)	Adult Day Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Blue Ridge Veterinary Clinic	Lehigh (T)	Animal Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
St. Paul's UCC Indianland Cemetery	Lehigh (T)	Cemeteries	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Sharon's Day Care	Lehigh (T)	Child Day Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Teddy Bear Day Care	Lehigh (T)	Child Day Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
LEHIGH TWP FIRE CO	Lehigh (T)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
District Court 03-3-01	Lehigh (T)	Judicial Buildings (Courthouses)	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Lehigh Township	Lehigh (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Cherryville Animal Hospital, P.C.	Lehigh (T)	Northampton	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
LEHIGH TWP PD	Lehigh (T)	Police	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Bethany Wesleyan Church	Lehigh (T)	Religious (Church)	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Lehigh Township Elementary School	Lehigh (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Bethany Wesleyan Church	Lehigh (T)	Shelter	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
United States Post Office	Lehigh (T)	USPS Mail Centers (Post Offices)	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
United States Post Office	Lehigh (T)	USPS Mail Centers (Post Offices)	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
United States Post Office	Lehigh (T)	USPS Mail Centers (Post Offices)	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
James Palmeri Funeral Home	Lower Mt Bethel (T)	Funeral Homes	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Sandt's Eddy Boat Access Ramp	Lower Mt Bethel (T)	Waterways	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
PPL Boat Access Ramp	Lower Mt Bethel (T)	Waterways	98.3	1.5	0.1	0	0	98.2	99.8	99.8	99.9
PPL Public Boat Access Ramp	Lower Mt Bethel (T)	Waterways	98.3	1.5	0.1	0	0	98.2	99.8	99.8	99.9
LOWER MT BETHEL FIRE CO	Lower Mt. Bethel (T)	Fire	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
LOWER MT BETHEL TWP FIRE	Lower Mt. Bethel (T)	Fire	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
Lower Mount Bethel Township	Lower Mt. Bethel (T)	Municipal	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Trio Farms	Lower Nazareth (T)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
VCA Northside Animal Hospital	Lower Nazareth (T)	Animal Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Governor Wolf	Lower Nazareth (T)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Nazareth Area Day Care	Lower Nazareth (T)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Lehigh Valley Child Care Lower Nazareth	Lower Nazareth (T)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
HECKTOWN EMS	Lower Nazareth (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
HECKTOWN FIRE CO	Lower Nazareth (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
District Court 03-2-03	Lower Nazareth (T)	Judicial Buildings (Courthouses)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Towneplace Suites By Marriott	Lower Nazareth (T)	Lodging (Hotels)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Any Lab Test Now	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Easton Hospital Laboratory Services	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Health Network Laboratories	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Progressive Physicians Vascular Lab	Lower Nazareth (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Lower Nazareth Township	Lower Nazareth (T)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Lower Nazareth Elementary School	Lower Nazareth (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
MARY ELLEN CONVALESC	Lower Saucon (T)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
VNA HOSPICE @ ST LUKES	Lower Saucon (T)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
IMMED.CARE FCTY/M/R	Lower Saucon (T)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
IMMED.CARE FCTY M/R	Lower Saucon (T)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Saucon Valley Animal Hospital	Lower Saucon (T)	Animal Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
New Jerusalem Evangelical Lutheran Chur*	Lower Saucon (T)	Cemeteries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Saucon Valley Com Center Fore & Aft	Lower Saucon (T)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
SE-WY-CO FIRE	Lower Saucon (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
LEITHSVILLE FIRE CO	Lower Saucon (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
SOUTHEASTERN FIRE CO	Lower Saucon (T)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
STEEL CITY FIRE CO	Lower Saucon (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			Woodland Hills Country Club	Lower Saucon (T)	Golf Courses	98.4	1.4	0.1	0	0	98.4
District Court 03-2-04	Lower Saucon (T)	Judicial Buildings (Courthouses)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Lower Saucon Township	Lower Saucon (T)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
LOWER SAUCON PD	Lower Saucon (T)	Police	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Lehigh University	Lower Saucon (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Saucon Valley School District Campus	Lower Saucon (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Emmanuel Lutheran Church Cemetery	Moore (T)	Cemeteries	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Covenant United Methodist Cemetery	Moore (T)	Cemeteries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Salem UCC Cemetery	Moore (T)	Cemeteries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Amy Pysher's Child Care Center	Moore (T)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
MOORE TWP EMS	Moore (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
KLECKNERSVILLE RANGERS FIRE CO	Moore (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Whitetail Golf Club	Moore (T)	Golf Courses	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Southmoore Golf Course	Moore (T)	Golf Courses	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Woodstone Country Club	Moore (T)	Golf Courses	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Moore Township	Moore (T)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Bensing Funeral Home, Inc.	Moore (T)	Funeral	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
MOORE TWP PD	Moore (T)	Police	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Moore Township Elementary School	Moore (T)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
138th State Legislative District	Moore (T)	State Buildings	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
ALEXANDRIA MANOR	Nazareth (B)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
MORAVIAN HALL MORNING STAR	Nazareth (B)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Nazareth Veterinary Center PC	Nazareth (B)	Animal Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
LV Child Care Nazareth Int School	Nazareth (B)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
St. John's Lutheran Day Care	Nazareth (B)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Kids Learning Kingdom	Nazareth (B)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton Country Childcare	Nazareth (B)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Lehigh Valley Child Care Shafer School	Nazareth (B)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
NANZARETH BORO EMS	Nazareth (B)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
VIGILANCE HOSE CO	Nazareth (B)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
District Court 03-2-08	Nazareth (B)	Judicial Buildings (Courthouses)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Nazareth Memorial Library	Nazareth (B)	Libraries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
W NORTH ST	Nazareth (B)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Quest Diagnostics, Inc.	Nazareth (B)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
St. Lukes Hospital	Nazareth (B)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Nazareth Medical Equipment	Nazareth (B)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Nazareth Borough	Nazareth (B)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Whitefield House Museum	Nazareth (B)	Museums	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Martin Guitar Museum	Nazareth (B)	Museums	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Reichel Funeral Home, Inc.	Nazareth (B)	Funeral	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Bartholomew-Schisler Funeral Home, Inc.	Nazareth (B)	Funeral	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
NAZARETH PD	Nazareth (B)	Police	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Nazareth Key	Nazareth (B)	Print Media	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
St. John's Lutheran Church	Nazareth (B)	Religious (Church)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
St. John's United Church of Christ	Nazareth (B)	Religious (Church)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Shafer Elementary School	Nazareth (B)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Holy Family School	Nazareth (B)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Holy Family School	Nazareth (B)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Holy Family School	Nazareth (B)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Holy Family School	Nazareth (B)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Saint John's Lutheran Church	Nazareth (B)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Saint John's United Church of Christ	Nazareth (B)	Shelter	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
137th State Legislative District	Nazareth (B)	State Buildings	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
United States Post Office	Nazareth (B)	USPS Mail Centers (Post Offices)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			Delabar Family	North Catasauqua (B)	Child Day Care	98.6	1.3	0.1	0	0	98.5
CHARITON HOSE CO	North Catasauqua (B)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
N CATASAUQUA MEDICAL	North Catasauqua (B)	Medical	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
North Catasauqua Borough	North Catasauqua (B)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
NORTH CATASAUQUA PD	North Catasauqua (B)	Police	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
NORTHAMPTON VILLAGE	Northampton (B)	Adult Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
SACRED HEART LIVING	Northampton (B)	Adult Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Unknown name	Northampton (B)	Adult Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
St. Michael's Cemetery	Bethlehem (C)	Cemeteries	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Duck Duck Goose	Northampton (B)	Child Day Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Northampton Community Center	Northampton (B)	Community Organization Facilities	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
NORTHAMPTON REGIONAL EMS	Northampton (B)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
NORTHAMPTON BORO FIRE DEPT	Northampton (B)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Schisler Funeral Home	Northampton (B)	Funeral Homes	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
District Court 03-2-07	Northampton (B)	Judicial Buildings (Courthouses)	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Northampton Area Public Library	Northampton (B)	Libraries	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
NORTH. MEDICAL ARTS	Northampton (B)	Medical	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Health Network Laboratories	Northampton (B)	Medical	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Sacred Heart Outpatient Lab Services	Northampton (B)	Medical	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			Newhard Pharmacy	Northampton (B)	Medical	59.1	39.5	1.2	0.1	0	59.1
Webb Medical Systems	Northampton (B)	Medical	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Northampton Borough	Northampton (B)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
PA DOT - Stockpile Hope Road	Bethlehem (T)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
PA DOT - Northampton Cty Maint District	Palmer (T)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
PA DOT - Stockpile Newburg	Lower Nazareth (T)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
PA DOT - Stockpile Danielsville	Lehigh (T)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
PA DOT - Stockpile Pen Argyl	Pen Argyl (TB)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Reichel Funeral Home, Inc.	Northampton (B)	Funeral	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
NORTHAMPTON BORO PD	Northampton (B)	Police	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Grace United Church of Christ	Northampton (B)	Religious (Church)	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Assumption of the Virgin Mary	Northampton (B)	Religious (Church)	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Franklin Elementary School	Northampton (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Our Lady of Hungary Elementary School	Northampton (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Saint John the Baptist Elementary School	Northampton (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Northampton Area Jr and Sr HS	Northampton (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Wolf Elementary School	Northampton (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Bethlehem Area Vo-Tech School	Northampton (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Washington Elementary School	Northampton (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Washington Elementary School	Northampton (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Grace United Church of Christ	Northampton (B)	Shelter	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Our Lady of Hungary Church	Northampton (B)	Shelter	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Assumption of The Virgin Mary Ukranian *	Northampton (B)	Shelter	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
183rd State Legislative District	Northampton (B)	State Buildings	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
United States Post Office	Northampton (B)	USPS Mail Centers (Post Offices)	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
MANOR CARE # 574	Palmer (T)	Adult Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Enclave at Knob Hill	Palmer (T)	Adult Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Traditions of Glenmoor	Palmer (T)	Adult Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Highlands at Glenmoor North	Palmer (T)	Adult Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Redi-Care Medical Center	Palmer (T)	Ambulatory Healthcare	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
William Penn Animal Hospital	Palmer (T)	Animal Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Serenity	Palmer (T)	Assisted Living	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Lehigh Valley Child Care at Easton	Palmer (T)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Patti Stout Group Child Day Care	Palmer (T)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Palmer Moravian Day School	Palmer (T)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Littlest Little People Country Club	Palmer (T)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Little People Country Club	Palmer (T)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
LPCC Extended Care at Tracy School	Palmer (T)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Charles Chrin Community Center of Palme*	Palmer (T)	Community Organization Facilities	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
SUBURBAN EMS	Palmer (T)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
PALMER TWP FIRE - STATION 2	Palmer (T)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
PALMER TWP FIRE	Palmer (T)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
District Court 03-2-09	Palmer (T)	Judicial Buildings (Courthouses)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Easton Area Public Library	Palmer (T)	Libraries	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Holiday Inn Express	Palmer (T)	Lodging (Hotels)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Comfort Inn	Palmer (T)	Lodging (Hotels)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Hampton Inn	Palmer (T)	Lodging (Hotels)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
DIAGNOSTIC IMAGING	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
UNIT 3 PALMER MED	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
30 COMMUNITY DR	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
UNIT 5 PALMER MED	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
UNIT 2 PALMER MED	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
UNIT 6 PALMER MED	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
GASTROENTEROLOGY CENTER	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
UNIT 4 PALMER MED	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
UNIT 1 PALMER MED	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
DENTAL OFFICE	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
DR. BODY, DENTIST	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
BOONSWANG MED OFF	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Easton Hospital Laboratory Services	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Pinnacle Lab	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Youngs Medical Equipment	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Redi-Care Medical Center	Palmer (T)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Palmer Township	Palmer (T)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
PALMER TWP PD	Palmer (T)	Police	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
New Creation United Church of Christ	Palmer (T)	Religious (Church)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
St. Paul's Third Lutheran Church	Palmer (T)	Religious (Church)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Easton Area High School	Palmer (T)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Palmer Elementary School	Palmer (T)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Edward Tracy Elementary School	Palmer (T)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
United States Post Office	Palmer (T)	USPS Mail Centers (Post Offices)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
MORNING STAR MANOR	Pen Argyl (B)	Adult Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Morning Star Manor	Pen Argyl (B)	Adult Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
AVH Veterinary Group	Pen Argyl (B)	Animal Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Kid's Campus Nursery and Day Care	Pen Argyl (B)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
PEN ARGYL FIRE CO	Pen Argyl (B)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Pen Argyl Borough	Pen Argyl (B)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
PEN ARGYL PD	Pen Argyl (B)	Police	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Pen Argyl Junior-Senior High School	Pen Argyl (B)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Immaculate Conception School	Pen Argyl (B)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
United States Post Office	Pen Argyl (B)	USPS Mail Centers (Post Offices)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
CHANDLER ESTATES IV	Plainfield (T)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Operation Smart Start	Plainfield (T)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
PLAINFIELD TWP FIRE & AMBULANCE	Plainfield (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
PLAINFIELD TWP FIRE & AMBULANCE	Plainfield (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Sawmill Golf Course	Plainfield (T)	Golf Courses	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
FAMILY CARE CENT INC	Plainfield (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
WIND GAP PROF CENTER	Plainfield (T)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Plainfield Township	Plainfield (T)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Chandler Estate, Inc.	Plainfield (T)	Northampton	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
PLAINFILED TWP PD	Plainfield (T)	Police	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
BELFAST PSP	Plainfield (T)	PSP	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Wind Gap Middle School	Plainfield (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Plainfield Elementary School	Plainfield (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
PORTLAND & VICINITY AMBULANCE CORPS	Portland (B)	Fire	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
PORTLAND HOOK & LADDER	Portland (B)	Fire	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
Portland Borough	Portland (B)	Municipal	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
PORTLAND PD	Portland (B)	Police	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
United States Post Office	Portland (B)	USPS Mail Centers (Post Offices)	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Our Lady of Mount Carmel Cemetery	Roseto (B)	Cemeteries	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
ROSETO FIRE CO	Roseto (B)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Roseto Borough	Roseto (B)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
ROSETO PD	Roseto (B)	Police	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Our Lady of Mount Carmel School	Roseto (B)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
United States Post Office	Roseto (B)	USPS Mail Centers (Post Offices)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
LIBERTY HOSE CO	Stockertown (B)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Stockertown Borough	Stockertown (B)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
STOCKERTOWN PD	Stockertown (B)	Police	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
United States Post Office	Stockertown (B)	USPS Mail Centers (Post Offices)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
TATAMY BORO FIRE DEPT	Tatamy (B)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Tatamy Borough	Tatamy (B)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
TATAMY PD	Tatamy (B)	Police	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
USGS Bushkill Creek Gauge SR2017 brdg	Tatamy (B)	Sensor and Monitoring Systems (GPS)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
USGS Bushkill Creek Gauge Route 33	Tatamy (B)	Sensor and Monitoring Systems (GPS)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
United States Post Office	Tatamy (B)	USPS Mail Centers (Post Offices)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Portland - Columbia Toll Bridge	Upper Mt Bethel (T)	Bridges	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Portland - Columbia Pedestrian Bridge	Upper Mt Bethel (T)	Bridges	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Mount Bethel Trinity Cemetery	Upper Mt Bethel (T)	Cemeteries	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Christ Evang Lutheran Church Cemetery	Upper Mt Bethel (T)	Cemeteries	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Bangor Area School District Day Care	Upper Mt Bethel (T)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Slate Belt Child Care	Upper Mt Bethel (T)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Wee Love & Care Day Care	Upper Mt Bethel (T)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Name	Municipality	Type	500-Year Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
			Doe Hollow Boat Access Ramp	Upper Mt Bethel (T)	Waterways	98.3	1.5	0.1	0	0	98.2
Portland Power Plant Boat Access Ramp	Upper Mt Bethel (T)	Waterways	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
BETHANY HOME	Upper Mt. Bethel (T)	Adult Care	98.3	1.5	0.1	0	0	98.2	99.8	99.8	99.9
MOUNT BETHEL FIRE CO	Upper Mt. Bethel (T)	Fire	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
NORTH BAQNGOR FIRE DEPT	Upper Mt. Bethel (T)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Upper Mount Bethel Township	Upper Mt. Bethel (T)	Municipal	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Bangor Sr/Jr/Five Points/Dom DeFranco	Upper Mt. Bethel (T)	School	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
911 OFFICE BLDG	Upper Nazareth (T)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
GRACEDALE	Upper Nazareth (T)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Northampton County EOC	Upper Nazareth (T)	EOC	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
EAST LAWN FIRE CO	Upper Nazareth (T)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Upper Nazareth Township	Upper Nazareth (T)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Gracedale Nursing Home	Upper Nazareth (T)	Nursing Home	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
UPPER NAZARETH TWP PD	Upper Nazareth (T)	Police	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Nazareth Area Junior and Senior HS	Upper Nazareth (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Nazareth Area Junior and Senior HS	Upper Nazareth (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Nazareth Area Middle School	Upper Nazareth (T)	School	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
CANAL SIDE MANOR	Walnutport (B)	Adult Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Pond View Manor Personal Care Home	Walnutport (B)	Assisted Living	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Hill Street Children's Center	Walnutport (B)	Child Day Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Kidz Place	Walnutport (B)	Child Day Care	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
DIAMOND FIRE CO	Walnutport (B)	Fire	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
WALNUTPORT MED. OFFI	Walnutport (B)	Medical	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
NORTHERN LEHIGH MED	Walnutport (B)	Medical	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Walnutport Borough	Walnutport (B)	Municipal	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
USGS Lehigh River Gauge at Walnutport, *	Walnutport (B)	USGS	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
WALNUTPORT BORO PD	Walnutport (B)	Police	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Walnutport Elementary School	Walnutport (B)	School	59.1	39.5	1.2	0.1	0	59.1	97.7	98.6	99.8
Seventh Day Adventist Church	Walnutport (B)	Shelter	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
United States Post Office	Walnutport (B)	USPS Mail Centers (Post Offices)	98.6	1.3	0.1	0	0	98.5	99.8	99.8	99.9
Five Points Veterinary Hospital	Washington (T)	Animal Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Childhood Treasures Day Care	Washington (T)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
WASHINGTON TWP FIRE CO	Washington (T)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
LIBERTY EMS	Washington (T)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
MEDIC 9 - NORTH	Washington (T)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Washington (N) Township	Washington (T)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
WASHINGTON TWP PD	Washington (T)	Police	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Washington Elementary School	Washington (T)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
WEST EASTON FIRE DEPT	West Easton (B)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
West Easton Borough	West Easton (B)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Country Classics at Morgan Hill	Williams (T)	Adult Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
The Center for Animal Health & Welfare	Williams (T)	Animal Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Interstate 78 Toll Bridge	Williams (T)	Bridges	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Abby Burns Daycare	Williams (T)	Child Day Care	98.4	1.5	0.1	0	0	98.3	99.8	99.8	99.9
Morgan Hill Day Care	Williams (T)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
WILLIAMS TWP EMS	Williams (T)	Fire	56.2	42.1	1.5	0.2	0	56.2	97.3	98.3	99.8
WILLIAMS TWP FIRE DEPT	Williams (T)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
The Club at Morgan Hill	Williams (T)	Golf Courses	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Williams Township	Williams (T)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
St. John's Lutheran Church	Williams (T)	Religious (Church)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Christ Evangelical Congregational Church	Williams (T)	Religious (Church)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Williams Township Elementary School	Williams (T)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
EASTWOOD CONVALESCEN	Wilson (B)	Adult Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
EASTERN COMFORT ASSISTED LIV	Wilson (B)	Adult Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Lehigh Valley Child Care at Avona School	Wilson (B)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Miss Cheri's Daycare and Preschool	Wilson (B)	Child Day Care	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
WILSON BORO FIRE DEPT	Wilson (B)	Fire	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Finegan Funeral Home	Wilson (B)	Funeral Homes	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
District Court 03-2-12	Wilson (B)	Judicial Buildings (Courthouses)	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Mary Meuser Memorial Library	Wilson (B)	Libraries	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Easton Hospital	Wilson (B)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
EASTON HOSPITAL	Wilson (B)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
DOUGLAS D DITMARS MD	Wilson (B)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
HAY SCHOOL	Wilson (B)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Easton Hospital Laboratory Services	Wilson (B)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Northampton Imaging Specialists	Wilson (B)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Quest Diagnostics Inc.	Wilson (B)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Bell Apothecary	Wilson (B)	Medical	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Wilson Borough	Wilson (B)	Municipal	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
Strunk Funeral Home, Inc.	Wilson (B)	Funeral	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
WILSON BORO PD	Wilson (B)	Police	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Philip F. Lauer Middle School	Wilson (B)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Wilson Elementary School	Wilson (B)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Wilson Area High School	Wilson (B)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Easton Children's Home	Wilson (B)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Avona Elementary School	Wilson (B)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
Avona Elementary School	Wilson (B)	School	57.2	41.3	1.4	0.1	0	57.1	97.5	98.4	99.8
24th State Senatorial District	Wilson (B)	State Buildings	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9
State Health Center - Dept Health	Wilson (B)	State Buildings	98.4	1.4	0.1	0	0	98.4	99.8	99.8	99.9

