Washington County 2015 Hazard Mitigation Plan Update

Prepared for:
Washington County Dept. of Public Safety
100 W. Beau Street
Washington, PA 15301
with support from PEMA

Prepared by:
Michael Baker Jr., Inc.
1818 Market Street, Suite 3110
Philadelphia, PA 19103

July 10, 2015
FEMA 2nd Submission

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Washington County Hazard Mitigation Plan Update

Certification of Annual Review Meetings

The Washington County Hazard Mitigation Steering Committee has reviewed this Hazard Mitigation Plan Update. See Section 7 of the Washington County 2015 Hazard Mitigation Plan Update for further details regarding this form. Michael Baker International was contracted to update complete the 2015 update to the Hazard Mitigation Plan. Ron Sicchitano, Deputy Director, Washington County Department of Public Safety will certify the reviews between now and the next plan update.

YEAR	DATE OF MEETING	PUBLIC OUTREACH ADDRESSED?*	SIGNATURE
2010	N/A	N/A	To the best knowledge of the Steering Committee, no HMP progress reports were submitted from municipalities for the period from 2010-2013. The public had continual access to the HMP through the County's website and some mitigation actions were accomplished in this period. Progress on actions is discussed in detail in Section 6.1 of this plan.
2011	N/A	N/A	
2012	N/A	N/A	
2013	N/A	N/A	
2014	- Hazard Mitigation Planning Workshops, 9/4/14 - Hazard Mitigation Plan Webinars, October 2014 - Public Meetings, 10/22/14	Yes, website available for update process and public notice provided for 10/22/14 Public Meeting	 Sarah K. Bowen, AICP, CFM Michael Baker International Project Manager
2015	- Hazard Mitigation Plan Webinars, February 2015	Yes, website available for update process	
2016	Plan for June meeting		
2017	Plan for June meeting		
2018	Plan for June meeting		
2019	Plan for June meeting		

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

Washington County Hazard Mitigation Plan Update

Record of Changes

DATE	DESCRIPTION OF CHANGE MADE, MITIGATION ACTION COMPLETED, OR PUBLIC OUTREACH PERFORMED	CHANGE MADE BY (PRINT NAME)	CHANGE MADE BY (SIGNATURE)
2010-2013	To the best knowledge of the Steering Committee, no HMP progress reports were submitted from municipalities for the period from 2010-2013. The public had continual access to the HMP through the County's website and some mitigation actions were accomplished in this period. Progress on actions is discussed in detail in Section 6.1 of this plan.	N/A	N/A
2014-2015	Comprehensive 5 year update to plan with outreach summarized in Section 3.	Update facilitated by Michael Baker International Project Manager Sarah K. Bowen based on municipal, county and other stakeholder input.	Sarah K Bowen

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

Table of Contents

Table of Tables

Table of Figures

1. Introduction

1.1. Background

Across the United States, natural and human-caused disasters have led to increasing levels of deaths, injuries, property damage, and interruption of business and government services. The time, money, and efforts to recover from these disasters exhaust resources, diverting attention from important public programs and private agendas. Since 1955 there have been 53 Presidential Disaster Declarations and nine Presidential Emergency Declarations in Pennsylvania, 5 and five of which have included Washington County. The emergency management community, citizens, elected officials, and other stakeholders in Washington County, Pennsylvania, recognized the impact of disasters on their community and concluded that proactive efforts were needed to reduce the impact of natural and human-caused hazards.

Federal and state governments have utilized mitigation concepts to minimize environmental degradation and to reduce loss of life and property associated with natural hazards. However, mitigation was most often applied in a post-disaster environment. In an effort to increase public awareness and to reduce the costs associated with disaster preparedness, the Federal Emergency Management Agency (FEMA) developed a National Mitigation Strategy. The National Mitigation Strategy was an outgrowth of changing perceptions of hazards and their relationship to development. It represents a sustained effort to reduce hazard vulnerabilities through public outreach and partnership development, and was created with input from federal agencies, state and local governments, and the general public.

Hazard mitigation is a phrase that describes actions taken to prevent or reduce the long-term risks to life and property from hazards. Pre-disaster mitigation actions are taken in advance of a hazard event and are essential to breaking the typical disaster cycle of damage, reconstruction, and repeated damage. With careful selection, mitigation actions can be long-term, cost-effective means of reducing the risk of loss.

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

1.2. Purpose

This Hazard Mitigation Plan Update was developed for the purpose of:

- To protect life, safety, and property by reducing the potential for future damages and economic losses that result from natural hazards';
- To qualify for additional grant funding, in both the pre-disaster and the post-disaster environment;
- To qualify for additional credit under the Community Ratings System (CRS);

- To speed recovery and redevelopment following future disaster events;
- To demonstrate a firm local commitment to hazard mitigation principles; and
- To comply with both state and federal legislative requirements for local hazard mitigation plans.
- Improving community resiliency following a disaster event.

1.3. Scope

The implementation actions within this HMP apply to Washington County and any municipalities that adopt this HMP as their own. However, only those municipalities that have participated in the plan update process will remain eligible for state and federal hazard mitigation funding through the HMP. For the purpose of this Plan update, municipal participation was defined as completion and submission of a Risk Assessment Update Worksheet and Capability Assessment Survey, and attendance by a municipal official at a planning or public meeting conducted as part of the planning process.

1.4. Authority and References

Authority for this plan originates from the following federal sources:

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

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

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

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

- FEMA 386-1: *Getting Started*. September 2002.
- FEMA 386-2: *Understanding Your Risks: Identifying Hazards and Estimating Losses*. August 2001.
- FEMA 386-3: *Developing the Mitigation Plan*. April 2003.
- FEMA 386-4: *Bringing the Plan to Life*. August 2003.
- FEMA 386-5: *Using Benefit-Cost Review in Mitigation Planning*. May 2007.
- FEMA 386-6: *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*. May 2005.
- FEMA 386-7: *Integrating Manmade Hazards into Mitigation Planning*. September 2003.
- FEMA 386-8: *Multijurisdictional Mitigation Planning*. August 2006.
- FEMA 386-9: *Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects*. August 2008.

- FEMA. *Local Mitigation Planning Handbook.* March 2013.
- FEMA. *Local Mitigation Plan Review Guide.* October 1, 2011.
- FEMA *National Fire Incident Reporting System 5.0: Complete Reference Guide*. January, 2008.
- FEMA Hazard Mitigation Assistance Unified Guidance. September 11, 2013.
- FEMA. Integrating Hazard Mitigation Into Local Planning: Case Studies and Tools for Community Officials. March 1, 2013
- FEMA. Mitigation Ideas. A Resource for Reducing Risk to Natural Hazards. January 2013.

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

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

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

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

2. Community Profile

2.1. Geography and Environment

Washington County is found in the southwest corner of Pennsylvania. Of the four major geographic regions in the state, Washington Co. is on the Allegheny Plateau. The Allegheny Plateau covers roughly half the state, bounded in the east by the ridges of Allegheny Mountains. Rolling hills delineated by creeks or "runs" and punctuated by springs comprise the area which was originally hardwood forest. The primeval forest supported black bear, elk, moose, deer, panthers, wildcats, wolves, wild ducks and geese, ruffed grouse, quail, pheasants, turkeys, raccoons, squirrels, rabbits, skunks, and woodchucks.

This part of the state drains into the Ohio River system. The Monongahela River, which flows northward to join the Allegheny River in Pittsburgh and form the Ohio River, forms Washington County's eastern boundary. The Youghiogheny River flows into the Monongahela at McKeesport which is now in Allegheny County just north of Washington Co. This location, referred to early as "the forks of the Yough", was important in the early days when pioneers followed the river Valley through southwestern Pennsylvania toward what is now the Pittsburgh area.

Washington County is 857 square miles in size, ranking 18th out of Pennsylvania's 67 counties. The County is located in south-western Pennsylvania and is bordered by Beaver County to the north, Allegheny County to the north and east, Westmoreland County to the east, Fayette County to the east and south, Greene County to the south. Washington County is also bordered by the West Virginia Counties of Hancock to the north-west, Brooke and Ohio Counties to the west and Marshall County to the south west.

The County is divided into three HUC8 watersheds, twelve HUC10 and forty-two HUC12 watersheds. A HUC is the abbreviation for hydrologic unit code which is the method for delineating watersheds and the numbers refer to how many digits in the code are being used so that the greater the number the more specificity of watershed is being examined. The HUC10 watersheds include: Buffalo Creek, Chartiers Creek, Cross Creek, Kings Creek-Ohio River, Lower Monongahela River, Racoon Creek, Redstone Creek, Robinson Fork-Enlow Fork, South Fork Ten Mile Creek, Ten Mile Creek, Upper Monongahela River, and Wheeling Creek. Most of these watersheds have their own, or are a part of a local watershed alliance. There is also an all-encompassing Washington County Watershed Alliance. These groups are influential in restoring floodplains and encouraging municipalities to develop and adopt storm water management ordinances consistent with the guidelines established by the Department of Environment Protection and the Washington County Flood Taskforce.

A base map showing the County's major transportation infrastructure, municipalities, and parks and forests is included as Figure 2.1-1. Figures 2.1-2 and 2.1-3 show the HUC8 and HUC10 watersheds.

Figure 2.1-1 Base Map of Washington County.

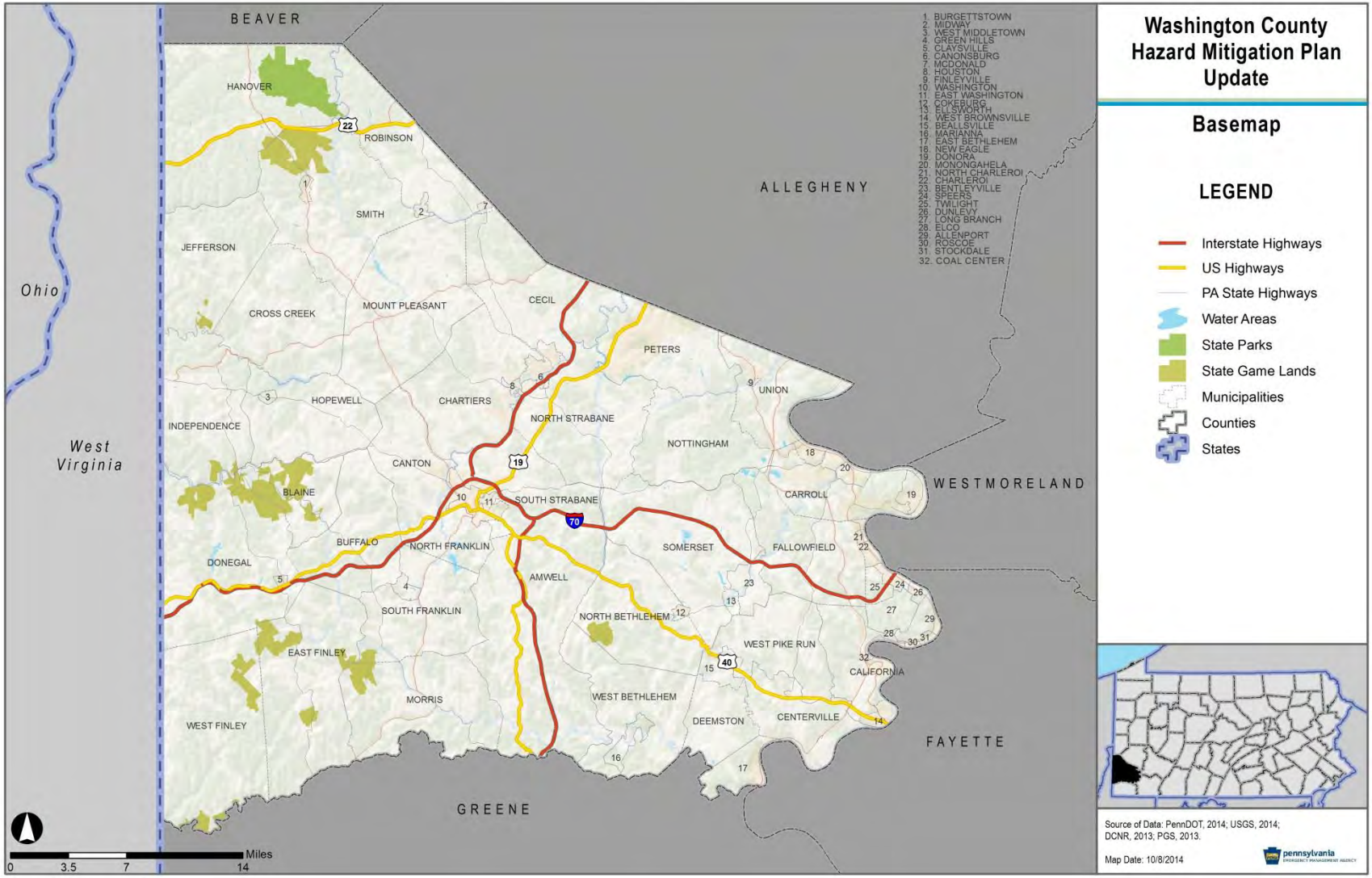


Figure 2.1-2 Washington County HUC8 Watersheds.

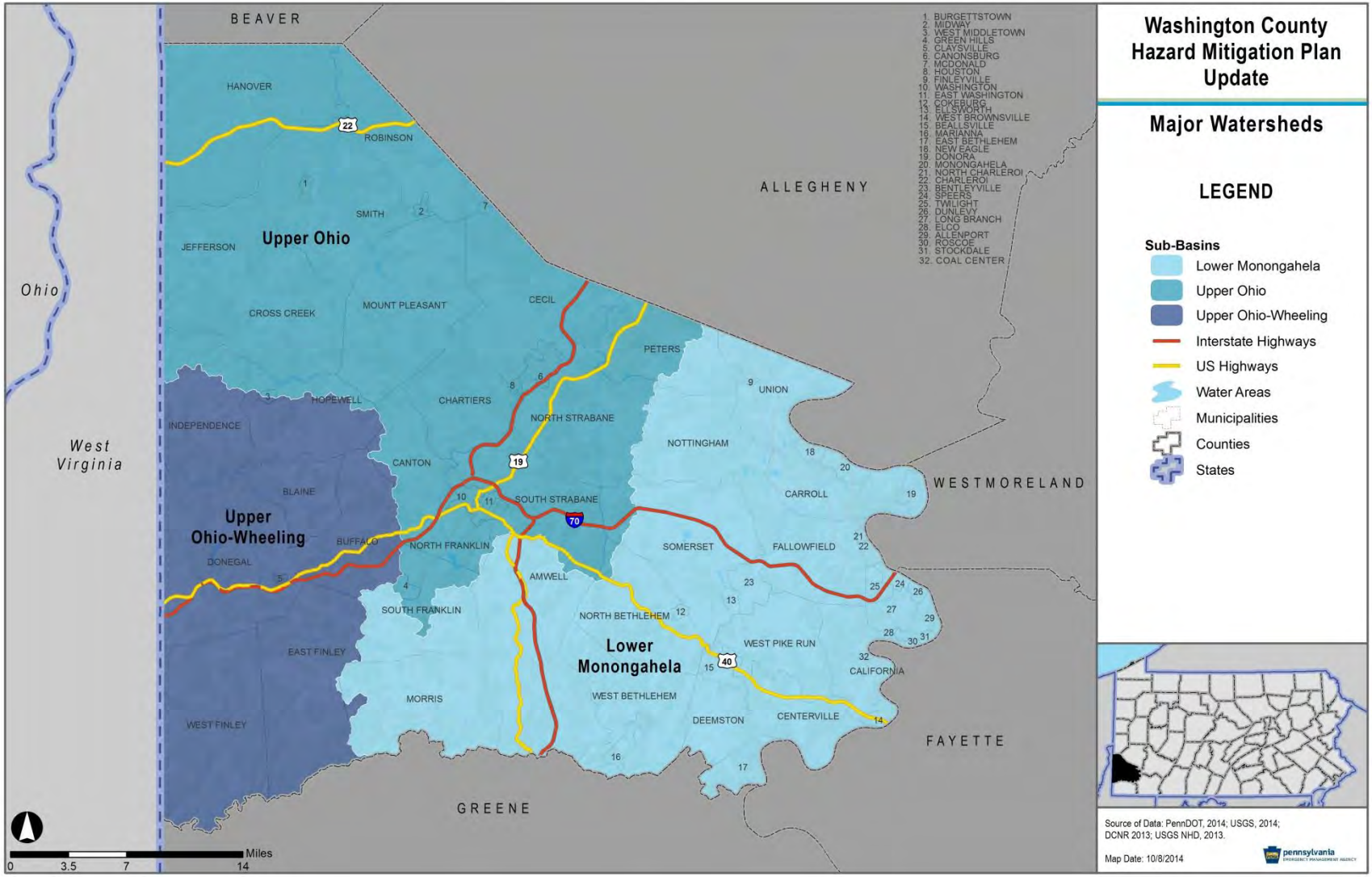
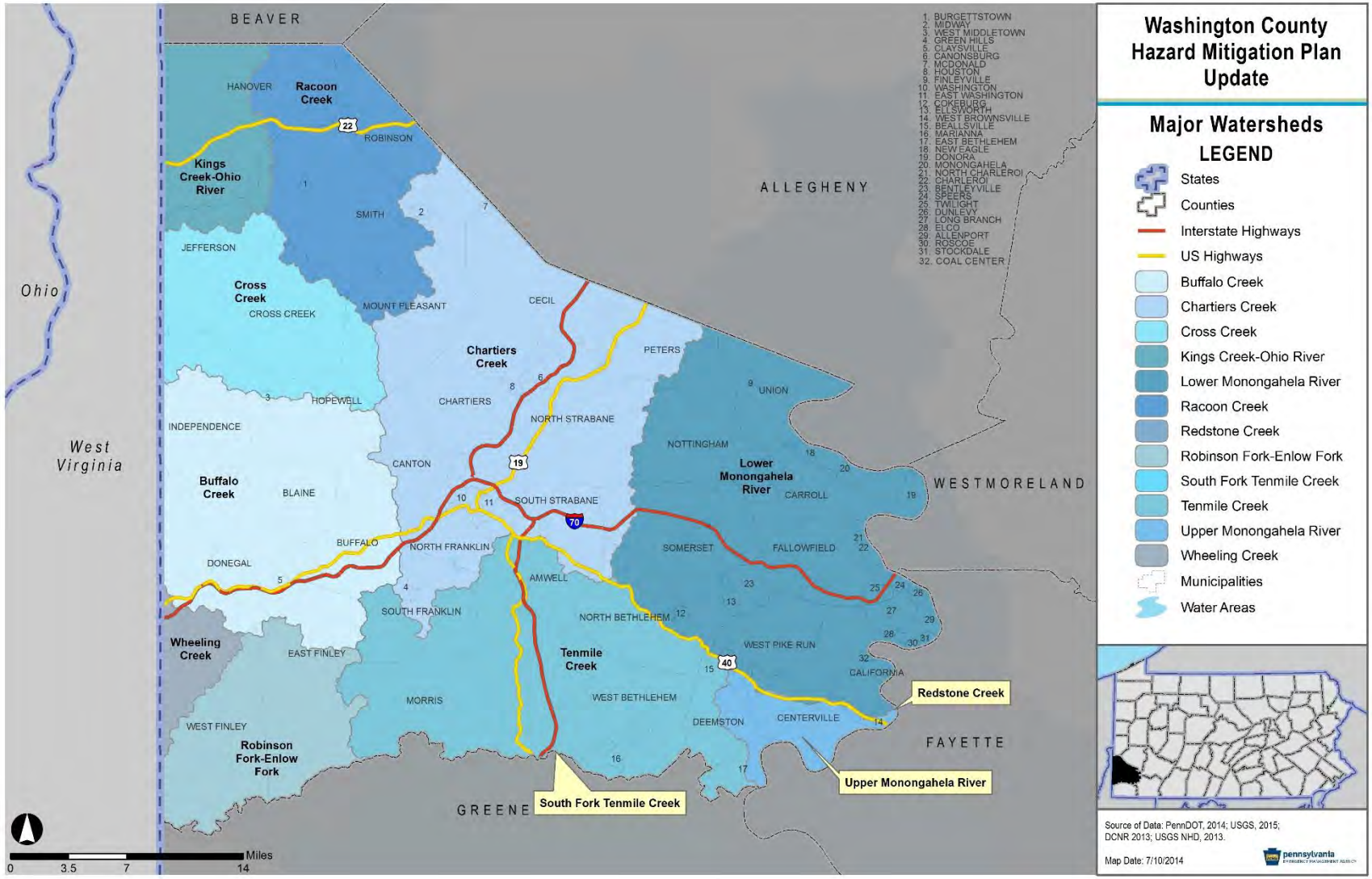


Figure 2.1-3 **Washington County HUC10 Watersheds.**



2.2. Community Facts

Washington County was created on March 28, 1781. It was the first county in the United States to be named after President George Washington. It was a young George Washington who passed through the region during the French and Indian War. Washington County is home to Meadowcroft Village; known nationwide for its 16,000 year old archeological dig and re-created 19th century village. Perhaps the most visited landmark in Washington County is its 23 covered bridges. Most are over a century old and are listed on the National Register of Historic Places. Today, Washington County is made up of 8 rolling farmlands, mountains, valleys, small villages and numerous towns. The Monongahela River forms the eastern border of the county for 40 miles. Once a center for the booming coal and oil industry of the early twentieth century, Washington County has become increasingly diverse. Today the county's largest employer is the service industry. Agriculture also plays a large role; there are more than 1,300 farms whose value of production is more than $38 million annually. Other important industries include the manufacture of fabricated and primary metals and industrial machinery and equipment. The I-79 corridor, which runs through the center of the county and is bisected by I-70 in Washington, has prompted a boom in both the residential and commercial construction industries as well as tourism.

Washington County includes 32 townships, 32 boroughs and 2 cities. The County's largest municipality, in terms of population, is Washington. The land use of Washington County includes traditional small lot housing and commercial areas located near industrial employment centers, suburban-style residential subdivisions developed along transportation corridors, and farming homesteads that continue to impart a strong agricultural flavor. Perhaps more than other counties in the region, Washington County had and continues to have its development patterns influenced by its existing transportation routes. The Monongahela River, the railroads, and National Pike (US Route 40) were significant forms of transportation and established historic settlement patterns. The I-79 corridor runs through the center of the county and is bisected by I-70 in Washington.

2.3. Population and Demographics

Population and demographic information provide baseline information about residents. Changes in demographics or populations may be used to identify higher-risk populations. Maintaining up-to-date data on demographics will allow the County to better assess magnitudes of hazards and develop more specific mitigation plans. Baseline demographic information for Washington County is provided in Table 2.3-1.

Table 2.3-1 Washington County Demographic Summary (U.S. Census)

DEMOGRAPHIC DATA POINT	2000	2010
Total Population	202,897	207,820
Male/Female	97,446/105,451	101,035/106,785
Median Age (years)	10.8	43.6
Under 5 years	11,235	10,556
5 – 19 years	38,774	38,039
20 – 64 years	116,565	122,859
65 years and older	36,323	36,366

Median age has been increasing and is now higher than Pennsylvania's median age of 40. The number of citizens over age 65 has been holding steady and is slightly over 17% of total population which signals the need to address hazard mitigation actions that take the increasing number of senior citizens into account. As senior citizens may not be able to drive, special evaluation plans may be required. Further, hearing or vision impairments could make receiving emergency instructions difficult.

Consideration should also be given to address hazard mitigation actions for citizens with disabilities. The Washington County Emergency Management Agency has a list of the residents who are identified as being disabled or having access or functional needs, to reach out to them at the time of a disaster, and will be transitioning this to a new Knowledge Center System. The list of residents that need assistance during disaster is consistently maintained and updated and currently included 631 residents in June of 2015.

Washington County has slightly increased in terms of population density. Based on Census 2010 data the County has a population density of 243 people per square mile, making Washington County the 22nd most densely population county in the state. This is an increase from the 2000 population density of 237 people per square mile. This trend should be taken into consideration when developing mitigation actions as the magnitude of a hazard increases proportionate to density.