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
WALDEN III ASSTD LIVING	Wind Gap (B)	Adult Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
Children's Center of Wind Gap	Wind Gap (B)	Child Day Care	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
WIND GAP EMS	Wind Gap (B)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
BLUE MT EMS	Wind Gap (B)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
WIND GAP FIRE DEPT	Wind Gap (B)	Fire	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
District Court 03-3-02	Wind Gap (B)	Judicial Buildings (Courthouses)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
FRENENIUS MEDICAL CARE	Wind Gap (B)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
South Broadway, Wind Gap (B)	Wind Gap (B)	Medical	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
Wind Gap Borough	Wind Gap (B)	Municipal	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9
WIND GAP PD	Wind Gap (B)	Police	58.2	40.4	1.3	0.1	0	58.1	97.6	98.5	99.8
United States Post Office	Wind Gap (B)	USPS Mail Centers (Post Offices)	98.5	1.4	0.1	0	0	98.5	99.8	99.8	99.9

Source: HAZUS-MH 2.1

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Table G-2. Estimated Damage and Loss of Functionality for Critical Facilities in the Lehigh Valley for the 2,500-Year MRP Earthquake Event

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Lehigh County											
ALBURTIS FIRE CO	Alburtis (B)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
ALBURTIS ELEMENTARY SCHOOL	Alburtis (B)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
St. Luke's Hospital Allentown	Allentown (C)	Medical	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
Lehigh Valley Hospital - 17th & Chew	Allentown (C)	Medical	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
Sacred Heart Hospital	Allentown (C)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
WESCOSVILLE FIRE COMPANY	Allentown (C)	Fire	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
WESTERN SALISBURY FIRE CO	Allentown (C)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
CETRONIA FIRE COMPANY	Allentown (C)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
WOODLAWN FIRE CO #1	Allentown (C)	Fire	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
COMM FIRE CO #1 S WH TWP	Allentown (C)	Fire	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
WOODLAWN FIRE CO #1	Allentown (C)	Fire	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
W SALISBURY VOL FIRE CO#3	Allentown (C)	Fire	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
CITY OF ALLENTOWN	Allentown (C)	Fire	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
CITY OF ALLENTOWN	Allentown (C)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
CITY OF ALLENTOWN	Allentown (C)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
CITY OF ALLENTOWN	Allentown (C)	Fire	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
CITY OF ALLENTOWN	Allentown (C)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
CITY OF ALLENTOWN	Allentown (C)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
SALISBURY TWP	Allentown (C)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
SALISBURY TWP SCHOOL AUTH	Allentown (C)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
SALISBURY FIRE CO #1	Allentown (C)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
HANOVER TOWNSHIP	Allentown (C)	Fire	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
UNION TERRACE ELEMENTARY SCHOOL	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
WILLIAM ALLEN HIGH SCHOOL	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
ST CATHERINE OF SIENA	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
ST CATHERINE OF SIENA	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
RAUB MIDDLE SCHOOL	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
WILLIAM ALLEN HIGH SCHOOL	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
WILLIAM ALLEN HIGH SCHOOL	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
LEHIGH PARKWAY ELEMENTARY SCHOOL	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Lehigh County											
LINCOLN ELEMENTARY SCHOOL	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
MUHLENBERG ELEMENTARY SCHOOL	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
JACKSON ELEMENTARY SCHOOL	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
TREXLER MIDDLE SCHOOL	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
ST FRANCIS OF ASSISI	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
MCKINLEY ELEMENTARY SCHOOL	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
CLEVELAND ELEMENTARY SCHOOL	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
WASHINGTON ELEMENTARY SCHOOL	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
CENTRAL ELEMENTARY SCHOOL	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
JEFFERSON ELEMENTARY SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
SOUTH MOUNTAIN MIDDLE SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
ROOSEVELT ELEMENTARY SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
WILSON EARLY CHILDHOOD CENTER	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
WILEY HOUSE	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
ROBERTO CLEMENTE CHARTER SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
ALLENTOWN CENTRAL CATHOLIC HIGH SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
SACRED HEART ELEMENTARY SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
ALLENTOWN CENTRAL CATHOLIC HIGH SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
SHERIDAN ELEMENTARY SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
HOLY SPIRIT SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
HARRISON-MORTON MIDDLE SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
MOSSER ELEMENTARY SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Lehigh County											
DIERUFF HIGH SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
RITTER ELEMENTARY SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
LEHIGH VALLEY CHRISTIAN HIGH SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
MIDWAY MANOR EARLY EDUCATION CENTER	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
KINGS WAY ACADEMY	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
THE LUTHERAN ACADEMY	Allentown (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
ST PAULS SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
MERCY DAY SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
OUR LADY HELP OF CHRISTIANS SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
HOLY SPIRIT ELEMENTARY SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
HIRAM DODD ELEMENTARY SCHOOL	Allentown (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
LEHIGH COUNTY HUMANE SOC	Allentown (C)	Municipal	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
CITY OF ALLENTOWN	Allentown (C)	Municipal	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
CITY OF ALLENTOWN	Allentown (C)	Municipal	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
CITY OF ALLENTOWN	Allentown (C)	Municipal	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
SALISBURY HOUSE OF NORTHEAST PA INC	Allentown (C)	Senior	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
COMMONWEALTH OF PA	Allentown (C)	Municipal	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
COMMONWEALTH OF PA	Allentown (C)	Municipal	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
CITY OF ALLENTOWN	Allentown (C)	Municipal	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
COMMONWEALTH OF PA	Allentown (C)	Municipal	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
COMMONWEALTH OF PA	Allentown (C)	Municipal	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
COMMONWEALTH OF PA	Allentown (C)	Municipal	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
OCASIO RAYMOND S & BERTHA L	Allentown (C)	Daycare	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Lehigh Valley Hospital - Muhlenberg	Bethlehem (C)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
CITY OF BETHLEHEM	Bethlehem (C)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
CITY OF BETHLEHEM	Bethlehem (C)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
REGIONAL ACADEMIC STANDARDS ACADEMY	Bethlehem (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
CENTENNIAL SCHOOL	Bethlehem (C)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Lehigh County											
CLEARVIEW ELEMENTARY SCHOOL	Bethlehem (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
JAMES BUCHANAN ELEMENTARY SCHOOL	Bethlehem (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
WILEY HOUSE	Bethlehem (C)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
CALYPSO ELEMENTARY SCHOOL	Bethlehem (C)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
NITSCHMANN MIDDLE SCHOOL	Bethlehem (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
VITALISTIC THERAPEUTIC SCHOOL	Bethlehem (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
CENTRAL CHRISTIAN ACADEMY	Bethlehem (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
NOTRE DAME SCHOOL	Bethlehem (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
ST SIMON & JUDE SCHOOL	Bethlehem (C)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Cantelmi Funeral Home P.C.	Bethlehem (C)	Funeral Homes	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
USGS Lehigh River Gauge at Bethlehem, PA	Bethlehem (C)	Lehigh	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
CITY OF BETHLEHEM	Bethlehem (C)	Municipal	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Morning Call	Bethlehem (C)	Print Media	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
United States Congressman Office	Bethlehem (C)	Federal Buildings	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
COUNTY OF LEHIGH	Bethlehem (C)	Municipal	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Notre Dame of Bethlehem	Bethlehem (C)	Religious (Churches	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
ARC of the Greater Lehigh Valley	Bethlehem (C)	Healthcare	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Homewood Suites By Hilton	Bethlehem (C)	Educational	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
SOUTHWARK HOSE CO #9	Catasauqua (B)	Lodging (Hotels)	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
EAST END FIRE CO	Catasauqua (B)	Fire	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
ST MARYS CATHOLIC SCHOOL	Catasauqua (B)	Fire	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
LINCOLN MIDDLE SCHOOL	Catasauqua (B)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
CATASAUQUA HIGH SCHOOL	Catasauqua (B)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
SHECKLER ELEMENTARY SCHOOL	Catasauqua (B)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
CORROCHER JOHN C & ARLANA L	Catasauqua (B)	School	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
BORO OF CATASAUQUA	Catasauqua (B)	Daycare	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
COOPERSBURG FIRE CO	Catasauqua (B)	Municipal	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91
LIBERTY BELL ELEMENTARY SCHOOL	Coopersburg (B)	Fire	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Lehigh County											
U S POSTAL SERVICE	Coopersburg (B)	Municipal	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
BORO OF COPLAY	Coplay (B)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
BORO OF EMMAUS	Emmaus (B)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
CITIZENS FIRE CO	Emmaus (B)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
CITIZENS FIRE CO	Emmaus (B)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
EMMAUS HIGH SCHOOL	Emmaus (B)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
EMMAUS HIGH SCHOOL	Emmaus (B)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
JEFFERSON ELEMENTARY SCHOOL	Emmaus (B)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
LINCOLN ELEMENTARY SCHOOL	Emmaus (B)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
ST ANNES PAROCHIAL SCHOOL	Emmaus (B)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
BORO OF EMMAUS	Emmaus (B)	Municipal	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
BORO OF EMMAUS	Emmaus (B)	Municipal	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
St. Luke's Hospital - Bethlehem	Fountain Hill (B)	Medical	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
FOUNTAIN HILL HOSE CO 1	Fountain Hill (B)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
BORO OF FOUNTAIN HILL	Fountain Hill (B)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
FOUNTAIN HILL ELEMENTARY SCHOOL	Fountain Hill (B)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
HOLY CHILD SCHOOL	Fountain Hill (B)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
HANOVER TOWNSHIP	Hanover (T)	Municipal	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
GOODWILL FIRE CO	Heidelberg (T)	Fire	9.1	64.9	18.5	6.1	1.4	9	72.4	74	92.5
NORTHWESTERN LEHIGH HIGH SCHOOL	Heidelberg (T)	School	9.1	64.9	18.5	6.1	1.4	9	72.4	74	92.5
NORTHWESTERN LEHIGH MIDDLE SCHOOL	Heidelberg (T)	School	9.1	64.9	18.5	6.1	1.4	9	72.4	74	92.5
HEIDELBERG TWP	Heidelberg (T)	Municipal	84.6	12.6	2.5	0.2	0.0	84.6	97.2	97.2	99.7
RITTER DEAN L & MARYBETH A	Heidelberg (T)	Senior	84.6	12.6	2.5	0.2	0.0	84.6	97.2	97.2	99.7
COMMONWEALTH OF PA	Heidelberg (T)	Municipal	84.8	12.5	2.5	0.2	0.0	84.7	97.2	97.3	99.8
LOWER MACUNGIE TWP	Lower Macungie (T)	Fire	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
THE HILLSIDE SCHOOL	Lower Macungie (T)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
LOWER MACUNGIE MIDDLE SCHOOL	Lower Macungie (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
LOWER MACUNGIE ELEMENTARY SCHOOL	Lower Macungie (T)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
WESCOSVILLE ELEMENTARY SCHOOL	Lower Macungie (T)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
EYER MIDDLE SCHOOL	Lower Macungie (T)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Lehigh County											
SHOEMAKER ELEMENTARY SCHOOL	Lower Macungie (T)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
MACUNGIE ELEMENTARY SCHOOL	Lower Macungie (T)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
Legacy Oaks at Lehigh Valley	Lower Macungie (T)	Senior	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Traditions at Wild Cherry Knoll	Lower Macungie (T)	Senior	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
Four Seasons at Farmington	Lower Macungie (T)	Senior	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
LOWER MACUNGIE TWP	Lower Macungie (T)	Municipal	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
LOWER MILFORD TWP FIRE CO #1	Lower Milford (T)	Fire	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
LOWER MILFORD ELEMENTARY SCHOOL	Lower Milford (T)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
PENNA DEPT OF TRANSPORTATION	Lower Milford (T)	Municipal	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
COMMUNITY FIRE CO OF NEW TRIPOLI	Lynn (T)	Fire	8.9	64.8	18.7	6.2	1.4	8.9	72.2	73.7	92.4
NEW TRIPOLI FIRE CO	Lynn (T)	Fire	9.2	65.1	18.4	6.0	1.3	9.2	72.7	74.2	92.6
LYNNPORT COMM FIRE CO #1	Lynn (T)	Fire	9.3	65.2	18.2	5.9	1.3	9.3	73	74.5	92.7
NORTHWESTERN LEHIGH ELEMENTARY SCHOOL	Lynn (T)	School	9.2	65.1	18.4	6.0	1.3	9.2	72.7	74.2	92.6
LYNN TOWNSHIP	Lynn (T)	Municipal	84.9	12.4	2.5	0.2	0.0	84.9	97.3	97.3	99.8
MACUNGIE FIRE CO #1	Macungie (B)	Fire	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
TRI-CLOVER FIRE CO	North Whitehall (T)	Fire	8.5	64.4	19.2	6.5	1.5	8.5	71.3	72.8	92
TRI-CLOVER FIRE CO	North Whitehall (T)	Fire	8.5	64.4	19.2	6.5	1.5	8.5	71.3	72.8	92
LAURY'S STATION VOLUNTEER FIRE CO #1	North Whitehall (T)	Fire	8.5	64.4	19.2	6.5	1.5	8.5	71.3	72.8	92
NEFFS VOLUNTEER FIRE COMPANY	North Whitehall (T)	Fire	8.7	64.5	19.0	6.4	1.4	8.6	71.6	73.1	92.1

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Lehigh County											
KERNSVILLE ELEMENTARY SCHOOL	North Whitehall (T)	School	8.5	64.4	19.2	6.5	1.5	8.5	71.3	72.8	92
LEHIGH CAREER & TECHNICAL INSTITUTE	North Whitehall (T)	School	8.5	64.4	19.2	6.5	1.5	8.5	71.3	72.8	92
SCHNECKSVILLE ELEMENTARY SCHOOL	North Whitehall (T)	School	8.5	64.4	19.2	6.5	1.5	8.5	71.3	72.8	92
IRONTON ELEMENTARY SCHOOL	North Whitehall (T)	School	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
NORTH WHITEHALL TWP	North Whitehall (T)	Municipal	83.9	13.2	2.7	0.2	0.0	83.8	97	97	99.7
COUNTY OF LEHIGH	North Whitehall (T)	Municipal	84.0	13.1	2.7	0.2	0.0	84	97	97.1	99.7
Lehigh Valley Hospital - Cedar Crest	Salisbury (T)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
SALISBURY MIDDLE SCHOOL	Salisbury (T)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
WESTERN SALISBURY ELEMENTARY SCHOOL	Salisbury (T)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
THE SWAIN SCHOOL	Salisbury (T)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
SALISBURY HIGH SCHOOL	Salisbury (T)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
HARRY S TRUMAN ELEMENTARY SCHOOL	Salisbury (T)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
WILEY HOUSE	Salisbury (T)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
WILEY HOUSE	Salisbury (T)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
LEHIGH CHRISTIAN ACADEMY	Salisbury (T)	School	7.9	63.6	19.9	6.9	1.6	7.9	70	71.5	91.4
ST THOMAS MORE	Salisbury (T)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
COUNTY OF LEHIGH	Salisbury (T)	County Buildings	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
BORO OF SLATINGTON	Slatington (B)	Fire	8.9	64.8	18.7	6.2	1.4	8.9	72.2	73.7	92.4
BORO OF SLATINGTON	Slatington (B)	Fire	8.9	64.8	18.7	6.2	1.4	8.9	72.2	73.7	92.4
BORO OF SLATINGTON	Slatington (B)	Fire	8.9	64.8	18.7	6.2	1.4	8.9	72.2	73.7	92.4
SLATINGTON ELEMENTARY SCHOOL	Slatington (B)	School	8.9	64.8	18.7	6.2	1.4	8.9	72.2	73.7	92.4
NORTHERN LEHIGH HIGH SCHOOL	Slatington (B)	School	8.9	64.8	18.7	6.2	1.4	8.9	72.2	73.7	92.4
NORTHERN LEHIGH MIDDLE SCHOOL	Slatington (B)	School	8.9	64.8	18.7	6.2	1.4	8.9	72.2	73.7	92.4
ST JOHN NEUMANN REGIONAL SCHOOL	Slatington (B)	School	8.9	64.8	18.7	6.2	1.4	8.9	72.2	73.7	92.4
BORO OF SLATINGTON	Slatington (B)	Municipal	84.5	12.7	2.6	0.2	0.0	84.4	97.1	97.2	99.7
Westfield Hospital	South Whitehall (T)	Medical	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Lehigh County											
ST JOSEPH THE WORKER ELEMENTARY SCHOOL	South Whitehall (T)	School	8.3	64.1	19.5	6.7	1.5	8.2	70.8	72.3	91.7
PARKWAY MANOR ELEMENTARY SCHOOL	South Whitehall (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
SPRINGHOUSE MIDDLE SCHOOL	South Whitehall (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
OREFIELD MIDDLE SCHOOL	South Whitehall (T)	School	8.5	64.4	19.2	6.5	1.5	8.5	71.3	72.8	92
PARKLAND HIGH SCHOOL	South Whitehall (T)	School	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
CETRONIA ELEMENTARY SCHOOL	South Whitehall (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
KRATZER ELEMENTARY SCHOOL	South Whitehall (T)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
JEWISH DAY SCHOOL	South Whitehall (T)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
JEWISH DAY SCHOOL	South Whitehall (T)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
JEWISH DAY SCHOOL	South Whitehall (T)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
ALLENTOWN CHRISTIAN SCHOOL	South Whitehall (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
DATZYK MONTESSORI SCHOOL	South Whitehall (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
CITY OF ALLENTOWN	South Whitehall (T)	Municipal	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
FOGELSVILLE VOL FIRE CO	Upper Macungie (T)	Fire	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
UPPER MACUNGIE TWP	Upper Macungie (T)	Fire	8.3	64.1	19.5	6.7	1.5	8.2	70.8	72.3	91.7
TREXLERTOWN GOOD WILL FIRE CO #1	Upper Macungie (T)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
FOGELSVILLE ELEMENTARY SCHOOL	Upper Macungie (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
FRED J JAINDL ELEMENTARY SCHOOL	Upper Macungie (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
COMMONWEALTH OF PA	Upper Macungie (T)	Municipal	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
CITY OF ALLENTOWN	Upper Macungie (T)	Municipal	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
CITY OF ALLENTOWN	Upper Macungie (T)	Municipal	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
CITY OF ALLENTOWN	Upper Macungie (T)	Municipal	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
UPPER MILFORD WESTERN DIST FIRE CO 1	Upper Milford (T)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
EMMAUS BAPTIST ACADEMY	Upper Milford (T)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
SOUTH MOUNTAIN AREA MEDIC V INC	Upper Saucon (T)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
UPPER SAUCON TWP	Upper Saucon (T)	Fire	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Lehigh County											
UPPER SAUCON TWP VOLUNTEER FIRE CO 1	Upper Saucon (T)	Fire	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
HOPEWELL ELEMENTARY SCHOOL	Upper Saucon (T)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
SOUTHERN LEHIGH MIDDLE SCHOOL	Upper Saucon (T)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
SOUTHERN LEHIGH HIGH SCHOOL	Upper Saucon (T)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
ASSUMPTION BVM SCHOOL	Upper Saucon (T)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
ST MICHAELS SCHOOL	Upper Saucon (T)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
FRIEDENS FIRE COMPANY	Washington (T)	Fire	8.9	64.8	18.7	6.2	1.4	8.9	72.2	73.7	92.4
EMERALD STAR HOSE COMPANY #1	Washington (T)	Fire	9.1	64.9	18.5	6.1	1.4	9	72.4	74	92.5
CITIZENS FIRE CO	Washington (T)	Fire	9.1	64.9	18.5	6.1	1.4	9	72.4	74	92.5
PETERS ELEMENTARY SCHOOL	Washington (T)	School	8.8	64.6	18.9	6.3	1.4	8.7	71.9	73.4	92.2
WASHINGTON TWP	Washington (T)	Municipal	84.6	12.6	2.5	0.2	0.0	84.6	97.2	97.2	99.7
WASHINGTON TWP	Washington (T)	Municipal	84.6	12.6	2.5	0.2	0.0	84.6	97.2	97.2	99.7
WEISENBERG TWP	Weisenberg (T)	Fire	8.7	64.5	19.0	6.4	1.4	8.6	71.6	73.1	92.1
WEISENBERG ELEMENTARY SCHOOL	Weisenberg (T)	School	8.7	64.5	19.0	6.4	1.4	8.6	71.6	73.1	92.1
EGYPT FIRE CO #1	Whitehall (T)	Fire	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
W CATASAUQUA FIRE CO	Whitehall (T)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
HOKENDAUQUA FIRE CO #1	Whitehall (T)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
LAUREL FIRE CO #1 INC	Whitehall (T)	Fire	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
LAUREL FIRE CO #1	Whitehall (T)	Fire	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
FULLERTON FIRE CO #1	Whitehall (T)	Fire	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
LEHIGH VALLEY 7TH DAY ADVENTIST SCHOOL	Whitehall (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
WHITEHALL-COPLAY HIGH SCHOOL	Whitehall (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
WHITEHALL-COPLAY MIDDLE SCHOOL	Whitehall (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
STECKEL ELEMENTARY SCHOOL	Whitehall (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
GOCKLEY ELEMENTARY SCHOOL	Whitehall (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
CHRIST THE KING SCHOOL	Whitehall (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Lehigh County											
ST STEPHENS SCHOOL	Whitehall (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72	91.6
ST ELIZABETH SCHOOL	Whitehall (T)	School	8.0	63.7	19.8	6.9	1.6	8	70.3	71.7	91.5
WHITEHALL TWP	Whitehall (T)	Municipal	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Briarwood Commons	Whitehall (T)	Senior	83.9	13.2	2.7	0.2	0.0	83.8	97	97	99.7

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
ALLEN TWP FIRE CO	Allen (T)	Fire	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
Lehigh Valley Lutheran School	Allen (T)	School	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
Willow Green	Allen (T)	Adult Care	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Thrash Family Day Care	Allen (T)	Child Day Care	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Childhood Dreams Daycare	Allen (T)	Child Day Care	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Allen Township	Allen (T)	Municipal	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Zion's Stone Cemetery	Allen (T)	Cemeteries	84.0	13.1	2.7	0.2	0.0	84.0	97.0	97.1	99.7
147 N 11TH ST	Bangor (B)	Medical	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
129 N 11TH ST	Bangor (B)	Medical	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
BANGOR DENTAL ASSO.	Bangor (B)	Medical	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
BANGOR PD	Bangor (B)	Police	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
BANGOR FIRE DEPT - LIBERTY	Bangor (B)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
BANGOR FIRE DEPT - RESCUE	Bangor (B)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
BANGOR FIRE DEPT - SECOND WARD	Bangor (B)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
BLUE VALLEY RESCUE	Bangor (B)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Pius X High School	Bangor (B)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
District Court 03-3-03	Bangor (B)	Judicial Buildings (Courthouses)	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Gaffney Funeral Home	Bangor (B)	Funeral Homes	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Learning Locomotion	Bangor (B)	Child Day Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
United States Post Office	Bangor (B)	USPS Mail Centers (Post Offices)	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Bangor Public Library	Bangor (B)	Libraries	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Fiore Funeral Home	Bangor (B)	Funeral Homes	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Bangor Borough	Bangor (B)	Municipal	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Saint John's Lutheran Church	Bath (B)	Shelter	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
Christ Church United Church of Christ	Bath (B)	Shelter	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Bath Drug	Bath (B)	Medical	8.0	63.7	19.8	6.9	1.6	8.0	70.3	71.7	91.5
COLONIAL REGIONAL PD	Bath (B)	Police	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
BATH BORO FIRE FIGHTERS AMBULANCE	Bath (B)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
BATH BORO FIRE FIGHTERS	Bath (B)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
George Wolf Elementary School	Bath (B)	School	8.0	63.7	19.8	6.9	1.6	8.0	70.3	71.7	91.5
Sacred Heart Elementary School	Bath (B)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
ALEXANDRIA MANOR	Bath (B)	Adult Care	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
Bartholomew Funeral Home	Bath (B)	Funeral Homes	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
Mid-County Senior Center	Bath (B)	Community Organization Facilities	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
Bath Borough	Bath (B)	Municipal	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Christ Church United Church of Christ	Bath (B)	Religious (Churches)	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Learn-N-Play Daycare	Bath (B)	Child Day Care	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Sacred Heart Parish's Cemetery	Bath (B)	Cemeteries	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
United States Post Office	Bath (B)	USPS Mail Centers (Post Offices)	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Spring Garden Children's Center	Bethlehem (C)	Northampton	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
ST LUKES UNION STATION	Bethlehem (C)	Medical	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
ST LUKES PHYSICAL THERAPY	Bethlehem (C)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
2223 LINDEN ST	Bethlehem (C)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
DENTIST OFFICE	Bethlehem (C)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
1458 STEFKO BLVD	Bethlehem (C)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
NEW ST. MEDICAL CNT	Bethlehem (C)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
1313 CENTER ST	Bethlehem (C)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Quest Diagnostic Inc.	Bethlehem (C)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Quest Diagnostics Inc.	Bethlehem (C)	Medical	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Superior Cardiac Imaging Mobile Svcs	Bethlehem (C)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Baxter Healthcare	Bethlehem (C)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Bio Med Sciences Inc.	Bethlehem (C)	Medical	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
C & S Medical Supply Inc.	Bethlehem (C)	Medical	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Hess Healthcare Services	Bethlehem (C)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Orasure Technologies Inc.	Bethlehem (C)	Medical	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Sun Inn Preservation Association	Bethlehem (C)	Medical	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Liberty Senior High School	Bethlehem (C)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Gateway School of the Lehigh Valley	Bethlehem (C)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Moravian College-South	Bethlehem (C)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
St. Anne's School	Bethlehem (C)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Edgeboro School	Bethlehem (C)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Moravian College-North	Bethlehem (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Marvine Elementary School	Bethlehem (C)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Lincoln Elementary School	Bethlehem (C)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Spring Garden Elementary School	Bethlehem (C)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Bethlehem Catholic High School	Bethlehem (C)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Thomas Jefferson Elementary School	Bethlehem (C)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Governor Wolf Elementary School	Bethlehem (C)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
East Hills Middle School	Bethlehem (C)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Holy Infancy School	Bethlehem (C)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Lehigh University	Bethlehem (C)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Lehigh University	Bethlehem (C)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Lehigh University	Bethlehem (C)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Lehigh University	Bethlehem (C)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Lehigh University	Bethlehem (C)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Lehigh University	Bethlehem (C)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Lehigh University	Bethlehem (C)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Broughal Middle School	Bethlehem (C)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Donegan Elementary School	Bethlehem (C)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
STS Cyril & Methodius Parochial School	Bethlehem (C)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Northeast Middle School	Bethlehem (C)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
William Penn Elementary School	Bethlehem (C)	School	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Lehigh University - Saucon Field Complex	Bethlehem (C)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Moravian Academy Lower School	Bethlehem (C)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Moravian Academy Middle School	Bethlehem (C)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Lehigh University Child Care	Bethlehem (C)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Stabler Arena	Bethlehem (C)	Arenas (Stadiums)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Murray H. Goodman Stadium	Bethlehem (C)	Arenas (Stadiums)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Ben Franklin Technology Center	Bethlehem (C)	Research and Development	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Christ Lutheran Church of Lower Saucon	Bethlehem (C)	Cemeteries	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Holiday Inn Express Hotel & Suites	Bethlehem (C)	Lodging (Hotels)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Holy Ghost Cemetery	Bethlehem (C)	Cemeteries	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Leeman-Turner Arena at Grace Hall	Bethlehem (C)	Arenas (Stadiums)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Fritz Memorial United Methodist Church	Bethlehem (C)	Religious (Churches)	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Fritz Memorial United Methodist Church	Bethlehem (C)	Shelter	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Millie's Creative Child Care	Bethlehem (C)	Child Day Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Saint Peter's Lutheran Church	Bethlehem (C)	Shelter	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Zoellner Arts Center - Lehigh University	Bethlehem (C)	Performing Arts (Theaters)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Saints Cyril and Methodius Roman Cathol*	Bethlehem (C)	Shelter	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Head Start of the LV - St. Peter's	Bethlehem (C)	Child Day Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Lehigh Valley Child Care Campus Center	Bethlehem (C)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
District Court 03-2-10	Bethlehem (C)	Judicial Buildings (Courthouses)	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Holy Infancy Roman Catholic Church	Bethlehem (C)	Shelter	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Saint John's Windish Evangelical Church	Bethlehem (C)	Shelter	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Bethlehem Area Public Library	Bethlehem (C)	Libraries	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
United States Post Office	Bethlehem (C)	USPS Mail Centers (Post Offices)	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Zion First Hungarian Lutheran Church	Bethlehem (C)	Shelter	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Abbe Hall LLC	Bethlehem (C)	Assisted Living	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
133rd State Legislative District	Bethlehem (C)	State Buildings	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
111 W 4TH ST	Bethlehem (C)	Adult Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Concordia Lutheran Church	Bethlehem (C)	Shelter	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
L V COMM HEALTH CNTR	Bethlehem (C)	Adult Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Donegan Childcare	Bethlehem (C)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Happy Faces Day Care	Bethlehem (C)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Comfort Suites	Bethlehem (C)	Lodging (Hotels)	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Bethlehem Press	Bethlehem (C)	Print Media	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
National Museum of Industrial History	Bethlehem (C)	Museums	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Lehigh Valley Industrial Park Inc.	Bethlehem (C)	Industrial Assets	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Bethlehem City	Bethlehem (C)	Municipal	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Union Cemetery	Bethlehem (C)	Cemeteries	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Nisky Hill Cemetery	Bethlehem (C)	Cemeteries	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
City of Bethlehem Health Bureau	Bethlehem (C)	Public Health	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Bethlehem Area Public Library	Bethlehem (C)	Libraries	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Hotel Bethlehem	Bethlehem (C)	Lodging (Hotels)	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Historic Bethlehem Partnership	Bethlehem (C)	Museums	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Historic Bethlehem Partnership	Bethlehem (C)	Museums	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Moravian Village of Bethlehem	Bethlehem (C)	Adult Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Head Start of the Lehigh Valley - Unita*	Bethlehem (C)	Child Day Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
John Herron Funeral Home	Bethlehem (C)	Funeral Homes	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
NURSING HOME	Bethlehem (C)	Adult Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Trinity Episcopal Church	Bethlehem (C)	Shelter	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Trinity Episcopal Church	Bethlehem (C)	Religious (Churches)	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Long Funeral Home	Bethlehem (C)	Funeral Homes	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Moravian Village	Bethlehem (C)	Adult Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
United States Post Office	Bethlehem (C)	USPS Mail Centers (Post Offices)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Christ Church- United Church of Christ	Bethlehem (C)	Shelter	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Snyder-Hinkle Lunsford Funeral Home	Bethlehem (C)	Funeral Homes	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Historic Bethlehem Partnership	Bethlehem (C)	Museums	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Sun Inn Preservation Association	Bethlehem (C)	Medical Supplies	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
United States SS Administration	Bethlehem (C)	Federal Buildings	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Northampton County Area Agency on Aging	Bethlehem (C)	Adult Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Northampton County - Bechtel Building	Bethlehem (C)	County Buildings	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
18th State Senatorial District	Bethlehem (C)	State Buildings	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Bethlehem YMCA Child Care	Bethlehem (C)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
District Court 03-2-01	Bethlehem (C)	Judicial Buildings (Courthouses)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
American Heart Association	Bethlehem (C)	Healthcare Educational	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Head Start of the Lehigh Valley - Salem	Bethlehem (C)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
135th State Legislative District	Bethlehem (C)	State Buildings	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
United States Internal Revenue Service	Bethlehem (C)	Federal Buildings	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Kindercare Campus	Bethlehem (C)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Connell Funeral Home, Inc.	Bethlehem (C)	Northampton	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Thomas Jefferson Child Care	Bethlehem (C)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Lehigh Valley Child Care at Fowler Cent*	Bethlehem (C)	Child Day Care	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
William Penn Child Care	Bethlehem (C)	Child Day Care	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
District Court 03-2-11	Bethlehem (C)	Judicial Buildings (Courthouses)	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Salisbury Behavioral Health	Bethlehem (C)	Adult Day Care	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Fairview Cemetery	Bethlehem (C)	Cemeteries	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Giggles Kid's Club	Bethlehem (C)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Lincoln Child Day Care	Bethlehem (C)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Bethlehem Memorial Park Cemetery	Bethlehem (C)	Cemeteries	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Memorial Park Cemetery	Bethlehem (C)	Cemeteries	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Bethlehem Manor	Bethlehem (C)	Assisted Living	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Pearson Funeral Home, Inc.	Bethlehem (C)	Northampton	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Blake Messman's Daycare	Bethlehem (C)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Stefko Child Care Center	Bethlehem (C)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
USGS Monocacy Creek Gauge at Bethlehem,*	Bethlehem (C)	Northampton	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
First Presbyterian Church	Bethlehem (C)	Child Day Care	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
First Presbyterian Church	Bethlehem (C)	Religious (Churches)	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Gaidula's Family Child Care	Bethlehem (C)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
First Presbyterian Church	Bethlehem (C)	Shelter	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
KIRKLAND VILLAGE (EASTWOOD)	Bethlehem (C)	Adult Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Spring Garden Child Care	Bethlehem (C)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Holy Cross Evangelical Lutheran Church	Bethlehem (C)	Shelter	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Wesley United Methodist Church	Bethlehem (C)	Religious (Churches)	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Wesley United Methodist Church	Bethlehem (C)	Shelter	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Holy Saviour Cemetery	Bethlehem (C)	Cemeteries	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Atria Bethlehem	Bethlehem (C)	Adult Day Care	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Valley Eye Surgical Center	Bethlehem (C)	Health Practitioner (Physician)	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Bethlehem Township's Coolidge Building	Bethlehem (C)	Shelter	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
St. Thomas UCC Cemetery	Bethlehem (C)	Cemeteries	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
District Court 03-1-04	Bethlehem (C)	Judicial Buildings (Courthouses)	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Spark Child Care	Bethlehem (C)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Bethlehem Township Community Center	Bethlehem (C)	Shelter	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Saint Mark's Evangelical Lutheran Church	Bethlehem (C)	Shelter	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
ALEXANDRIA LIVING	Bethlehem (C)	Adult Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
First United Church of Christ	Bethlehem (C)	Shelter	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Northampton Community College	Bethlehem (C)	Morgues	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Ebenezer Bible Fellowship Church	Bethlehem (C)	Shelter	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
ST LUKES RIVERSIDE	Bethlehem (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
DUNKIN DONUT/ MINI MART	Bethlehem (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
COORDINATED HEALTH SERVICES	Bethlehem (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Health Network Laboratories	Bethlehem (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
St. Lukes Hospital	Bethlehem (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Digirad Imaging Solutions	Bethlehem (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Invatec	Bethlehem (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
BETHLEHEM TWP PD	Bethlehem (T)	Police	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
BETHLEHEM TWP EMS	Bethlehem (T)	Fire	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
NANCY RUN FIRE DEPT	Bethlehem (T)	Fire	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
BETHLEHEM TWP FIRE CO	Bethlehem (T)	Fire	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Freedom High School	Bethlehem (T)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Freedom High School	Bethlehem (T)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Bethlehem Area Vocational Tech School	Bethlehem (T)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Our Lady of Perpetual Church and School	Bethlehem (T)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Moravian Academy	Bethlehem (T)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Northampton County Area Comm College	Bethlehem (T)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Northampton County Area Comm College	Bethlehem (T)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Miller Heights Elementary School	Bethlehem (T)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Farmersville Elementary School	Bethlehem (T)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Notre Dame High School	Bethlehem (T)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
First Church of Christ	Bethlehem (T)	Shelter	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Caring Connection	Bethlehem (T)	Assisted Living	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Precious Ones Day Care	Bethlehem (T)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Miller Heights Child Care	Bethlehem (T)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
United States Post Office	Bethlehem (T)	USPS Mail Centers (Post Offices)	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Animal Therapy Center	Bethlehem (T)	Animal Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Bethlehem Township Coolidge Building	Bethlehem (T)	Community Organization Facilities	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
MANOR CARE	Bethlehem (T)	Adult Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Bethlehem Township Community Center	Bethlehem (T)	Community Organization Facilities	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Chapel Family Child Care	Bethlehem (T)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Federal Express - Freight	Bethlehem (T)	Courier Centers	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Courtyard by Marriott - Bethlehem	Bethlehem (T)	Lodging (Hotels)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Marriott Courtyard Bethlehem	Bethlehem (T)	Lodging (Hotels)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
United Parcel Service	Bethlehem (T)	Courier Centers	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Bethlehem Township Municipal Bldg	Bethlehem (T)	Shelter	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Farmersville Child Care	Bethlehem (T)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Northampton Country Club	Bethlehem (T)	Golf Courses	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Bethlehem Township	Bethlehem (T)	Municipal	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
St. John's Lutheran of Farmersville	Bethlehem (T)	Cemeteries	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Green Pond Country Club	Bethlehem (T)	Golf Courses	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Lehigh Valley Friends Meetinghouse	Bethlehem (T)	Shelter	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Lehigh Valley Child Care Stone's Crossi*	Bethlehem (T)	Child Day Care	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
Country Meadows	Bethlehem (T)	Adult Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
BLDG 1 & 2 COUNTRY MEADOWS BET	Bethlehem (T)	Adult Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Comfort Inn	Bethlehem (T)	Lodging (Hotels)	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Northampton Memorial Shrine Inc.	Bethlehem (T)	Cemeteries	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Lehigh River Boat Access Ramp	Bethlehem (T)	Waterways	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
Cummings Veterinary Hospital, LLC	Bethlehem (T)	Medical	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
BUSHKILL TWP PD	Bushkill (T)	Police	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
BUSHKILL TWP EMS	Bushkill (T)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
BUSHKILL TWP FIRE CO	Bushkill (T)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
Bushkill Elementary School	Bushkill (T)	School	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Jacobsburg Historical Society	Bushkill (T)	Museums	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Holy Cross Day Care Center	Bushkill (T)	Child Day Care	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Jacobsburg EE Center Bureau State Parks	Bushkill (T)	State Buildings	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Little Buddies Childcare and Preschool	Bushkill (T)	Child Day Care	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Bushkill Township	Bushkill (T)	Municipal	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Sullivan Trail Golf Course	Bushkill (T)	Golf Courses	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Catasauqua High School	Catasauqua (B)	Shelter	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Chapman Borough	Chapman (B)	Municipal	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
BATH COMMUNITY MED	East Allen (T)	Medical	8.0	63.7	19.8	6.9	1.6	8.0	70.3	71.7	91.5