Washington County has 92,991 residential units as of the 2010 census. These properties may be vulnerable to various natural hazards, in particular, flooding and windstorms. Damage to residential properties is not only expensive to repair or rebuild, but also devastating to the displaced family. Meanwhile, approximately 9.5 percent of the County's residential properties

are vacant. Vacant buildings are particularly vulnerable to arson and criminal activity. Since many vacant properties may not have been maintained, they may be structurally deficient and at risk of collapsing during a hazard event.

Table 2.3-2 Housing Characteristics (U.S. Census, 2000 and 2010 SF1 datasets).

HOUSING CHARACTERISTIC	2000	2010
Total Housing Units	87,267	92,991
Occupied Housing Units	81,130	84,123
Vacant Housing Units	6,137	8,868
Owner-Occupied Housing Units	62,561	64,381
Renter-Occupied Housing Units	18,569	19,742
Median Home Value (1)	$86,200	$141,000

(1) Questions pertaining to home value were not included in SF1 Datasets; therefore, American Community Survey 2012 Estimates and Census 2000 SF 3 were used.

Table 2.3-3 Municipal Population in Washington County (US Census).		
MUNICIPALITY	US CENSUS POPULATION	
	2000	2010
Allenport Borough	549	537
Amwell Township	3,960	3,751
Beallsville Borough	511	466
Bentleyville Borough	2,502	2,581
Blaine Township	597	690
Buffalo Township	2,100	2,069
Burgettstown Borough	1,576	1,388
California Borough	5,274	6,795
Canonsburg Borough	8,607	8,992
Canton Township	8,826	8,375
Carroll Township	5,677	5,640
Cecil Township	9,756	11,271
Centerville Borough	3,390	3,263
Charleroi Borough	4,871	4,120
Chartiers Township	7,154	7,818
Claysville Borough	724	829
Coal Center Borough	134	139
Cokeburg Borough	705	630
Cross Creek Township	1,685	1,556
Deemston Borough	809	722
Donegal Township	2,428	2,465
Donora Borough	5,653	4,781
Dunlevy Borough	397	381
East Bethlehem Township	2,524	2,354
East Finley Township	1,489	1,392
East Washington Borough	1,930	2,234
Elco Borough	362	323
Ellsworth Borough	1,083	1,027
Fallowfield Township	4,461	4,321
Finleyville Borough	459	461
Green Hills Borough	18	29
Hanover Township	2,795	2,673
Hopewell Township	992	957
Houston Borough	1,314	1,296
Independence Township	1,218	1,557
Jefferson Township	1,218	1,162
Long Branch Borough	539	447
Marianna Borough	626	494
McDonald Borough	1,866	1,766
Midway Borough	982	913
Monongahela City	4,761	4,300
Morris Township	1,272	1,105
Mount Pleasant Township	3,422	3,515

Table 2.3-3 Municipal Population in Washington County (US Census).		
MUNICIPALITY	**US CENSUS POPULATION**	
	2000	**2010**
New Eagle Borough	2,262	2,184
North Bethlehem Township	1,746	1,631
North Charleroi Borough	1,409	1,313
North Franklin Township	4,818	4,583
North Strabane Township	10,057	13,408
Nottingham Township	2,522	3,036
Peters Township	17,566	21,213
Robinson Township	2,193	1,931
Roscoe Borough	848	812
Smith Township	4,567	4,476
Somerset Township	2,701	2,684
South Franklin Township	3,796	3,310
South Strabane Township	7,987	9,346
Speers Borough	1,241	1,154
Stockdale Borough	555	502
Twilight Borough	241	233
Union Township	5,599	5,700
Washington City	15,268	13,663
West Bethlehem Township	1,432	1,460
West Brownsville Borough	1,075	992
West Finley Township	951	878
West Middletown Borough	144	139
West Pike Run Township	1,925	1,587
Washington County	**204,439**	**207,820**

Approximately 21 percent of the County's population rents. Renters are more transient than home owners; therefore, communicating with renters may be more difficult than with home owners. Similarly, tourists would be a harder population to communicate with during an emergency event. Communication strategies should be developed to ensure that these populations can be given proper notification.

From a race and ethnicity perspective, Washington County citizens are predominantly white. The number of Hispanic or Latino citizens increased from 1,170 to 2,366 between 2000 and 2010. Refer to Table 2.3-4. However, the number of citizens speaking a language other than English actually decreased from 2000 to 2010, with the majority of the citizens speaking Other Indo-European languages. Additional languages spoken other than English include: Spanish or Spanish Creole (0.9%), Asian and Pacific Island (0.4%), and Other languages (0.1%). It may be important to consider hazard mitigation strategies to address language barriers to ensure all residents receive emergency instructions.

Table 2.3-4 Race and Ethnicity Profile		
DEMOGRAPHIC INDICATOR	**2000**	**2010**
One Race	201,228	204,653
White	193,297	195,657
Black or African American	6,606	6,757
American Indian and Alaska Native	175	251
Asian	725	1,327
Pacific Islander	44	31
Some Other Race	381	630
Two or More Races	1,669	3,167
Hispanic or Latino	1,170	2,366
Speak a language other than English	6,912	6,303(1)

Source: U.S. Census.
(1) Number was obtained from the U.S. Census American Community Survey, 2012 Estimates as this question was not asked as part of Census 2010.

Table 2.3-5 Income Levels & Wage Statistics (U.S. Census, ACS 2010 and 2013 Estimates; PA Department of Labor & Industry, Labor Market Statistics, Quarterly Census of Employment and Wages).				
INCOME	**WASHINGTON COUNTY**		**PENNSYLVANIA**	
	2010	**2013 ESTIMATES(1)**	**2010**	**2013 ESTIMATES (1)**
Median Household Income	37,607	$53,326	49,288	52,007
Median Family Income	47,287	$67,219	61,890	66,522
Per Capita Income	19,935	$27,778	26,374	28,647
WAGES (1ST QUARTER 2014)	**WASHINGTON COUNTY**		**PENNSYLVANIA**	
Average Weekly Wage	$1,067		$1,007	
Average Annual Wage (2013)	$55,494		$49,077	

According to L & I as of September 2014, Washington County had a civilian labor force of 108,000 with 101,700 employed and 6,200 unemployed. This translates to an unemployment rate of 5.8%; the same as Pennsylvania's unemployment rate of 5.8%.

2.4. Land Use and Development

According to the Washington County Economic Development Strategy, the county's contemporary development pattern generally follows the I-79/U.S. 19 corridor south from the Allegheny County line down the center of the county to the city of Washington area. Historically, population and economic activities were centered in the Mon Valley and the City of Washington. The shift in the development pattern is a reflection of Interstates 70 and 79 an in-migration from Allegheny County, and the decline of the steel and primary metals industry. Accordingly, those municipalities displaying more prosperous socioeconomic conditions are generally located in the middle of the county. Groupings of municipalities located in the extreme northwest corner of the county and the northern portion of the Mon Valley also display prosperous socioeconomic conditions. Groupings of less prosperous municipalities are concentrated in the southwest, southeast and northwest corners of the county and the Washington-Canton area. Table 2.4.1 shows the breakdown of the land use in Washington County as of 2005.

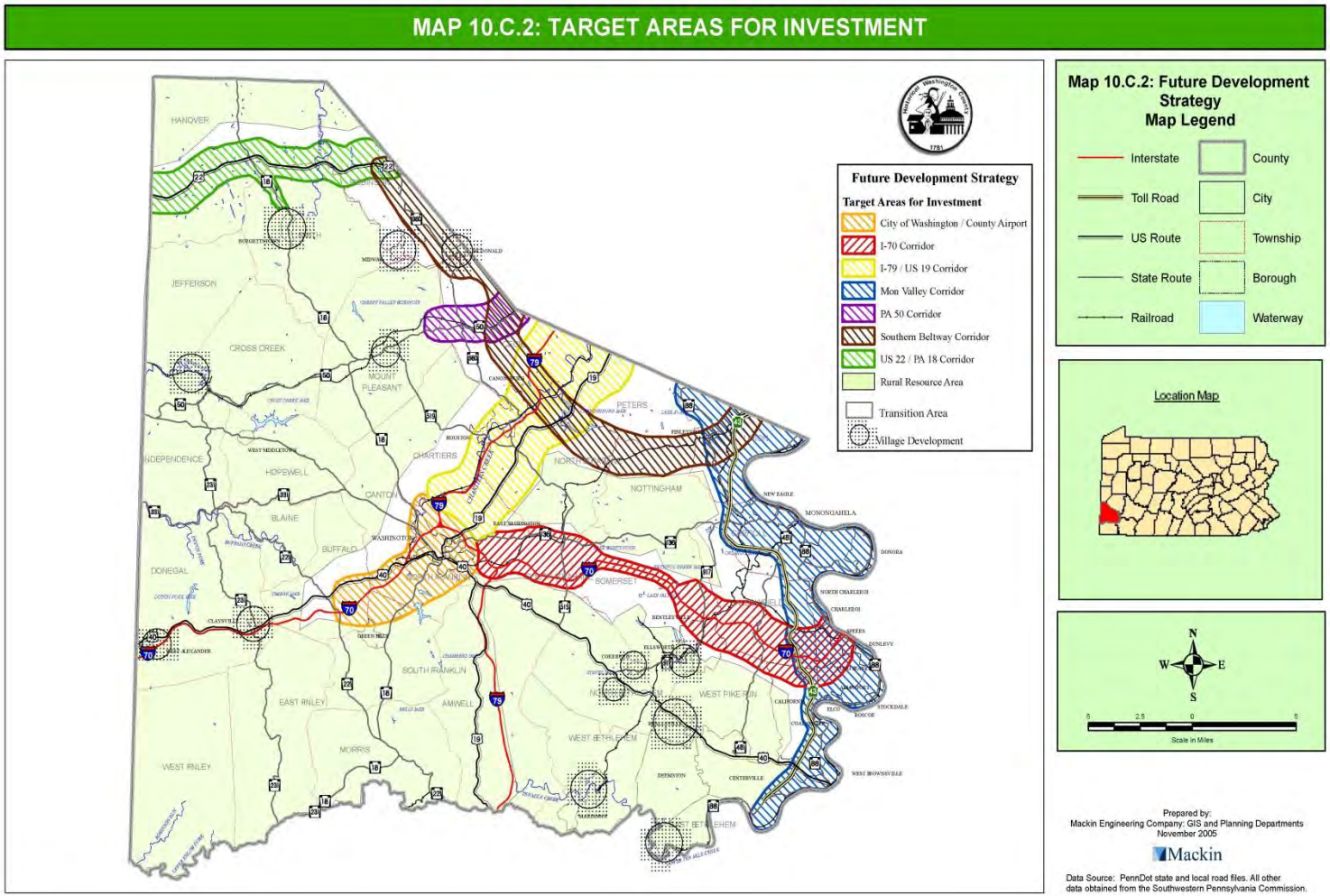
Table 2.4-1 Washington County Land Use (Washington County, 2005)

LAND CLASSIFICATION	% OF TOTAL LAND USE
Agriculture	25.7
Community Facilities (Cemetery, College, Hospital)	0.2
Recreation (Golf Course, Parks)	1.8
Open Space (includes Game Lands, Open Space, Wooded)	64.7
Commercial (includes Shopping Center)	0.1
Industrial (includes Industrial Park & Major Employers)	0.8
Mixed Use	1.6
Residential	4.9

Much of the population is concentrated in the central and north-central parts of the county, running north from North Franklin Township to Cecil and Peters Townships. Not surprisingly, the heavy population areas coincide with the locations of public sewer and water infrastructure.

Future growth is expected to remain concentrated in the center of the county, primarily north of the Greater City of Washington Area. The historically active Mon Valley region will experience some growth, but most Mon Valley communities will remain relatively unchanged. This information comes from the 2005 Washington County Comprehensive Plan. Figure 2.4-2 shows Washington County target areas for investment as of 2005. Each of the target investment areas include at least one special flood hazard area, but the I-79/US-19 Corridor Investment Area contains a large segment of the SHFA around Charles Creek. Additionally, all of the target areas are in places with steep and north-facing slopes, and the target areas on the eastern part of Washington County are in areas more susceptible to subsidence. More information on each of these hazards follows in Section 4.3, and more information on how future development patterns impact vulnerability to hazards is contained in Section 4.4.4.

Figure 2.4-2 **Washington County planning areas for growth (Washington County 2005 Comprehensive Plan).**



2.5. Data Sources and Limitations

The Washington County Department of Public Safety's Addresses (point data) was used as an inventory of properties throughout the County. However, this dataset also included things like fire alarm boxes, railroad crossings, and highway interchanges that, while helpful for public safety, are not actually structures. These points were removed from the dataset to avoid overestimating vulnerability. The addresses included a general type code; this was used to add a type to each structure so that both the number and type of buildings vulnerable to hazards could be evaluated. While this allows for generalized discussion of the type of buildings at risk in Washington County, the number of buildings by type used throughout this HMP should be considered estimates. The actual building and land use may differ than information contained in the database. The CAD coding "TRPRK" was used to extract numbers of trailer parks. The buildings layer also did not have a value associated with each structure, and parcel assessed values were not provided.

Flood hazard data used in this plan is Washington County's 2nd Revised Preliminary DFIRM database from the Map Service Center dated June 27, 2014. This data is a digital representation of features of Flood Insurance Rate Maps (FIRMs). Washington County provided other GIS datasets including transportation infrastructure, boundaries, structures, parcels, and community facilities. Additional data for the base map was provided by the Pennsylvania Department of Transportation, Pennsylvania Game Commission, and the Pennsylvania Department of Conservation and Natural Resources.

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

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

available for certain kinds of natural hazards; incidences listed in this plan reflect data housed in the NCDC Storm Events Database as of September 2014.

HAZUS-MH is a powerful risk assessment methodology for analyzing potential losses from floods, hurricane winds and earthquakes. In HAZUS-MH, current scientific and engineering knowledge is coupled with the latest GIS technology to produce estimates of hazard-related damage before, or after, a disaster occurs. HAZUS version 2.1 was used to estimate losses for floods in Washington County; this plan incorporates an enhanced analysis, meaning that county-specific data was incorporated into the model to make it more precise. In addition, Washington County's 1% annual-chance depth grid, a Risk MAP non-regulatory product, was used to incorporate the most recent hydraulic and hydrologic modeling in the county. For more information on the enhanced analysis methodology used for this plan's flood model, please see Appendix F.

This HMP evaluates the vulnerability of the County's critical facilities. The list of critical facilities provided in Appendix E was developed based on information provided by the Washington County GIS Department. For the purposes of this plan, critical facilities are those entities that are essential to the health and welfare of the community.. Table 2.5-1 summarizes the critical facilities in Washington County by type and by municipality. For a complete listing of critical facilities and their vulnerability to individual hazards, please see Appendix E.

Table 2.5-1 Critical facilities by community and type.																							
MUNICIPALITY	AIRPORTS	CELL TOWER	CELL TOWERS	CEMETERIES	COMPRESSOR STATIONS	COUNTY FACILITIES	DAY CARE	EAP DAMS	ELECTRIC POWER	EMS	EOC/911 CENTER	FIRE DEPARTMENTS	GOV. COMMUNICATION TOWERS	HOSPITALS	MUNICIPAL BUILDINGS	PARKS AND REC FACILITIES	PERSONAL CARE HOMES	POLICE STATIONS	POTABLE WATER	PUBLIC SCHOOLS	PUBLIC WORKS FACILITIES	SARA FACILITIES	SEWER FACILITIES	GRAND TOTAL
Allenport Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	1	1	5
Amwell Township	0	0	7	0	3	0	0	0	0	0	0	2	0	0	1	6	0	0	0	1	1	3	0	24
Beallsville Borough	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	3
Bentleyville Borough	0	0	2	0	0	0	1	0	0	0	0	1	0	0	1	3	0	0	0	2	0	4	0	14
Blaine Township	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	1	0	5
Buffalo Township	0	0	2	0	2	0	0	0	0	0	0	0	0	0	1	3	0	0	0	2	1	3	0	14
Burgettstown Borough	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	4
California Borough	0	0	2	1	0	0	1	0	0	0	0	1	0	0	1	7	0	1	0	2	1	4	2	23
Canonsburg Borough	0	0	1	2	0	1	1	0	0	0	0	1	0	0	1	4	1	1	0	4	1	2	0	20
Canton Township	0	0	3	1	1	0	2	1	0	0	0	2	0	0	1	2	1	0	0	1	0	10	0	25
Carroll Township	0	0	5	2	0	0	1	4	0	0	0	2	0	1	1	8	2	2	0	2	0	3	2	35
Cecil Township	0	0	7	1	0	0	3	2	0	0	0	3	0	0	1	5	0	1	0	3	0	11	5	42
Centerville Borough	0	0	2	1	0	0	0	0	0	0	0	2	0	0	1	3	0	1	0	0	0	0	1	11
Charleroi Borough	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	5	0	1	1	0	1	6	1	18
Chartiers Township	0	0	0	1	3	2	1	0	0	0	0	1	0	0	1	2	1	1	0	2	0	19	0	34

Table 2.5-1 Critical facilities by community and type.

MUNICIPALITY	AIRPORTS	CELL TOWER	CELL TOWERS	CEMETERIES	COMPRESSOR STATIONS	COUNTY FACILITIES	DAY CARE	EAP DAMS	ELECTRIC POWER	EMS	EOC/911 CENTER	FIRE DEPARTMENTS	GOV. COMMUNICATION TOWERS	HOSPITALS	MUNICIPAL BUILDINGS	PARKS AND REC FACILITIES	PERSONAL CARE HOMES	POLICE STATIONS	POTABLE WATER	PUBLIC SCHOOLS	PUBLIC WORKS FACILITIES	SARA FACILITIES	SEWER FACILITIES	GRAND TOTAL
Claysville Borough	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	3
Coal Center Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Cokeburg Borough	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	4
Cross Creek Township	0	0	0	1	0	0	1	2	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	8
Deemston Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	1	0	5
Donegal Township	0	0	4	2	1	0	0	3	0	0	0	1	1	0	1	3	0	1	0	0	1	2	0	20
Donora Borough	0	0	0	2	0	1	2	0	0	0	0	1	0	0	1	6	0	1	0	0	1	7	1	23
Dunlevy Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	2
East Bethlehem Township	0	0	2	0	0	0	1	0	0	0	0	1	0	0	1	3	0	1	0	0	0	1	2	12
East Finley Township	0	0	3	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1	0	8
East Washington Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	1	0	0	0	0	0	4
Elco Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	3
Ellsworth Borough	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	0	4
Fallowfield Township	0	0	4	1	0	0	1	2	0	0	0	1	0	0	1	4	0	0	0	2	1	9	2	28
Finleyville	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	4

Table 2.5-1 Critical facilities by community and type.																								
MUNICIPALITY	AIRPORTS	CELL TOWER	CELL TOWERS	CEMETERIES	COMPRESSOR STATIONS	COUNTY FACILITIES	DAY CARE	EAP DAMS	ELECTRIC POWER	EMS	EOC/911 CENTER	FIRE DEPARTMENTS	GOV. COMMUNICATION TOWERS	HOSPITALS	MUNICIPAL BUILDINGS	PARKS AND REC FACILITIES	PERSONAL CARE HOMES	POLICE STATIONS	POTABLE WATER	PUBLIC SCHOOLS	PUBLIC WORKS FACILITIES	SARA FACILITIES	SEWER FACILITIES	GRAND TOTAL
Borough																								
Green Hills Borough	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Hanover Township	0	0	3	1	0	0	0	7	0	0	0	1	0	0	1	3	0	1	0	0	1	3	1	22
Hopewell Township	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	4
Houston Borough	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	0	0	0	4
Independence Township	0	0	1	0	1	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	1	2	1	9
Jefferson Township	0	0	0	0	0	0	0	2	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	5
Long Branch Borough	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	4
Marianna Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
McDonald Borough	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	1	0	1	0	0	0	1	0	6
Midway Borough	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	3
Monongahela, City of	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	4	0	1	0	0	1	2	1	13
Morris Township	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	0	5
Mount Pleasant Township	0	0	5	1	2	0	0	1	0	0	0	2	0	0	1	6	0	1	0	2	0	3	1	25
New Eagle Borough	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	0	0	0	1	2	0	7

Table 2.5-1 Critical facilities by community and type.																							
MUNICIPALITY	AIRPORTS	CELL TOWER	CELL TOWERS	CEMETERIES	COMPRESSOR STATIONS	COUNTY FACILITIES	DAY CARE	EAP DAMS	ELECTRIC POWER	EMS	EOC/911 CENTER	FIRE DEPARTMENTS	GOV. COMMUNICATION TOWERS	HOSPITALS	MUNICIPAL BUILDINGS	PARKS AND REC FACILITIES	PERSONAL CARE HOMES	POLICE STATIONS	POTABLE WATER	PUBLIC SCHOOLS	PUBLIC WORKS FACILITIES	SARA FACILITIES	SEWER FACILITIES	GRAND TOTAL
North Bethlehem Township	1	0	3	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	2	10
North Charleroi Borough	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	2
North Franklin Township	0	0	1	1	0	0	0	2	0	0	0	3	0	1	1	6	1	1	0	3	1	0	1	22
North Strabane Township	0	0	5	1	0	1	2	3	0	1	0	3	0	1	1	7	3	1	0	3	0	13	1	46
Nottingham Township	0	0	2	0	0	1	1	1	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	9
Peters Township	0	0	4	4	0	0	6	7	0	0	0	2	0	0	1	8	2	1	0	5	1	5	4	50
Robinson Township	2	0	0	0	1	0	0	3	1	0	0	0	0	0	1	2	0	0	0	0	0	1	1	12
Roscoe Borough	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	3
Smith Township	1	0	2	1	2	0	3	0	0	0	0	2	0	0	1	4	0	1	0	3	0	6	1	27
Somerset Township	0	0	4	0	0	0	0	5	0	0	0	0	0	0	1	4	0	0	0	1	1	3	1	20
South Franklin Township	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	1	2	3	12
South Strabane Township	0	0	6	2	0	0	0	1	0	0	0	2	1	0	1	11	1	1	0	1	1	12	3	43
Speers Borough	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	3	1	7

Table 2.5-1 Critical facilities by community and type.																								
MUNICIPALITY	**AIRPORTS**	**CELL TOWER**	**CELL TOWERS**	**CEMETERIES**	**COMPRESSOR STATIONS**	**COUNTY FACILITIES**	**DAY CARE**	**EAP DAMS**	**ELECTRIC POWER**	**EMS**	**EOC/911 CENTER**	**FIRE DEPARTMENTS**	**GOV. COMMUNICATION TOWERS**	**HOSPITALS**	**MUNICIPAL BUILDINGS**	**PARKS AND REC FACILITIES**	**PERSONAL CARE HOMES**	**POLICE STATIONS**	**POTABLE WATER**	**PUBLIC SCHOOLS**	**PUBLIC WORKS FACILITIES**	**SARA FACILITIES**	**SEWER FACILITIES**	**GRAND TOTAL**
Stockdale Borough	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	1	0	0	0	0	0	5
Twilight Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Union Township	1	1	3	0	0	0	0	4	3	0	0	1	0	0	1	6	0	1	1	2	0	6	0	30
Washington, City of	0	0	1	0	0	6	7	1	0	0	1	3	0	1	1	4	0	2	0	3	1	6	0	37
West Bethlehem Township	0	0	0	2	0	0	1	1	0	0	0	1	0	0	1	1	0	0	0	0	1	0	0	8
West Brownsville Borough	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	0	1	0	0	0	1	0	6
West Finley Township	0	0	4	0	0	0	0	2	0	0	0	1	0	0	1	0	0	0	0	0	0	2	1	11
West Middletown Borough	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	3
West Pike Run Township	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	2	5
TOTAL	**6**	**1**	**92**	**33**	**19**	**12**	**41**	**56**	**4**	**1**	**1**	**61**	**2**	**4**	**65**	**164**	**12**	**29**	**2**	**50**	**21**	**166**	**43**	**885**

3. Planning Process

3.1. Update Process and Participation Summary

A successful planning process builds partnerships and brings together members representing government agencies, the public, and other stakeholders to reach consensus on how the community will prepare for and respond to hazards that are most likely to occur. Applying a comprehensive and transparent process adds validity to the Plan. Those involved gain a better understanding of the problem or issue and how solutions and actions were devised. The result is an updated set of common community values and widespread support for directing financial, technical, and human resources to an agreed-upon action. The planning process has been an integral part of updating the Washington County All Hazard Mitigation Plan (HMP), which was previously approved June 21, 2010. This section describes Washington County's update process and how the HMP evolved since it was first approved by the Federal Emergency Management Agency (FEMA).