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Health Network Laboratories	East Allen (T)	Medical	8.0	63.7	19.8	6.9	1.6	8.0	70.3	71.7	91.5
EAST ALLEN TWP AMBULANCE CORPS	East Allen (T)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
EAST ALLEN TWP FIRE CO	East Allen (T)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
16th State Senatorial District	East Allen (T)	State Buildings	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
138th State Legislative District	East Allen (T)	State Buildings	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
East Allen Township	East Allen (T)	Municipal	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
St. Peter's UCC Cemetery	East Allen (T)	Cemeteries	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
EAST BANGOR PD	East Bangor (B)	Police	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
EAST BANGOR FIRE CO	East Bangor (B)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
East Bangor Borough	East Bangor (B)	Municipal	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
412 MONROE ST	Easton (C)	Medical	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
EASTON CHIROPRACTIC	Easton (C)	Medical	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
NORTHAMPTON COUNTY SHERIFF DEPT	Easton (C)	Police	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
EASTON CITY PD	Easton (C)	Police	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
EASTON EMERGENCY SQUAD	Easton (C)	Fire	7.4	63.0	20.5	7.3	1.8	7.4	68.9	70.4	90.8
EASTON CITY FIRE DEPT - CENTRAL	Easton (C)	Fire	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
EASTON CITY FIRE DEPT - COLLEGE HILL	Easton (C)	Fire	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
EASTON CITY FIRE DEPT - SOUTH SIDE	Easton (C)	Fire	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
PA WATER RECUE	Easton (C)	Fire	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Easton Catholic and EC-ST Joseph ES	Easton (C)	School	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
March Elementary School	Easton (C)	School	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
Cheston Elementary School	Easton (C)	School	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
Cheston Elementary School	Easton (C)	School	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
Cheston Elementary School	Easton (C)	School	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
Cheston Elementary School	Easton (C)	School	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
Cheston Elementary School	Easton (C)	School	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
Lafayette College	Easton (C)	School	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
Lafayette College	Easton (C)	School	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
Easton Area Middle School	Easton (C)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Saint John's Evangelical Lutheran Church	Easton (C)	Shelter	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
Saint John's United Church of Christ	Easton (C)	Shelter	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Christ Evangelical Congregational Churc*	Easton (C)	Shelter	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
Morello Funeral Home	Easton (C)	Funeral Homes	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
River of God Fellowship Church	Easton (C)	Religious (Churches	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
River of God Fellowship Church	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Hays Cemetery	Easton (C)	Cemeteries	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Holy Ghost Ukranian Catholic Church	Easton (C)	Shelter	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
New Life Presbyterian Church	Easton (C)	Shelter	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Saint Paul's Lutheran Church	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
St. Paul Lutheran Church	Easton (C)	Religious (Churches	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Head Start of the LV - Easton Paul's	Easton (C)	Child Day Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Pride and Joy Educational Day Care	Easton (C)	Child Day Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Shiloh Baptist Church-Enrichment Center	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Shiloh Manor Inc.	Easton (C)	Assisted Living	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Greater Shiloh Church	Easton (C)	Religious (Churches	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Family YMCA of Easton	Easton (C)	Child Day Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Head Start of the LV - Our Lady of Mercy	Easton (C)	Child Day Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Memorial United Church of Christ	Easton (C)	Shelter	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Salisbury Behavioral Health	Easton (C)	Adult Day Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
All My Children Daycare	Easton (C)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
USGS Lehigh River Gauge at Easton, PA	Easton (C)	Northampton	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Northampton County - Archives Building	Easton (C)	County Buildings	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Northampton County Archives	Easton (C)	Storage and Preservation (Archive)	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
1PRAXIS NURSING HOME	Easton (C)	Adult Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
1EASTON NURSING CENT	Easton (C)	Adult Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
St. Anthony's Youth Center	Easton (C)	Religious (Churches	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Saint Anthony's Youth Center	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Northampton County Courthouse	Easton (C)	Judicial Buildings (Courthouses)	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Quality Inn	Easton (C)	Lodging (Hotels)	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
NORTHAMPTON CTY DOMESTIC RELATIONS	Easton (C)	County Building	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Faith Unity Church	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
NORTHAMPTON CTY CORONER OFFICE	Easton (C)	County Building	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
NH Cty Courthouse & Gov Center	Easton (C)	County Building	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
NORTHAMPTON COUNTY PRISON	Easton (C)	PRISON	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Northampton County Prison - Work Release	Easton (C)	County Buildings	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Saint Bernard's Roman Catholic Church	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Christ Lutheran Church	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
United States SS Administration	Easton (C)	Federal Buildings	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Christ Lutheran Church	Easton (C)	Religious (Churches)	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Dutchman Cemetery	Easton (C)	Cemeteries	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
St. Bernard's Oratory	Easton (C)	Religious (Churches)	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Saint John's Evangelical Lutheran Church	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Northampton County Juvenile Detention	Easton (C)	County Buildings	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Northampton County Prison	Easton (C)	Prisons	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
St. John's Evangelical Lutheran Church	Easton (C)	Religious (Churches)	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Lou Reda Productions	Easton (C)	Motion Picture and Sound	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Church of God by Faith Inc.	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Easton (Lehigh River) Boat Access Ramp	Easton (C)	Waterways	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
DAR Parsons Taylor House	Easton (C)	Museums	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Our Lady of Lebanon Church	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Pennsylvania Department of Health	Easton (C)	Public Health	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Second Baptist Church	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
United States Post Office	Easton (C)	USPS Mail Centers (Post Offices)	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
EASTON HOME/PRESBY SENIORS	Easton (C)	Adult Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Easton (Delaware River) Boat Access Ramp	Easton (C)	Waterways	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Easton Irregular	Easton (C)	Print Media	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Ashton Funeral Home, Inc.	Easton (C)	Northampton	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Olivet Wee Care Daycare and Nursery	Easton (C)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Olivet United Presbyterian Church	Easton (C)	Religious (Churches)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Easton City	Easton (C)	Municipal	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Olivet United Presbyterian Church	Easton (C)	Shelter	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
District Court 03-2-05	Easton (C)	Judicial Buildings (Courthouses)	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
United States National Park Service	Easton (C)	Federal Buildings	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Binney & Smith Crayola Crayon Tours	Easton (C)	Museums	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Hugh Moore Park & Museum	Easton (C)	Museums	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
National Canal Museum	Easton (C)	Museums	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
NC Historical & Genealogical Society	Easton (C)	Museums	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
ACJC Day Care Center	Easton (C)	Child Day Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Head Start of the LV - Northampton Stre*	Easton (C)	Child Day Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
First Evangelical Congregational Church	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
State Theatre Center for the Arts	Easton (C)	Performing Arts (Theaters)	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
First Evangelical Congregational Church	Easton (C)	Religious (Churches)	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
136th State Legislative District	Easton (C)	State Buildings	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Bachmann Publick House	Easton (C)	Museums	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Angel's Daycare Center	Easton (C)	Child Day Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Express Times	Easton (C)	Print Media	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Easton Area Public Library	Easton (C)	Libraries	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Northampton County - Governor Wolf Bldg	Easton (C)	County Buildings	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
First United Church of Christ	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Third Street Alliance for Women & Child*	Easton (C)	Child Day Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Church of The Nazarene	Easton (C)	Shelter	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Trinity Episcopal Church	Easton (C)	Religious (Churches)	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
First Moravian Church	Easton (C)	Religious (Churches)	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
First Presbyterian Church	Easton (C)	Religious (Churches)	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
First Moravian Church	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
First Presbyterian Church	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
USGS Delaware River Gauge Phillipsburg,*	Easton (C)	Northampton	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Easton - Phillipsburg Toll Bridge	Easton (C)	Bridges	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Easton Cemetery Company	Easton (C)	Cemeteries	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Trinity Child Care	Easton (C)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Easton Heights Cemetery Company	Easton (C)	Cemeteries	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Family YMCA of Easton	Easton (C)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Fisher Stadium	Easton (C)	Arenas (Stadiums)	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Lafayette Early Learning Center	Easton (C)	Child Day Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Saint Paul's Third Lutheran Church	Easton (C)	Shelter	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Lehigh Valley Child Care March School	Easton (C)	Child Day Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Arndt's Lutheran Church	Easton (C)	Shelter	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Faith Lutheran Church	Easton (C)	Shelter	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Creative Learning Center	Easton (C)	Child Day Care	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
Quest Diagnostics Inc.	Forks (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
FORKS TWP PD	Forks (T)	Police	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
FORKS TWP EMS	Forks (T)	Fire	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
FORKS TWP FIRE DEPT	Forks (T)	Fire	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
MEDIC 9 - SOUTH	Forks (T)	Fire	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
Forks Elementary School	Forks (T)	School	7.3	62.8	20.7	7.4	1.8	7.3	68.6	70.1	90.7
Paxinosa ES and Shawnee Intermediate	Forks (T)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Career Institute of Technology	Forks (T)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Riverview Golf & Country Club	Forks (T)	Golf Courses	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
Binney & Smith	Forks (T)	Museums	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Family YMCA of Easton	Forks (T)	Child Day Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Thoreau Veterinary Hospital	Forks (T)	Animal Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Forks Township Community Center	Forks (T)	Community Organization Facilities	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Family YMCA of Easton	Forks (T)	Child Day Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Lehigh Valley Child Care at Forks School	Forks (T)	Child Day Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Forks Township	Forks (T)	Municipal	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Goddard School	Forks (T)	Child Day Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Faith Lutheran Church	Forks (T)	Religious (Churches)	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Easton Animal Hospital	Forks (T)	Animal Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Home Sweet Home	Forks (T)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
VILLAGE AT SULLIVAN TRAIL	Forks (T)	Adult Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Majestic Athletic, Ltd.	Forks (T)	Northampton	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
The Village at Upstream Farm	Forks (T)	Adult Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Riverview Estates	Forks (T)	Adult Care	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
Jacob's Farm	Forks (T)	Adult Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Lehigh Valley Child Care Great Beginnin*	Forks (T)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
PA Army Natl Guard - Easton Ctr	Forks (T)	National Guard Facilities	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Tech Tyke Center	Forks (T)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
FREEMANSBURG PD	Freemansburg (B)	Police	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
FREEMANSBURG FIRE	Freemansburg (B)	Fire	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Freemansburg Elementary School	Freemansburg (B)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Freemansburg Borough	Freemansburg (B)	Municipal	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Freemansburg Child Care	Freemansburg (B)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Pembroke Pee Wee's Child Care	Freemansburg (B)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Glendon Borough	Glendon (B)	Municipal	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
USGS Lehigh River Gauge at Glendon, PA	Glendon (B)	Northampton	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
ST. LUKES NORTH	Hanover (T)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
52 HIGHLAND AVE	Hanover (T)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
CAMPBELL MEDICAL CEN	Hanover (T)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Radiology & MRI of Bethlehem	Hanover (T)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
St. Lukes Hospital	Hanover (T)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Boas Surgical Inc.	Hanover (T)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Helping Hands Medical Supply	Hanover (T)	Medical	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Homestar Medical Equip & Infusion Center	Hanover (T)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Lincare	Hanover (T)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
HANOVER TWP EMS	Hanover (T)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
HANOVER TWP FIRE	Hanover (T)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Asa Packer Elementary School	Hanover (T)	School	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Hanover Elementary School	Hanover (T)	School	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Holy Cross Evangelical Lutheran Church	Hanover (T)	Religious (Churches)	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Atria Bethlehem	Hanover (T)	Assisted Living	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
SR QUARTERS AT MUHLE	Hanover (T)	Adult Care	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Visiting Nurse Association	Hanover (T)	Healthcare and Public Health - Other	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Miller Keystone Blood Center	Hanover (T)	Blood	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Asa Packer Child Care	Hanover (T)	Child Day Care	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Holiday Inn Express Hotels & Suites	Hanover (T)	Lodging (Hotels)	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Hanover Glen	Hanover (T)	Adult Care	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Hanover (N) Township	Hanover (T)	Municipal	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Hampton Inn & Suites	Hanover (T)	Lodging (Hotels)	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Best Western Conference Center	Hanover (T)	Lodging (Hotels)	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Hanover Child Care	Hanover (T)	Child Day Care	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Triangle Tech	Hanover (T)	Specialized Education	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Lehigh Valley Friends Meetinghouse	Hanover (T)	Religious (Churches)	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Division of Long Term Care - Dept Health	Hanover (T)	State Buildings	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
Department of Environmental Protection	Hanover (T)	State Buildings	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
Federal Express	Hanover (T)	Courier Centers	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
Traditions of America at Hanover	Hanover (T)	Adult Care	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
Miller Keystone Blood Center	Hanover (T)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Visiting Nurse Association	Hanover (T)	Medical	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
SAUCON VALLEY FAMILY PRACTICE	Hellertown (B)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Quest Diagnostics Inc.	Hellertown (B)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
St. Lukes Hospital	Hellertown (B)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Yeagers Pharmacy	Hellertown (B)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
HELLERTOWN PD	Hellertown (B)	Police	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
DEWEY FIRE COMPANY AMBULANCE	Hellertown (B)	Fire	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
METRO EMS	Hellertown (B)	Fire	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
DEWEY FIRE COMPANY	Hellertown (B)	Fire	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Christ Lutheran Center	Hellertown (B)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Hellertown Union Cemetery	Hellertown (B)	Cemeteries	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Saucon Valley Community Center	Hellertown (B)	Community Organization Facilities	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Saucon Valley Community Center	Hellertown (B)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Heintzelman Funeral Home	Hellertown (B)	Funeral Homes	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Hellertown Area Library	Hellertown (B)	Libraries	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
United States Post Office	Hellertown (B)	USPS Mail Centers (Post Offices)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Hellertown Borough	Hellertown (B)	Municipal	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
SAUCON VALLEY MANOR/SENIORLIVI	Hellertown (B)	Adult Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Silver Creek Country Club	Hellertown (B)	Golf Courses	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Society of Little Learners Child Care	Hellertown (B)	Child Day Care	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
Saint Theresa School	Hellertown (B)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Bethany Wesleyan Church	Lehigh (T)	Shelter	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
LEHIGH TWP PD	Lehigh (T)	Police	8.7	64.5	19.0	6.4	1.4	8.6	71.6	73.1	92.1
LEHIGH TWP FIRE CO	Lehigh (T)	Fire	8.7	64.5	19.0	6.4	1.4	8.6	71.6	73.1	92.1
Lehigh Township Elementary School	Lehigh (T)	School	8.7	64.5	19.0	6.4	1.4	8.6	71.6	73.1	92.1
United States Post Office	Lehigh (T)	USPS Mail Centers (Post Offices)	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
Sharon's Day Care	Lehigh (T)	Child Day Care	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
Cherryville Animal Hospital, P.C.	Lehigh (T)	Northampton	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
Teddy Bear Day Care	Lehigh (T)	Child Day Care	84.0	13.1	2.7	0.2	0.0	84.0	97.0	97.1	99.7
Bethany Wesleyan Church	Lehigh (T)	Religious (Churches)	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
United States Post Office	Lehigh (T)	USPS Mail Centers (Post Offices)	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
St. Paul's UCC Indianland Cemetery	Lehigh (T)	Cemeteries	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
District Court 03-3-01	Lehigh (T)	Judicial Buildings (Courthouses)	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
CHANDLER III	Lehigh (T)	Adult Care	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
Blue Ridge Veterinary Clinic	Lehigh (T)	Animal Care	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
Lehigh Township	Lehigh (T)	Municipal	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
PERSONAL CARE HOME	Lehigh (T)	Adult Care	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
Liza's House Personal Care Home	Lehigh (T)	Adult Day Care	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
United States Post Office	Lehigh (T)	USPS Mail Centers (Post Offices)	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
Sandt's Eddy Boat Access Ramp	Lower Mt Bethel (T)	Waterways	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
James Palmeri Funeral Home	Lower Mt Bethel (T)	Funeral Homes	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
PPL Boat Access Ramp	Lower Mt Bethel (T)	Waterways	82.3	14.3	3.1	0.2	0.0	82.3	96.6	96.6	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
PPL Public Boat Access Ramp	Lower Mt Bethel (T)	Waterways	82.3	14.3	3.1	0.2	0.0	82.3	96.6	96.6	99.7
LOWER MT BETHEL FIRE CO	Lower Mt. Bethel (T)	Fire	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
LOWER MT BETHEL TWP FIRE	Lower Mt. Bethel (T)	Fire	7.4	63.0	20.5	7.3	1.8	7.4	68.9	70.4	90.8
Lower Mount Bethel Township	Lower Mt. Bethel (T)	Municipal	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
1NORTHWOOD MED. ARTS	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Any Lab Test Now	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Easton Hospital Laboratory Services	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Health Network Laboratories	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Progressive Physicians Vascular Lab	Lower Nazareth (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
HECKTOWN EMS	Lower Nazareth (T)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
HECKTOWN FIRE CO	Lower Nazareth (T)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Lower Nazareth Elementary School	Lower Nazareth (T)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Governor Wolf	Lower Nazareth (T)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
VCA Northside Animal Hospital	Lower Nazareth (T)	Animal Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
District Court 03-2-03	Lower Nazareth (T)	Judicial Buildings (Courthouses)	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Nazareth Area Day Care	Lower Nazareth (T)	Child Day Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Lower Nazareth Township	Lower Nazareth (T)	Municipal	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Lehigh Valley Child Care Lower Nazareth	Lower Nazareth (T)	Child Day Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Towneplace Suites By Marriott	Lower Nazareth (T)	Lodging (Hotels)	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Trio Farms	Lower Nazareth (T)	Adult Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
LOWER SAUCON PD	Lower Saucon (T)	Police	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
SE-WY-CO FIRE	Lower Saucon (T)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
LEITHSVILLE FIRE CO	Lower Saucon (T)	Fire	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
SOUTHEASTERN FIRE CO	Lower Saucon (T)	Fire	7.4	63.0	20.5	7.3	1.8	7.4	68.9	70.4	90.8
STEEL CITY FIRE CO	Lower Saucon (T)	Fire	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
Lehigh University	Lower Saucon (T)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Saucon Valley School District Campus	Lower Saucon (T)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Saucon Valley Animal Hospital	Lower Saucon (T)	Animal Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
New Jerusalem Evangelical Lutheran Chur*	Lower Saucon (T)	Cemeteries	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
MARY ELLEN CONVALESC	Lower Saucon (T)	Adult Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Saucon Valley Com Center Fore & Aft	Lower Saucon (T)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
VNA HOSPICE @ ST LUKES	Lower Saucon (T)	Adult Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
District Court 03-2-04	Lower Saucon (T)	Judicial Buildings (Courthouses)	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
IMMED.CARE FCTY/M/R	Lower Saucon (T)	Adult Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
IMMED.CARE FCTY M/R	Lower Saucon (T)	Adult Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Lower Saucon Township	Lower Saucon (T)	Municipal	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Woodland Hills Country Club	Lower Saucon (T)	Golf Courses	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
MOORE TWP PD	Moore (T)	Police	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
MOORE TWP EMS	Moore (T)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
KLECKNERSVILLE RANGERS FIRE CO	Moore (T)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
Moore Township Elementary School	Moore (T)	School	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
Whitetail Golf Club	Moore (T)	Golf Courses	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Southmoore Golf Course	Moore (T)	Golf Courses	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Emmanuel Lutheran Church Cemetery	Moore (T)	Cemeteries	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Covenant United Methodist Cemetery	Moore (T)	Cemeteries	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Moore Township	Moore (T)	Municipal	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Bensing Funeral Home, Inc.	Moore (T)	Northampton	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Salem UCC Cemetery	Moore (T)	Cemeteries	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Woodstone Country Club	Moore (T)	Golf Courses	84.0	13.1	2.7	0.2	0.0	84.0	97.0	97.1	99.7
Amy Pysher's Child Care Center	Moore (T)	Child Day Care	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
138th State Legislative District	Moore (T)	State Buildings	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
W NORTH ST	Nazareth (B)	Medical	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Quest Diagnostics, Inc.	Nazareth (B)	Medical	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
St. Lukes Hospital	Nazareth (B)	Medical	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Nazareth Medical Equipment	Nazareth (B)	Medical	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
NAZARETH PD	Nazareth (B)	Police	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
NANZARETH BORO EMS	Nazareth (B)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
VIGILANCE HOSE CO	Nazareth (B)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Shafer Elementary School	Nazareth (B)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Holy Family School	Nazareth (B)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Holy Family School	Nazareth (B)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Holy Family School	Nazareth (B)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Holy Family School	Nazareth (B)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
LV Child Care Nazareth Int School	Nazareth (B)	Child Day Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
137th State Legislative District	Nazareth (B)	State Buildings	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Saint John's Lutheran Church	Nazareth (B)	Shelter	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
St. John's Lutheran Church	Nazareth (B)	Religious (Churches)	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
St. John's Lutheran Day Care	Nazareth (B)	Child Day Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Nazareth Veterinary Center PC	Nazareth (B)	Animal Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Saint John's United Church of Christ	Nazareth (B)	Shelter	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Kids Learning Kingdom	Nazareth (B)	Child Day Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
St. John's United Church of Christ	Nazareth (B)	Religious (Churches)	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Reichel Funeral Home, Inc.	Nazareth (B)	Northampton	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Nazareth Borough	Nazareth (B)	Municipal	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
District Court 03-2-08	Nazareth (B)	Judicial Buildings (Courthouses)	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Northampton Country Childcare	Nazareth (B)	Child Day Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Lehigh Valley Child Care Shafer School	Nazareth (B)	Child Day Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
ALEXANDRIA MANOR	Nazareth (B)	Adult Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Whitefield House Museum	Nazareth (B)	Museums	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Bartholomew-Schisler Funeral Home, Inc.	Nazareth (B)	Northampton	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Nazareth Memorial Library	Nazareth (B)	Libraries	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
United States Post Office	Nazareth (B)	USPS Mail Centers (Post Offices)	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
MORAVIAN HALL MORNING STAR	Nazareth (B)	Adult Care	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Nazareth Key	Nazareth (B)	Print Media	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Martin Guitar Museum	Nazareth (B)	Museums	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
N CATASAUQUA MEDICAL	North Catasauqua (B)	Medical	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
NORTH CATASAUQUA PD	North Catasauqua (B)	Police	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
CHARITON HOSE CO	North Catasauqua (B)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
North Catasauqua Borough	North Catasauqua (B)	Municipal	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Delabar Family	North Catasauqua (B)	Child Day Care	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
St. Michael's Cemetery	Bethlehem (C)	Cemeteries	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
PA DOT - Stockpile Hope Road	Bethlehem (T)	Municipal Buildings	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
PA DOT - Northampton Cty Maint District	Palmer (T)	Municipal Buildings	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
PA DOT - Stockpile Newburg	Lower Nazareth (T)	Municipal Buildings	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
PA DOT - Stockpile Danielsville	Lehigh (T)	Municipal Buildings	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
PA DOT - Stockpile Pen Argyl	Pen Argyl (TB)	Municipal Buildings	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
NORTH. MEDICAL ARTS	Northampton (B)	Medical	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
Health Network Laboratories	Northampton (B)	Medical	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
Sacred Heart Outpatient Lab Services	Northampton (B)	Medical	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
Newhard Pharmacy	Northampton (B)	Medical	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
Webb Medical Systems	Northampton (B)	Medical	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
NORTHAMPTON BORO PD	Northampton (B)	Police	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
NORTHAMPTON REGIONAL EMS	Northampton (B)	Fire	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
NORTHAMPTON BORO FIRE DEPT	Northampton (B)	Fire	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
Franklin Elementary School	Northampton (B)	School	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
Our Lady of Hungary Elementary School	Northampton (B)	School	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Saint John the Baptist Elementary School	Northampton (B)	School	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
Northampton Area Jr and Sr HS	Northampton (B)	School	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
Wolf Elementary School	Northampton (B)	School	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
Bethlehem Area Vo-Tech School	Northampton (B)	School	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
Washington Elementary School	Northampton (B)	School	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
Washington Elementary School	Northampton (B)	School	8.4	64.2	19.3	6.6	1.5	8.3	71.1	72.6	91.9
Duck Duck Goose	Northampton (B)	Child Day Care	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Grace United Church of Christ	Northampton (B)	Shelter	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Grace United Church of Christ	Northampton (B)	Religious (Churches)	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Assumption of the Virgin Mary	Northampton (B)	Religious (Churches)	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
NORTHAMPTON VILLAGE	Northampton (B)	Adult Care	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Our Lady of Hungary Church	Northampton (B)	Shelter	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Assumption of The Virgin Mary Ukranian *	Northampton (B)	Shelter	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Northampton Borough	Northampton (B)	Municipal	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Northampton Community Center	Northampton (B)	Community Organization Facilities	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Northampton Area Public Library	Northampton (B)	Libraries	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
United States Post Office	Northampton (B)	USPS Mail Centers (Post Offices)	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
183rd State Legislative District	Northampton (B)	State Buildings	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
District Court 03-2-07	Northampton (B)	Judicial Buildings (Courthouses)	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Schisler Funeral Home	Northampton (B)	Funeral Homes	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Reichel Funeral Home, Inc.	Northampton (B)	Northampton	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
SACRED HEART LIVING	Northampton (B)	Adult Care	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
Unknown name	Northampton (B)	Adult Care	83.9	13.2	2.7	0.2	0.0	83.8	97.0	97.0	99.7
DIAGNOSTIC IMAGING	Palmer (T)	Medical	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
UNIT 3 PALMER MED	Palmer (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
30 COMMUNITY DR	Palmer (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
UNIT 5 PALMER MED	Palmer (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
UNIT 2 PALMER MED	Palmer (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
UNIT 6 PALMER MED	Palmer (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
GASTROENTEROLOGY CENTER	Palmer (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
UNIT 4 PALMER MED	Palmer (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
UNIT 1 PALMER MED	Palmer (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
DENTAL OFFICE	Palmer (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
DR. BODY, DENTIST	Palmer (T)	Medical	7.4	63.0	20.5	7.3	1.8	7.4	68.9	70.4	90.8
BOONSWANG MED OFF	Palmer (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Easton Hospital Laboratory Services	Palmer (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Pinnacle Lab	Palmer (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Youngs Medical Equipment	Palmer (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
PALMER TWP PD	Palmer (T)	Police	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
SUBURBAN EMS	Palmer (T)	Fire	7.4	63.0	20.5	7.3	1.8	7.4	68.9	70.4	90.8
PALMER TWP FIRE - STATION 2	Palmer (T)	Fire	7.4	63.0	20.5	7.3	1.8	7.4	68.9	70.4	90.8
PALMER TWP FIRE	Palmer (T)	Fire	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Easton Area High School	Palmer (T)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Palmer Elementary School	Palmer (T)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Edward Tracy Elementary School	Palmer (T)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Serenity	Palmer (T)	Assisted Living	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
William Penn Animal Hospital	Palmer (T)	Animal Care	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
United States Post Office	Palmer (T)	USPS Mail Centers (Post Offices)	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
Lehigh Valley Child Care at Easton	Palmer (T)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
New Creation United Church of Christ	Palmer (T)	Religious (Churches)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Holiday Inn Express	Palmer (T)	Lodging (Hotels)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Charles Chrin Community Center of Palme*	Palmer (T)	Community Organization Facilities	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
MANOR CARE # 574	Palmer (T)	Adult Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Patti Stout Group Child Day Care	Palmer (T)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Redi-Care Medical Center	Palmer (T)	Ambulatory Healthcare	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Comfort Inn	Palmer (T)	Lodging (Hotels)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Palmer Moravian Day School	Palmer (T)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Enclave at Knob Hill	Palmer (T)	Adult Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Littlest Little People Country Club	Palmer (T)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Little People Country Club	Palmer (T)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Palmer Township	Palmer (T)	Municipal	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
St. Paul's Third Lutheran Church	Palmer (T)	Religious (Churches)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
District Court 03-2-09	Palmer (T)	Judicial Buildings (Courthouses)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Easton Area Public Library	Palmer (T)	Libraries	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Hampton Inn	Palmer (T)	Lodging (Hotels)	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
LPCC Extended Care at Tracy School	Palmer (T)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Traditions of Glenmoor	Palmer (T)	Adult Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Highlands at Glenmoor North	Palmer (T)	Adult Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Redi-Care Medical Center	Palmer (T)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
PEN ARGYL PD	Pen Argyl (B)	Police	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
PEN ARGYL FIRE CO	Pen Argyl (B)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Pen Argyl Junior-Senior High School	Pen Argyl (B)	School	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Immaculate Conception School	Pen Argyl (B)	School	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
MORNING STAR MANOR	Pen Argyl (B)	Adult Care	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Morning Star Manor	Pen Argyl (B)	Adult Day Care	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
United States Post Office	Pen Argyl (B)	USPS Mail Centers (Post Offices)	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Pen Argyl Borough	Pen Argyl (B)	Municipal	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Kid's Campus Nursery and Day Care	Pen Argyl (B)	Child Day Care	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
AVH Veterinarian Group	Pen Argyl (B)	Animal Care	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
FAMILY CARE CENT INC	Plainfield (T)	Medical	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
WIND GAP PROF CENTER	Plainfield (T)	Medical	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
PLAINFIELD TWP PD	Plainfield (T)	Police	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
PLAINFIELD TWP FIRE & AMBULANCE	Plainfield (T)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
PLAINFIELD TWP FIRE & AMBULANCE	Plainfield (T)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Wind Gap Middle School	Plainfield (T)	School	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
Plainfield Elementary School	Plainfield (T)	School	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Sawmill Golf Course	Plainfield (T)	Golf Courses	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
BELFAST PSP	Plainfield (T)	PSP	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Plainfield Township	Plainfield (T)	Municipal	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
CHANDLER ESTATES IV	Plainfield (T)	Adult Care	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Chandler Estate, Inc.	Plainfield (T)	Northampton	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Operation Smart Start	Plainfield (T)	Child Day Care	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
PORTLAND PD	Portland (B)	Police	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
PORTLAND & VICINITY AMBULANCE CORPS	Portland (B)	Fire	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
PORTLAND HOOK & LADDER	Portland (B)	Fire	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Portland Borough	Portland (B)	Municipal	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
United States Post Office	Portland (B)	USPS Mail Centers (Post Offices)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
ROSETO PD	Roseto (B)	Police	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
ROSETO FIRE CO	Roseto (B)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Our Lady of Mount Carmel School	Roseto (B)	School	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Our Lady of Mount Carmel Cemetery	Roseto (B)	Cemeteries	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
United States Post Office	Roseto (B)	USPS Mail Centers (Post Offices)	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
Roseto Borough	Roseto (B)	Municipal	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
STOCKERTOWN PD	Stockertown (B)	Police	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
LIBERTY HOSE CO	Stockertown (B)	Fire	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
United States Post Office	Stockertown (B)	USPS Mail Centers (Post Offices)	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Stockertown Borough	Stockertown (B)	Municipal	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
TATAMY PD	Tatamy (B)	Police	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
TATAMY BORO FIRE DEPT	Tatamy (B)	Fire	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
United States Post Office	Tatamy (B)	USPS Mail Centers (Post Offices)	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Tatamy Borough	Tatamy (B)	Municipal	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
USGS Bushkill Creek Gauge SR2017 brdg	Tatamy (B)	Sensor and Monitoring Systems (GPS)	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
USGS Bushkill Creek Gauge Route 33	Tatamy (B)	Sensor and Monitoring Systems (GPS)	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Doe Hollow Boat Access Ramp	Upper Mt Bethel (T)	Waterways	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Mount Bethel Trinity Cemetery	Upper Mt Bethel (T)	Cemeteries	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Christ Evang Lutheran Church Cemetery	Upper Mt Bethel (T)	Cemeteries	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Bangor Area School District Day Care	Upper Mt Bethel (T)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Slate Belt Child Care	Upper Mt Bethel (T)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Wee Love & Care Day Care	Upper Mt Bethel (T)	Child Day Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Portland Power Plant Boat Access Ramp	Upper Mt Bethel (T)	Waterways	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Portland - Columbia Toll Bridge	Upper Mt Bethel (T)	Bridges	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Portland - Columbia Pedestrian Bridge	Upper Mt Bethel (T)	Bridges	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
MOUNT BETHEL FIRE CO	Upper Mt. Bethel (T)	Fire	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
NORTH BAQNGOR FIRE DEPT	Upper Mt. Bethel (T)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Bangor Sr/Jr/Five Points/Dom DeFranco	Upper Mt. Bethel (T)	School	7.7	63.3	20.2	7.1	1.7	7.6	69.4	70.9	91.1
BETHANY HOME	Upper Mt. Bethel (T)	Adult Care	82.5	14.2	3.0	0.2	0.0	82.4	96.6	96.7	99.7
Upper Mount Bethel Township	Upper Mt. Bethel (T)	Municipal	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
UPPER NAZARETH TWP PD	Upper Nazareth (T)	Police	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
EAST LAWN FIRE CO	Upper Nazareth (T)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Nazareth Area Junior and Senior HS	Upper Nazareth (T)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Nazareth Area Junior and Senior HS	Upper Nazareth (T)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Nazareth Area Middle School	Upper Nazareth (T)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
911 OFFICE BLDG	Upper Nazareth (T)	Adult Care	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
Gracedale Nursing Home	Upper Nazareth (T)	Nursing Home	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
GRACEDALE	Upper Nazareth (T)	Adult Care	83.4	13.5	2.8	0.2	0.0	83.4	96.9	96.9	99.7
Upper Nazareth Township	Upper Nazareth (T)	Municipal	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7
Northampton County EOC	Upper Nazareth (T)	EOC	69.5	17.7	10.2	2.3	0.3	69.4	86.7	87.1	97.3
WALNUTPORT MED. OFFI	Walnutport (B)	Medical	8.9	64.8	18.7	6.2	1.4	8.9	72.2	73.7	92.4
NORTHERN LEHIGH MED	Walnutport (B)	Medical	8.9	64.8	18.7	6.2	1.4	8.9	72.2	73.7	92.4
WALNUTPORT BORO PD	Walnutport (B)	Police	8.9	64.8	18.7	6.2	1.4	8.9	72.2	73.7	92.4
DIAMOND FIRE CO	Walnutport (B)	Fire	8.9	64.8	18.7	6.2	1.4	8.9	72.2	73.7	92.4
Walnutport Elementary School	Walnutport (B)	School	8.9	64.8	18.7	6.2	1.4	8.9	72.2	73.7	92.4
Seventh Day Adventist Church	Walnutport (B)	Shelter	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
United States Post Office	Walnutport (B)	USPS Mail Centers (Post Offices)	84.5	12.7	2.6	0.2	0.0	84.4	97.1	97.2	99.7
Walnutport Borough	Walnutport (B)	Municipal	84.5	12.7	2.6	0.2	0.0	84.4	97.1	97.2	99.7
Hill Street Children's Center	Walnutport (B)	Child Day Care	84.5	12.7	2.6	0.2	0.0	84.4	97.1	97.2	99.7
CANAL SIDE MANOR	Walnutport (B)	Adult Care	84.5	12.7	2.6	0.2	0.0	84.4	97.1	97.2	99.7
USGS Lehigh River Gauge at Walnutport, *	Walnutport (B)	Northampton	84.5	12.7	2.6	0.2	0.0	84.4	97.1	97.2	99.7
Kidz Place	Walnutport (B)	Child Day Care	84.5	12.7	2.6	0.2	0.0	84.4	97.1	97.2	99.7
Pond View Manor Personal Care Home	Walnutport (B)	Assisted Living	84.2	13.0	2.6	0.2	0.0	84.1	97.1	97.1	99.7
WASHINGTON TWP PD	Washington (T)	Police	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
WASHINGTON TWP FIRE CO	Washington (T)	Fire	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
LIBERTY EMS	Washington (T)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
MEDIC 9 - NORTH	Washington (T)	Fire	7.9	63.6	19.9	6.9	1.6	7.9	70.0	71.5	91.4
Washington Elementary School	Washington (T)	School	7.8	63.4	20.1	7.0	1.7	7.7	69.7	71.2	91.2
Washington (N) Township	Washington (T)	Municipal	83.1	13.8	2.9	0.2	0.0	83.1	96.8	96.8	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
Five Points Veterinary Hospital	Washington (T)	Animal Care	83.0	13.9	2.9	0.2	0.0	82.9	96.7	96.8	99.7
Childhood Treasures Day Care	Washington (T)	Child Day Care	83.3	13.7	2.9	0.2	0.0	83.2	96.8	96.9	99.7
WEST EASTON FIRE DEPT	West Easton (B)	Fire	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
West Easton Borough	West Easton (B)	Municipal	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
WILLIAMS TWP EMS	Williams (T)	Fire	7.2	62.6	20.8	7.5	1.8	7.2	68.3	69.8	90.6
WILLIAMS TWP FIRE DEPT	Williams (T)	Fire	7.4	63.0	20.5	7.3	1.8	7.4	68.9	70.4	90.8
Williams Township Elementary School	Williams (T)	School	7.4	63.0	20.5	7.3	1.8	7.4	68.9	70.4	90.8
St. John's Lutheran Church	Williams (T)	Religious (Churches)	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
The Center for Animal Health & Welfare	Williams (T)	Animal Care	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
Williams Township	Williams (T)	Municipal	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
Abby Burns Daycare	Williams (T)	Child Day Care	82.3	14.3	3.1	0.2	0.0	82.3	96.6	96.6	99.7
Morgan Hill Day Care	Williams (T)	Child Day Care	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
Christ Evangelical Congregational Church	Williams (T)	Religious (Churches)	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
The Club at Morgan Hill	Williams (T)	Golf Courses	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Country Classics at Morgan Hill	Williams (T)	Adult Care	82.3	14.3	3.1	0.2	0.0	82.3	96.6	96.6	99.7
Interstate 78 Toll Bridge	Williams (T)	Bridges	82.3	14.3	3.1	0.2	0.0	82.3	96.6	96.6	99.7
Easton Hospital	Wilson (B)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
EASTON HOSPITAL	Wilson (B)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
DOUGLAS D DITMARS MD	Wilson (B)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
HAY SCHOOL	Wilson (B)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Easton Hospital Laboratory Services	Wilson (B)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Northampton Imaging Specialists	Wilson (B)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Quest Diagnostics Inc.	Wilson (B)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Bell Apothecary	Wilson (B)	Medical	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
WILSON BORO PD	Wilson (B)	Police	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
WILSON BORO FIRE DEPT	Wilson (B)	Fire	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Philip F. Lauer Middle School	Wilson (B)	School	7.4	63.0	20.5	7.3	1.8	7.4	68.9	70.4	90.8
Wilson Elementary School	Wilson (B)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Wilson Area High School	Wilson (B)	School	7.6	63.1	20.4	7.2	1.7	7.5	69.2	70.6	91.0
Easton Children's Home	Wilson (B)	School	7.4	63.0	20.5	7.3	1.8	7.4	68.9	70.4	90.8
Avona Elementary School	Wilson (B)	School	7.4	63.0	20.5	7.3	1.8	7.4	68.9	70.4	90.8
Avona Elementary School	Wilson (B)	School	7.4	63.0	20.5	7.3	1.8	7.4	68.9	70.4	90.8
Lehigh Valley Child Care at Avona School	Wilson (B)	Child Day Care	82.7	14.1	3.0	0.2	0.0	82.6	96.7	96.7	99.7
Wilson Borough	Wilson (B)	Municipal	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year											
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality			
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 14	Day 30
Northampton County											
District Court 03-2-12	Wilson (B)	Judicial Buildings (Courthouses)	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Miss Cheri's Daycare and Preschool	Wilson (B)	Child Day Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Finegan Funeral Home	Wilson (B)	Funeral Homes	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
24th State Senatorial District	Wilson (B)	State Buildings	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
EASTWOOD CONVALESCEN	Wilson (B)	Adult Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
EASTERN COMFORT ASSISTED LIV	Wilson (B)	Adult Care	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Strunk Funeral Home, Inc.	Wilson (B)	Northampton	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
Mary Meuser Memorial Library	Wilson (B)	Libraries	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
State Health Center - Dept Health	Wilson (B)	State Buildings	82.8	14.0	3.0	0.2	0.0	82.8	96.7	96.7	99.7
FRENENIUS MEDICAL CARE	Wind Gap (B)	Medical	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
South Broadway, Wind Gap (B)	Wind Gap (B)	Medical	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
WIND GAP PD	Wind Gap (B)	Police	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
WIND GAP EMS	Wind Gap (B)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
BLUE MT EMS	Wind Gap (B)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
WIND GAP FIRE DEPT	Wind Gap (B)	Fire	8.1	63.9	19.6	6.8	1.6	8.1	70.5	72.0	91.6
District Court 03-3-02	Wind Gap (B)	Judicial Buildings (Courthouses)	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Wind Gap Borough	Wind Gap (B)	Municipal	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
Children's Center of Wind Gap	Wind Gap (B)	Child Day Care	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
United States Post Office	Wind Gap (B)	USPS Mail Centers (Post Offices)	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7
WALDEN III ASSTD LIVING	Wind Gap (B)	Adult Care	83.6	13.4	2.8	0.2	0.0	83.5	96.9	96.9	99.7