The 2015 HMP update was again led by the Washington County Department of Public Safety. To facilitate the update of the 2015 HMP, Washington County contracted with Michael Baker International (Baker), to assist in updating Washington County's HMP. In accordance with the Disaster Mitigation Act of 2000 (DMA 2000) requirements, this plan document the following topics:

1. Planning process
2. Hazard identification
3. Risk assessment
4. Mitigation strategy: goals, actions, and projects
5. Formal adoption by the participating jurisdictions
6. PEMA and FEMA approval

During the 2010 update process, planners began by identifying the hazards that could significantly impact the County and its municipalities, and they determined these hazards' economic, social, and environmental impacts. From this analysis, the County created an action strategy identifying technically feasible and cost-effective mitigation actions to reduce hazard impacts. During the 2015 update, stakeholder feedback was solicited through meetings, workshops, a project website, and written and electronic communication. A total of seven hazards were identified and profiled in 2010. Stakeholders were asked to provide information on identified hazards and to assist with the Risk Factor ranking.

The mitigation strategy was reviewed by the Steering Committee and stakeholders provided information about what had been accomplished over the last five years along with actions and projects to be implemented moving forward.

The report format is structured in accordance with the most current planning guidance from FEMA, Local Mitigation Handbook (2013), and PEMA, Standard Operating Guide (SOG) (October 2013). As a result, the format of the 2015 Washington County Hazard Mitigation Plan Update contrasts significantly from the 2010 Washington County Hazard Mitigation Plan Update. Table 3.1-1 shows the changes in format between the 2010 and 2015 HMPs.

Table 3.1-1 Summary of changes to the format of the 2010 and 2015 versions of the Washington County HMP Update.	
2010 SECTION	**2015 SECTION**
Introduction	1. Introduction
A. Purpose	1.2 Purpose
B. Scope	1.3 Scope
C. Authority	1.4 Authority
D. Background	1.1 Background
Description of the Planning Area	2. Community Profile
Description of the Planning Process	3. Planning Process
Participants in the Planning Process	3.2 The Planning Team
Coordination	3.3 Meetings and Documentation; 3.4 Public and Stakeholder Participation
Adoption Process and Documentation	8. Plan Adoption
Risk Analysis	4. Risk Assessment
Hazard Identification and Historical Events	4.2 Hazard Identification
Severe Winter Weather	4.3.7 Winter Storm
Thunderstorms and Tornadoes	4.3.6 Tornado, Windstorm
Drought	4.3.1 Drought
Subsidence - Natural/Mine Related	4.3.5 Subsidence, Sinkhole
Landslides	4.3.4 Landslide
Earthquakes	4.3.2 Earthquake
Washington County's Resources	5. Capability Assessment
Washington County's Capabilities	5. Capability Assessment
Emergency Management Considerations	5.2.1.2 Emergency Management
Action Plan	6. Mitigation Strategy
Implementation	6.4 Mitigation Action Plan
Maintenance	7. Plan Maintenance
Monitoring	7.2 Monitoring, Evaluating, and Updating the Plan
Evaluation	7.2 Monitoring, Evaluating, and Updating the Plan
Update	7.2 Monitoring, Evaluating, and Updating the Plan

In addition to the section changes described above, the 2015 uses the following terminology and tools defined in the FEMA Local Mitigation Handbook and PEMA's SOG:

Hazard Definitions. A standard list of hazard definitions, Risk Assessment Hazard Descriptions, has been developed. Therefore, hazards identified in the 2010 HMP Update are referred to in the 2015 HMP Update using slightly different terminology. For example, 'Flooding' in the 2010 HMP Update is referred to as 'Flood, Flash Flood, Ice Jam' in the 2015 HMP Update.

Mitigation Techniques. FEMA's 2013 Local Mitigation Handbook has reduced the number of mitigation techniques from six to four as shown in the following table. The major difference is that emergency services is no longer a mitigation technique category, as emergency services activities are more appropriately located in an emergency response plan.

Planning Data Collection Tools. Standard data collection and documentation tools were developed as part of the SOG and have been used in the 2015 HMP Update including: a revised Capability Assessment Survey, a National Flood Insurance Program (NFIP) worksheet, a Hazard Identification and Risk Evaluation Worksheet, and tools to evaluate and prioritize mitigation actions.

Specific process updates pertaining to each section of the HMP Update are included in Sections 4.1, 5.1, 6.1 and 7.1.

3.2. The Planning Team

The County's Steering Committee consists of:

- Jeff Yates, Director, Washington County Department of Public Safety
- Ron Sicchitano, Deputy Director, Washington County Department of Public Safety
- Jonathan Madaras, GIS Manager, Washington County Department of Public Safety
- Kathy Ross, Secretary, Washington County Department of Public Safety

The Steering Committee was supported by municipal officials and other agency/organization representatives. The Steering Committee provided overall guidance for the plan update process. The provided data to be used in risk and vulnerability analysis, guidance on hazard concerns, and mitigation priorities. The Steering Committee assisted in reviewing information in the existing plan for the best way to update it for 2015. Their input helped to focus the discussion at meetings with the municipalities, stakeholder and public. The municipalities provided input by commenting on forms what hazards they wanted profiled in the plan and what they were concerned about mitigating. Municipalities participated through meetings, forms, and conference call to tailor the plan to their jurisdiction. Additional details on the topics of each meeting, forms and participation by municipality follow in sections 3.3, 3.4 and 3.5 and in Appendix C.

The stakeholders listed in Table 3.2-1 served on the 2015 planning team, demonstrating their commitment to actively participate in the planning process by attending meetings, completing assessments, surveys, and worksheets, and/or submitting comments. The planning team consisted of county and local officials including municipal supervisors and council members, emergency management coordinators, and the other identified stakeholders

Table 3.2-1 Participants in the 2015 Washington County HMP Update.

MUNICIPALITY/ORGANIZATION	PARTICIPANT(S)
Allenport Borough	Dennis Martinak – President, Council
Amwell Township	Wayne Montgomery – Supervisor
Beallsville Borough	
Bentleyville Borough	Roy Larimer – VP, Council Tim Jansante – Council
Blaine Township	
Buffalo Township	Don Lachman – Supervisor Jim Arborg – Code Enforcement Tim Domak - Supervisor
Burgettstown Borough	Thomas Repole – EMC
California Borough	Jeff Tuday - Street Commissioner John Mosher - EMC
Canonsburg Borough	Joshua Bell – EMS Supervisor David Rhome - Mayor
Canton Township	Chris Hammett – Code Enforcement
Carroll Township	Paul Brand – Chief of Police
Cecil Township	Don Gennuso - Manager
Centerville Borough	Carol A. Matesich - Secretary
Charleroi Borough	Donna Henderson – Borough Manager

Table 3.2-1 Participants in the 2015 Washington County HMP Update.	
MUNICIPALITY/ORGANIZATION	**PARTICIPANT(S)**
Chartiers Township	Robert Fetty – EMC
Claysville Borough	Brad Simms – EMC
Coal Center Borough	
Cokeburg Borough	
Cross Creek Township	Robert Gagliani – EMC
Deemston Borough	Charles Caprini – Council
Donegal Township	
Donora Borough	Don Pavelko – EMC/Council/Firefighter Dennis Fisher – Borough Administrator
Dunlevy Borough	
East Bethlehem Township	Maryann Kubacki - Secretary
East Finley Township	Rich Dorsey – EMC Melissa Metz – Sec./Treasurer
East Washington Borough	Robert Caldwell – PD
Elco Borough	
Ellsworth Borough	Joseph D. Kudlac – Mayor
Fallowfield Township	Bruce Smith – Supervisor/Public Safety Liaison
Finleyville Borough	
Green Hills Borough	
Hanover Township	
Hopewell Township	
Houston Borough	James Stubenbordt – Mayor Charles Fife – Council President
Independence Township	Chris Maust – EMC
Jefferson Township	Alan Gould – Zoning Official Patty Lawrence – Planning Commission
Long Branch Borough	
Marianna Borough	David Knitwen - EMS
McDonald Borough	Bob Amrhein - EMC
Midway Borough	William Dale Baird - EMC
Monongahela City	William Polonoli – EMC Aaron Benney - EMC
Morris Township	
Mount Pleasant Township	Kevin James Dry – EMC Gary Farner - Supervisor
New Eagle Borough	
North Bethlehem Township	
North Charleroi Borough	
North Franklin Township	
North Strabane Township	Paul Shirino – Deputy EMC
Nottingham Township	
Peters Township	Michael Silvestri – Manager Matt DiFiore – Administrative Intern Harry Fruecht – Chief of Police Mike McLaughlin – Deputy Fire Chief
Robinson Township	Erin Sakalik, Township Manager
Roscoe Borough	
Smith Township	J. Christopher Lander – EMC/Firefighter
Somerset Township	Mary Ann Lobodinsky - Secretary
South Franklin Township	Tyler Linck - Manager
South Strabane Township	John Stickle – Manager Chris Barton – EMC Laynee Zipko - Supervisor
Speers Borough	
Stockdale Borough	Charles Furlong – Council/EMC William Furlong – Asst. EMC

Table 3.2-1 Participants in the 2015 Washington County HMP Update.	
MUNICIPALITY/ORGANIZATION	**PARTICIPANT(S)**
Twilight Borough	Carol Otto – Sec./Treasurer
Union Township	Larry Spahr - Supervisor
Washington City	Ron McIntyre – Code Enforcement Gerald Coleman – Captain, FD Brenda Davis – Mayor Traci Graham - Council
West Bethlehem Township	Thomas Donahoo - Supervisor
West Brownsville Borough	Ada Brosky – Council Pat Maxon – Council Jim Pflugh - Council
West Finley Township	Stephen Emery – EMC/Fire Chief
West Middletown Borough	
West Pike Run Township	Laura Hough – EMC/Supervisor
Washington County	Jeff Yates – Director, WCDPS Ron Sicchitano – Deputy Director, WCDPS Jonathan Madaras – GIS Manager, WCDPS Kathy Ross – Secretary, WCDPS Jason E. Theakston - Land Use Planner, Washington County Planning Commission

3.3. Meetings and Documentation

The following meetings, both in person and teleconference, were held as part of the planning process. Meeting documentation in the form of invitations (letter and e-mail format), agendas, sign-in sheets, handouts, presentations, flyers, and minutes are included in Appendix C - Meeting and Other Participation Documentation.

Steering Committee Kick-off Meeting, June 4, 2014: This meeting was held with the Steering Committee to plan the update process. Discussion topics including meeting schedules, stakeholder list, data needs, and mitigation strategy were covered during the teleconference.

Hazard Mitigation Planning Workshop, Thursday, September 4, 2014: The purpose of the meeting was to reconvene the Planning Team and to review and evaluate the existing hazard mitigation plan.

As part of the workshop, municipalities and stakeholders were asked to complete a hazard risk evaluation form (Hazards in Your Community). The form included the 7 hazards to be profiled for the 2015 HMP Update and requested attendees to rank hazards relative spatial extent, probable impact, probability of future events, and overall significance. Results of the hazard risk evaluation form were used to prepare the 2015 Risk Factor ranking.

The HMP Workshop provided the opportunity for municipalities to submit and ask questions about Capability Assessment Surveys. Capability Assessment Surveys were printed and distributed at the HMP Workshop. Municipalities were asked to complete the Capability Assessment. The NFIP worksheet was pre-populated for each community with community specific information from FEMA's Community Information System (CIS) database. Fields that were not pre-populated were to be completed by each municipality.

Workshop attendees reviewed the mitigation strategy from the 2010 HMP using Mitigation Strategy Evaluation Form. Municipalities and other stakeholders provided input on municipal-specific mitigation actions by identifying progress on actions and by identifying new actions to implement over the next five years.

Forms completed during the HMP Workshop were mailed to all municipalities that were unable to attend the HMP Workshop. All forms were also made available for download on the project website.

Hazard Mitigation Plan Webinars, October 3, 7, 10, 2014: The purpose of this meeting was to obtain additional participation and information from municipalities. The HMP planning process was summarized and forms and questionnaires reviewed.

Public Meeting, October 22, 2014: This public meeting was held to review the Draft HMP and to obtain feedback from stakeholders. Additional mitigation actions were developed and collected as well. Attendees were provided with comment forms to submit questions or comments about the material that had been covered during the meeting.

Hazard Mitigation Plan Webinars, February 13, 23, 26, & 27 2014: The purpose of this meeting was to obtain additional participation and information from municipalities. The HMP planning process was summarized and forms and questionnaires reviewed.

3.4. Public & Stakeholder Participation

Local, state, and federal agencies, neighboring jurisdictions, local businesses, community leaders, educators, and other relevant private and nonprofit groups (e.g., watershed associations) that had a vested interest in the development of the updated Plan were given the opportunity (through direct invitation – see the meeting materials in Appendix C) to participate in the planning process by attending a planning meeting, public meeting, webinar, teleconference, or offering comment on the Web site posting the existing HMP. Forty-five municipalities' representatives attended at least one of these meetings. Through attendance at a Steering Committee and/or public meetings, municipal representatives, state agencies, and other organizations were provided the opportunity to guide the HMP's development. Representatives of these organizations participated in discussions and provided input on the HMP during the meetings they attended.

Through a public notice published in the Observer Reporter, the above groups and the general public were notified of the public meeting and invited to review the Plan on the project web site (http://www.pennsylvaniahmp.com/washington-hmp). The October 19, 2014 public notice for the public meeting is shown below and a copy of the actual tear sheet can be found in Appendix C.

Figure 3.4-1 Washington County HMP Newspaper Notice.

DRAFT

LEGAL NOTICE

Notice is hereby given that the **Washington County Department of Public Safety** intends to review the draft of the updated Washington County Hazard Mitigation Plan (HMP) on October 22, 2014 at 2pm and at 6pm. This meeting is to be held at the South Strabane Fire Department Social Hall, 172 Oak Springs Road, Washington, PA, 15301. The HMP describes the hazards that can affect Washington County and its municipalities and the actions that can be taken to reduce their impact on the community. Questions may be directed to Ron Sicchitano, Washington County Department of Public Safety at 724-228-6911 or SicchitR@co.washington.pa.us. Interested persons may download and review an electronic copy of the Draft Plan at http://www.pennsylvaniahmp.com/washington-hmp starting on October 20, 2014.

10-19

The project website, which was updated throughout the planning process, included a project calendar, announcements page and a library, where important planning documents and forms were made available for upload. A copy of the Draft HMP was also available for download and comment at the website. Interested parties were able to comment on the plan through the project website or a comment form could be downloaded, filled in, and faxed, mailed, or emailed. As of March 28, 2015, the project website had 342 hits, 190 of which were unique visitors to the site.

Figure 3.4-2 Washington County HMP Project Website, www.pennsylvaniahmp.com/washington-hmp.

3.5. Multi-Jurisdictional Planning

Washington County had 45 of 66 municipalities participate in the planning process. Participating municipalities accounted for 86% of the county population. A detailed account of municipal participation can be found in Table 3.5-1.

Each municipality was part of the Planning Team developed for the 2015 HMP Update and invited to participate in meetings held in the South Strabane Fire Hall and via webinar.

The HMP Workshop was held on September 4, 2014 with a total of 32 municipalities represented at the meeting. Meeting invitations were mailed to municipal CEO's on August 18, 2014 and other stakeholders received a letter from the Washington County Department of Public Safety.

The Washington County Department of Public Safety followed up the initial letter with another dated on September 26, 2014 inviting those municipalities who were not able to attend the meeting to attend a series of webinars to be held on October 3, 7, and 10, 2014.

In addition to discussing the Capability Assessment Survey and NFIP worksheet, the HMP Workshop provided the opportunity for municipalities to comment on hazards identified by the Steering Committee. This was accomplished through a risk assessment exercise in which municipalities were asked to complete a hazard risk evaluation form (Hazards in Your Community). The form listed hazards to be profiled for the 2015 HMP Update and prompted municipalities to rank hazards relative to spatial extent, probable impact, probability of future events, and overall significance. Results of the hazard risk evaluation form were used to prepare the 2015 Risk Factor ranking. The form also afforded municipalities the opportunity to provide input on specific instances of a listed hazard in their community and on additional hazards that may impact their community.

The HMP Workshop provided the opportunity to review and comment on the 2010 Mitigation Strategy. Through use of the Mitigation Strategy Evaluation Form, municipalities provided input on mitigation actions by identifying if an action was completed, canceled, deferred, or is ongoing; what was accomplished for the action during the reporting period; obstacles encountered; and if the action is still relevant or if it should be revised. Municipalities were asked to identify progress on actions not identified in the 2010 plan, identify new actions to accomplish in the next 5 years, and complete a mitigation action form for new mitigation actions.

A letter was mailed to each municipality announcing the public meeting held on October 22, 2014. In addition to providing upcoming meeting information, the project website and Draft HMP review information was listed.

A final round of Hazard Mitigation Plan Webinars was held February 13, 23, 26, & 27 2015 to increase participation in the plan update.

Table 3.5-1 Municipal participation in the 2015 HMP Update is summarized in Table 3.5-1. Documentation of all other participation in meetings and completion of surveys is included in Appendix C - Meeting and Other Participation Documentation. Washington County 2015 HMP Update Community Participation

MUNICIPALITY	MEETINGS				SURVEYS/FORMS		
	HMP Workshop (9/4/14)	Webinars (10/3, 10/7, 10/10)	Public Meeting (10/22/14)	Teleconference Meetings (October and February 2015)	Capability Assessment Survey / NFIP Worksheet	Risk Assessment Worksheet	5-Year Mitigation Strategy and Action Evaluations
Allenport Borough			X				
Amwell Township	X						
Beallsville Borough							
Bentleyville Borough	X					X	
Blaine Township							
Buffalo Township	X					X	
Burgettstown Borough	X				X	X	
California Borough				X		X	X
Canonsburg Borough	X		X				
Canton Township	X						
Carroll Township		X	X		X		X
Cecil Township				X			
Centerville Borough				X			
Charleroi Borough	X					X	
Chartiers Township	X					X	
Claysville Borough	X		X				
Coal Center Borough							
Cokeburg Borough							
Cross Creek Township	X				X	X	
Deemston Borough	X				X	X	X
Donegal Township							
Donora Borough	X		X		X	X	X
Dunlevy Borough							
East Bethlehem Township				X		X	X
East Finley Township	X		X		X	X	X
East Washington Borough	X					X	

Table 3.5-1 Municipal participation in the 2015 HMP Update is summarized in Table 3.5-1. Documentation of all other participation in meetings and completion of surveys is included in Appendix C - Meeting and Other Participation Documentation. Washington County 2015 HMP Update Community Participation

MUNICIPALITY	MEETINGS				SURVEYS/FORMS		
	HMP Workshop (9/4/14)	Webinars (10/3, 10/7, 10/10)	Public Meeting (10/22/14)	Teleconference Meetings (October and February 2015)	Capability Assessment Survey / NFIP Worksheet	Risk Assessment Worksheet	5-Year Mitigation Strategy and Action Evaluations
Elco Borough							
Ellsworth Borough			X				
Fallowfield Township	X		X		X	X	X
Finleyville Borough							
Green Hills Borough							
Hanover Township							
Hopewell Township							
Houston Borough	X		X		X	X	
Independence Township	X				X		
Jefferson Township	X				X		X
Long Branch Borough							
Marianna Borough					X	X	X
McDonald Borough	X					X	
Midway Borough	X		X		X	X	X
Monongahela City	X		X		X	X	X
Morris Township							
Mount Pleasant Township	X						
New Eagle Borough							
North Bethlehem Township							
North Charleroi Borough							
North Franklin Township							
North Strabane Township	X						
Nottingham Township							
Peters Township	X	X	X				
Robinson Township				X			
Roscoe Borough							

Table 3.5-1 Municipal participation in the 2015 HMP Update is summarized in Table 3.5-1. Documentation of all other participation in meetings and completion of surveys is included in Appendix C - Meeting and Other Participation Documentation. Washington County 2015 HMP Update Community Participation

MUNICIPALITY	MEETINGS				SURVEYS/FORMS		
	HMP Workshop (9/4/14)	Webinars (10/3, 10/7, 10/10)	Public Meeting (10/22/14)	Teleconference Meetings (October and February 2015)	Capability Assessment Survey / NFIP Worksheet	Risk Assessment Worksheet	5-Year Mitigation Strategy and Action Evaluations
Smith Township			X				
Somerset Township		X					
South Franklin Township	X						
South Strabane Township	X		X		X	X	X
Speers Borough							
Stockdale Borough	X				X	X	X
Twilight Borough		X					
Union Township		X					
Washington City	X		X			X	
West Bethlehem Township	X				X		X
West Brownsville Borough	X		X		X	X	X
West Finley Township	X	X	X			X	
West Middletown Borough							
West Pike Run Township	X					X	

4. Risk Assessment

4.1. Update Process Summary

The risk assessment provides a factual basis for activities proposed by the County in their mitigation strategy. Hazards that may affect Washington County are identified and defined in terms of their location and extent, magnitude of impacts, previous events, and probability of future events. The Risk Assessment section of the Washington County HMP update utilizes existing data and analysis from the previous Federal Emergency Management Agency (FEMA)-approved HMP as well as more recent data and analysis on hazards occurring during the last five years.

As Washington County's development, people, and economy change, too do its hazards and vulnerabilities. In 2010, Washington County profiled the following hazards:

- Severe Winter Weather,
- Thunderstorms & Tornadoes,
- Drought,
- Subsidence – Natural and Mine Related,
- Landslides, and
- Earthquakes.

For the 2015 update, Washington County retained all previously identified and profiled hazards. However, the names of the hazard being profiled in the HMP were refined to match the 2013 Pennsylvania Standard Operating Guidance. In addition, the Washington County Steering Committee evaluated the development, population, and growth trends in the County vis-à-vis the Pennsylvania Standard List of Hazards and the 2013 Pennsylvania Standard State All-Hazard Mitigation Plan. After this evaluation and in light of the extensive oil and gas extraction in Washington County, the Planning Team added one new hazard to the 2015 HMP Update: Environmental Hazards. In this plan, Environmental Hazards covers both conventional and unconventional oil and gas well drilling. In addition, because Washington County is in a moderate radon exposure hazard zone, it has been added to this HMP. Finally, because Washington County has 42 Category 1 dams, which indicate that loss of life could be substantial and economic losses could be excessive, this HMP profiles dam failure hazards.

Hazard profiles were then developed in order to define the characteristics of each hazard as they apply to Washington County and South-West Pennsylvania. Each municipality and the other stakeholders participating in the planning process then evaluated the impact of hazard profiled in their jurisdiction or organization using the Hazards in Your Community Worksheet (see Appendix C). This evaluation, together with the research and analysis of each hazard, allowed for an assessment of jurisdictional risk, discussed in Section 4.4.2.

Following hazard identification and profiling, a vulnerability assessment was conducted for each hazard to identify the impact of both natural and human-made hazard events on people, buildings, infrastructure, and the community, as appropriate. Each hazard is discussed in terms of its potential impact on individual communities, including the types of structures that may be at

risk. This assessment allows the County and its municipalities to focus on and prioritize local mitigation efforts on areas that are most likely to be damaged or require early response to a hazard event. A vulnerability analysis was performed which identifies structures, critical facilities, and/or populations that may be impacted during hazard events and describes what events can do to physical, social, and economic assets.

4.2. Hazard Identification

Pennsylvania's disaster history helps provide direction on the identification of hazards and their significance both at the state and local level. PEMA maintains a historical log of all disasters that have occurred in the Commonwealth dating back to 1955. An analysis of the past occurrences of each hazard is the first step toward predicting the future susceptibility to that hazard. By noting the hazards of the past, Washington County and its municipalities will be able to better understand and prepare for future natural and human-made disasters.

4.2.1. Table of Presidential Disaster Declarations

Under the Stafford Act, there are two forms of presidential action that authorize federal disaster assistance dollars. *Presidential Emergency Declarations* are intended to spur activities that will protect property and strengthen public safety to lessen impacts or avoid a catastrophic event. *Presidential Disaster Declarations* are made as a result of a disaster event and provide supplemental coordination and financial assistance beyond the ability of state and local governments (McCarthy, 2011). Because of the difference in these declarations, a single event may qualify for both kinds of declarations.

There is no financial threshold for an Emergency Declaration, but there are two thresholds for Presidential Disaster Declarations established under the Stafford Act: a state and a county threshold. These thresholds are based on a formula that uses the population of the jurisdiction (as recorded in the decennial Census) times a set per capita indicator. As of federal fiscal year 2013-14, these thresholds are $3.50 per capita for counties and $1.37 per capita for the state. With a population of 207,820, the Washington County threshold is approximately $727,370. State and county thresholds must be simultaneously attained for a Presidential Disaster Declaration to be issued.

Table 4.2-1 displays the Presidential Disaster and Emergency Declarations that have affected Washington County from 1955-2014 from most recent to oldest event.

Table 4.2-1 Presidential Disaster and Emergency Declarations affecting Washington County.

DATE	DECLARATION AND EVENT TYPE	DECLARATION NUMBER	AFFECTED AREAS
October 2012	Emergency Declaration – Hurricane Sandy	3356	All counties
September 2005 (Emergency Declaration)	Emergency Declaration – Hurricane Katrina	3235	All counties: Proclamation of Emergency to Render Mutual Aid and to Receive and House Evacuees

Table 4.2-1 Presidential Disaster and Emergency Declarations affecting Washington County.			
DATE	**DECLARATION AND EVENT TYPE**	**DECLARATION NUMBER**	**AFFECTED AREAS**
February 2003	Emergency Declaration – Severe Winter Storm	3180	Adams, Bedford, Berks, Blair, Cambria, Carbon, Chester, Clinton, Columbia, Cumberland, Dauphin, Delaware, Fayette, Franklin, Fulton, Greene, Huntingdon, Juniata, Lancaster, Lebanon, Lehigh, Washington, Mifflin, Montour, Montgomery, Northampton, Northumberland, Perry, Philadelphia, Schuylkill, Snyder, Somerset, Union, Washington, Westmoreland, and York Counties
January 1996	Presidential Disaster Declaration - Flooding	1093	All counties
January 1996	Presidential Disaster Declaration - Severe Winter Storms	1085	Adams, Allegheny, Armstrong, Beaver, Bedford, Berks, Blair, Bradford, Bucks, Cambria, Cameron, Carbon, Centre, Chester, Clearfield, Clinton, Columbia, Cumberland, Dauphin, Delaware, Elk, Fayette, Franklin, Fulton, Greene, Huntingdon, Indiana, Jefferson, Juniata, Lackawanna, Lancaster, Lebanon, Lehigh, Lycoming, Luzerne, McKean, Mifflin, Monroe, Montgomery, Montour, Northampton, Northumberland, Perry, Philadelphia, Pike, Potter, Schuylkill, Snyder, Somerset, Sullivan, Susquehanna, Tioga, Union, Wayne, Westmoreland, Wyoming and York Counties - Public Assistance; All 67 counties declared for Individual Assistance
January and February 1994	Presidential Disaster Declaration - Severe Winter Storms	1015	All counties
March 1993	Emergency Declaration – Blizzard	3105	All counties
November 1985	Presidential Disaster Declaration – Severe Storms, Flooding	754	Fayette County, Washington County and Westmoreland County

Table 4.2-1 Presidential Disaster and Emergency Declarations affecting Washington County.			
DATE	**DECLARATION AND EVENT TYPE**	**DECLARATION NUMBER**	**AFFECTED AREAS**
January 1977	Emergency Declaration - Snowstorms	3026	Beaver County, Cambria County, Carbon County, Clarion County, Clearfield County, Crawford County, Erie County, Fayette County, Indiana County, Jefferson County, Lawrence County, Luzerne County, Mercer County, Potter County, Schuylkill County, Somerset County, Tioga County, Venango County, Washington County, Wayne County and Westmoreland County
June 1972	Presidential Disaster Declaration - Flood (Agnes)	340	All counties

4.2.1. Summary of Hazards

As described in Section 4.1, at the initiation of the plan update process, the Steering Committee reviewed the Pennsylvania Standard List of Hazards to evaluate new and changing hazards in Washington County. Following a review of the hazards considered in the 2009 HMP, the 2013 Standard State All-Hazard Mitigation Plan, and the Standard List of Hazards, the Steering Committee decided that the 2015 plan update should identify, profile, and analyze eight hazards. The hazards include all hazards profiled in the 2010 plan. Table 4.2-2 contains a complete list of the eight hazards identified for hazard profiling in the 2015 HMP update. Hazard profiles are included in Section 4.3 for each of these hazards.

Table 4.2-2 Definition of hazards profiled in the 2015 Washington County HMP Update.	
PROFILED HAZARDS	**DESCRIPTION**
NATURAL	
Drought	Drought is a natural climatic condition which occurs in virtually all climates, the consequence of a natural reduction in the amount of precipitation experienced over a long period of time, usually a season or more in length. High temperatures, prolonged winds, and low relative humidity can exacerbate the severity of drought. This hazard is of particular concern in Pennsylvania due to the presence of farms as well as water-dependent industries and recreation areas across the Commonwealth. A prolonged drought could severely impact these sectors of the local economy, as well as residents who depend on wells for drinking water and other personal uses. (National Drought Mitigation Center, 2006).
Earthquake	An earthquake is the motion or trembling of the ground produced by sudden displacement of rock usually within the upper 10-20 miles of the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of underground caverns. Earthquakes can affect hundreds of thousands of square miles, cause damage to property measured in the tens of billions of dollars, result in loss of life and injury to hundreds of thousands of persons, and disrupt the social and economic functioning of the affected area. Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking which is dependent upon amplitude and duration of the earthquake. (FEMA, 1997).
Flood, Flash Flood, Ice Jam	Flooding is the temporary condition of partial or complete inundation on normally dry land and it is the most frequent and costly of all hazards in Pennsylvania. Flooding events are generally the result of excessive precipitation. General flooding is typically experienced when precipitation occurs over a given river basin for an extended period of time. Flash flooding is usually a result of heavy localized precipitation falling in a short time period over a given location, often along mountain streams and in urban areas where much of the ground is covered by impervious surfaces. The severity of a flood event is dependent upon a combination of stream and river basin topography and physiography, hydrology, precipitation and weather patterns, present soil moisture conditions, the degree of vegetative clearing as well as the presence of impervious surfaces in and around flood-prone areas. (NOAA, 2009). Winter flooding can include ice jams which occur when warm temperatures and heavy rain cause snow to melt rapidly. Snow melt combined with heavy rains can cause frozen rivers to swell, which breaks the ice layer on top of a river. The ice layer often breaks into large chunks, which float downstream, piling up in narrow passages and near other obstructions such as bridges and dams. All forms of flooding can damage infrastructure (USACE, 2007).

Table 4.2-2 Definition of hazards profiled in the 2015 Washington County HMP Update.	
PROFILED HAZARDS	**DESCRIPTION**
Landslide	A landslide is the downward and outward movement of slope-forming soil, rock, and vegetation reacting to the force of gravity. Landslides may be triggered by both natural and human-caused changes in the environment, including heavy rain, rapid snow melt, steepening of slopes due to construction or erosion, earthquakes, and changes in groundwater levels. Mudflows, mudslides, rockfalls, rockslides, and rock topples are all forms of a landslide. Areas that are generally prone to landslide hazards include previous landslide areas, the bases of steep slopes, the bases of drainage channels, developed hillsides, and areas recently burned by forest and brush fires. (Delano & Wilshusen, 2001).
Radon Exposure	Radon is a cancer-causing natural radioactive gas that you can't see, smell, or taste. It is a large component of the natural radiation that humans are exposed to and can pose a serious threat to public health when it accumulates in poorly ventilated residential and occupation settings. According to the USEPA, radon is estimated to cause about 21,000 lung cancer deaths per year, second only to smoking as the leading cause of lung cancer (EPA 402-R-03-003: EPA Assessment…, 2003). An estimated 40% of the homes in Pennsylvania are believed to have elevated radon levels (Pennsylvania Department of Environmental Protection, 2009).
Subsidence, Sinkhole	Subsidence is a natural geologic process that commonly occurs in areas with underlying limestone bedrock and other rock types that are soluble in water. Water passing through naturally occurring fractures dissolves these materials leaving underground voids. Eventually, overburden on top of the voids causes a collapse which can damage structures with low strain tolerances. This collapse can take place slowly over time or quickly in a single event, but in either case. Karst topography describes a landscape that contains characteristic structures such as sinkholes, linear depressions, and caves. In addition to natural processes, human activity such as water, natural gas, and oil extraction can cause subsidence and sinkhole formations. (FEMA, 1997).

Table 4.2-2 Definition of hazards profiled in the 2015 Washington County HMP Update.	
PROFILED HAZARDS	**DESCRIPTION**
Tornado, Wind Storm	A wind storm can occur during severe thunderstorms, winter storms, coastal storms, or tornadoes. Straight-line winds such as a downburst have the potential to cause wind gusts that exceed 100 miles per hour. Based on 40 years of tornado history and over 100 years of hurricane history, FEMA identifies western and central Pennsylvania as being more susceptible to higher winds than eastern Pennsylvania. (FEMA, 1997). A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity (but sometimes result from hurricanes or tropical storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of high wind velocities and wind-blown debris. According to the National Weather Service, tornado wind speeds can range between 30 to more than 300 miles per hour. They are more likely to occur during the spring and early summer months of March through June and are most likely to form in the late afternoon and early evening. Most tornadoes are a few dozen yards wide and touch down briefly, but even small, short-lived tornadoes can inflict tremendous damage. Destruction ranges from minor to catastrophic depending on the intensity, size, and duration of the storm. Structures made of light materials such as mobile homes are most susceptible to damage. Waterspouts are weak tornadoes that form over warm water and are relatively uncommon in Pennsylvania. Each year, an average of over 800 tornadoes is reported nationwide, resulting in an average of 80 deaths and 1,500 injuries (NOAA, 2002). Based on NOAA Storm Prediction Center Statistics, the number of recorded F3, F4, & F5 tornadoes between 1950-1998 ranges from <1 to 15 per 3,700 square mile area across Pennsylvania (FEMA, 2009). A water spout is a tornado over a body of water (American Meteorological Society, 2009).
Winter Storm	Winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. A winter storm can range from a moderate snowfall or ice event over a period of a few hours to blizzard conditions with wind-driven snow that lasts for several days. Many winter storms are accompanied by low temperatures and heavy and/or blowing snow, which can severely impair visibility and disrupt transportation. The Commonwealth of Pennsylvania has a long history of severe winter weather. (NOAA, 2009).

Table 4.2-2 Definition of hazards profiled in the 2015 Washington County HMP Update.	
PROFILED HAZARDS	**DESCRIPTION**
Dam Failure	A dam is a barrier across flowing water that obstructs, directs, or slows down water flow. Dams provide benefits such as flood protection, power generation, drinking water, irrigation, and recreation. Failure of these structures results in an uncontrolled release of impounded water. Failures are relatively rare, but immense damage and loss of life is possible in downstream communities when such events occur. Aging infrastructure, hydrologic, hydraulic and geologic characteristics, population growth, and design and maintenance practices should be considered when assessing dam failure hazards. The failure of the South Fork Dam, located in Johnstown, PA, was the deadliest dam failure ever experienced in the United States. It took place in 1889 and resulted in the Johnstown Flood which claimed 2,209 lives (FEMA, 1997). Today there are approximately 3,200 dams and reservoirs throughout Pennsylvania (Pennsylvania Department of Environmental Protection, 2009).
Environmental Hazards	Environmental hazards are hazards that pose threats to the natural environment, the built environment, and public safety through the diffusion of harmful substances, materials, or products. For the purposes of this HMP, environmental hazards include both unconventional and conventional p oil and gas well incidents; including the release of the release of harmful chemical and waste materials into water bodies or the atmosphere, explosions, fires, and other other hazards and threats to life safety stemming from oil and gas extraction (Environmental Protection Agency, Natural Disaster PSAs, 2009).

4.3. Hazard Profiles and Vulnerability Analysis

Disaster frequency and its effects or severity are an important basis for planning emergency response and mitigation. Natural hazards tend to reoccur on a predictable seasonal basis, whereas human-caused or technological events tend to change over time with advancements in technology and methods of operation.

As defined in the Pennsylvania Standard Operating Guide, five criteria were used to assure a systematic and comprehensive approach to hazard analysis:

- **Location and Extent**: The location and extent of the County's vulnerability to a certain hazard can vary throughout the County.
- **Range of Magnitude**: Each individual hazard poses certain threats to the County and its municipalities. It is important to identify which hazards pose the greatest threat and focus mitigation actions toward those hazards. The maximum threat or worst-case disaster should be considered for each hazard. However, secondary effects of many hazards can be just as devastating. These secondary effects cause many hazards to become regional hazards affecting many areas with differing impacts.
- **Past Occurrences**: A record of past events is particularly helpful to evaluate hazards. Past records of the County's hazards also offer valuable information when tempered with the knowledge of preventative efforts, changes in preventative efforts, and advancements in technology that may reduce the frequency or severity of such events.

- **Future Occurrences**: The probability of an occurrence in the future is another important factor to consider when preparing for an all-hazards response. An event that occurs annually with relatively minor impact may deserve more emphasis than a major event that occurs once every 50 to 100 years.
- **Vulnerability Assessment**: The susceptibility of a community to destruction, injury, or death resulting from a hazard event defines the degree of vulnerability. The degree of vulnerability may be related to geographic location, as with floodplains, the type of facilities or structures, or the socioeconomics of a given area. Additionally, certain population groups may be more vulnerable to some hazards because of immobility or their inability to take protective action. The vulnerability assessment section of each hazard profile lists the buildings, critical infrastructure, and populations (where appropriate) within the respective hazard areas.

NATURAL HAZARDS

4.3.1. Drought

4.3.1.1. Location and Extent

Drought is a normal part of virtually all climates, the consequence of a natural reduction in the amount of precipitation experienced over a long period of time, usually a season or more in length. High temperatures, prolonged winds, and low relative humidity can exacerbate the severity of drought.

Drought is defined as the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. Droughts are regional climatic events, so they typically impact all communities in a relatively uniform fashion with only minor localized variations in rainfall events. Droughts often occur across county boundaries, affecting large areas of Pennsylvania at the same time. The spatial extent for areas of impact can range from localized areas in Pennsylvania to the entire Mid-Atlantic region. Areas with extensive agriculture uses are particularly vulnerable to drought. Areas along waterways will show drought conditions later than those areas away from waterways.

By definition, drought is a meteorological phenomenon, said to exist when the amount of precipitation over an area is significantly below (10 to 20 percent depending on the season) the long-term average for that area. However, drought conditions are qualified in different ways, depending upon the group impacted. A soil moisture deficit that inhibits crop production is typically referred to as an “agricultural drought.” Whereas agricultural droughts may result from a rapid depletion of soil moisture, hydrological droughts often take months to fully materialize, as groundwater levels slowly decline and water storage decreases. Clearly, operational definitions are necessary to develop a common understanding of drought and its impacts. Operational definitions help hydrologists determine the onset, severity, and impact of droughts, which vary with the type of moisture deficit. Although climate is a primary contributor to hydrological drought, the construction of dams, deforestation, and land degradation all affect the hydrological system.

Drought can be broadly defined as a time period of prolonged dryness that contributes to the depletion of ground and surface water. There are three types:

Meteorological Drought – A deficiency in moisture in the atmosphere. This will have very little effect on the crops and water supply, depending on the preceding conditions.

Agricultural Drought – Inhibits the growth of crops, because of a moisture deficiency in the soil. This type of drought, if persistent, can lead to a hydrologic drought.

Hydrologic Drought – A prolonged period of time without rainfall that can have adverse effects on agriculture, streams, lakes, and groundwater levels.

The biggest concern in Washington County communities is the high demand on the water supply and below average rainfall for recharge of aquifers and reservoirs. Low water levels in the Monongahela River affect the drinking water supply for all County residents with public water service. The Washington County Board of Commissioners has appointed a Drought Taskforce to help address issues that would arise from a drought. This group has met several times in response to prolonged dry periods, and developed brief contingency plans to address the most significant areas of concern. Through the efforts of this group, there has been a heightened degree of public awareness and voluntary water conservation during prolonged dry periods.

4.3.1.2. Range of Magnitude

Droughts can have varying effects, depending upon what month they occur, severity, duration and location. Some droughts may have their greatest impact on agriculture and even short term droughts, when coupled with extreme temperatures can be devastating. Others may impact water supply or other water use activities such as recreation. Most droughts cause direct impacts to aquatic resources. Drought events are defined by rainfall amounts, vegetation conditions, soil-moisture conditions, water levels in reservoirs, stream flow, agricultural productivity, or economic impacts.

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

The Commonwealth uses five parameters to assess drought conditions:

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

Table 4.3.1-1 Palmer Drought Severity Index (PSDI) classifications (NDMC, 2006).	
SEVERITY CATEGORY	**PSDI VALUE**
Extremely wet	4.0 or more
Very wet	3.0 to 3.99
Moderately wet	2.0 to 2.99
Slightly wet	1.0 to 1.99
Incipient wet spell	0.5 to 0.99
Near normal	0.49 to -0.49
Incipient dry spell	-0.5 to -0.99
Mild drought	-1.0 to -1.99
Moderate drought	-2.0 to -2.99
Severe drought	-3.0 to -3.99
Extreme drought	-4.0 or less

In Pennsylvania, PEMA has primary responsibility for managing droughts with direct support from the Department of Environmental Protection (DEP). According to *Drought Management in Pennsylvania* (2102), PEMA and DEP use the following three stages to describe and manage droughts. They are listed in order of increasing severity:

- **Drought Watch:** A period to alert government agencies, public water suppliers, water users and the public regarding the potential for future drought-related problems, Drought Watches are invoked when three or more drought indicators are present for a county or group of counties. The focus is on increased monitoring, awareness and preparation for response if conditions worsen. A request for voluntary water conservation is made. The objective of voluntary water conservation measures during a drought watch is to reduce water uses by 5 percent in the affected areas. Due to varying conditions, individual water suppliers or municipalities may be asking for more stringent conservation actions.

- **Drought Warning:** This phase involves a coordinated response to imminent drought conditions and potential water supply shortages through concerted voluntary conservation measures to avoid or reduce shortages, relieve stressed sources, develop new sources, and if possible, forestall the need to impose mandatory water use restrictions. The objective of voluntary water conservation measures during a drought warning is to reduce overall water uses by 10-15 percent in the affected areas. Due to varying conditions, individual water suppliers or municipalities may be asking for more stringent conservation actions. At

- **Drought Emergency:** This stage is a phase of concerted management operations to marshal all available resources to respond to actual emergency conditions, to avoid depletion of water sources, to assure at least minimum water supplies to protect public health and safety, to support essential and high priority water uses and to avoid unnecessary economic dislocations. It is possible during this phase to impose mandatory restrictions on non-essential water uses that are provided in the Pennsylvania Code (Chapter 119), if deemed necessary and if ordered by the Governor of Pennsylvania. The

objective of water use restrictions (mandatory or voluntary) and other conservation measures during this phase is to reduce consumptive water use in the affected area by fifteen percent, and to reduce total use to the extent necessary to preserve public water system supplies, to avoid or mitigate local or area shortages and to assure equitable sharing of limited supplies.

In addition, local water rationing is an option for communities:

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

The Pennsylvania Crop Insurance Education and Participation Program (a partnership of the US Department of Agriculture, the Pennsylvania Department of Agriculture, and Penn State University) estimated that drought was the top reason for crop failure in Pennsylvania from 1981-2009; roughly 59% of all crop failures were due to drought.

The drought of 1999 had a significant impact on Washington County's agricultural production. According to the Pennsylvania Agricultural Statistics Service, there are 205,821 acres of land under active farm use in Washington County. During the drought, Washington County farmers felt the negative impact. Although few public water companies in Pennsylvania instituted water rationing plans, Washington County faced mandatory nonessential water use restrictions. It demonstrated that drought is as much a social phenomenon as a climatic one.

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; decrease in supply to fight fires
- 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
- Loss of quality in landscape through loss in plants and plant diversity
- Loss of water for navigation and recreation

- Increase in nitrate levels which can have health impacts on pregnant women and children.

The worst drought in Washington County (and all of Pennsylvania) occurred in the mid-1960s. This prolonged siege caused some serious and prolonged water supply problems. During the summer of 1983, the second worst drought in 30 years occurred causing over $196 million in damage to state crops. Washington County was included in drought watches in 1980, 1991, and 1999. There were not widespread problems; however, there were residents whose wells had gone dry. In some cases, the quality of the drinking water was substandard due to low river pool near the water intakes. The low pool also caused problems for some barge traffic on the Monongahela River

4.3.1.3. Past Occurrence

Droughts are not a frequent hazard since the Commonwealth lies outside the arid and semi-arid belts of the mid and western parts of the continent. However, there have been serious droughts faced by Pennsylvanians, like the 1960s drought described in Section 4.3.1.2. According to the Pennsylvania Department of Environmental Resources' Bureau of Resources Programming, there will be seven areas in Washington County where water shortages may develop. Water suppliers projected to face deficiencies include Smith Township Municipal Authority, Claysville Donegal Joint Municipal Authority, PAWC-McDonald District, PAWC-Westland District, and PAWC-Washington District.

Pennsylvania's most devastating drought in recent history began in the winter of 1999 and continued through the spring, summer, and fall months. What began as an agricultural drought advanced to a hydrologic drought, a more severe drought due to the period of time and water uses that were impacted. Throughout the summer of 1999, most of the Mid-Atlantic region was experiencing drought conditions. This drought was the worst to hit Pennsylvania in 10 years. A winter season of little snowfall, followed by a dry spring and summer, left stream and groundwater levels at an all-time low. Many of the state's groundwater observation wells were at emergency levels. The situation was so severe that Governor Ridge declared a drought emergency in 55 Pennsylvania counties, allowing mandatory water use restrictions to be enforced and public water suppliers to implement local water rationing plans. In Washington County, there were not widespread problems associated with this drought, but some residents whose wells went dry. In addition, low river levels caused problems for some barge traffic on the Monongahela River.

Table 4.3.1-2 provides a complete accounting of drought watches, warnings, and emergencies in Washington County since 1982.

Table 4.3.1-2 Past drought events in Washington County since 1982 (PA DEP 2014).