Source: HAZUS-MH 2.1



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Table G-3. Estimated Utility Impacts in the Lehigh Valley from the 500-year MRP Earthquake Event

500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
Lehigh County										
CITY OF ALLENTOWN	ALLENTOWN (C)	Electric	96.3	3.5	0.2	0	0	98	99.9	99.9
U G I CORP-LEHIGH DIV	ALLENTOWN (C)	Electric	96.3	3.5	0.2	0	0	98	99.9	99.9
CITY OF ALLENTOWN	ALLENTOWN (C)	Electric	96.3	3.5	0.2	0	0	98	99.9	99.9
PENNA POWER & LIGHT CO	ALLENTOWN (C)	Electric	96.3	3.5	0.2	0	0	98	99.9	99.9
PENNA POWER & LIGHT CO	Allentown (C)	Communication	96.3	3.5	0.2	0	0	99.8	99.9	99.9
LIBERTY RECYCLING INC	Allentown (C)	Communication	96.3	3.5	0.2	0	0	99.8	99.9	99.9
BORO OF CATASAUQUA	CATASAUQUA (B)	Electric	96.3	3.5	0.2	0	0	98	99.9	99.9
PENNA POWER & LIGHT CO	CATASAUQUA (B)	Electric	96.3	3.5	0.2	0	0	98	99.9	99.9
PENNA POWER & LIGHT CO	CATASAUQUA (B)	Electric	96.3	3.5	0.2	0	0	98	99.9	99.9
EMMAUS MUNICIPAL AUTH-TOWN HALL	EMMAUS (B)	Electric	96.3	3.5	0.2	0	0	98	99.9	99.9
GOLDSTEIN LEE A ET AL	Emmaus (B)	Communication	96.3	3.5	0.2	0	0	99.8	99.9	99.9
HEIDELBERG TWP	Heidelberg (T)	Communication	97.1	2.8	0.1	0	0	99.9	99.9	99.9
ALBURTIS BORO AUTHORITY	LOWER MACUNGIE (T)	Electric	96.7	3.1	0.1	0	0	98.3	99.9	99.9
CONTEL OF PENNSYLVANIA INC	LOWER MACUNGIE (T)	Electric	96.3	3.5	0.2	0	0	98	99.9	99.9
Lynn Township Sewer Auth	Lynn (T)	WWTF	97.5	2.4	0.1	0	0	99.9	99.9	99.9
DIETRICH BRIAN C & FAY R	Lynn (T)	Communication	97.1	2.8	0.1	0	0	99.9	99.9	99.9
NORTHAMPTON BORO MUN AUTH	NORTH WHITEHALL (T)	Electric	96.7	3.1	0.1	0	0	98.3	99.9	99.9
NORTHAMPTON BORO MUN AUTH	NORTH WHITEHALL (T)	Electric	96.7	3.1	0.1	0	0	98.3	99.9	99.9
PFG GAS INC	SLATINGTON (B)	Electric	97.1	2.8	0.1	0	0	98.5	99.9	99.9
PENNA POWER & LIGHT CO	SOUTH WHITEHALL (T)	Electric	96.7	3.1	0.1	0	0	98.3	99.9	99.9
PENNA POWER & LIGHT CO	UPPER MACUNGIE (T)	Electric	96.7	3.1	0.1	0	0	98.3	99.9	99.9
COUNTY OF LEHIGH	UPPER MACUNGIE (T)	Electric	96.7	3.1	0.1	0	0	98.3	99.9	99.9
UPPER MACUNGIE TWP AUTH	UPPER MACUNGIE (T)	Electric	96.7	3.1	0.1	0	0	98.3	99.9	99.9
HAAF CHARLES J ESTATE	Upper Macungie (T)	Communication	96.7	3.1	0.1	0	0	99.9	99.9	99.9
PENNA POWER & LIGHT CO	UPPER MILFORD (T)	Electric	96.3	3.5	0.2	0	0	98	99.9	99.9
Upper Saucon Sewage Trtmt Auth	Upper Saucon (T)	WWTF	95.9	3.9	0.2	0	0	99.8	99.9	99.9
QUAKER STATE TELEPHONE CO	WEISENBERG (T)	Communication	97.1	2.8	0.1	0	0	99.9	99.9	99.9
QUAKER STATE TELEPHONE CO	WEISENBERG (T)	Communication	96.7	3.1	0.1	0	0	99.9	99.9	99.9
Coplay-Whitehall Sewer Auth	Whitehall (T)	WWTF	96.3	3.5	0.2	0	0	99.8	99.9	99.9

APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
Northampton County										
BANGOR PLT	Bangor (B)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
BANGOR PLT	Bangor (B)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
BATH BORO WATER SYS	Bath (B)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
BATH BORO WATER SYS	Bath (B)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
BATH BORO WATER SYS	Bath (B)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
BATH BORO WATER SYS	Bath (B)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
BATH BORO WATER SYS	Bath (B)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
Bath Sewer Plant	Bath (B)	WWTF	96.3	3.5	0.2	0	0	97.4	99.9	99.9
BETHLEHEM CITY WATER SYS	Bethlehem (C)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
BETHLEHEM CITY WATER SYS	Bethlehem (C)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
BETHLEHEM CITY WATER SYS	Bethlehem (C)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
BETHLEHEM CITY WATER SYS	Bethlehem (C)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
Bethlehem WWTP	Bethlehem (C)	WWTF	95.9	3.9	0.2	0	0	97.1	99.9	99.9
UGI - Lehigh Valley	Bethlehem (C)	Natural Gas	96.3	3.5	0.2	0	0	98.5	99.9	99.9
Fritch, Inc.	Bethlehem (C)	Natural Gas	96.3	3.5	0.2	0	0	98.5	99.9	99.9
Inergy Propane LLC	Bethlehem (C)	Natural Gas	96.3	3.5	0.2	0	0	98.5	99.9	99.9
Calpine Bethlehem Energy Center	Bethlehem (C)	Electric	95.9	3.9	0.2	0	0	97.8	99.9	99.9
RCN Television	Bethlehem (C)	Communication	96.3	3.5	0.2	0	0	99.8	99.9	99.9
Service Electric Cable TV & Comm	Bethlehem (C)	Communication	96.3	3.5	0.2	0	0	99.8	99.9	99.9
TV 2 - Entertainment and News	Bethlehem (C)	Communication	96.3	3.5	0.2	0	0	99.8	99.9	99.9
WLVR 91.3 FM Radio Station	Bethlehem (C)	Communication	96.3	3.5	0.2	0	0	99.8	99.9	99.9
WGPA 1100 AM Radio Station	Bethlehem (C)	Communication	96.3	3.5	0.2	0	0	99.8	99.9	99.9
WDIY 88.1 FM Public Radio Station	Bethlehem (C)	Communication	96.3	3.5	0.2	0	0	99.8	99.9	99.9
EASTON SUBURBAN WATER AUTH	Bethlehem (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
BETHLEHEM CITY WATER SYS	Bethlehem (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
BETHLEHEM CITY WATER SYS	Bethlehem (T)	Potable Water	96.7	3.1	0.1	0	0	98.7	99.9	99.9
SCHWEPS MHP	Bethlehem (T)	Potable Water	97.1	2.8	0.1	0	0	98.8	99.9	99.9
EASTON SUBURBAN WATER AUTH	Bethlehem (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
EASTON SUBURBAN WATER AUTH	Bethlehem (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
EATMA EAST ALLEN GARDENS WATER	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
EATMA WIL MAR MANOR WATER SYS	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
EATMA EAST ALLEN GARDENS WATER	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
EATMA EAST ALLEN GARDENS WATER	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
SPRING LAKE VILLAGE WATER SYS	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
EATMA COUNTRY SQUIRE ESTATES	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
EATMA COUNTRY SQUIRE ESTATES	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
EAST ALLEN TWP MUNI AUTH VICTORIA	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
MILLER MANOR WATER SYS	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
BEATRICE LN WATER SYS	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
SHADY LANE WATER SYS	East Allen (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
EATMA EAST ALLEN GARDENS WATER	East Allen (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
EATMA EAST ALLEN GARDENS WATER	East Allen (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
EATMA EAST ALLEN GARDENS WATER	East Allen (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
EATMA WIL MAR MANOR WATER SYS	East Allen (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
GREENBRIAR VILLAGE MHP	East Allen (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
EATMA EAST ALLEN GARDENS WATER	East Allen (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
EATMA WIL MAR MANOR WATER SYS	East Allen (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
EATMA EAST ALLEN GARDENS WATER	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EATMA EAST ALLEN GARDENS WATER	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
SPRING LAKE VILLAGE WATER SYS	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EATMA COUNTRY SQUIRE ESTATES	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EATMA COUNTRY SQUIRE ESTATES	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EAST ALLEN TWP MUNI AUTH VICTORIA	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
MILLERS EDGEWOOD MHP	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
BEATRICE LN WATER SYS	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
GROFFS MHP	East Allen (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
EATMA EAST ALLEN GARDENS WATER	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
EATMA WIL MAR MANOR WATER SYS	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
EATMA EAST ALLEN GARDENS WATER	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
EATMA EAST ALLEN GARDENS WATER	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
SPRING LAKE VILLAGE WATER SYS	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
EATMA COUNTRY SQUIRE ESTATES	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
EATMA COUNTRY SQUIRE ESTATES	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
EAST ALLEN TWP MUNI AUTH VICTORIA	East Allen (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
E BANGOR MUNI AUTH WATER SYS	East Bangor (B)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
Collins and Maxwell	Easton (C)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EASTON CITY WATER TRMT PLT	Easton (C)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EASTON CITY WATER TRMT PLT	Easton (C)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EASTON CITY WATER TRMT PLT	Easton (C)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EASTON CITY WATER TRMT PLT	Easton (C)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EASTON CITY WATER TRMT PLT	Easton (C)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EASTON CITY WATER TRMT PLT	Easton (C)	Potable Water	96.7	3.1	0.1	0	0	98.7	99.9	99.9
EASTON SUBURBAN WATER AUTH	Easton (C)	Potable Water	97.1	2.8	0.1	0	0	98.8	99.9	99.9
Easton Suburban Water Authority	Easton (C)	WWTF	95.9	3.9	0.2	0	0	97.1	99.9	99.9
WODE 99.9 FM Radio Station	Easton (C)	Communication	95.4	4.3	0.2	0	0	99.8	99.9	99.9
EASTON CITY WATER TRMT PLT	Forks (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EASTON CITY WATER TRMT PLT	Forks (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
GPU - Easton	Forks (T)	Electric	95.4	4.3	0.2	0	0	97.6	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	96.7	3.1	0.1	0	0	98.7	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	96.7	3.1	0.1	0	0	98.7	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
VILLAGE VIEW WATER SYS	Hanover (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
WESTGATE WATER SYS	Hanover (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
Hellertown Borough Authority	Hellertown (B)	WWTF	95.9	3.9	0.2	0	0	97.1	99.9	99.9
BETHLEHEM CITY WATER SYS	Lehigh (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
GAP VIEW MHP	Lehigh (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
MOUNTAINVIEW MHP	Lehigh (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
WALNUTPORT MHP	Lehigh (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
WALNUTPORT MHP	Lehigh (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
WALNUTPORT AUTH WATER SUPPLY	Lehigh (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
WALNUTPORT AUTH WATER SUPPLY	Lehigh (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
BETHLEHEM CITY WATER SYS	Lehigh (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
LEHIGH TWP MUNI AUTH CHERRYVILLE	Lehigh (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
TREICHLERS WATER SYS	Lehigh (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
HERITAGE VILLAGE	Lehigh (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
WALNUTPORT AUTH WATER SUPPLY	Lehigh (T)	Potable Water	97.1	2.8	0.1	0	0	97.9	99.9	99.9
LEHIGH TWP MUNI AUTH CHERRYVILLE	Lehigh (T)	Potable Water	96.7	3.1	0.1	0	0	97.7	99.9	99.9
TREICHLERS WATER SYS	Lehigh (T)	Potable Water	96.7	3.1	0.1	0	0	97.7	99.9	99.9
WALNUTPORT AUTH WATER SUPPLY	Lehigh (T)	Potable Water	97.1	2.8	0.1	0	0	97.9	99.9	99.9
LEHIGH TWP MUNI AUTH CHERRYVILLE	Lehigh (T)	Potable Water	96.7	3.1	0.1	0	0	97.7	99.9	99.9
TREICHLERS WATER SYS	Lehigh (T)	Potable Water	96.7	3.1	0.1	0	0	97.7	99.9	99.9
Bethlehem Water Treatment Plant	Lehigh (T)	WWTF	96.7	3.1	0.1	0	0	97.7	99.9	99.9
Blue Ridge Communications	Lehigh (T)	Communication	97.1	2.8	0.1	0	0	99.9	99.9	99.9
James Palmeri	Lower Mt Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
O.G. Capriotti	Lower Mt Bethel (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
RIVERSEDGE MHP	Lower Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
RIVERSEDGE MHP	Lower Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
RIVERSEDGE MHP	Lower Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
RIVERSEDGE MHP	Lower Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
HILLENDALE ON THE DELAWARE	Lower Mt. Bethel (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
BERRY HOLLOW ESTATES WATER SYS	Lower Mt. Bethel (T)	Potable Water	97.1	2.8	0.1	0	0	98.8	99.9	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
CEDAR GROVE MHP	Lower Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
DRIFTWOOD COURT MHP	Lower Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
LOWER NAZARETH TWP MUNI AUTH	Lower Nazareth (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EASTON SUBURBAN WATER AUTH	Lower Nazareth (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EASTON SUBURBAN WATER AUTH	Lower Nazareth (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
Suburban Propane	Lower Nazareth (T)	Natural Gas	95.9	3.9	0.2	0	0	98.3	99.9	99.9
BETHLEHEM CITY WATER SYS	Lower Saucon (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
BETHLEHEM CITY WATER SYS	Lower Saucon (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
BETHLEHEM CITY WATER SYS	Lower Saucon (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
BETHLEHEM CITY WATER SYS	Lower Saucon (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
HELLERTOWN BORO WATER SYS	Lower Saucon (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
HELLERTOWN BORO WATER SYS	Lower Saucon (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
HELLERTOWN BORO WATER SYS	Lower Saucon (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
HELLERTOWN BORO WATER SYS	Lower Saucon (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
Columbia Gas Transmission Company	Lower Saucon (T)	Natural Gas	95.9	3.9	0.2	0	0	98.3	99.9	99.9
ROYAL OAKS MHP	Moore (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
ROYAL OAKS MHP	Moore (T)	Potable Water	97.1	2.8	0.1	0	0	98.8	99.9	99.9
CLEARVIEW FARM ESTATES WATER	Moore (T)	Potable Water	97.1	2.8	0.1	0	0	98.8	99.9	99.9
CLEARVIEW FARM ESTATES WATER	Moore (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
CLEARVIEW FARM ESTATES WATER	Moore (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EVANWOOD ACRES WATER SYS	Moore (T)	Potable Water	96.7	3.1	0.1	0	0	98.7	99.9	99.9
HICKORY HILLS MHP	Moore (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
HICKORY HILLS MHP	Moore (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
CROSSROADS MHP	Moore (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
WHISPERING HOLLOW NORTH MHP	Moore (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
WHISPERING HOLLOW NORTH MHP	Moore (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
HICKORY HILLS MHP	Moore (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
HICKORY HILLS MHP	Moore (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
BATH BORO WATER SYS	Moore (T)	Potable Water	96.7	3.1	0.1	0	0	98.7	99.9	99.9
BATH BORO WATER SYS	Moore (T)	Potable Water	96.7	3.1	0.1	0	0	98.7	99.9	99.9
BATH BORO WATER SYS	Moore (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
CHRISTIAN SPRINGS WATER SYS	Moore (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
CROSSROADS MHP	Moore (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
HICKORY HILLS MHP	Moore (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
HICKORY HILLS MHP	Moore (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
HERD MANUFACTURED HOMES	Moore (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
HERD MANUFACTURED HOMES	Moore (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
HERD MANUFACTURED HOMES	Moore (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
Sullivan Oil & Propane	Moore (T)	Natural Gas	96.3	3.5	0.2	0	0	98.5	99.9	99.9
CITIZENS UTILILITIES BLUE MNT	Nazareth (B)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
CITIZENS UTILILITIES BLUE MNT	Nazareth (B)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
PA Am Water Co Blue Mt Dist Dietz PS	Northampton (B)	WWTF	96.3	3.5	0.2	0	0	97.4	99.9	99.9
Northampton Borough Municipal Authority	Northampton (B)	WWTF	96.7	3.1	0.1	0	0	97.7	99.9	99.9
Cogentrix Energy - Northampton Gen Co	Northampton (B)	Electric	96.7	3.1	0.1	0	0	98.3	99.9	99.9
CITIZENS UTILILITIES BLUE MNT	Palmer (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
PALMER TWP MUNI WATER SYS	Palmer (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
CITIZENS UTILILITIES BLUE MNT	Palmer (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
EASTON SUBURBAN WATER AUTH	Palmer (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
EASTON SUBURBAN WATER AUTH	Palmer (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
CITIZENS UTILILITIES BLUE MNT	Palmer (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
CITIZENS UTILILITIES BLUE MNT	Palmer (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
EASTON SUBURBAN WATER AUTH	Palmer (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
CITIZENS UTILILITIES BLUE MNT	Palmer (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
CITIZENS UTILITIES BLUE MNT	Palmer (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
EASTON SUBURBAN WATER AUTH	Palmer (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
CITIZENS UTILITIES BLUE MNT	Pen Argyl (B)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
CITIZENS UTILITIES BLUE MNT	Pen Argyl (B)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
CITIZENS UTILITIES BLUE MNT	Pen Argyl (B)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
CITIZENS UTILITIES BLUE MNT	Pen Argyl (B)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
CITIZENS UTILITIES BLUE MNT	Pen Argyl (B)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
CITIZENS UTILITIES BLUE MNT	Pen Argyl (B)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
PA Am Water Co - Pen Argyl WWTP	Pen Argyl (B)	WWTF	96.3	3.5	0.2	0	0	97.4	99.9	99.9
EASTON SUBURBAN WATER AUTH	Plainfield (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
BANGOR PLT	Plainfield (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
EASTON SUBURBAN WATER AUTH	Plainfield (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
EASTON SUBURBAN WATER AUTH	Plainfield (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
Knowles LP Gas	Plainfield (T)	Natural Gas	96.3	3.5	0.2	0	0	98.5	99.9	99.9
Portland Borough Authority	Portland (B)	WWTF	95.9	3.9	0.2	0	0	97.1	99.9	99.9
BANGOR PLT	Roseto (B)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
PA American Water Co - Bangor District	Upper Mt Bethel (T)	WWTF	96.3	3.5	0.2	0	0	97.4	99.9	99.9
GAP VIEW TRAILER PARK	Upper Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
PORTLAND MHP	Upper Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
TUSCARORA VILLAGE WATER SYS	Upper Mt. Bethel (T)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
PORTLAND BORO AUTH	Upper Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
E BANGOR MUNI AUTH WATER SYS	Upper Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EVERGREEN VILLAGE MHP	Upper Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EVERGREEN VILLAGE MHP	Upper Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
BANGOR PLT	Upper Mt. Bethel (T)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
BANGOR PLT	Upper Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
BANGOR PLT	Upper Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
BANGOR PLT	Upper Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
BANGOR PLT	Upper Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
BANGOR PLT	Upper Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
GAP VIEW TRAILER PARK	Upper Mt. Bethel (T)	Potable Water	96.7	3.1	0.1	0	0	98.7	99.9	99.9
PORTLAND BORO AUTH	Upper Mt. Bethel (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
E BANGOR MUNI AUTH WATER SYS	Upper Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
PORTLAND BORO AUTH	Upper Mt. Bethel (T)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
E BANGOR MUNI AUTH WATER SYS	Upper Mt. Bethel (T)	Potable Water	96.3	3.5	0.2	0	0	97.4	99.9	99.9
Beatty Contractors	Upper Nazareth (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
KELLOWS MHP	Upper Nazareth (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
Nazareth Wastewater Treatment Plant	Upper Nazareth (T)	WWTF	96.3	3.5	0.2	0	0	97.4	99.9	99.9
Walnutport Authority	Walnutport (B)	WWTF	97.1	2.8	0.1	0	0	97.9	99.9	99.9
MEADOWBROOK MHP	Washington (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
BANGOR PLT	Washington (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
Bangor Sewage Treatment Plant	Washington (T)	WWTF	95.9	3.9	0.2	0	0	97.1	99.9	99.9
Tolino's Fuel Service	Washington (T)	Natural Gas	95.9	3.9	0.2	0	0	98.3	99.9	99.9
RIEGELSVILLE WATER CO	Williams (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EASTON CITY WATER TRMT PLT	Williams (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
DEL AIRE MHP	Williams (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
GREEN ACRES MHP	Williams (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EASTON CITY WATER TRMT PLT	Williams (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
GREEN ACRES MHP	Williams (T)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EASTON CITY WATER TRMT PLT	Williams (T)	Potable Water	95.4	4.3	0.2	0	0	96.8	99.9	99.9
EASTON CITY WATER TRMT PLT	Williams (T)	Potable Water	95.4	4.3	0.2	0	0	96.8	99.9	99.9
EASTON CITY WATER TRMT PLT	Williams (T)	Potable Water	95.4	4.3	0.2	0	0	96.8	99.9	99.9
EASTON CITY WATER TRMT PLT	Williams (T)	Potable Water	95.4	4.3	0.2	0	0	96.8	99.9	99.9
EASTON CITY WATER TRMT PLT	Wilson (B)	Potable Water	95.4	4.3	0.2	0	0	98.2	99.9	99.9
EASTON CITY WATER TRMT PLT	Wilson (B)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9
EASTON SUBURBAN WATER AUTH	Wilson (B)	Potable Water	95.9	3.9	0.2	0	0	98.3	99.9	99.9
EASTON CITY WATER TRMT PLT	Wilson (B)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
EASTON CITY WATER TRMT PLT	Wilson (B)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
EASTON CITY WATER TRMT PLT	Wilson (B)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
EASTON CITY WATER TRMT PLT	Wilson (B)	Potable Water	95.9	3.9	0.2	0	0	97.1	99.9	99.9
C.A. Lessig Oil & Propane	Wilson (B)	Natural Gas	95.9	3.9	0.2	0	0	98.3	99.9	99.9
J.H. Beers, Inc.	Wind Gap (B)	Potable Water	96.3	3.5	0.2	0	0	98.5	99.9	99.9