DATE	DROUGHT STATUS	DATE	DROUGHT STATUS
Nov 8, 1982 – Nov 10, 1982	Emergency	Jan 15, 1999 – March 15, 1999	Watch
Nov 10, 1982 – Feb 8, 1983	Emergency	March 15, 1999 – June 10, 1999	Watch
Jul 7, 1988 - Aug 24, 1988	Watch	June 10, 1999 – June 18, 1999	Watch
Aug 24, 1988 - Dec 12, 1988	Warning	June 18, 1999 – July 20, 1999	Warning

Table 4.3.1-2 Past drought events in Washington County since 1982 (PA DEP 2014).			
DATE	**DROUGHT STATUS**	**DATE**	**DROUGHT STATUS**
Jun 28, 1991 - Jul 24, 1991	Warning	July 20, 1999 – Sept 30, 1999	Emergency
Jul 24, 1991 – Aug 16, 1991	Warning	Sept 30, 1999 – Dec 16, 1999	Warning
Aug 16, 1991 - Sep 13, 1991	Warning	Dec 16, 1999 - Feb 25, 2000	Warning
Sep 13, 1991 - Oct 21, 1991	Warning	Sept 5, 2002 - Nov 7, 2002	Watch
Oct 21, 1991 - Jan 16, 1992	Warning	Nov 7, 2002 – Dec 19,2002	Watch
Jan 17, 1992 - Apr 20, 1992	Warning	Dec 19, 2002 – Jan 8, 2003	Watch
April 20, 1992 – June 23, 1992	Warning	Jan 8, 2003 – Jun 18, 2003	Watch
Jun 23, 1992 – Sep 11, 1992	Watch	April 11, 2006 - June 30, 2006	Watch
Sep 1, 1995 - Sep 20, 1995	Watch	Aug 6, 2007 – Sept 5, 2007	Watch
Sep 20, 1995 - Nov 8, 1995	Watch	Sept 5, 2007 – Oct 5, 2007	Watch
Nov 8, 1995 - Dec 18, 1995	Watch	Oct 5, 2007 - Jan 11, 2008	Watch
Dec 3, 1998 - Dec 8, 1998	Watch	Nov 7, 2008 – Jan 26, 2009	Watch
Dec 3, 1998 - Dec 8, 1998	Watch	Sept 16, 2010 - Nov 10, 2010	Warning
Dec 8, 1998 - Dec 14, 1998	Watch	Nov 10, 2010 – Dec 17, 2010	Watch
Dec 14, 1998 - Dec 16, 1998	Watch	Jul 19, 2012 – Aug 31, 2012	Watch
Dec 16, 1998 – Jan 15, 1999	Watch		

Washington County has not had a drought emergency since 1999. According to DEP's Watershed Management Drought Information Center, the County has had eleven drought watches and three drought warnings in the period since the last drought emergency in the summer of 1999. The USDA Risk Management Agency operates and manages the Federal Crop Insurance Corporation program. Since Washington County farms are eligible for crop insurance, it is possible to determine agricultural losses due to drought in Washington County, which indicates years in which there were drought occurrences, even mild droughts. Table 4.3.1-3 displays the crop loss insurance payments due to drought in Washington County since 1999.

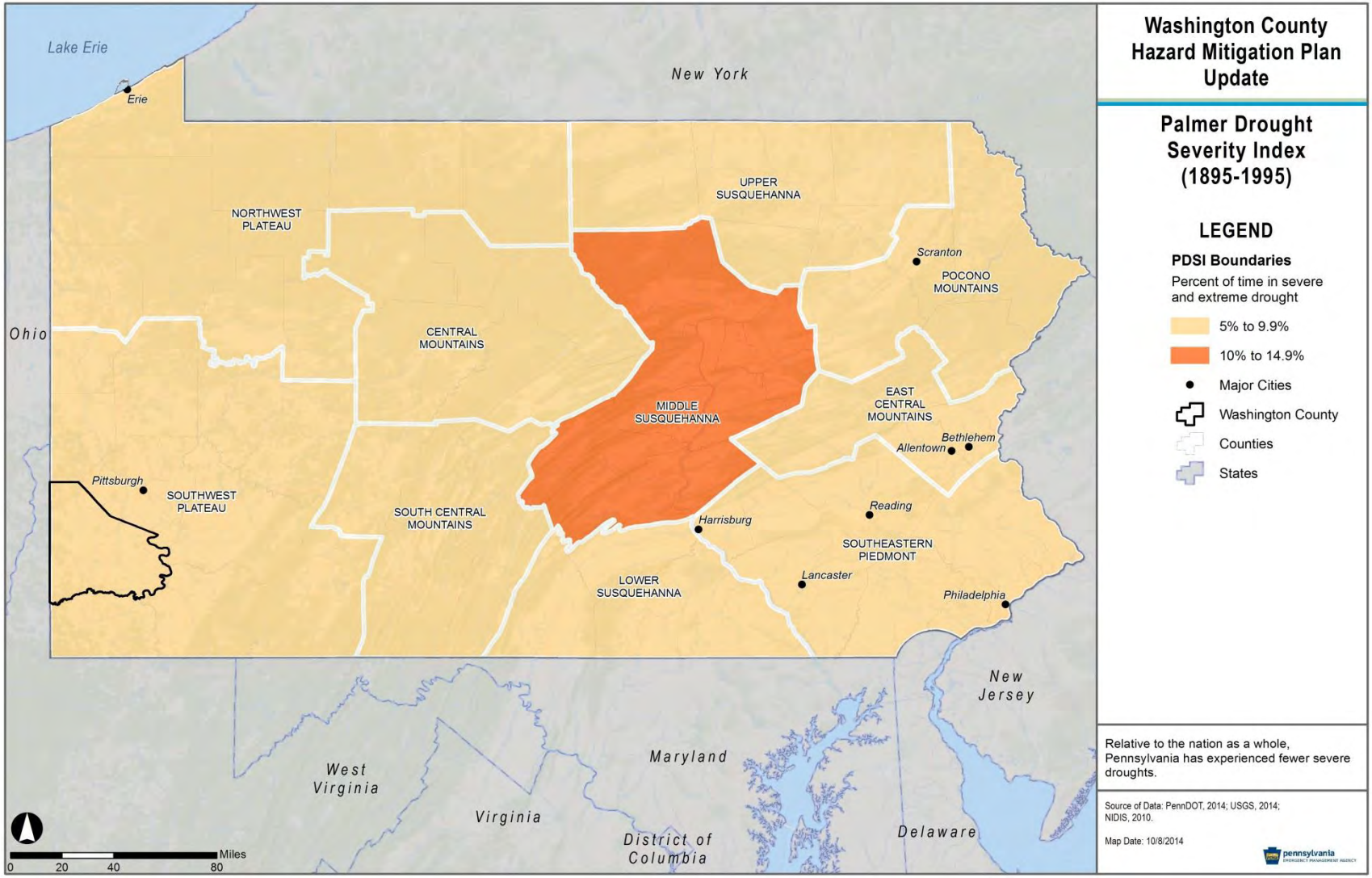
Table 4.3.1-3 Crop loss insurance compensation due to drought. (U.S. Dept. RMA)	
CROP YEAR	**INDEMNITY AMOUNT ($)**
1999	$4,044.00
2001	$3,344.00
2002	$25,470.00
2005	$2,606.00
2006	$2,170.00
2007	$556.00
2008	$59.00
2009	$21,266.00
2010	$41,829.30
2011	$26,368.00
2012	$85,942.30
TOTAL	**$213,654.60**

4.3.1.4. Future Occurrence

One way to measure the magnitude of future droughts is through the Palmer Drought Severity Index. This index is based on several meteorological and hydrological factors, including temperature and soil moisture levels, and is computed weekly by the National Weather Service's Climate Prediction Center. The index compares precipitation received against the average amount expected during that period. Droughts are expressed as negative numbers. Palmer values of
-2.00 to -2.99 indicate a watch status; values of -3.00 to -3.99 indicate a warning; and values of -4.00 and less indicate an emergency.

According to the Palmer Drought Severity Index, Washington County spent 5% to 9.9% of the time between 1895 and 1995 in a severe and extreme drought (i.e., Palmer values less than or equal to -3).

Figure 4.3.1-1 Percent of time areas of the United States have PSDI values <= -3 (NDMC, 2009).



As stated above, Washington County spent 5% to 9.9% of the time between 1895 and 1995 in a severe and extreme drought; it can be assumed that the County will spend at least 5% to 9.9% of the future in these same drought conditions. While some form of drought condition frequently exists in Washington County, the impact depends on the duration of the event, severity of conditions, and area affected. According to the Pennsylvania Department of Environmental Resources' Bureau of Resources Programming, there will be seven areas in Washington County where water shortages may develop. Water suppliers projected to face deficiencies include Smith Township Municipal Authority, Claysville Donegal Joint Municipal Authority, PAWC-McDonald District, PAWC-Westland District, and PAWC-Washington District. Additionally, droughts and water supply deficiencies are likely to increase with increasing demands for water by residential, industrial, and agricultural consumers. On the whole, though, the probability of future drought events can be considered *possible* according to the Risk Factor Methodology (see Table 4.4.2-1).

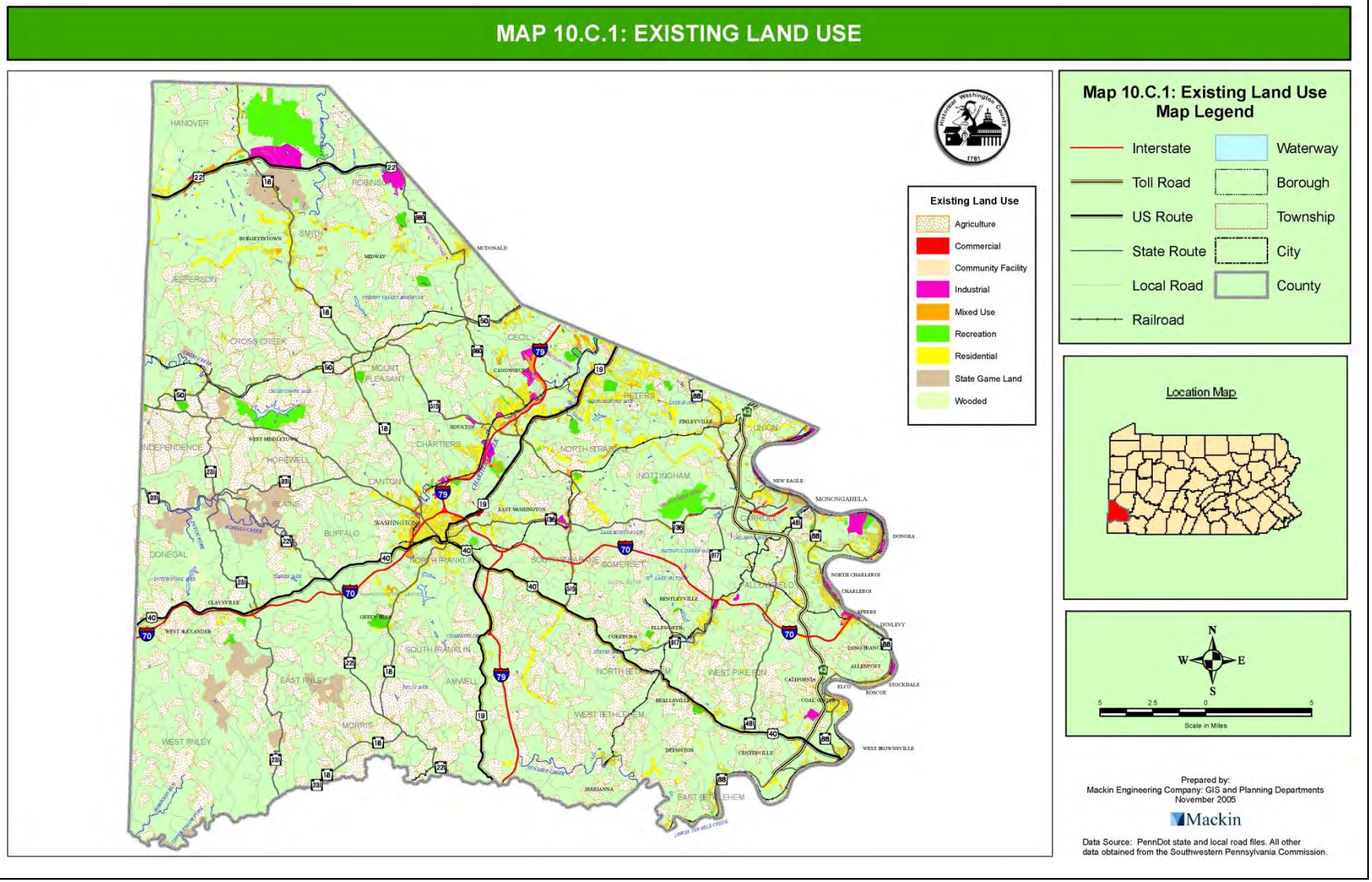
4.3.1.5. Vulnerability Assessment

Drought vulnerability depends on the duration and area of impact. However, other factors contribute to the severity of a drought. Unseasonably high temperatures, prolonged winds, and low humidity can heighten the impact of a drought. Extended periods of drought can lead to lowered stream levels, altering the delicate balance of riverine ecosystems. Certain tree species are susceptible to fungal infections during prolonged periods of soil moisture deficit. Fall droughts pose a particular threat because groundwater levels are typically at their lowest following the height of the summer growing season.

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

Drought has serious implications for the agricultural sector of Washington County's economy. According to the 2012 USDA Census of Agriculture, Washington County has 205,821 acres in 1,915 farms. In addition, Washington County has the highest number of sheep for agricultural production in the state (PA DEP, 2009). Major crop items include forage-land used for hay and haylage, grass silage, and greenchop; corn for both grain and sileage; soybeans and vegetables. Major livestock inventory items include over 21,000 cattle and calves, over 7,500 sheep and lambs, over 6,000 layers, and over 5,400 horses and ponies. The market value of all agricultural products sold exceeded $35.4 million in 2012; some or this entire product is at risk during a drought event. Figure 4.3.1-2 shows the existing land uses in Washington County; agricultural uses are distributed throughout the county, with the exception of in Washington City and its environs and the Monongahela River towns.

Figure 4.3.1-2 Washington County existing Land Use (2005)



Wildfire is the most severe secondary effect associated with drought. Wildfires can devastate wooded and agricultural areas, threatening natural resources and farm production facilities. Prolonged drought conditions can cause major ecological changes, such as increases in scrub growth, flash flooding, and soil erosion.

Long-term water shortages can have a high impact on agribusinesses, hydropower-dependent utilities, and other industries reliant on water for production services; all critical infrastructure in Washington County is vulnerable to the effects of a drought. Drought can cause municipalities to enforce water rationing and distribution. This strains the availability of consumable water for the community. It also increases Washington County's vulnerability to other hazards such as severe weather, extreme heat, and public health emergencies. The special needs population of any county also must be considered during drought conditions.

Washington County residents that use private domestic wells are more vulnerable to droughts. Table 4.3.1-4 shows the number of domestic wells per municipality. It is important to note that the well data was obtained from the Pennsylvania Groundwater Information System (PaGWIS). **PaGWIS relies on voluntary submissions of well record data by well drillers; as a result, it is not a complete database of all domestic wells in the County.** This is the most complete dataset of domestic wells available.

Table 4.3.1-4 PaGWIS Data for Washington County.

MUNICIPALITY	NUMBER OF REPORTED DOMESTIC WELLS	MUNICIPALITY	NUMBER OF REPORTED DOMESTIC WELLS
Allenport Borough	0	Independence Township	32
Amwell Township	161	Jefferson Township	35
Beallsville Borough	5	Long Branch Borough	7
Bentleyville Borough	6	Marianna Borough	0
Blaine Township	51	McDonald Borough	0
Buffalo Township	63	Midway Borough	0
Burgettstown Borough	0	Monongahela, City of	0
California Borough	15	Morris Township	38
Canonsburg Borough	0	Mount Pleasant Township	235
Canton Township	40	New Eagle Borough	0
Carroll Township	11	North Bethlehem Township	57
Cecil Township	52	North Charleroi Borough	0
Centerville Borough	8	North Franklin Township	7
Charleroi Borough	0	North Strabane Township	56
Chartiers Township	32	Nottingham Township	60
Claysville Borough	2	Peters Township	36
Coal Center Borough	0	Robinson Township	23
Cokeburg Borough	0	Roscoe Borough	0
Cross Creek Township	56	Smith Township	46

Table 4.3.1-4 PaGWIS Data for Washington County.			
MUNICIPALITY	**NUMBER OF REPORTED DOMESTIC WELLS**	**MUNICIPALITY**	**NUMBER OF REPORTED DOMESTIC WELLS**
Deemston Borough	2	Somerset Township	89
Donegal Township	72	South Franklin Township	94
Donora Borough	1	South Strabane Township	39
Dunlevy Borough	0	Speers Borough	0
East Bethlehem Township	10	Stockdale Borough	1
East Finley Township	37	Twilight Borough	2
East Washington Borough	0	Union Township	14
Elco Borough	0	Washington, City of	1
Ellsworth Borough	0	West Bethlehem Township	26
Fallowfield Township	45	West Brownsville Borough	1
Finleyville Borough	0	West Finley Township	61
Green Hills Borough	0	West Middletown Borough	20
Hanover Township	39	West Pike Run Township	29
Hopewell Township	88	Unknown	135
Houston Borough	0	**TOTAL**	**1940**

While less prone to drought than wells, water utilities are be impact by drought and can regulate supply in drought conditions. The following table from the Washington County Comprehensive Plan provides a list of water service providers with Washington County customers; some supplies are based in neighboring counties and states.

Table 4.3.1-5 Water Service Providers in Washington County.		
PROVIDER	**SERVICE CAPACITY**	**CUSTOMERS**
Ellsworth Borough Municipal Water Authority	580,000 Gallons/Day	1,450 Customers 661 Tap-ins
Cokeburg Borough Municipal Water Authority	100,000 Gallons/Day	780 Customers 390 Tap-ins
Bentleyville Borough Municipal Water Authority	See Charleroi	1,007 Tap-ins
West Alexander/Donegal Joint Municipal Water Authority Owned by Ohio County Public Service	200,000 Gallons/Day	287 Customers
Claysville Donegal Joint Municipal Authority	520,000 Gallons/Day	1,500 Customers 600 Tap-ins
Authority of the Borough of Charleroi	9,000,000 Gallons/Day	28,500 Customers 11,500 Tap-ins
Marianna Borough Municipal Water Works	425,000 Gallons/Day	1,037 Customers 435 Tap-ins

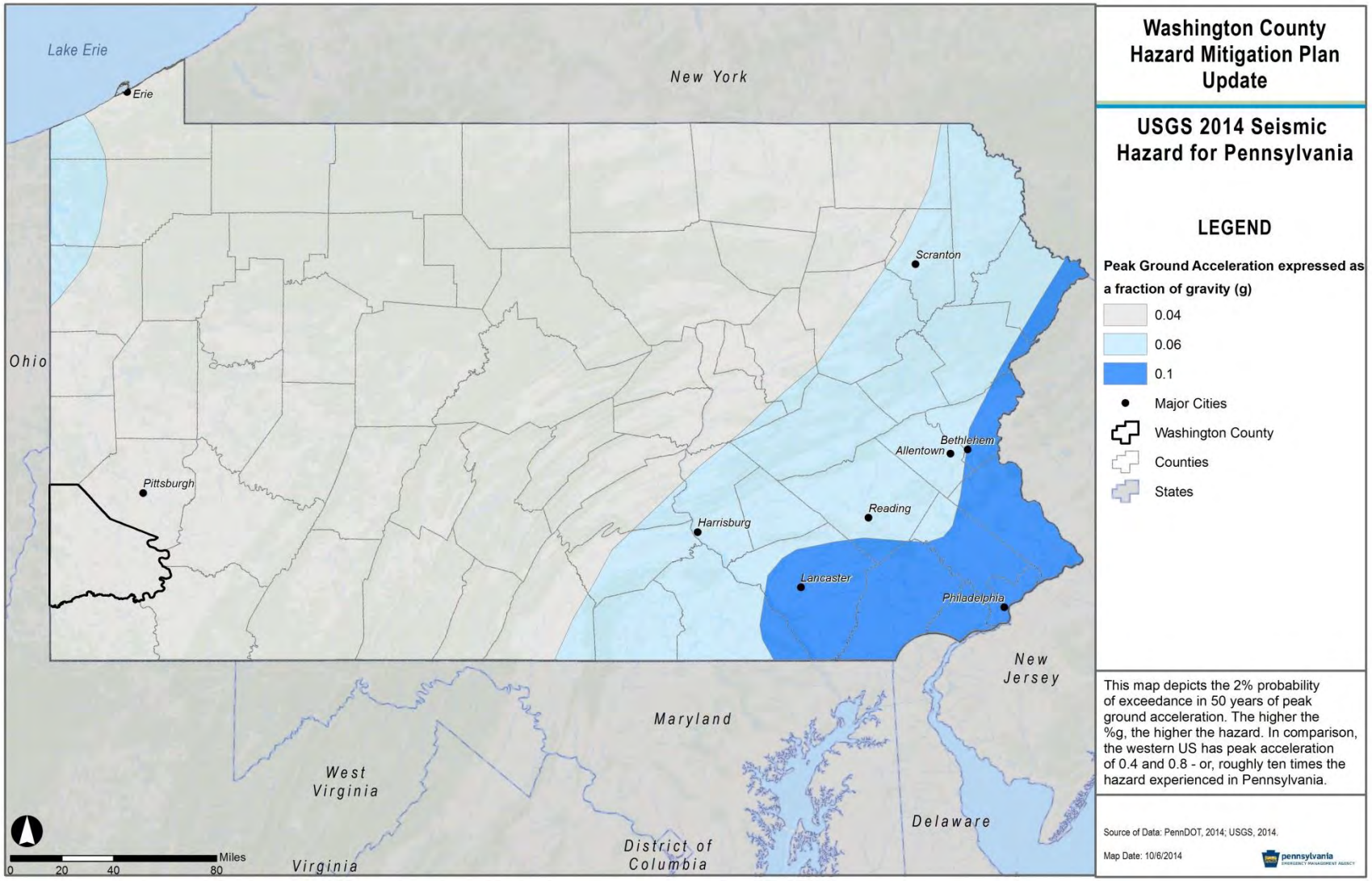
Table 4.3.1-5 Water Service Providers in Washington County.		
PROVIDER	**SERVICE CAPACITY**	**CUSTOMERS**
Southwestern Pennsylvania Water Authority	7,500,000 Gallons/Day	12,000 Customers
Redstone Water Company	64,000 Gallons/Day	774 Customers
Tri County Joint Municipal Authority	2,100,000 Gallons/Day	3,500 Customers
Pennsylvania American Water	13,000,000 Gallons/Day	48,325 Customers

4.3.2. Earthquake

4.3.2.1. Location and Extent

Earthquake events in Pennsylvania typically do not impact areas greater than 100 km from the epicenter, and earthquakes with epicenters in Pennsylvania are fairly rare. Southwestern Pennsylvania is not known for seismicity, and USGS downgraded the probabilistic seismic hazard for much of Pennsylvania in 2014. Figure 4.3.2-1 shows the 2014 earthquake hazard in Pennsylvania and Washington County, expressed as the two-percent probability of exceedance in 50 years of peak ground acceleration (g). This map was digitized from the 2014 National Seismic Hazard report. Washington County lies in the 0.04 zone, indicating that the hazard is slight. Earthquakes originating from outside Pennsylvania can also impact the Commonwealth, as was the case with a magnitude 5.8 earthquake in Virginia in August 2011 (see Section 4.3.2.3).

Figure 4.3.2-1 Approximate USGS Seismic Hazard for Pennsylvania (Petersen et al, 2014).



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 Richter Scale magnitudes as they relate to the spatial extent of impacted areas. Based on historical events, earthquakes in the Pennsylvania region do not exceed magnitudes greater than 6.0.

Table 4.3.2-1 Richter scale magnitudes and associated earthquake size effects.

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

The Richter Scale does not give any indication of the impact or damage of an earthquake, although it can be inferred that higher magnitude events cause more damage. Instead, the impact of an earthquake event is measured in terms of earthquake intensity, usually measured using the Modified Mercalli Intensity Scale, 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. Therefore, little or no damage is expected. No injury or severe damage from earthquake events has been reported in Washington County.

Table 4.3.2-2 Modified Mercalli Intensity Scale with associated impacts.

SCALE	INTENSITY	DESCRIPTION OF EFFECTS	CORRESPONDING RICHTER SCALE MAGNITUDE
I	**Instrumental**	Usually detected only on seismographs.	<4.2
II	**Feeble**	Felt only by a few persons at rest, especially on upper floors of buildings.	
III	**Slight**	Felt quite noticeably indoors, especially on upper floors. Most people don't recognize it as an earthquake (i.e. a truck rumbling).	
IV	**Moderate**	Can be felt by people walking; dishes, windows, and doors are disturbed.	
V	**Slightly Strong**	Sleepers are awoken; unstable objects are overturned.	<4.8
VI	**Strong**	Trees sway; suspended objects swing; objects fall off shelves; damage is slight.	<5.4

Table 4.3.2-2 Modified Mercalli Intensity Scale with associated impacts.			
SCALE	**INTENSITY**	**DESCRIPTION OF EFFECTS**	**CORRESPONDING RICHTER SCALE MAGNITUDE**
VII	**Very Strong**	Damage is negligible in buildings of good design and construction, slight to moderate in well-built ordinary structures, and considerable in poorly built or badly designed structures; some chimneys are broken.	<6.1
VIII	**Destructive**	Damage is slight in specially designed structures; considerable in ordinary, substantial buildings. Moving cars become uncontrollable; masonry fractures, poorly constructed buildings damaged.	<6.9
IX	**Ruinous**	Some houses collapse, ground cracks, pipes break open; damage is considerable in specially designed structures; buildings are shifted off foundations.	
X	**Disastrous**	Some well-built wooden structures are destroyed; most masonry and frame structures are destroyed along with foundations. Ground cracks profusely; liquefaction and landslides widespread.	<7.3
XI	**Very Disastrous**	Most buildings and bridges collapse, roads, railways, pipes and cables destroyed.	<8.1
XII	**Catastrophic**	Total destruction; trees fall; lines of sight and level are distorted; ground rises and falls in waves; objects are thrown upward into the air.	>8.1

Since the strongest earthquake in Pennsylvania history had a magnitude of 5.1, the worst-case earthquake in Washington County would therefore only result in trees swaying and objects falling off walls.

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

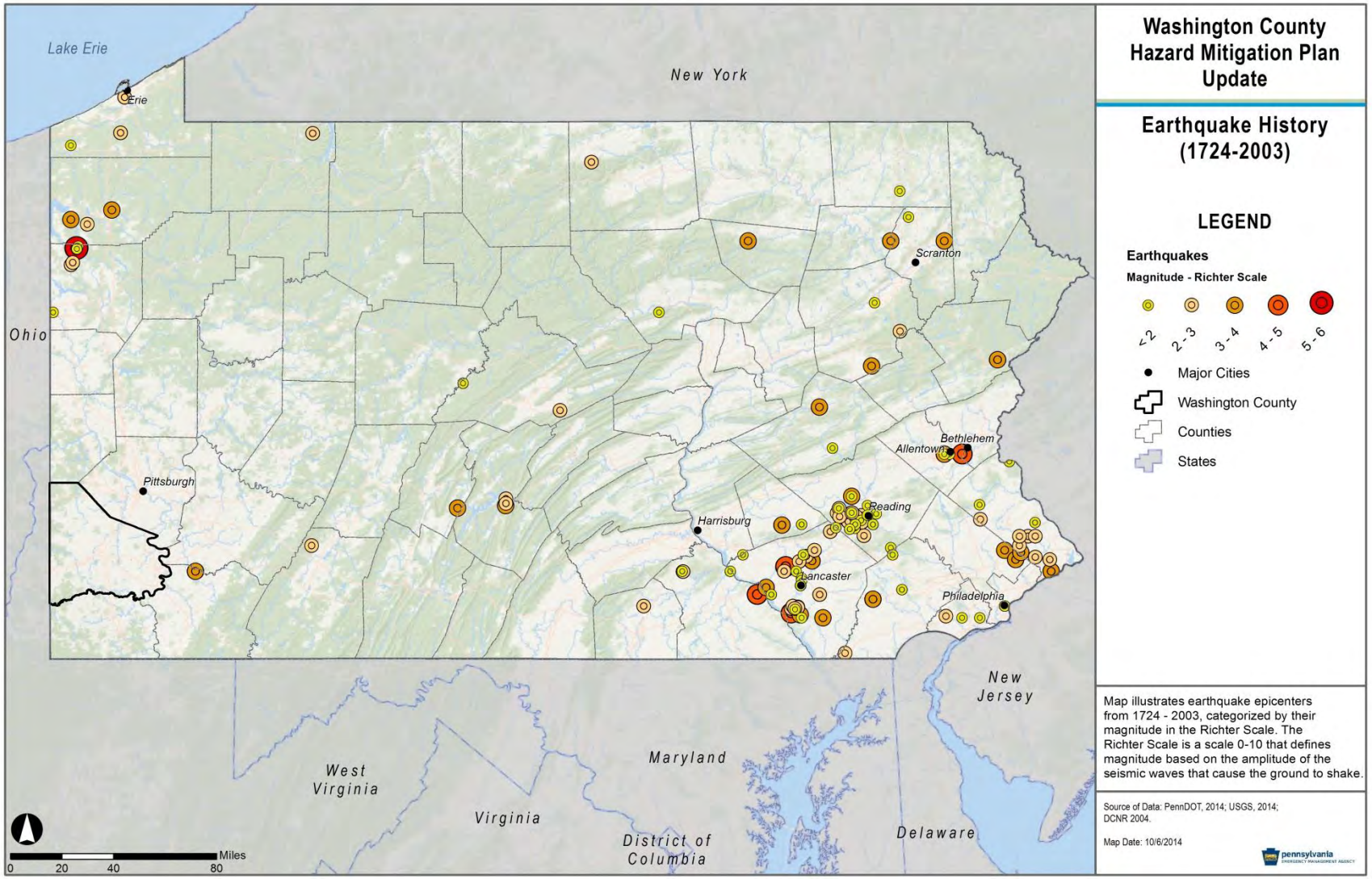
1. Induced flooding or landslides and avalanches;
2. Poor water quality;
3. Damage to vegetation; and
4. Breakage in sewage or toxic material containments.

4.3.2.3. Past Occurrence

There have not been earthquake epicenters in Washington County reported to DCNR. However, the Washington County Hazard Vulnerability Analysis states that there was a “noticeable earthquake” in January 1986. There was no reported damage (Washington County Dept. of Public Safety, 2006). Figure 4.3.2-2 shows recorded earthquake epicenters in Pennsylvania between 1724 and 2003. Earthquake events are shown in other areas of Pennsylvania, with a particular concentration of events occurring in the eastern part of the Commonwealth. DCNR’s earthquake records end in 2003, but a number of minor earthquakes have occurred in

Pennsylvania and have been documented by USGS's Seismic Hazard Program. The closest recent earthquake to Washington County was a magnitude 2.2 event in northeastern Ohio. More recently, a magnitude 5.8 earthquake with an epicenter in rural Louisa County, VA was felt throughout Pennsylvania, triggering evacuations, emergency bridge and tunnel inspections, and minor damage to buildings. This shallow earthquake occurring along the Spotsylvania Fault was felt as far north as Ontario, Canada and as far south as Alabama.

Figure 4.3.2-2 Map of earthquake epicenters in Pennsylvania (DCNR, 2004).



4.3.2.4. Future Occurrence

One way to express an earthquake's severity is to compare its acceleration to the normal acceleration due to gravity. Peak ground acceleration (PGA) measures the strength of ground movements in this manner. PGA represents the rate in change of motion of the earth's surface during an earthquake as a percentage of the established rate of acceleration due to gravity. As shown in Figure 4.3.2-1, Washington County has a very low PGA ratio of 0.04. With a PGA this low, very little damage is expected, but 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. On the whole, though, the probability of future earthquake events can be considered *unlikely* according to the Risk Factor Methodology (see Table 4.4.2-1).

4.3.2.5. Vulnerability Assessment

Washington County is located in a zone where no to minor earthquake damage is expected. No damage or casualties have been reported from neighboring earthquake events. As a result, Washington County's vulnerability to earthquakes can be considered low. Major structural damage is not expected, but unanchored objects may fall or be otherwise disturbed.

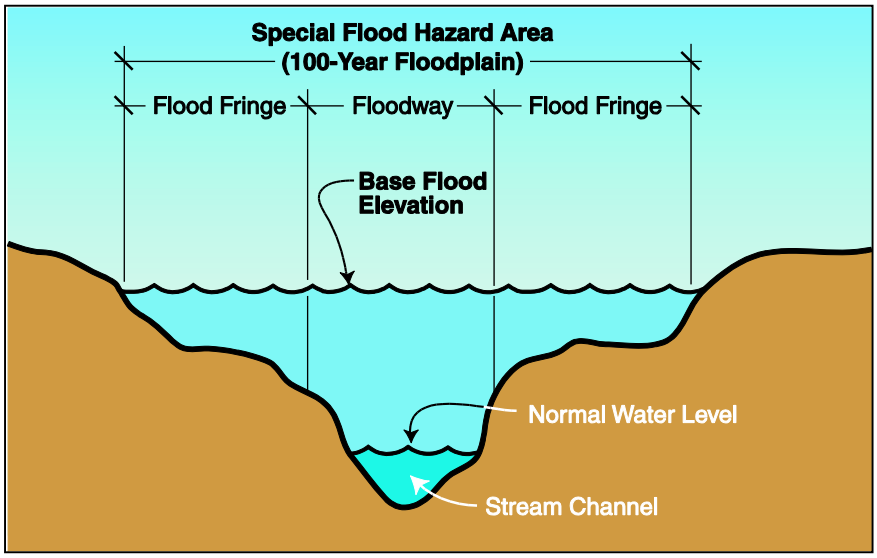
4.3.3. Flood, Flash Flood, Ice Jam

4.3.3.1. Location and Extent

A flood is a natural event for rivers and streams. For areas like south-western Pennsylvania, excess water from snowmelt or rainfall accumulates and overflows onto the stream banks and adjacent floodplains. Floodplains are lowlands adjacent to rivers, streams and creeks that are subject to recurring floods. The size of the floodplain is described by the recurrence interval of a given flood. Flood recurrence intervals are explained in more detail in Section 4.3.4.4. However, in assessing the potential spatial extent of flooding it is important to know that a floodplain associated with a flood that has a 10 percent chance of occurring in a given year is smaller than the floodplain associated with a flood that has a 0.2% annual chance of occurring.

The National Flood Insurance Program (NFIP), for which FIRMs are published, identifies the 1% annual chance flood. This 1% annual chance flood event is used to delineate the special flood hazard area (SFHA) and identify Base Flood Elevations. Figure 4.3.3-1 illustrates these terms. The SFHA serves as the primary regulatory boundary used by FEMA, the Commonwealth of Pennsylvania and Washington County local governments.

Figure 4.3.3-1 Diagram identifying Special Flood Hazard Area, 1%-annual-chance (100-Year) floodplain, floodway and flood fringe.



Washington County's FIRMs are currently paper with the exception of McDonald Borough, which was updated with Allegheny County in 2014. The County is in the midst of updating its FIRMs and DFIRM data under the Risk Mapping, Assessment, and Planning (Risk MAP) Program. This plan makes use of Washington County's 2nd Revised Preliminary DFIRM database obtained from the FEMA Map Service Center (http://www.msc.fema.gov) and dated June 27, 2014. Washington County's estimated effective date for the new DFIRM data is September 2015.

The FIRMs can be used to identify the expected spatial extent and elevation of flooding from a 1% and 0.2% annual chance event. Sixty-two of the municipalities in the County participate in the NFIP; those that do not participate have no SFHAs and have never been mapped. Figure 4.3.3-2 shows the special flood hazard areas and watercourses of Washington County as captured in the 2014 2nd Revised Preliminary database.

Chartiers Creek, Lower Monongahela River, and Upper Monongahela River watersheds are Washington County's major high-risk flood areas. Thirty-three percent of the county's population and fifty-one percent of its housing stock that are susceptible to flooding are located in these two watersheds. Other watersheds that have experienced significant flooding are Cross Creek and Ten Mile Creek. Small stream flooding has been an ongoing problem within Washington County for decades, Development, stream channel erosion, poor floodplain management, and a general lack of stormwater management regulations have contributed to increased frequency and severity of small stream flooding.

There is one levee in Washington County per the R3Leevees website. The levee was built to protect the South Strabane Sewage Treatment Plant and is not shown on the current Preliminary DIRM as providing protection from the 1% annual chance flood.

Figure 4.3.3-2 Snapshot of Primary DFIRM showing that South Strabane Sewage Treatment Plant Levee is not providing protection from 1% Annual Chance Flood.

Chartiers Creek has a history of flooding Houston Borough and Chartiers Township. Canonsburg Borough was also affected prior to the Army Corp of Engineers stream dredging and widening project in the early 1970s. There are still some low lying areas of Canonsburg that occasionally suffer from basement flooding following a particularly intense storm.

Houston Borough frequently suffers flood damage, ranging from nuisance flooding through major structural damage. During the late 1980s, an isolated thunderstorm resulted in a flashflood on Chartiers Creek in Houston Borough. The flood waters trapped a Circus, with all its animals and performers on the American Legion picnic grounds, severely damaged several businesses, and flooded dozens of homes. In the middle of town, floodwaters caused a short circuit in the basement of a commercial building. The ensuing fire heavily damaged the building, and businesses located within. Fire Department response was compromised because of the high water surrounding the burning building.

Pigeon Creek also has a history of flooding. Areas of Bentleyville, Fallowfield Township, Carroll Township, and Monongahela are normally affected. The most significant damage in Monongahela and Carroll Township is usually from the backflow of the Monongahela River.

A number of factors contribute to the high percentage of flood prone areas in Washington County:

- Washington County topography is characterized by moderately steep slopes. Over sixty percent of its slopes have a gradient in excess of 16 percent.
- Washington County exhibits a humid continental type of climate and receives an average of 38.8 inches of precipitation annually.
- Washington County has 1,121 miles of streams and 40 miles of river.
- Washington County is divided into three HUC8 watersheds, twelve HUC10 and forty-two HUC12 watersheds
- Washington County is Pennsylvania's 18th largest County according to population. In 2010, the county numbered 207,820 persons.
- In 2010, Washington County had 92,977 housing units with a vacancy rate of only 8.5%.

Figure 4.3.3-3 **Map showing Special Flood Hazard Areas in Washington County.**

4.3.3.2. Range of Magnitude

Floods are considered hazards when people and property are affected. Nationwide, hundreds of floods occur each year, making them one of the most common hazards in all 50 states and U.S. territories. In Pennsylvania, flooding occurs commonly and can happen during any season of the year from a variety of sources. Every two to three years, serious flooding occurs along one or more of Pennsylvania's major rivers or streams, and it is not unusual for this to occur several years in succession. 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 time span can result in flash flood conditions. Small amounts of rain can result in floods in locations where the soil is frozen or saturated from a previous wet period or if the rain is concentrated in an area of impermeable surfaces such as large parking lots, paved roadways, or other impervious developed areas.

Several factors determine the severity of floods, including rainfall intensity and duration, topography, ground cover and rate of snowmelt. Water runoff is greater in areas with steep slopes and little or no vegetative ground cover. Also, urbanization typically results in the replacement of vegetative ground cover with asphalt and concrete, increasing the volume of surface runoff and stormwater, particularly in areas with poorly planned stormwater drainage systems.

In Southwest Pennsylvania, including Washington County, there are seasonal differences in the causes for floods. Washington County's main flood season is December through April. In the winter and early spring (February to April), major flooding has occurred as a result of heavy rainfall on dense snowpack throughout contributing watersheds, although the snowpack is generally moderate during most winters. Winter floods also have resulted from runoff of intense rainfall on frozen ground, and local flooding can be exacerbated by ice jams in rivers, streams, and creeks. Ice jam floods occur on rivers that are totally or partially frozen. A rise in stream stage will break up a totally frozen river and create ice flows that can pile up on channel obstructions such as shallow riffles, log jams, or bridge piers. The jammed ice creates a dam across the channel over which the water and ice mixture continues to flow, allowing for more jamming to occur.

Summer floods have occurred from intense rainfall on previously saturated soils. Summer thunderstorms deposit large quantities of rainfall over a short period of time that can result in flash flood events.

Flood effects can be volume or force related. Major floods along larger streams having wide floodplains tend to result in large-scale inundations. This causes widespread damage through soaking and silt deposits in homes, businesses, and industrial plants. In hilly regions where runoff paths are steep, flash floods may be prevalent. Flash floods are short in duration and usually occur in a somewhat localized area. In these floods, the velocity rather than the volume of water causes flood damages. Torrents of water can rush down minor hillside gullies at 30-50 miles per hour, carrying trees, debris, and rocks. These floods are often unpredictable and, particularly if they occur at night, can cause major panic and loss of life. Frozen surfaces can

more than double normal runoff velocities, particularly in small drainage areas. This causes flash floods which can be compounded by ice and debris jams in channels and culverts. Also obstructions within the floodplain such as bridges and undersized culverts can also increase flooding.

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

The worst stream flooding in recorded history occurred in September 2004 in the aftermath of Hurricane Ivan. The closest Hurricane Ivan came to Washington County was 300 miles as a tropical depression. The ensuing flood resulted in the structural damage shown in Table 4.3.3-1.

Table 4.3.3-1 Hurricane Ivan damages in Washington County

STRUCTURE TYPE	DESTROYED	MAJOR	MINOR	AFFECTED	TOTAL
Businesses	4	54	74	201	234
Mobile Homes	100	3	9	65	177
Multi-Family Residential	1	8	21	7	37
Single-Family Residential	25	90	240	435	790
TOTAL	**130**	**155**	**344**	**609**	**1,238**

Washington County's emergency manager at the time filed the following details with the National Climatic Data Center:

> *Rain from the remnants of Hurricane Ivan started during the night of the 16th [of September], and continued into the evening of the 17th. At 1:15 PM EDT on 17th, roads flooded in Canonsburg and Washington. At 2:06 PM, there was widespread stream flooding in Burgettstown, McDonald, and Midway. At 2:17 PM, Houston flooded. 3:15 PM, Rtes 50 and 980 were flooded in Avella and Cecil. 5 PM, mud slides in Peters Twp, which had 4" of rain. By 8 PM, Washington 5" of rain. Towns hard hit: Avella, Burgettstown, Cecil, Independence, Peters, Washington. Many roads closed by mud slides or flooded. Trailer park in Canton washed away. Some trailer park residents were trapped atop their mobile homes until dark, asking for help by signaling SOS with their flashlights. Other mobile homes destroyed. Houses lifted off foundations; railroad track beds gone; several roads washed out, including Rte 19 near Houston; grocery store destroyed. 11 boats, docked in Millsboro, damaged. Total rain: 5.9" in Canonsburg.*

In the aftermath of Ivan, FEMA provided over two million dollars in Public Assistance to the affected municipalities in Washington County to repair damaged roads, public buildings, and other critical infrastructure. FEMA has provided over seven million dollars in Individual assistance.

4.3.3.3. Past Occurrence

During the winter of 1996, unseasonably high temperatures began to melt an immense snow pack that had accumulated during the "Blizzard of 1996." Accompanying heavy rainfall and high winds carried large volumes of runoff, overwhelming small and large watersheds. Before the week was over, all 67 of Pennsylvania's counties had been declared federal disaster areas. The Upper Ohio River Basin saw flooding on the Allegheny, Clarion, Conemaugh, Monongahela, Cheat, Youghiogheny and the Upper Ohio River. Runoff estimates from the snow melt on January 18th and the rainfall that fell on January 19th was between 2.50 and 3.00 inches over the two-day period across much of the area. In some of the more mountainous areas, runoff was estimated as high as 4.50 inches in a 24-hour period. These totals exceed the normal precipitation amount for the entire month of January. The Monongahela River, as measured at the Charleroi Lock and Dam, crested at 39.80 feet. Flood stage in this area is 28 feet, and major flood stage at this measuring point is 35 feet. The highest recorded crest at this point of the Monongahela is 44.7 feet, in 1985. Table 4.3.3-2 shows other major Monongahela River flood events from the late 1800s.

Table 4.3.3-2 Major Monongahela River Flood Events

DATE	CREST *26' FLOOD STAGE*
November 5, 1985 (Election Day)	44.7
March 14-15, 1907 (Ides of March)	42.5
March 17, 1936 (St. Patrick's Day)	40.1
January, 20 1996	39.8
March 7, 1967	39.7
February 19, 2000	38.5
July 18, 1886	37.1
February 23, 1897	37.1
March 25, 1936	36.0
July 18, 1888	35.6
June 24, 1972 (Hurricane Agnes)	35.4
January 27, 1978	34.2
April 19, 1952	34.0
January 10, 1862	33.95
April 6, 1852	33.9
March 5, 1963	33.8
March 30, 1924	32.4
January 17, 1877	32.11
February 26, 1979	31.6
November 20, 2003	31.4

Table 4.3.3-2 Major Monongahela River Flood Events	
DATE	**CREST *26' FLOOD STAGE***
August 3, 1875	31.2

In addition to the Monongahela River flooding, the NCDC records flooding events throughout Washington County. The following table contains information on flooding-related events since 1996 that impacted Washington County. These are the oldest floods for which data is available from the NCDC. Reported property damages are estimates reported to the NCDC and displayed in the Storm Events database today; a zero dollar amount may not necessarily mean there was zero property damage or crop damage, but that it could have been simply not reported.

Table 4.3.3-3 Flood and flash flood events reported to the NCDC up to May 2014.