Source: HAZUS-MH 2.1

Notes: B = Borough; C = City; MRP = Mean return period; T = Township; WWTF = Wastewater Treatment Facility



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

Table G-4. Estimated Utility Impacts in the Lehigh Valley from the 2,500-year MRP Earthquake Event

2,500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
Lehigh County										
CITY OF ALLENTOWN	ALLENTOWN (C)	Electric	41.9	41	15.3	1.7	0.1	63.8	99.8	99.9
U G I CORP-LEHIGH DIV	ALLENTOWN (C)	Electric	41.3	41.2	15.6	1.7	0.1	63.4	99.8	99.9
CITY OF ALLENTOWN	ALLENTOWN (C)	Electric	41.3	41.2	15.6	1.7	0.1	63.4	99.8	99.9
PENNA POWER & LIGHT CO	ALLENTOWN (C)	Electric	41.3	41.2	15.6	1.7	0.1	63.4	99.8	99.9
PENNA POWER & LIGHT CO	Allentown (C)	Communicatio	41.3	41.2	15.6	1.7	0.1	90.4	99.6	99.9
LIBERTY RECYCLING INC	Allentown (C)	Communicatio	41.3	41.2	15.6	1.7	0.1	90.4	99.6	99.9
BORO OF CATASAUQUA	CATASAUQUA (B)	Electric	42.4	40.8	15.1	1.6	0.1	64.2	99.8	99.9
PENNA POWER & LIGHT CO	CATASAUQUA (B)	Electric	42.4	40.8	15.1	1.6	0.1	64.2	99.8	99.9
PENNA POWER & LIGHT CO	CATASAUQUA (B)	Electric	42.4	40.8	15.1	1.6	0.1	64.2	99.8	99.9
EMMAUS MUNICIPAL AUTH-TOWN	EMMAUS (B)	Electric	40.8	41.4	15.9	1.8	0.1	63	99.8	99.9
GOLDSTEIN LEE A ET AL	Emmaus (B)	Communicatio	40.8	41.4	15.9	1.8	0.1	90.2	99.6	99.8
HEIDELBERG TWP	Heidelberg (T)	Communicatio	46.4	39.3	13	1.2	0.1	92.1	99.7	99.9
ALBURTIS BORO AUTHORITY	LOWER MACUNGIE (T)	Electric	42.4	40.8	15.1	1.6	0.1	64.2	99.8	99.9
CONTEL OF PENNSYLVANIA INC	LOWER MACUNGIE (T)	Electric	41.9	41	15.3	1.7	0.1	63.8	99.8	99.9
Lynn Township Sewer Auth	Lynn (T)	WWTF	47.1	39	12.7	1.2	0.1	92.3	99.7	99.9
DIETRICH BRIAN C & FAY R	Lynn (T)	Communicatio	46.4	39.3	13	1.2	0.1	92.1	99.7	99.9
NORTHAMPTON BORO MUN AUTH	NORTH WHITEHALL (T)	Electric	45.1	39.8	13.6	1.3	0.1	66.3	99.8	99.9
NORTHAMPTON BORO MUN AUTH	NORTH WHITEHALL (T)	Electric	45.1	39.8	13.6	1.3	0.1	66.3	99.8	99.9
PFG GAS INC	SLATINGTON (B)	Electric	46.4	39.3	13	1.2	0.1	67.2	99.8	99.9
PENNA POWER & LIGHT CO	SOUTH WHITEHALL (T)	Electric	42.9	40.6	14.8	1.6	0.1	64.6	99.8	99.9
PENNA POWER & LIGHT CO	UPPER MACUNGIE (T)	Electric	42.4	40.8	15.1	1.6	0.1	64.2	99.8	99.9
COUNTY OF LEHIGH	UPPER MACUNGIE (T)	Electric	42.4	40.8	15.1	1.6	0.1	64.2	99.8	99.9
UPPER MACUNGIE TWP AUTH	UPPER MACUNGIE (T)	Electric	42.9	40.6	14.8	1.6	0.1	64.6	99.8	99.9
HAAF CHARLES J ESTATE	Upper Macungie (T)	Communicatio	44.6	40	13.9	1.4	0.1	91.5	99.6	99.9
PENNA POWER & LIGHT CO	UPPER MILFORD (T)	Electric	39.8	41.7	16.5	1.9	0.1	62.2	99.8	99.9
Upper Saucon Sewage Trtmt Auth	Upper Saucon (T)	WWTF	39.3	41.8	16.8	1.9	0.1	89.6	99.5	99.9
QUAKER STATE TELEPHONE CO	WEISENBERG (T)	Communicatio	44.6	40	13.9	1.4	0.1	91.5	99.6	99.9
QUAKER STATE TELEPHONE CO	WEISENBERG (T)	Communicatio	44.6	40	13.9	1.4	0.1	91.5	99.6	99.9



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
Coplay-Whitehall Sewer Auth	Whitehall (T)	WWTF	43.5	40.4	14.5	1.5	0.1	91.1	99.6	99.9
Northampton County										
BANGOR PLT	Bangor (B)	Potable Water	41.3	41.2	15.6	1.7	0.1	57.7	98.4	98.5
BANGOR PLT	Bangor (B)	Potable Water	41.3	41.2	15.6	1.7	0.1	57.7	98.4	98.5
BATH BORO WATER SYS	Bath (B)	Potable Water	44	40.2	14.2	1.4	0.1	59.7	98.7	98.7
BATH BORO WATER SYS	Bath (B)	Potable Water	44	40.2	14.2	1.4	0.1	59.7	98.7	98.7
BATH BORO WATER SYS	Bath (B)	Potable Water	43.5	40.4	14.5	1.5	0.1	72.2	99.1	99.8
BATH BORO WATER SYS	Bath (B)	Potable Water	44	40.2	14.2	1.4	0.1	59.7	98.7	98.7
BATH BORO WATER SYS	Bath (B)	Potable Water	44	40.2	14.2	1.4	0.1	59.7	98.7	98.7
Bath Sewer Plant	Bath (B)	WWTF	42.4	40.8	15.1	1.6	0.1	57.2	98.3	98.5
BETHLEHEM CITY WATER SYS	Bethlehem (C)	Potable Water	39.3	41.8	16.8	1.9	0.1	69.5	98.9	99.8
BETHLEHEM CITY WATER SYS	Bethlehem (C)	Potable Water	40.3	41.5	16.2	1.8	0.1	70.2	98.9	99.8
BETHLEHEM CITY WATER SYS	Bethlehem (C)	Potable Water	39.3	41.8	16.8	1.9	0.1	69.5	98.9	99.8
BETHLEHEM CITY WATER SYS	Bethlehem (C)	Potable Water	40.3	41.5	16.2	1.8	0.1	70.2	98.9	99.8
Bethlehem WWTP	Bethlehem (C)	WWTF	39.3	41.8	16.8	1.9	0.1	54.7	98	98.2
UGI - Lehigh Valley	Bethlehem (C)	Natural Gas	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
Fritch, Inc.	Bethlehem (C)	Natural Gas	40.3	41.5	16.2	1.8	0.1	70.2	98.9	99.8
Inergy Propane LLC	Bethlehem (C)	Natural Gas	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
Calpine Bethlehem Energy Center	Bethlehem (C)	Electric	38.3	42.1	17.3	2.1	0.2	61	99.8	99.9
RCN Television	Bethlehem (C)	Communicatio	41.3	41.2	15.6	1.7	0.1	90.4	99.6	99.9
Service Electric Cable TV & Comm	Bethlehem (C)	Communicatio	42.4	40.8	15.1	1.6	0.1	90.8	99.6	99.9
TV 2 - Entertainment and News	Bethlehem (C)	Communicatio	41.3	41.2	15.6	1.7	0.1	90.4	99.6	99.9
WLVR 91.3 FM Radio Station	Bethlehem (C)	Communicatio	40.3	41.5	16.2	1.8	0.1	90	99.5	99.8
WGPA 1100 AM Radio Station	Bethlehem (C)	Communicatio	40.3	41.5	16.2	1.8	0.1	90	99.5	99.8
WDIY 88.1 FM Public Radio Station	Bethlehem (C)	Communicatio	40.3	41.5	16.2	1.8	0.1	90	99.5	99.8
EASTON SUBURBAN WATER AUTH	Bethlehem (T)	Potable Water	39.3	41.8	16.8	1.9	0.1	56.1	98.2	98.3
BETHLEHEM CITY WATER SYS	Bethlehem (T)	Potable Water	40.3	41.5	16.2	1.8	0.1	70.2	98.9	99.8
BETHLEHEM CITY WATER SYS	Bethlehem (T)	Potable Water	45.1	39.8	13.6	1.3	0.1	73.3	99.2	99.8
SCHWEPS MHP	Bethlehem (T)	Potable Water	46.4	39.3	13	1.2	0.1	74.1	99.3	99.8
EASTON SUBURBAN WATER AUTH	Bethlehem (T)	Potable Water	39.8	41.7	16.5	1.9	0.1	69.8	98.9	99.7
EASTON SUBURBAN WATER AUTH	Bethlehem (T)	Potable Water	39.3	41.8	16.8	1.9	0.1	56.1	98.2	98.3



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
EATMA EAST ALLEN GARDENS	East Allen (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	59.3	98.6	98.7
EATMA WIL MAR MANOR WATER	East Allen (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	59.3	98.6	98.7
EATMA EAST ALLEN GARDENS	East Allen (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	59.3	98.6	98.7
EATMA EAST ALLEN GARDENS	East Allen (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	59.3	98.6	98.7
SPRING LAKE VILLAGE WATER SYS	East Allen (T)	Potable Water	42.4	40.8	15.1	1.6	0.1	58.5	98.5	98.6
EATMA COUNTRY SQUIRE ESTATES	East Allen (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	59.3	98.6	98.7
EATMA COUNTRY SQUIRE ESTATES	East Allen (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	59.3	98.6	98.7
EAST ALLEN TWP MUNI AUTH	East Allen (T)	Potable Water	42.4	40.8	15.1	1.6	0.1	58.5	98.5	98.6
MILLER MANOR WATER SYS	East Allen (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
BEATRICE LN WATER SYS	East Allen (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
SHADY LANE WATER SYS	East Allen (T)	Potable Water	39.8	41.7	16.5	1.9	0.1	69.8	98.9	99.7
EATMA EAST ALLEN GARDENS	East Allen (T)	Potable Water	36.9	42.5	18.2	2.2	0.2	67.9	98.7	99.7
EATMA EAST ALLEN GARDENS	East Allen (T)	Potable Water	37.9	42.3	17.6	2.1	0.2	68.5	98.8	99.7
EATMA EAST ALLEN GARDENS	East Allen (T)	Potable Water	37.9	42.3	17.6	2.1	0.2	68.5	98.8	99.7
EATMA WIL MAR MANOR WATER	East Allen (T)	Potable Water	37.9	42.3	17.6	2.1	0.2	68.5	98.8	99.7
GREENBRIAR VILLAGE MHP	East Allen (T)	Potable Water	37.9	42.3	17.6	2.1	0.2	68.5	98.8	99.7
EATMA EAST ALLEN GARDENS	East Allen (T)	Potable Water	38.8	42	17	2	0.1	69.2	98.8	99.7
EATMA WIL MAR MANOR WATER	East Allen (T)	Potable Water	36.9	42.5	18.2	2.2	0.2	67.9	98.7	99.7
EATMA EAST ALLEN GARDENS	East Allen (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	72.2	99.1	99.8
EATMA EAST ALLEN GARDENS	East Allen (T)	Potable Water	42.4	40.8	15.1	1.6	0.1	71.5	99.1	99.8
SPRING LAKE VILLAGE WATER SYS	East Allen (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
EATMA COUNTRY SQUIRE ESTATES	East Allen (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
EATMA COUNTRY SQUIRE ESTATES	East Allen (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
EAST ALLEN TWP MUNI AUTH	East Allen (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
MILLERS EDGEWOOD MHP	East Allen (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
BEATRICE LN WATER SYS	East Allen (T)	Potable Water	42.4	40.8	15.1	1.6	0.1	71.5	99.1	99.8
GROFFS MHP	East Allen (T)	Potable Water	38.3	42.1	17.3	2.1	0.2	68.9	98.8	99.7
EATMA EAST ALLEN GARDENS	East Allen (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	59.3	98.6	98.7
EATMA WIL MAR MANOR WATER	East Allen (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	59.3	98.6	98.7
EATMA EAST ALLEN GARDENS	East Allen (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	59.3	98.6	98.7
EATMA EAST ALLEN GARDENS	East Allen (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	59.3	98.6	98.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
SPRING LAKE VILLAGE WATER SYS	East Allen (T)	Potable Water	42.4	40.8	15.1	1.6	0.1	58.5	98.5	98.6
EATMA COUNTRY SQUIRE ESTATES	East Allen (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	59.3	98.6	98.7
EATMA COUNTRY SQUIRE ESTATES	East Allen (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	59.3	98.6	98.7
EAST ALLEN TWP MUNI AUTH	East Allen (T)	Potable Water	42.4	40.8	15.1	1.6	0.1	58.5	98.5	98.6
E BANGOR MUNI AUTH WATER SYS	East Bangor (B)	Potable Water	38.3	42.1	17.3	2.1	0.2	68.9	98.8	99.7
Collins and Maxwell	Easton (C)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
EASTON CITY WATER TRMT PLT	Easton (C)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
EASTON CITY WATER TRMT PLT	Easton (C)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
EASTON CITY WATER TRMT PLT	Easton (C)	Potable Water	43.5	40.4	14.5	1.5	0.1	72.2	99.1	99.8
EASTON CITY WATER TRMT PLT	Easton (C)	Potable Water	43.5	40.4	14.5	1.5	0.1	72.2	99.1	99.8
EASTON CITY WATER TRMT PLT	Easton (C)	Potable Water	43.5	40.4	14.5	1.5	0.1	72.2	99.1	99.8
EASTON CITY WATER TRMT PLT	Easton (C)	Potable Water	45.7	39.5	13.4	1.3	0.1	73.6	99.2	99.8
EASTON SUBURBAN WATER AUTH	Easton (C)	Potable Water	46.4	39.3	13	1.2	0.1	74.1	99.3	99.8
Easton Suburban Water Authority	Easton (C)	WWTF	38.8	42	17	2	0.1	54.3	97.9	98.1
WODE 99.9 FM Radio Station	Easton (C)	Communicatio	37.9	42.3	17.6	2.1	0.2	89	99.5	99.8
EASTON CITY WATER TRMT PLT	Forks (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
EASTON CITY WATER TRMT PLT	Forks (T)	Potable Water	38.3	42.1	17.3	2.1	0.2	68.9	98.8	99.7
GPU - Easton	Forks (T)	Electric	37.9	42.3	17.6	2.1	0.2	60.6	99.8	99.9
WESTGATE WATER SYS	Hanover (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
WESTGATE WATER SYS	Hanover (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
WESTGATE WATER SYS	Hanover (T)	Potable Water	39.8	41.7	16.5	1.9	0.1	69.8	98.9	99.7
WESTGATE WATER SYS	Hanover (T)	Potable Water	42.9	40.6	14.8	1.6	0.1	71.9	99.1	99.8
WESTGATE WATER SYS	Hanover (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	72.2	99.1	99.8
WESTGATE WATER SYS	Hanover (T)	Potable Water	44.6	40	13.9	1.4	0.1	72.9	99.2	99.8
WESTGATE WATER SYS	Hanover (T)	Potable Water	44.6	40	13.9	1.4	0.1	72.9	99.2	99.8
WESTGATE WATER SYS	Hanover (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	72.2	99.1	99.8
WESTGATE WATER SYS	Hanover (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	57.7	98.4	98.5
WESTGATE WATER SYS	Hanover (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	57.7	98.4	98.5
WESTGATE WATER SYS	Hanover (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	57.7	98.4	98.5
WESTGATE WATER SYS	Hanover (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	57.7	98.4	98.5
VILLAGE VIEW WATER SYS	Hanover (T)	Potable Water	38.3	42.1	17.3	2.1	0.2	68.9	98.8	99.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
WESTGATE WATER SYS	Hanover (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	57.7	98.4	98.5
WESTGATE WATER SYS	Hanover (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	57.7	98.4	98.5
WESTGATE WATER SYS	Hanover (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	57.7	98.4	98.5
WESTGATE WATER SYS	Hanover (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	57.7	98.4	98.5
Hellertown Borough Authority	Hellertown (B)	WWTF	39.3	41.8	16.8	1.9	0.1	54.7	98	98.2
BETHLEHEM CITY WATER SYS	Lehigh (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
GAP VIEW MHP	Lehigh (T)	Potable Water	42.4	40.8	15.1	1.6	0.1	71.5	99.1	99.8
MOUNTAINVIEW MHP	Lehigh (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
WALNUTPORT MHP	Lehigh (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
WALNUTPORT MHP	Lehigh (T)	Potable Water	38.3	42.1	17.3	2.1	0.2	68.9	98.8	99.7
WALNUTPORT AUTH WATER SUPPLY	Lehigh (T)	Potable Water	42.4	40.8	15.1	1.6	0.1	71.5	99.1	99.8
WALNUTPORT AUTH WATER SUPPLY	Lehigh (T)	Potable Water	39.3	41.8	16.8	1.9	0.1	69.5	98.9	99.8
BETHLEHEM CITY WATER SYS	Lehigh (T)	Potable Water	39.3	41.8	16.8	1.9	0.1	69.5	98.9	99.8
LEHIGH TWP MUNI AUTH CHERRYVILLE	Lehigh (T)	Potable Water	40.3	41.5	16.2	1.8	0.1	70.2	98.9	99.8
TREICHLERS WATER SYS	Lehigh (T)	Potable Water	38.3	42.1	17.3	2.1	0.2	68.9	98.8	99.7
HERITAGE VILLAGE	Lehigh (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
WALNUTPORT AUTH WATER SUPPLY	Lehigh (T)	Potable Water	47.1	39	12.7	1.2	0.1	62	98.9	98.9
LEHIGH TWP MUNI AUTH CHERRYVILLE	Lehigh (T)	Potable Water	45.7	39.5	13.4	1.3	0.1	61	98.8	98.9
TREICHLERS WATER SYS	Lehigh (T)	Potable Water	45.7	39.5	13.4	1.3	0.1	61	98.8	98.9
WALNUTPORT AUTH WATER SUPPLY	Lehigh (T)	Potable Water	47.1	39	12.7	1.2	0.1	62	98.9	98.9
LEHIGH TWP MUNI AUTH CHERRYVILLE	Lehigh (T)	Potable Water	45.7	39.5	13.4	1.3	0.1	61	98.8	98.9
TREICHLERS WATER SYS	Lehigh (T)	Potable Water	45.7	39.5	13.4	1.3	0.1	61	98.8	98.9
Bethlehem Water Treatment Plant	Lehigh (T)	WWTF	45.1	39.8	13.6	1.3	0.1	59.4	98.6	98.7
Blue Ridge Communications	Lehigh (T)	Communicatio	46.4	39.3	13	1.2	0.1	92.1	99.7	99.9
James Palmeri	Lower Mt Bethel (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
O.G. Capriotti	Lower Mt Bethel (T)	Potable Water	39.8	41.7	16.5	1.9	0.1	69.8	98.9	99.7
RIVERSEDGE MHP	Lower Mt. Bethel (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
RIVERSEDGE MHP	Lower Mt. Bethel (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
RIVERSEDGE MHP	Lower Mt. Bethel (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
RIVERSEDGE MHP	Lower Mt. Bethel (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
HILLENDALE ON THE DELAWARE WATER SYS	Lower Mt. Bethel (T)	Potable Water	42.9	40.6	14.8	1.6	0.1	71.9	99.1	99.8
BERRY HOLLOW ESTATES WATER SYS	Lower Mt. Bethel (T)	Potable Water	46.4	39.3	13	1.2	0.1	74.1	99.3	99.8
CEDAR GROVE MHP	Lower Mt. Bethel (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
DRIFTWOOD COURT MHP	Lower Mt. Bethel (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
LOWER NAZARETH TWP MUNI AUTH	Lower Nazareth (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	72.2	99.1	99.8
EASTON SUBURBAN WATER AUTH	Lower Nazareth (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	72.2	99.1	99.8
EASTON SUBURBAN WATER AUTH	Lower Nazareth (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	72.2	99.1	99.8
Suburban Propane	Lower Nazareth (T)	Natural Gas	40.3	41.5	16.2	1.8	0.1	70.2	98.9	99.8
BETHLEHEM CITY WATER SYS	Lower Saucon (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	72.2	99.1	99.8
BETHLEHEM CITY WATER SYS	Lower Saucon (T)	Potable Water	42.4	40.8	15.1	1.6	0.1	71.5	99.1	99.8
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	72.2	99.1	99.8
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	43.5	40.4	14.5	1.5	0.1	72.2	99.1	99.8
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	42.4	40.8	15.1	1.6	0.1	71.5	99.1	99.8
BETHLEHEM CITY WATER SYS	Lower Saucon (T)	Potable Water	42.4	40.8	15.1	1.6	0.1	71.5	99.1	99.8
BETHLEHEM CITY WATER SYS	Lower Saucon (T)	Potable Water	38.3	42.1	17.3	2.1	0.2	68.9	98.8	99.7
HELLERTOWN BORO WATER SYS	Lower Saucon (T)	Potable Water	36.9	42.5	18.2	2.2	0.2	67.9	98.7	99.7
HELLERTOWN BORO WATER SYS	Lower Saucon (T)	Potable Water	42.9	40.6	14.8	1.6	0.1	71.9	99.1	99.8
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	39.3	41.8	16.8	1.9	0.1	56.1	98.2	98.3
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	39.3	41.8	16.8	1.9	0.1	56.1	98.2	98.3
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	40.3	41.5	16.2	1.8	0.1	56.9	98.3	98.4
HELLERTOWN BORO WATER SYS	Lower Saucon (T)	Potable Water	39.3	41.8	16.8	1.9	0.1	56.1	98.2	98.3
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	39.3	41.8	16.8	1.9	0.1	56.1	98.2	98.3
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	39.3	41.8	16.8	1.9	0.1	56.1	98.2	98.3
LOWER SAUCON WATER SYS	Lower Saucon (T)	Potable Water	40.3	41.5	16.2	1.8	0.1	56.9	98.3	98.4
HELLERTOWN BORO WATER SYS	Lower Saucon (T)	Potable Water	39.3	41.8	16.8	1.9	0.1	56.1	98.2	98.3
Columbia Gas Transmission Company	Lower Saucon (T)	Natural Gas	38.3	42.1	17.3	2.1	0.2	68.9	98.8	99.7
ROYAL OAKS MHP	Moore (T)	Potable Water	42.9	40.6	14.8	1.6	0.1	71.9	99.1	99.8



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
ROYAL OAKS MHP	Moore (T)	Potable Water	47.1	39	12.7	1.2	0.1	74.5	99.3	99.8
CLEARVIEW FARM ESTATES WATER SYS	Moore (T)	Potable Water	47.1	39	12.7	1.2	0.1	74.5	99.3	99.8
CLEARVIEW FARM ESTATES WATER SYS	Moore (T)	Potable Water	40.3	41.5	16.2	1.8	0.1	70.2	98.9	99.8
CLEARVIEW FARM ESTATES WATER SYS	Moore (T)	Potable Water	40.3	41.5	16.2	1.8	0.1	70.2	98.9	99.8
EVANWOOD ACRES WATER SYS	Moore (T)	Potable Water	45.1	39.8	13.6	1.3	0.1	73.3	99.2	99.8
HICKORY HILLS MHP	Moore (T)	Potable Water	39.3	41.8	16.8	1.9	0.1	69.5	98.9	99.8
HICKORY HILLS MHP	Moore (T)	Potable Water	40.3	41.5	16.2	1.8	0.1	70.2	98.9	99.8
CROSSROADS MHP	Moore (T)	Potable Water	39.3	41.8	16.8	1.9	0.1	69.5	98.9	99.8
WHISPERING HOLLOW NORTH MHP	Moore (T)	Potable Water	38.3	42.1	17.3	2.1	0.2	68.9	98.8	99.7
WHISPERING HOLLOW NORTH MHP	Moore (T)	Potable Water	42.4	40.8	15.1	1.6	0.1	71.5	99.1	99.8
HICKORY HILLS MHP	Moore (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
HICKORY HILLS MHP	Moore (T)	Potable Water	37.9	42.3	17.6	2.1	0.2	68.5	98.8	99.7
BATH BORO WATER SYS	Moore (T)	Potable Water	45.7	39.5	13.4	1.3	0.1	73.6	99.2	99.8
BATH BORO WATER SYS	Moore (T)	Potable Water	45.7	39.5	13.4	1.3	0.1	73.6	99.2	99.8
BATH BORO WATER SYS	Moore (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
CHRISTIAN SPRINGS WATER SYS	Moore (T)	Potable Water	39.8	41.7	16.5	1.9	0.1	69.8	98.9	99.7
CROSSROADS MHP	Moore (T)	Potable Water	39.3	41.8	16.8	1.9	0.1	69.5	98.9	99.8
HICKORY HILLS MHP	Moore (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
HICKORY HILLS MHP	Moore (T)	Potable Water	39.8	41.7	16.5	1.9	0.1	69.8	98.9	99.7
HERD MANUFACTURED HOMES	Moore (T)	Potable Water	42.9	40.6	14.8	1.6	0.1	71.9	99.1	99.8
HERD MANUFACTURED HOMES	Moore (T)	Potable Water	38.8	42	17	2	0.1	69.2	98.8	99.7
HERD MANUFACTURED HOMES	Moore (T)	Potable Water	36.9	42.5	18.2	2.2	0.2	67.9	98.7	99.7
Sullivan Oil & Propane	Moore (T)	Natural Gas	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
CITIZENS UTILILITIES BLUE MNT WATER SYS	Nazareth (B)	Potable Water	37.9	42.3	17.6	2.1	0.2	68.5	98.8	99.7
CITIZENS UTILILITIES BLUE MNT WATER SYS	Nazareth (B)	Potable Water	37.9	42.3	17.6	2.1	0.2	68.5	98.8	99.7
PA Am Water Co Blue Mt Dist Dietz PS	Northampton (B)	WWTF	44	40.2	14.2	1.4	0.1	58.5	98.5	98.6
Northampton Borough Municipal	Northampton (B)	WWTF	44.6	40	13.9	1.4	0.1	59	98.5	98.7



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
Cogentrix Energy - Northampton Gen Co	Northampton (B)	Electric	44.6	40	13.9	1.4	0.1	65.9	99.8	99.9
CITIZENS UTILTILITIES BLUE MNT WATER SYS	Palmer (T)	Potable Water	37.9	42.3	17.6	2.1	0.2	68.5	98.8	99.7
PALMER TWP MUNI WATER SYS	Palmer (T)	Potable Water	37.9	42.3	17.6	2.1	0.2	68.5	98.8	99.7
CITIZENS UTILTILITIES BLUE MNT WATER SYS	Palmer (T)	Potable Water	38.8	42	17	2	0.1	69.2	98.8	99.7
EASTON SUBURBAN WATER AUTH	Palmer (T)	Potable Water	39.3	41.8	16.8	1.9	0.1	69.5	98.9	99.8
EASTON SUBURBAN WATER AUTH	Palmer (T)	Potable Water	38.3	42.1	17.3	2.1	0.2	68.9	98.8	99.7
CITIZENS UTILTILITIES BLUE MNT WATER SYS	Palmer (T)	Potable Water	39.8	41.7	16.5	1.9	0.1	56.5	98.3	98.4
CITIZENS UTILTILITIES BLUE MNT WATER SYS	Palmer (T)	Potable Water	39.8	41.7	16.5	1.9	0.1	56.5	98.3	98.4
EASTON SUBURBAN WATER AUTH	Palmer (T)	Potable Water	37.9	42.3	17.6	2.1	0.2	55	98.1	98.2
CITIZENS UTILTILITIES BLUE MNT WATER SYS	Palmer (T)	Potable Water	39.8	41.7	16.5	1.9	0.1	56.5	98.3	98.4
CITIZENS UTILTILITIES BLUE MNT WATER SYS	Palmer (T)	Potable Water	39.8	41.7	16.5	1.9	0.1	56.5	98.3	98.4
EASTON SUBURBAN WATER AUTH	Palmer (T)	Potable Water	37.9	42.3	17.6	2.1	0.2	55	98.1	98.2
CITIZENS UTILTILITIES BLUE MNT WATER SYS	Pen Argyl (B)	Potable Water	38.8	42	17	2	0.1	69.2	98.8	99.7
CITIZENS UTILTILITIES BLUE MNT WATER SYS	Pen Argyl (B)	Potable Water	37.9	42.3	17.6	2.1	0.2	68.5	98.8	99.7
CITIZENS UTILTILITIES BLUE MNT WATER SYS	Pen Argyl (B)	Potable Water	42.9	40.6	14.8	1.6	0.1	58.9	98.6	98.6
CITIZENS UTILTILITIES BLUE MNT WATER SYS	Pen Argyl (B)	Potable Water	42.9	40.6	14.8	1.6	0.1	58.9	98.6	98.6
CITIZENS UTILTILITIES BLUE MNT WATER SYS	Pen Argyl (B)	Potable Water	42.9	40.6	14.8	1.6	0.1	58.9	98.6	98.6
CITIZENS UTILTILITIES BLUE MNT WATER SYS	Pen Argyl (B)	Potable Water	42.9	40.6	14.8	1.6	0.1	58.9	98.6	98.6
PA Am Water Co - Pen Argyl WWTP	Pen Argyl (B)	WWTF	42.9	40.6	14.8	1.6	0.1	57.6	98.3	98.5
EASTON SUBURBAN WATER AUTH	Plainfield (T)	Potable Water	38.8	42	17	2	0.1	69.2	98.8	99.7
BANGOR PLT	Plainfield (T)	Potable Water	39.8	41.7	16.5	1.9	0.1	69.8	98.9	99.7
EASTON SUBURBAN WATER AUTH	Plainfield (T)	Potable Water	39.8	41.7	16.5	1.9	0.1	56.5	98.3	98.4



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
EASTON SUBURBAN WATER AUTH	Plainfield (T)	Potable Water	39.8	41.7	16.5	1.9	0.1	56.5	98.3	98.4
Knowles LP Gas	Plainfield (T)	Natural Gas	42.9	40.6	14.8	1.6	0.1	71.9	99.1	99.8
Portland Borough Authority	Portland (B)	WWTF	39.8	41.7	16.5	1.9	0.1	55.1	98	98.2
BANGOR PLT	Roseto (B)	Potable Water	39.3	41.8	16.8	1.9	0.1	69.5	98.9	99.8
PA American Water Co - Bangor District	Upper Mt Bethel (T)	WWTF	42.9	40.6	14.8	1.6	0.1	57.6	98.3	98.5
GAP VIEW TRAILER PARK	Upper Mt. Bethel (T)	Potable Water	42.4	40.8	15.1	1.6	0.1	71.5	99.1	99.8
PORTLAND MHP	Upper Mt. Bethel (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
TUSCARORA VILLAGE WATER SYS	Upper Mt. Bethel (T)	Potable Water	37.9	42.3	17.6	2.1	0.2	68.5	98.8	99.7
PORTLAND BORO AUTH	Upper Mt. Bethel (T)	Potable Water	42.9	40.6	14.8	1.6	0.1	71.9	99.1	99.8
E BANGOR MUNI AUTH WATER SYS	Upper Mt. Bethel (T)	Potable Water	42.9	40.6	14.8	1.6	0.1	71.9	99.1	99.8
EVERGREEN VILLAGE MHP	Upper Mt. Bethel (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
EVERGREEN VILLAGE MHP	Upper Mt. Bethel (T)	Potable Water	42.9	40.6	14.8	1.6	0.1	71.9	99.1	99.8
BANGOR PLT	Upper Mt. Bethel (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
BANGOR PLT	Upper Mt. Bethel (T)	Potable Water	42.9	40.6	14.8	1.6	0.1	71.9	99.1	99.8
BANGOR PLT	Upper Mt. Bethel (T)	Potable Water	42.9	40.6	14.8	1.6	0.1	71.9	99.1	99.8
BANGOR PLT	Upper Mt. Bethel (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
BANGOR PLT	Upper Mt. Bethel (T)	Potable Water	42.9	40.6	14.8	1.6	0.1	71.9	99.1	99.8
GAP VIEW TRAILER PARK	Upper Mt. Bethel (T)	Potable Water	45.7	39.5	13.4	1.3	0.1	73.6	99.2	99.8
PORTLAND BORO AUTH	Upper Mt. Bethel (T)	Potable Water	42.9	40.6	14.8	1.6	0.1	58.9	98.6	98.6
E BANGOR MUNI AUTH WATER SYS	Upper Mt. Bethel (T)	Potable Water	42.9	40.6	14.8	1.6	0.1	58.9	98.6	98.6
PORTLAND BORO AUTH	Upper Mt. Bethel (T)	Potable Water	42.9	40.6	14.8	1.6	0.1	58.9	98.6	98.6
E BANGOR MUNI AUTH WATER SYS	Upper Mt. Bethel (T)	Potable Water	42.9	40.6	14.8	1.6	0.1	58.9	98.6	98.6
Beatty Contractors	Upper Nazareth (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
KELLOWS MHP	Upper Nazareth (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
Nazareth Wastewater Treatment Plant	Upper Nazareth (T)	WWTF	41.3	41.2	15.6	1.7	0.1	56.4	98.2	98.4
Walnutport Authority	Walnutport (B)	WWTF	46.4	39.3	13	1.2	0.1	60.4	98.7	98.8
MEADOWBROOK MHP	Washington (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
BANGOR PLT	Washington (T)	Potable Water	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
Bangor Sewage Treatment Plant	Washington (T)	WWTF	41.3	41.2	15.6	1.7	0.1	56.4	98.2	98.4
Tolino's Fuel Service	Washington (T)	Natural Gas	41.3	41.2	15.6	1.7	0.1	70.9	99	99.8
RIEGELSVILLE WATER CO	Williams (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8



APPENDIX G: EARTHQUAKE VULNERABILITY ASSESSMENT RESULTS

2,500-Year MRP Event										
Name	Municipality	Type	Percent Probability of Sustaining Damage					Percent Functionality		
			None	Slight	Moderate	Extensive	Complete	Day 1	Day 14	Day 30
EASTON CITY WATER TRMT PLT	Williams (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
DEL AIRE MHP	Williams (T)	Potable Water	42.4	40.8	15.1	1.6	0.1	71.5	99.1	99.8
GREEN ACRES MHP	Williams (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
EASTON CITY WATER TRMT PLT	Williams (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
GREEN ACRES MHP	Williams (T)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
EASTON CITY WATER TRMT PLT	Williams (T)	Potable Water	36.9	42.5	18.2	2.2	0.2	54.3	97.9	98.1
EASTON CITY WATER TRMT PLT	Williams (T)	Potable Water	36.9	42.5	18.2	2.2	0.2	54.3	97.9	98.1
EASTON CITY WATER TRMT PLT	Williams (T)	Potable Water	36.9	42.5	18.2	2.2	0.2	54.3	97.9	98.1
EASTON CITY WATER TRMT PLT	Williams (T)	Potable Water	36.9	42.5	18.2	2.2	0.2	54.3	97.9	98.1
EASTON CITY WATER TRMT PLT	Wilson (B)	Potable Water	37.9	42.3	17.6	2.1	0.2	68.5	98.8	99.7
EASTON CITY WATER TRMT PLT	Wilson (B)	Potable Water	44	40.2	14.2	1.4	0.1	72.6	99.1	99.8
EASTON SUBURBAN WATER AUTH	Wilson (B)	Potable Water	39.8	41.7	16.5	1.9	0.1	69.8	98.9	99.7
EASTON CITY WATER TRMT PLT	Wilson (B)	Potable Water	38.8	42	17	2	0.1	55.7	98.2	98.3
EASTON CITY WATER TRMT PLT	Wilson (B)	Potable Water	38.8	42	17	2	0.1	55.7	98.2	98.3
EASTON CITY WATER TRMT PLT	Wilson (B)	Potable Water	38.8	42	17	2	0.1	55.7	98.2	98.3
EASTON CITY WATER TRMT PLT	Wilson (B)	Potable Water	38.8	42	17	2	0.1	55.7	98.2	98.3
EASTON CITY WATER TRMT PLT	Wilson (B)	Potable Water	38.8	42	17	2	0.1	55.7	98.2	98.3
C.A. Lessig Oil & Propane	Wilson (B)	Natural Gas	38.8	42	17	2	0.1	69.2	98.8	99.7
J.H. Beers, Inc.	Wind Gap (B)	Potable Water	42.4	40.8	15.1	1.6	0.1	71.5	99.1	99.8

Source: HAZUS-MH 2.1

Notes: B = Borough; C = City; MRP = Mean return period; T = Township; WWTF = Wastewater Treatment Facility