LOCATION	DATE	TYPE	DEATH	INJURY	PROPERTY DAMAGE ($)	CROP DAMAGE ($)
Washington	1/19/1996	Flash Flood	0	0	$10,000	$0
Countywide	1/19/1996	Flood	0	0	$1,400,000	$0
Countywide	2/28/1996	Flash Flood	0	0	$5,000	$0
Westland	5/9/1996	Flash Flood	0	0	$0	$0
Countywide	5/18/1996	Flood	0	0	$0	$0
McDonald	6/18/1996	Flash Flood	0	0	$0	$0
Midway	6/18/1996	Flash Flood	0	0	$5,000	$0
Bentleyville	6/24/1996	Flash Flood	0	0	$1,000	$0
Countywide	7/20/1996	Flood	0	0	$5,000	$0
Countywide	3/2/1997	Flood	0	0	$0	$0
Ginger Hill	5/19/1997	Flash Flood	1	0	$0	$0
Washington	5/19/1997	Flash Flood	0	0	$3,000	$0
East Finley	5/19/1997	Flash Flood	0	0	$0	$0
Claysville	5/19/1997	Flash Flood	0	0	$0	$0
Chartiers Creek	5/25/1997	Flash Flood	0	0	$1,000	$0
West Brownsville	1/9/1998	Flash Flood	0	0	$0	$0
Washington	6/26/1998	Flash Flood	0	0	$20,000	$0
Southern Portion	6/27/1998	Flash Flood	0	0	$100,000	$0
Claysville	6/30/1998	Flash Flood	0	0	$25,000	$0
Countywide	8/24/1998	Flood	0	0	$10,000	$0
Burgettstown	4/9/1999	Flash Flood	0	0	$0	$0
Countywide	2/19/2000	Flood	0	0	$2,000,000	$0
Countywide	2/19/2000	Flash Flood	0	0	$20,000	$0
Burgettstown	7/28/2000	Flash Flood	0	0	$5,000	$0
Bavington	7/28/2000	Flash Flood	0	0	$0	$0
Washington	8/6/2000	Flash Flood	0	0	$0	$0
McMurray	8/6/2000	Flash Flood	0	0	$0	$0
Countywide	8/7/2000	Flash Flood	0	0	$500,000	$0

Table 4.3.3-3 Flood and flash flood events reported to the NCDC up to May 2014.						
LOCATION	DATE	TYPE	DEATH	INJURY	PROPERTY DAMAGE ($)	CROP DAMAGE ($)
Washington	7/10/2001	Flash Flood	0	0	$10,000	$0
California	8/10/2001	Flash Flood	0	0	$10,000	$0
Charleroi	3/21/2002	Flash Flood	0	0	$5,000	$0
Countywide	3/26/2002	Flood	0	0	$50,000	$0
West Bornwsville	5/9/2002	Flash Flood	0	0	$500,000	$0
Charleroi	6/13/2002	Flash Flood	0	0	$3,000,000	$0
California	2/23/2003	Flash Flood	0	0	$0	$0
Deemston	2/23/2003	Flash Flood	0	0	$0	$0
Countywide	2/24/2003	Flood	0	0	$0	$0
McMurray	5/10/2003	Flash Flood	0	0	$0	$0
Bentleyville	5/10/2003	Flash Flood	0	0	$0	$0
Finleyville	5/10/2003	Flash Flood	0	0	$0	$0
Cecil	5/10/2003	Flash Flood	0	0	$0	$0
McMurray	6/20/2003	Flash Flood	0	0	$0	$0
Washington	6/20/2003	Flash Flood	0	0	$5,000	$0
McDonald	7/10/2003	Flash Flood	0	0	$0	$0
McMurray	8/4/2003	Flash Flood	0	0	$0	$0
McMurray	8/27/2003	Flash Flood	0	0	$0	$0
Washington	11/19/2003	Flash Flood	0	0	$0	$0
McMurray	11/19/2003	Flash Flood	0	0	$0	$0
Countywide	11/19/2003	Flood	0	0	$0	$0
Avella	12/10/2003	Flash Flood	0	0	$0	$0
Van Voorhis	12/10/2003	Flash Flood	0	0	$0	$0
Countywide	1/3/2004	Flood	0	0	$0	$0
Countywide	1/4/2004	Flood	0	0	$0	$0
Monongahela	2/3/2004	Flash Flood	0	0	$30,000	$0
Countywide	2/6/2004	Flood	0	0	$0	$0
Countywide	2/7/2004	Flood	0	0	$5,000	$0
Countywide	4/14/2004	Flood	0	0	$7,000	$0
Countywide	6/14/2004	Flood	0	0	$100,000	$0
Burgettstown	6/15/2004	Flash Flood	0	0	$6,000	$0
Countywide	9/8/2004	Flood	0	0	$25,000	$0
Countywide	9/17/2004	Flood	0	0	$5,130,000	$0
Countywide	1/6/2005	Flood	0	0	$500,000	$0
Countywide	1/12/2005	Flood	0	0	$0	$0
Countywide	3/29/2005	Flood	0	0	$0	$0
Washington	6/6/2005	Flash Flood	0	0	$10,000	$0
Beallsville	6/30/2005	Flash Flood	0	0	$30,000	$0
McMurray	8/8/2005	Flash Flood	0	0	$30,000	$0
Washington	3/15/2007	Flood	0	0	$0	$0
Washington	3/23/2007	Flash Flood	0	0	$0	$0

Table 4.3.3-3 Flood and flash flood events reported to the NCDC up to May 2014.						
LOCATION	**DATE**	**TYPE**	**DEATH**	**INJURY**	**PROPERTY DAMAGE ($)**	**CROP DAMAGE ($)**
Washington	7/5/2007	Flash Flood	0	0	$10,000	$0
Allenport	8/9/2007	Flash Flood	0	0	$50,000	$0
Ellsworth	8/9/2007	Flash Flood	0	0	$75,000	$0
Ellsworth	8/9/2007	Flash Flood	0	0	$25,000	$0
Monongahela	5/5/2009	Flood	0	0	$150,000	$0
Wolfdale	3/10/2011	Flood	0	0	$5,000	$0
Bissel	4/5/2011	Flood	0	0	$5,000	$0
Tylerdale	4/5/2011	Flood	0	0	$50,000	$0
Muse	5/13/2011	Flood	0	0	$10,000	$0
Vestaburg	5/13/2011	Flood	0	0	$15,000	$0
Claysville	5/18/2011	Flood	0	0	$5,000	$0
Countywide	6/20/2011	Flood	0	0	$75,000	$0
Countywide	6/20/2011	Flood	0	0	$75,000	$0
Countywide	6/20/2011	Flood	0	0	$50,000	$0
Gastonville	8/19/2011	Flood	0	0	$40,000	$0
Pleasant Grove	6/18/2012	Flash Flood	0	0	$5,000	$0
Budaville	6/18/2012	Flash Flood	0	0	$5,000	$0
Washington	10/30/2012	Flood	0	0	$50,000	$0
Washington	6/28/2013	Flash Flood	0	0	$5,000	$0
Strabane	7/10/2013	Flash Flood	0	0	$5,000	$0
Midway	7/10/2013	Flash Flood	0	0	$35,000	$0
McMurray	7/10/2013	Flash Flood	0	0	$10,000	$0
Lawrence Hills	7/10/2013	Flash Flood	0	0	$10,000	$0
Charleroi	7/10/2013	Flash Flood	0	0	$5,000	$0
Bentleyville	7/16/2013	Flood	0	0	$15,000	$0
Centerville	8/23/2013	Flood	0	0	$0	$0
Ellsworth	8/23/2013	Flood	0	0	$0	$0
Allenport	8/23/2013	Flood	0	0	$0	$0
Roscoe	8/23/2013	Flood	0	0	$0	$0
Ellsworth	8/23/2013	Flood	0	0	$0	$0
Lawrence Hills	5/27/2014	Flood	0	0	$1,000	$0
TOTALS:			**1**	**0**	**$14,349,000**	**$0**

The following definition of RL and SRL properties from the Hazard Mitigation Assistance (HMA) Unified Guidance from July 2013 reflects changes made in the Biggert-Waters Flood Insurance Reform Act of 2012. A **Repetitive Loss** property is a structure covered by a contract for flood insurance made available under the NFIP that:

(a) Has incurred flood-related damage on two occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and

(b) At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage. (Please note: Homes are eligible for ICC coverage after first loss, however cost for ICC is part of all policies.)

A **Severe Repetitive Loss** property is a structure that:

(a) Is covered under a contract for flood insurance made available under the NFIP; and

(b) Has incurred flood related damage (i) For which four or more separate claims payments have been made under flood insurance coverage with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or (ii) For which at least two separate claims payments have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

According to the 2015 data from PEMA, there were 62 repetitive loss properties in Washington County, one of which has been mitigated (PEMA, 2015). The mitigated property was non-residential and located in Canton Township. Table 4.3.4-2 shows the number of repetitive loss properties by municipality. There are 3 severe repetitive loss properties in Washington County shown in table 4.3.3-5.

Table 4.3.3-4 Summary of the number and type of Repetitive Loss properties by municipality (PEMA, 2015). Please note that only communities with Repetitive Loss properties are shown.

MUNICIPALITY	TYPE					SUM OF REPETITIVE LOSS PROPERTIES
	2-4 FAMILY	ASSEMBLED CONDO	NON-RESIDENTIAL	OTHER RESIDENTIAL	SINGLE FAMILY	
Allenport Borough	0	0	0	0	2	**2**
Amwell Township	0	0	0	0	1	**1**
California Borough	0	0	1	1	0	**2**
Canonsburg Borough	0	0	0	0	1	**1**
Canton Township	0	0	2	0	1	**3**
Carroll Township	0	0	1	0	0	**1**
Cecil Township	0	0	0	0	1	**1**
Centerville Borough	0	0	0	0	1	**1**
Charleroi Borough	0	0	3	0	0	**3**
East Bethlehem Township	0	0	3	0	3	**6**
Elco Borough	0	0	0	0	5	**5**
Fallowfield Township	0	0	0	0	1	**1**
Hopewell Township	0	0	0	0	1	**1**
Houston Borough	1	0	0	0	2	**3**
Monongahela, City of	2	0	2	1	1	**6**
North Charleroi Borough	0	1	1	0	3	**5**

Table 4.3.3-4 Summary of the number and type of Repetitive Loss properties by municipality (PEMA, 2015). Please note that only communities with Repetitive Loss properties are shown.

MUNICIPALITY	TYPE					SUM OF REPETITIVE LOSS PROPERTIES
	2-4 FAMILY	ASSEMBLED CONDO	NON-RESIDENTIAL	OTHER RESIDENTIAL	SINGLE FAMILY	
North Franklin Township	0	0	1	0	0	**1**
Roscoe Borough	0	0	0	0	2	**2**
Speers Borough	0	0	1	0	0	**1**
Stockdale Borough	2	0	0	0	2	**4**
Union Township	0	0	0	0	1	**1**
Washington, City of	0	0	3	0	3	**6**
West Bethlehem Township	0	0	0	0	1	**1**
West Brownsville Borough	0	0	1	0	3	**4**
TOTAL	**5**	**1**	**22**	**2**	**35**	**62**

Table 4.3.3-5 Summary of the number and type of Severe Repetitive Loss properties by municipality (PEMA, 2015). Please note that only communities with Severe Repetitive Loss properties are shown.

MUNICIPALITY	TYPE					SUM OF REPETITIVE LOSS PROPERTIES
	2-4 FAMILY	ASSEMBLED CONDO	NON-RESIDENTIAL	OTHER RESIDENTIAL	SINGLE FAMILY	
Monongahela, City of	0	0	1	0	0	**1**
Washington, City of	0	0	2	0	0	**2**
TOTAL	**0**	**0**	**3**	**0**	**0**	**3**

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

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

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

Today, nearly 90 WYO insurance companies issue and service the SFIP under their own names. More than 4.4 million federal flood insurance policies are in force. These policies represent $650 billion in flood insurance coverage for homeowners, renters, and business owners throughout the United States and its territories.

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

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

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

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

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

The minimum floodplain management requirements include:

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

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

Table 4.3.3-5 lists the Washington County municipalities participating in the NFIP along with previous claims and substantial damage claims. For more information on the NFIP in

Washington County, please see Section 5.2.1.2. The number of NFIP policies and percent of structures with NFIP policies was calculated to show communities that are more flood prone. In Allenport, Elco, Roscoe, and Stockdale 10% or more of the total structures have NFIP insurance; these cells are highlighted pink below. Municipalities with 1-10% of their total structures with NFIP insurance are highlighted yellow. Additionally, this statistic may be viewed in the inverse that the percent of structures not covered by a flood policy provides an opportunity for outreach to increase insurance coverage.

Table 4.3.3-6 Washington County Municipal Participation in the National Flood Insurance Program (FEMA CIS, 2014). **Table 4.3.3-7**

COMMUNITY	PARTICIPATION STATUS	TOTAL AMOUNT OF PAID CLAIMS	# CLAIMS	# SUBSTANTIAL DAMAGE CLAIMS	# NFIP POLICIES	% OF TOTAL STRUCTURES WITH NFIP POLICIES
Allenport Borough	Participating	$117,477	19	0	32	11.85%
Amwell Township	Participating	$6,759	3	0	12	0.72%
Beallsville Borough	Participating	$0	0	0	0	0.00%
Bentleyville Borough	Participating	$38,913	1	0	6	0.55%
Blaine Township	Participating	$5,244	2	0	1	0.37%
Buffalo Township	Participating	$29,034	1	0	2	0.23%
Burgettstown Borough	Participating	$277,258	8	0	11	1.65%
California Borough	Participating	$251,613	24	0	72	4.02%
Canonsburg Borough	Participating	$146,712	10	3	15	0.37%
Canton Township	Participating	$692,688	15	1	19	0.51%
Carroll Township	Participating	$138,795	10	0	19	0.78%
Cecil Township	Participating	$444,427	24	2	48	0.87%
Centerville Borough	Participating	$80,735	10	2	25	1.48%
Charleroi Borough	Participating	$391,339	29	1	23	1.10%
Chartiers Township	Participating	$560,216	8	2	27	0.75%
Claysville Borough	Not Participating	$0	0	0	0	0.00%
Coal Center Borough	Participating	$71,558	11	1	8	9.41%
Cokeburg Borough	Not Participating	$0	0	0	0	0.00%
Cross Creek Township	Participating	$92,327	3	1	12	1.58%

Table 4.3.3-6 Washington County Municipal Participation in the National Flood Insurance Program (FEMA CIS, 2014).						Table 4.3.3-7
COMMUNITY	PARTICIPATION STATUS	TOTAL AMOUNT OF PAID CLAIMS	# CLAIMS	# SUBSTANTIAL DAMAGE CLAIMS	# NFIP POLICIES	% OF TOTAL STRUCTURES WITH NFIP POLICIES
Deemston Borough	Participating	$0	0	0	2	0.55%
Donegal Township	Participating	$0	0	0	1	0.08%
Donora Borough	Participating	$2,712	2	0	2	0.08%
Dunlevy Borough	Participating	$33,095	5	1	4	1.85%
East Bethlehem Township	Participating	$955,284	43	4	40	3.18%
East Finley Township	Participating	$24,453	2	0	3	0.47%
East Washington Borough	Participating	$0	0	0	2	0.31%
Elco Borough	Participating	$220,591	26	1	15	10.07%
Ellsworth Borough	Participating	$0	0	0	0	0.00%
Fallowfield Township	Participating	$16,946	5	0	11	0.54%
Finleyville Borough	Participating	$49,430	8	0	6	2.83%
Green Hills Borough	Not Participating	$0	0	0	0	0.00%
Hanover Township	Participating	$0	0	0	6	0.49%
Hopewell Township	Participating	$19,219	2	0	0	0.00%
Houston Borough	Participating	$554,464	31	3	43	7.56%
Independence Township	Participating	$43,476	6	0	9	1.19%
Jefferson Township	Participating	$0	0	0	1	0.19%
Long Branch Borough	Participating	$0	0	0	3	1.21%
Marianna Borough	Participating	$0	0	0	0	0.00%
McDonald Borough	Participating	$309,461	19	0	14	1.46%
Midway Borough	Participating	$9,324	3	0	3	0.72%
Monongahela City	Participating	$122,731	72	8	44	2.10%
Morris Township	Participating	$31,997	1	0	1	0.21%
Mount Pleasant	Participating	$0	0	0	5	0.30%

Table 4.3.3-6 Washington County Municipal Participation in the National Flood Insurance Program (FEMA CIS, 2014).						Table 4.3.3-7
COMMUNITY	PARTICIPATION STATUS	TOTAL AMOUNT OF PAID CLAIMS	# CLAIMS	# SUBSTANTIAL DAMAGE CLAIMS	# NFIP POLICIES	% OF TOTAL STRUCTURES WITH NFIP POLICIES
Township						
New Eagle Borough	Participating	$9,934	3	0	3	0.30%
North Bethlehem Township	Participating	$0	0	0	2	0.26%
North Charleroi Borough	Participating	$376,325	39	1	13	2.22%
North Franklin Township	Participating	$97,689	9	0	20	1.02%
North Strabane Township	Participating	$73,043	3	0	21	0.34%
Nottingham Township	Participating	$2,593	1	0	6	0.47%
Peters Township	Participating	$73,748	7	0	46	0.56%
Robinson Township	Participating	$2,865	1	0	1	0.11%
Roscoe Borough	Participating	$303,900	42	3	87	21.59%
Smith Township	Participating	$10,350	1	0	8	0.37%
Somerset Township	Participating	$0	0	0	8	0.61%
South Franklin Township	Participating	$14,275	2	0	14	0.96%
South Strabane Township	Participating	$81,621	2		15	0.38%
Speers Borough	Participating	$256,669	7	0	18	2.97%
Stockdale Borough	Participating	$203,981	25	2	62	24.60%
Twilight Borough	Participating	$0	0	0	1	0.94%
Union Township	Participating	$131,158	9	1	24	0.86%
Washington City	Participating	$1,132,417	49	2	56	1.00%
West Bethlehem Township	Participating	$7,941	2	0	9	1.29%
West Brownsville Borough	Participating	$250,705	24	1	18	3.40%
West Finley Township	Participating	$0	0	0	3	0.71%
West Middletown	Not Participating	$0	0	0	0	0.00%

Table 4.3.3-6 Washington County Municipal Participation in the National Flood Insurance Program (FEMA CIS, 2014).						Table 4.3.3-7
COMMUNITY	PARTICIPATION STATUS	TOTAL AMOUNT OF PAID CLAIMS	# CLAIMS	# SUBSTANTIAL DAMAGE CLAIMS	# NFIP POLICIES	% OF TOTAL STRUCTURES WITH NFIP POLICIES
Borough						
West Pike Run Township	Participating	$0	0	0	3	0.36%

4.3.3.4. Future Occurrence

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. The National Flood Insurance Program (NFIP) uses historical records to determine the probability of occurrence for different extents of flooding. The probability of occurrence is expressed in percentages as the chance of a flood of a specific extent occurring in any given year.

A specific flood that is used for a number of purposes is called the “base flood,” which has a 1 percent chance of occurring in any particular year. The base flood is often referred to as the “100-year flood,” since its probability of occurrence suggests it should reoccur once every 100 years, although this is not the case in practice. The term “100-year flood” is a misnomer. Experiencing a 100-year flood does not mean a similar flood cannot happen for the next 99 years; rather, it reflects the probability that over a long period of time a flood of that magnitude has a 1 percent chance of occurring in any given year.

Smaller floods occur more often than larger (deeper and more widespread) floods. Thus, a “10-year” flood has a greater likelihood of occurring than a “100-year” flood. Table 4.3.3-4 shows a range of flood recurrence intervals and their probabilities of occurrence.

The extent of flooding associated with a 1 percent probability of occurrence – the base flood – is used as a regulatory boundary by a number of federal, state, and local agencies. Also referred to as the “special flood hazard area,” this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities, since many communities like Washington County have maps available that show the extent of the base flood and the likely depths that will be experienced.

Table 4.3.3-8 Recurrence intervals and associated probabilities of occurrence (FEMA, 2007).	
RECURRENCE INTERVAL	CHANCE OF OCCURRENCE IN ANY GIVEN YEAR (%)
10 year	10
50 year	2
100 year	1
500 year	0.2

The Allegheny River Basin lies almost entirely within the Appalachian Plateaus Physiographic Province. The entire study area is underlain by sedimentary rocks that have been fractured in

many places by folding and faulting. These rocks carry ground water in much of the area and are referred to as fractured-rock aquifers. The northwestern parts of the Allegheny River Basin were glaciated. The glaciers deposited sand, gravel, silt, and clay in the valleys and eroded the hills, leaving a terrain of more consistent altitude.

Based on previous events, Washington County can expect up to 5 flood events per year. However, future development may affect the flood likelihood and intensity. For example, development often comes hand in hand with an increase in impervious surface, which can intensify and increase flooding events. On the whole, though, the probability of future flood, flash flood, and ice jam events can be considered *highly likely* according to the Risk Factor Methodology (see Table 4.4.2-1).

4.3.3.5. Vulnerability Assessment

Despite the fact that almost all of Washington County's 66 municipalities participate in the National Flood Insurance Program (NFIP), communities need to strengthen floodplain management by reviewing current codes and ordinances and by strongly enforcing their floodplain codes on new development to avoid aggravating further flooding. Significant residential growth in the outlying rural townships can increase opportunities for flash flooding if floodplain development and stormwater management are not properly regulated. Numerous times since the January 1996 floods, localized rainstorms went undetected by the National Weather Service and created surface flooding.

The flood hazard vulnerability assessment for the County focused on the community assets that are located in the 1%-annual-chance floodplain. While greater and smaller floods are possible, information about the extent and depth for the 1%-annual-chance floodplain is available in a similar format for all of Washington County, providing a consistent basis for analysis. Table 4.3.3-6 shows the structures, critical facilities, and populations located in the SFHA; there are 2,855 structures in the SFHA county-wide (just over 3% of all structures). Roscoe Borough has the highest proportion of structures in the floodplain at over 70% of all structures vulnerable to flooding. Allenport, Stockdale, Coal Center, and Elco Boroughs also have high proportions of structures in the SFHA. All critical facilities in Coal Center, Dunlevy, Houston, Roscoe and Twilight Boroughs are located in the SFHA, but just under half of all municipalities do not have any critical facilities in the floodplain. When looking at structures by property type, shown in Table 4.3.3-7, the majority of vulnerable structures are unsurprisingly residential in nature followed by commercial uses.

Table 4.3.3-9 Community flood vulnerability for Washington County.

MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES IN SFHA	PERCENT OF STRUCTURES IN SFHA	TOTAL CRITICAL FACILITIES IN MUNICIPALITY	TOTAL CRITICAL FACILITIES IN SFHA	PERCENT CRITICAL FACILITIES IN SFHA	TOTAL 2010 POPULATION	2010 POPULATION IN SFHA*	PERCENT POPULATION IN SFHA
Allenport Borough	270	109	40.4%	5	2	40.0%	537	222	41.3%
Amwell Township	1,664	25	1.5%	24	6	25.0%	3,751	104	2.8%
Beallsville Borough	227	1	0.4%	3	0	0.0%	466	41	8.8%
Bentleyville Borough	1,088	13	1.2%	14	0	0.0%	2,581	261	10.1%
Blaine Township	273	6	2.2%	5	1	20.0%	690	46	6.7%
Buffalo Township	869	7	0.8%	14	3	21.4%	2,069	24	1.2%
Burgettstown Borough	668	9	1.3%	4	0	0.0%	1,388	39	2.8%
California Borough	1,789	330	18.4%	23	4	17.4%	6,795	724	10.7%
Canonsburg Borough	4,070	33	0.8%	20	1	5.0%	8,992	144	1.6%
Canton Township	3,726	128	3.4%	25	2	8.0%	8,375	327	3.9%
Carroll Township	2,439	72	3.0%	35	1	2.9%	5,640	168	3.0%
Cecil Township	5,516	36	0.7%	42	1	2.4%	11,271	138	1.2%
Centerville Borough	1,685	155	9.2%	11	0	0.0%	3,263	210	6.4%
Charleroi Borough	2,099	87	4.1%	18	6	33.3%	4,120	100	2.4%
Chartiers Township	3,600	56	1.6%	34	2	5.9%	7,818	239	3.1%
Claysville Borough	337	0	0.0%	3	0	0.0%	829	0	0.0%
Coal Center Borough	85	45	52.9%	1	1	100.0%	139	82	59.0%
Cokeburg Borough	367	0	0.0%	4	0	0.0%	630	0	0.0%
Cross Creek Township	761	15	2.0%	8	2	25.0%	1,556	115	7.4%
Deemston Borough	362	3	0.8%	5	0	0.0%	722	4	0.6%
Donegal Township	1,244	4	0.3%	20	3	15.0%	2,465	0	0.0%
Donora Borough	2,553	0	0.0%	23	0	0.0%	4,781	0	0.0%
Dunlevy Borough	216	79	36.6%	2	2	100.0%	381	119	31.2%
East Bethlehem Township	1,258	112	8.9%	12	4	33.3%	2,354	203	8.6%
East Finley Township	639	4	0.6%	8	0	0.0%	1,392	16	1.1%
East Washington Borough	653	0	0.0%	4	0	0.0%	2,234	0	0.0%

Table 4.3.3-9 Community flood vulnerability for Washington County.

MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES IN SFHA	PERCENT OF STRUCTURES IN SFHA	TOTAL CRITICAL FACILITIES IN MUNICIPALITY	TOTAL CRITICAL FACILITIES IN SFHA	PERCENT CRITICAL FACILITIES IN SFHA	TOTAL 2010 POPULATION	2010 POPULATION IN SFHA*	PERCENT POPULATION IN SFHA
Elco Borough	149	71	47.7%	3	1	33.3%	323	123	38.1%
Ellsworth Borough	460	0	0.0%	4	0	0.0%	1,027	5	0.5%
Fallowfield Township	2,048	17	0.8%	28	1	3.6%	4,321	12	0.3%
Finleyville Borough	212	17	8.0%	4	0	0.0%	461	95	20.6%
Green Hills Borough	8	0	0.0%	2	0	0.0%	29	0	0.0%
Hanover Township	1,231	9	0.7%	22	1	4.5%	2,673	31	1.2%
Hopewell Township	423	4	0.9%	4	0	0.0%	957	36	3.8%
Houston Borough	569	108	19.0%	4	4	100.0%	1,296	185	14.3%
Independence Township	759	10	1.3%	9	0	0.0%	1,557	50	3.2%
Jefferson Township	536	0	0.0%	5	0	0.0%	1,162	21	1.8%
Long Branch Borough	248	0	0.0%	4	0	0.0%	447	0	0.0%
Marianna Borough	266	1	0.4%	1	0	0.0%	494	2	0.4%
McDonald Borough	960	0	0.0%	6	0	0.0%	1,766	0	0.0%
Midway Borough	416	32	7.7%	3	1	33.3%	913	101	11.1%
Monongahela, City of	2,093	187	8.9%	13	6	46.2%	4,300	353	8.2%
Morris Township	477	15	3.1%	5	1	20.0%	1,105	8	0.7%
Mount Pleasant Township	1,676	4	0.2%	25	0	0.0%	3,515	35	1.0%
New Eagle Borough	988	5	0.5%	7	1	14.3%	2,184	9	0.4%
North Bethlehem Township	773	0	0.0%	10	0	0.0%	1,631	5	0.3%
North Charleroi Borough	586	56	9.6%	2	0	0.0%	1,313	49	3.7%
North Franklin Township	1,960	14	0.7%	22	0	0.0%	4,583	42	0.9%
North Strabane Township	6,094	8	0.1%	46	1	2.2%	13,408	38	0.3%
Nottingham Township	1,287	8	0.6%	9	0	0.0%	3,036	29	1.0%
Peters Township	8,286	17	0.2%	50	3	6.0%	21,213	67	0.3%
Robinson Township	903	3	0.3%	12	2	16.7%	1,931	38	2.0%
Roscoe Borough	403	285	70.7%	3	3	100.0%	812	607	74.8%

Table 4.3.3-9 Community flood vulnerability for Washington County.

MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES IN SFHA	PERCENT OF STRUCTURES IN SFHA	TOTAL CRITICAL FACILITIES IN MUNICIPALITY	TOTAL CRITICAL FACILITIES IN SFHA	PERCENT CRITICAL FACILITIES IN SFHA	TOTAL 2010 POPULATION	2010 POPULATION IN SFHA*	PERCENT POPULATION IN SFHA
Smith Township	2,173	29	1.3%	27	0	0.0%	4,476	236	5.3%
Somerset Township	1,308	3	0.2%	20	0	0.0%	2,684	106	3.9%
South Franklin Township	1,458	26	1.8%	12	0	0.0%	3,310	69	2.1%
South Strabane Township	3,934	10	0.3%	43	2	4.7%	9,346	27	0.3%
Speers Borough	606	42	6.9%	7	1	14.3%	1,154	54	4.7%
Stockdale Borough	252	124	49.2%	5	2	40.0%	502	330	65.7%
Twilight Borough	106	11	10.4%	1	1	100.0%	233	16	6.9%
Union Township	2,797	39	1.4%	30	4	13.3%	5,700	121	2.1%
Washington, City of	5,585	142	2.5%	37	1	2.7%	13,663	0	0.0%
West Bethlehem Township	697	47	6.7%	8	1	12.5%	1,460	95	6.5%
West Brownsville Borough	529	98	18.5%	6	2	33.3%	992	142	9.7%
West Finley Township	425	11	2.6%	11	1	9.1%	878	41	4.1%
West Middletown Borough	85	0	0.0%	3	0	0.0%	139	293	33.4%
West Pike Run Township	826	73	8.8%	5	1	20.0%	1587	24	17.3%
TOTAL	**93,050**	**2,855**	**3.1%**	**885**	**82**	**9.3%**	**207,820**	**6,821**	**3.3%**

Table 4.3.3-10 Floodprone structures by generalized type.

MUNICIPALITY	TOTAL STRUCTURES	ANIMAL	COMMERCIAL	EDUCATION	GOVERNMENT	MEDICAL	RECREATION	RELIGIOUS	RESIDENTIAL	TRANSPOR-TATION	UNKNOWN	UTILITY	TOTAL IN SFHA
Allenport Borough	270	0	1	0	0	0	3	0	104	0	0	1	**109**
Amwell Township	1,664	0	3	0	0	0	0	0	18	0	3	1	**25**
Beallsville Borough	227	0	0	0	0	0	0	0	1	0	0	0	**1**
Bentleyville Borough	1,088	0	3	0	0	0	0	0	10	0	0	0	**13**
Blaine Township	273	0	0	0	0	0	1	0	5	0	0	0	**6**
Buffalo Township	869	0	1	0	0	0	0	0	4	0	2	0	**7**
Burgettstown Borough	668	0	5	0	0	0	0	0	4	0	0	0	**9**
California Borough	1,789	0	46	7	0	4	0	1	258	0	14	0	**330**
Canonsburg Borough	4,070	0	25	1	0	1	0	0	5	0	1	0	**33**
Canton Township	3,726	0	21	0	0	0	2	1	103	1	0	0	**128**
Carroll Township	2,439	0	11	0	0	1	0	0	60	0	0	0	**72**
Cecil Township	5,516	1	4	0	0	0	0	0	29	0	2	0	**36**
Centerville Borough	1,685	0	8	0	0	0	3	0	142	0	2	0	**155**
Charleroi Borough	2,099	0	29	0	0	2	5	1	45	1	2	2	**87**
Chartiers Township	3,600	0	7	0	0	0	1	0	47	0	1	0	**56**
Claysville Borough	337	0	0	0	0	0	0	0	0	0	0	0	**0**
Coal Center Borough	85	0	2	0	1	0	0	1	40	0	1	0	**45**
Cokeburg Borough	367	0	0	0	0	0	0	0	0	0	0	0	**0**
Cross Creek Township	761	0	3	0	0	0	1	0	9	0	1	1	**15**
Deemston Borough	362	0	0	0	0	0	0	0	3	0	0	0	**3**
Donegal Township	1,244	0	1	0	0	0	0	0	1	0	1	1	**4**
Donora Borough	2,553	0	0	0	0	0	0	0	0	0	0	0	**0**
Dunlevy Borough	216	0	10	0	1	0	0	0	68	0	0	0	**79**

Table 4.3.3-10 Floodprone structures by generalized type.

MUNICIPALITY	TOTAL STRUCTURES	ANIMAL	COMMERCIAL	EDUCATION	GOVERNMENT	MEDICAL	RECREATION	RELIGIOUS	RESIDENTIAL	TRANSPOR-TATION	UNKNOWN	UTILITY	TOTAL IN SFHA
East Bethlehem Township	1,258	0	38	0	1	1	3	1	63	0	3	2	**112**
East Finley Township	639	0	0	0	0	0	1	0	2	0	1	0	**4**
East Washington Borough	653	0	0	0	0	0	0	0	0	0	0	0	**0**
Elco Borough	149	0	3	0	0	0	3	0	63	0	2	0	**71**
Ellsworth Borough	460	0	0	0	0	0	0	0	0	0	0	0	**0**
Fallowfield Township	2,048	0	1	0	0	0	0	0	16	0	0	0	**17**
Finleyville Borough	212	0	5	0	0	0	0	0	12	0	0	0	**17**
Green Hills Borough	8	0	0	0	0	0	0	0	0	0	0	0	**0**
Hanover Township	1,231	0	0	0	0	0	0	0	9	0	0	0	**9**
Hopewell Township	423	0	0	0	0	0	1	0	3	0	0	0	**4**
Houston Borough	569	0	25	1	1	0	5	0	74	0	2	0	**108**
Independence Township	759	0	2	1	0	0	0	0	7	0	0	0	**10**
Jefferson Township	536	0	0	0	0	0	0	0	0	0	0	0	**0**
Long Branch Borough	248	0	0	0	0	0	0	0	0	0	0	0	**0**
Marianna Borough	266	0	0	0	0	0	0	0	1	0	0	0	**1**
McDonald Borough	960	0	0	0	0	0	0	0	0	0	0	0	**0**
Midway Borough	416	0	0	0	0	0	1	0	31	0	0	0	**32**
Monongahela, City of	2,093	0	66	1	1	5	0	3	107	1	3	0	**187**
Morris Township	477	0	0	0	0	0	0	0	15	0	0	0	**15**
Mount Pleasant Township	1,676	0	0	0	0	0	0	0	3	0	0	1	**4**
New Eagle Borough	988	0	3	0	0	0	0	0	0	0	2	0	**5**
North Bethlehem Township	773	0	0	0	0	0	0	0	0	0	0	0	**0**
North Charleroi Borough	586	0	7	0	0	0	0	0	48	0	1	0	**56**

Table 4.3.3-10 Floodprone structures by generalized type.

MUNICIPALITY	TOTAL STRUCTURES	ANIMAL	COMMERCIAL	EDUCATION	GOVERNMENT	MEDICAL	RECREATION	RELIGIOUS	RESIDENTIAL	TRANSPOR-TATION	UNKNOWN	UTILITY	TOTAL IN SFHA
North Franklin Township	1,960	0	6	0	0	0	0	0	8	0	0	0	**14**
North Strabane Township	6,094	0	2	0	0	0	0	0	2	0	3	1	**8**
Nottingham Township	1,287	0	1	0	0	0	0	0	7	0	0	0	**8**
Peters Township	8,286	0	3	0	0	0	0	0	12	0	2	0	**17**
Robinson Township	903	0	1	0	0	0	0	0	2	0	0	0	**3**
Roscoe Borough	403	0	14	1	1	0	4	4	258	0	2	1	**285**
Smith Township	2,173	0	3	0	0	0	1	1	24	0	0	0	**29**
Somerset Township	1,308	0	1	0	0	0	0	0	2	0	0	0	**3**
South Franklin Township	1,458	0	2	0	0	0	0	0	24	0	0	0	**26**
South Strabane Township	3,934	0	6	0	0	0	1	0	3	0	0	0	**10**
Speers Borough	606	0	15	0	0	2	0	0	21	0	4	0	**42**
Stockdale Borough	252	0	3	0	0	0	1	0	119	0	0	1	**124**
Twilight Borough	106	0	0	0	1	0	0	0	10	0	0	0	**11**
Union Township	2,797	0	6	0	0	0	0	0	33	0	0	0	**39**
Washington, City of	5,585	0	38	0	0	0	4	0	99	0	0	1	**142**
West Bethlehem Township	697	0	10	0	0	0	2	0	33	1	1	0	**47**
West Brownsville Borough	529	0	12	1	0	0	1	2	77	0	5	0	**98**
West Finley Township	425	0	0	0	0	0	1	0	9	0	0	1	**11**
West Middletown Borough	85	0	0	0	0	0	0	0	0	0	0	0	**0**
West Pike Run Township	826	0	2	0	0	0	1	0	69	0	0	1	**73**
TOTAL	**93,050**	**1**	**455**	**13**	**7**	**16**	**46**	**15**	**2,222**	**4**	**61**	**15**	**2,855**

Mobile homes and commercial trailers are also particularly vulnerable to flooding due to their lightweight and unanchored design. As discussed in Section 2.5, Washington County's structures database included a marker for trailer parks, though not for individual trailers. Table 4.3.3-8 shows the number of trailer parks in each municipality along with the number and proportion located in the SFHA. While this indicates the generalized location of trailers, without information about the specific number of trailers in each park, this is a very broad estimation of risk to this type of structure.

Table 4.3.3-11 Mobile homes per jurisdiction (Washington County GIS)

MUNICIPALITY	NUMBER OF TRAILER PARKS IN MUNICIPALITY	NUMBER OF TRAILER PARKS IN SFHA	PERCENT TRAILER PARKS IN SFHA
Allenport Borough	0	0	0.0%
Amwell Township	2	0	0.0%
Beallsville Borough	1	0	0.0%
Bentleyville Borough	3	0	0.0%
Blaine Township	0	0	0.0%
Buffalo Township	1	0	0.0%
Burgettstown Borough	0	0	0.0%
California Borough	0	0	0.0%
Canonsburg Borough	0	0	0.0%
Canton Township	6	0	0.0%
Carroll Township	2	0	0.0%
Cecil Township	0	0	0.0%
Centerville Borough	0	0	0.0%
Charleroi Borough	0	0	0.0%
Chartiers Township	1	0	0.0%
Claysville Borough	0	0	0.0%
Coal Center Borough	0	0	0.0%
Cokeburg Borough	0	0	0.0%
Cross Creek Township	0	0	0.0%
Deemston Borough	0	0	0.0%
Donegal Township	1	0	0.0%
Donora Borough	0	0	0.0%
Dunlevy Borough	2	1	50.0%
East Bethlehem Township	0	0	0.0%

Table 4.3.3-11 Mobile homes per jurisdiction (Washington County GIS)			
MUNICIPALITY	**NUMBER OF TRAILER PARKS IN MUNICIPALITY**	**NUMBER OF TRAILER PARKS IN SFHA**	**PERCENT TRAILER PARKS IN SFHA**
East Finley Township	0	0	0.0%
East Washington Borough	0	0	0.0%
Elco Borough	0	0	0.0%
Ellsworth Borough	0	0	0.0%
Fallowfield Township	2	0	0.0%
Finleyville Borough	0	0	0.0%
Green Hills Borough	0	0	0.0%
Hanover Township	6	0	0.0%
Hopewell Township	0	0	0.0%
Houston Borough	0	0	0.0%
Independence Township	0	0	0.0%
Jefferson Township	0	0	0.0%
Long Branch Borough	0	0	0.0%
Marianna Borough	0	0	0.0%
McDonald Borough	0	0	0.0%
Midway Borough	2	0	0.0%
Monongahela, City of	0	0	0.0%
Morris Township	0	0	0.0%
Mount Pleasant Township	0	0	0.0%
New Eagle Borough	4	0	0.0%
North Bethlehem Township	1	0	0.0%
North Charleroi Borough	0	0	0.0%
North Franklin Township	0	0	0.0%
North Strabane Township	1	0	0.0%
Nottingham Township	1	0	0.0%
Peters Township	0	0	0.0%
Robinson Township	0	0	0.0%
Roscoe Borough	0	0	0.0%
Smith Township	0	0	0.0%
Somerset Township	3	0	0.0%
South Franklin Township	6	0	0.0%

Table 4.3.3-11 Mobile homes per jurisdiction (Washington County GIS)			
MUNICIPALITY	**NUMBER OF TRAILER PARKS IN MUNICIPALITY**	**NUMBER OF TRAILER PARKS IN SFHA**	**PERCENT TRAILER PARKS IN SFHA**
South Strabane Township	0	0	0.0%
Speers Borough	0	0	0.0%
Stockdale Borough	1	1	100.0%
Twilight Borough	0	0	0.0%
Union Township	1	0	0.0%
Washington, City of	1	0	0.0%
West Bethlehem Township	0	0	0.0%
West Brownsville Borough	0	0	0.0%
West Finley Township	0	0	0.0%
West Middletown Borough	0	0	0.0%
West Pike Run Township	0	0	0.0%
TOTAL	**48**	**2**	**4.2%**

Flood events also frequently cause road closures in the County and its municipalities. Affected areas of roadway may vary from a few feet for only a few hours (as in the case of flash flooding) to several hundred feet for a few days (as in the case of riverine flooding). Road closures limit accessibility to certain areas of the County, which in turn delays the provision of emergency services to the residents in those areas. In addition, despite posted signs warning drivers to stay out of floodwaters, inevitably there are individuals who must be rescued from their cars that become stranded in floodwaters.

4.3.4. Landslide

4.3.4.1. Location and Extent

Rockfalls and other slope failures can occur in areas of Washington County with moderate to steep slopes. Many slope failures are associated with precipitation events – periods of sustained above-average precipitation, specific rainstorms, or snowmelt events. Areas experiencing erosion, decline in vegetation cover, and earthquakes are also susceptible to landslides. Human activities that contribute to slope failure include altering the natural slope gradient, increasing soil water content, and removing vegetation cover.

The Department of Conservation and Natural Resources describes landslide incidence in Washington County as high. Figure 4.3.4-1 shows Pennsylvania's areas of low, moderate and combo-high landslide susceptibility as determined by the U.S. Geological Survey. Landslides are a serious risk in the majority of Washington County but are more likely to occur in to the hill and valley areas of Washington County. Areas of steep slopes associated with the banks of

major watercourses in the County could collapse under heavy rainfall to produce a localized landslide; Figure 4.3.4-2 shows the steep slope soils as defined by the Natural Resources Conservation Service (NRCS). Steep slopes are also prevalent along many of the roads in Washington County that were cut into the hillsides.

The USGS studied landslides in Washington County in the late 1970s, including conducting an extensive survey of landslides. The geological study located a large number of landslides that occurred or were occurring in the county. The mapping program delineated approximately 5,900 slides and identified them as active, either pre-historic, or ancient events. Active landslides are defined as those areas characterized scars that indicate present movement. Pre-Historic landslides are those areas presently stable but characterized by such obvious evidence as hummocky ground and slump blocks that indicate past movement. Ancient Landslides are defined as those areas also presently stable but characterized by very subdued evidence indicating movement occurred in the distant past. Although the latter two types of landslide are defined as presently stable, they can be easily reactivated. In addition, the report found that in Washington County, most landslides take place on north-facing slopes with a 20-to-35 percent grade (Pomeroy 1982). The potential of damage to lives or property from this type of natural hazard is significant.

Figure 4.3.4-3 illustrates the north-facing slopes in Washington County as well as the slopes that which are both steep and north-facing, and therefore pose a greater landslide risk.

Table 4.3.4-1 Map of general landslide hazard areas (by incidence and susceptibility) for Pennsylvania (USGS, 2014)

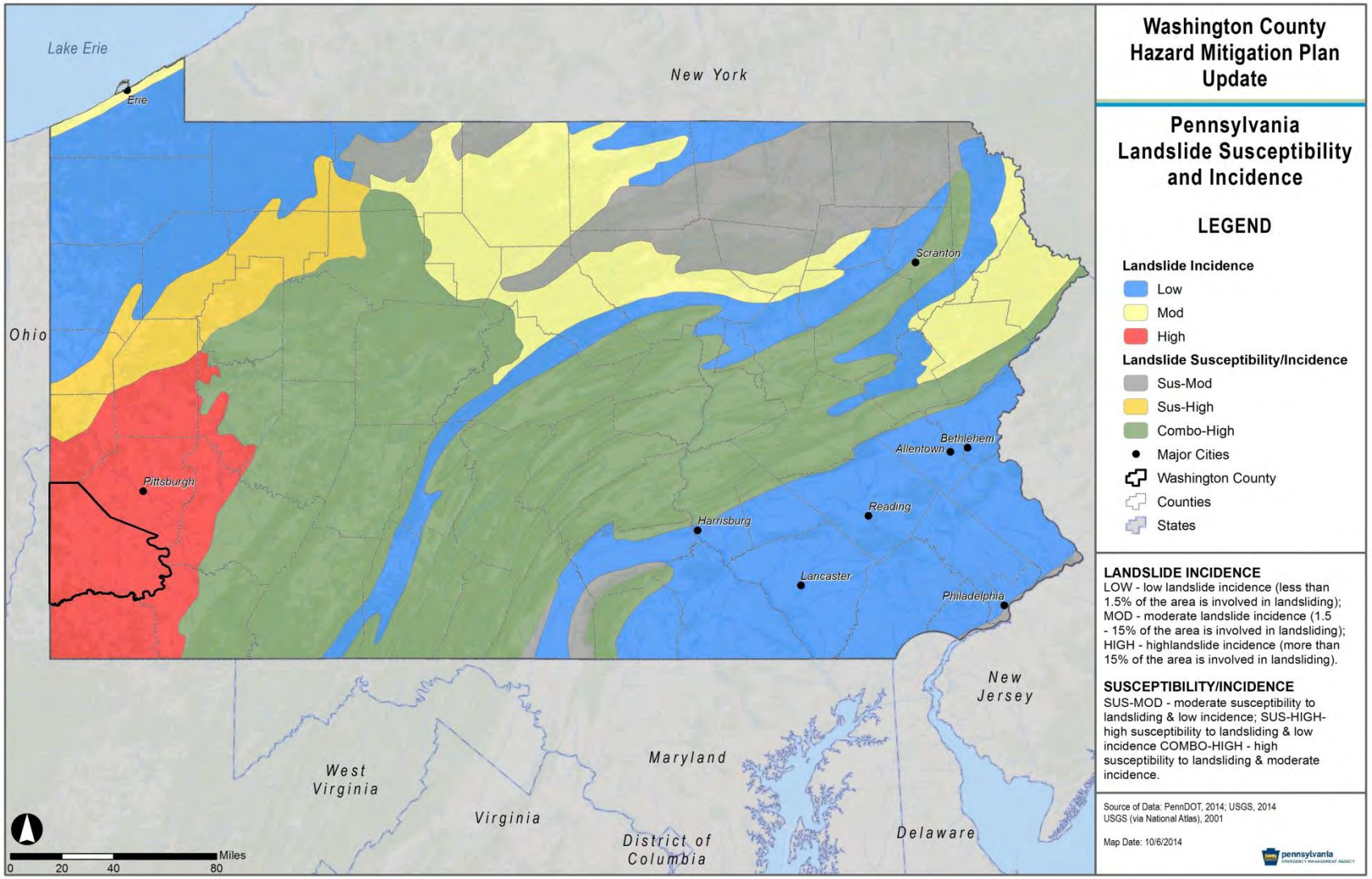


Table 4.3.4-2 Map of steep slopes in Washington County (NRCS, 2014).

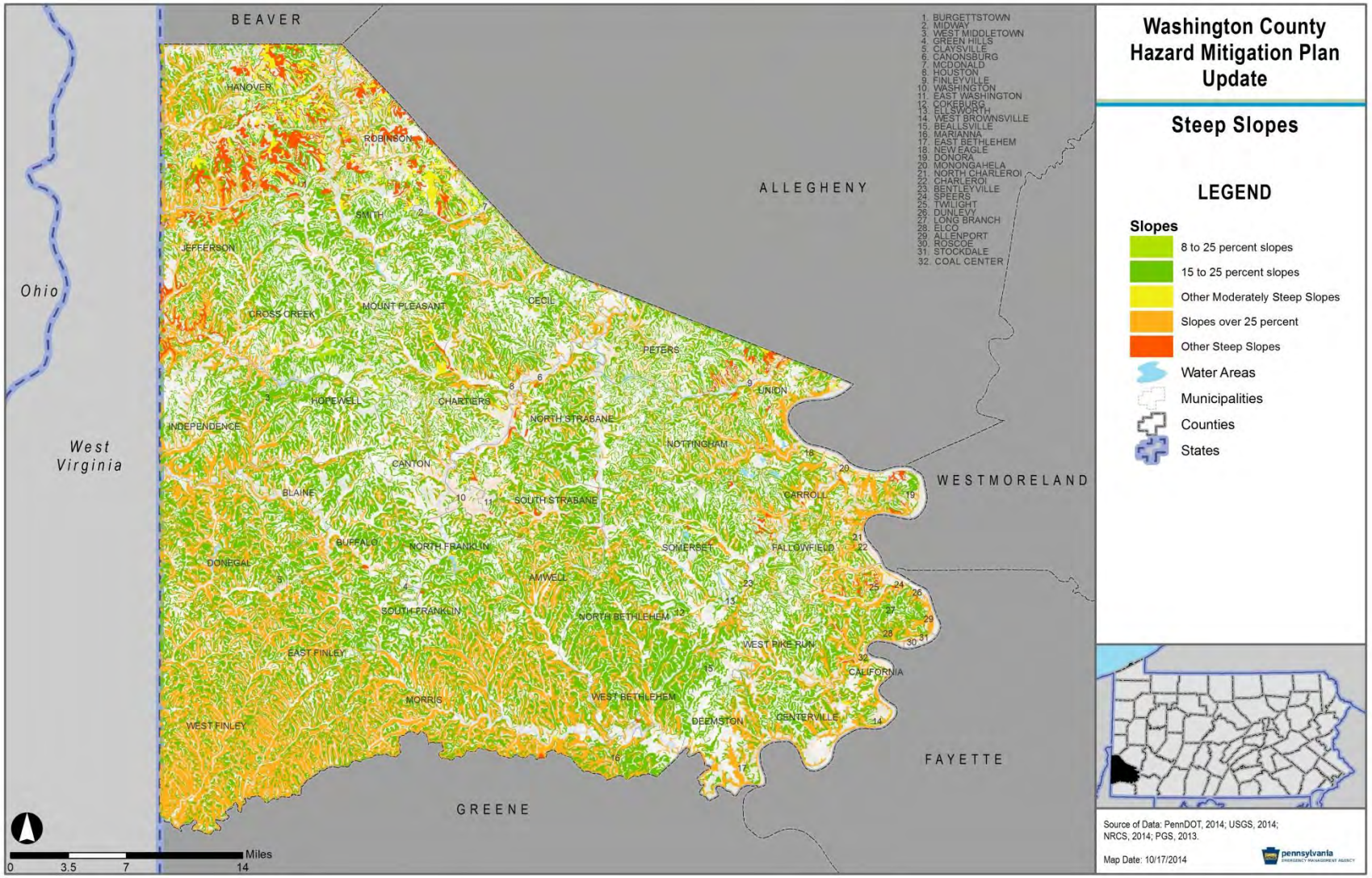
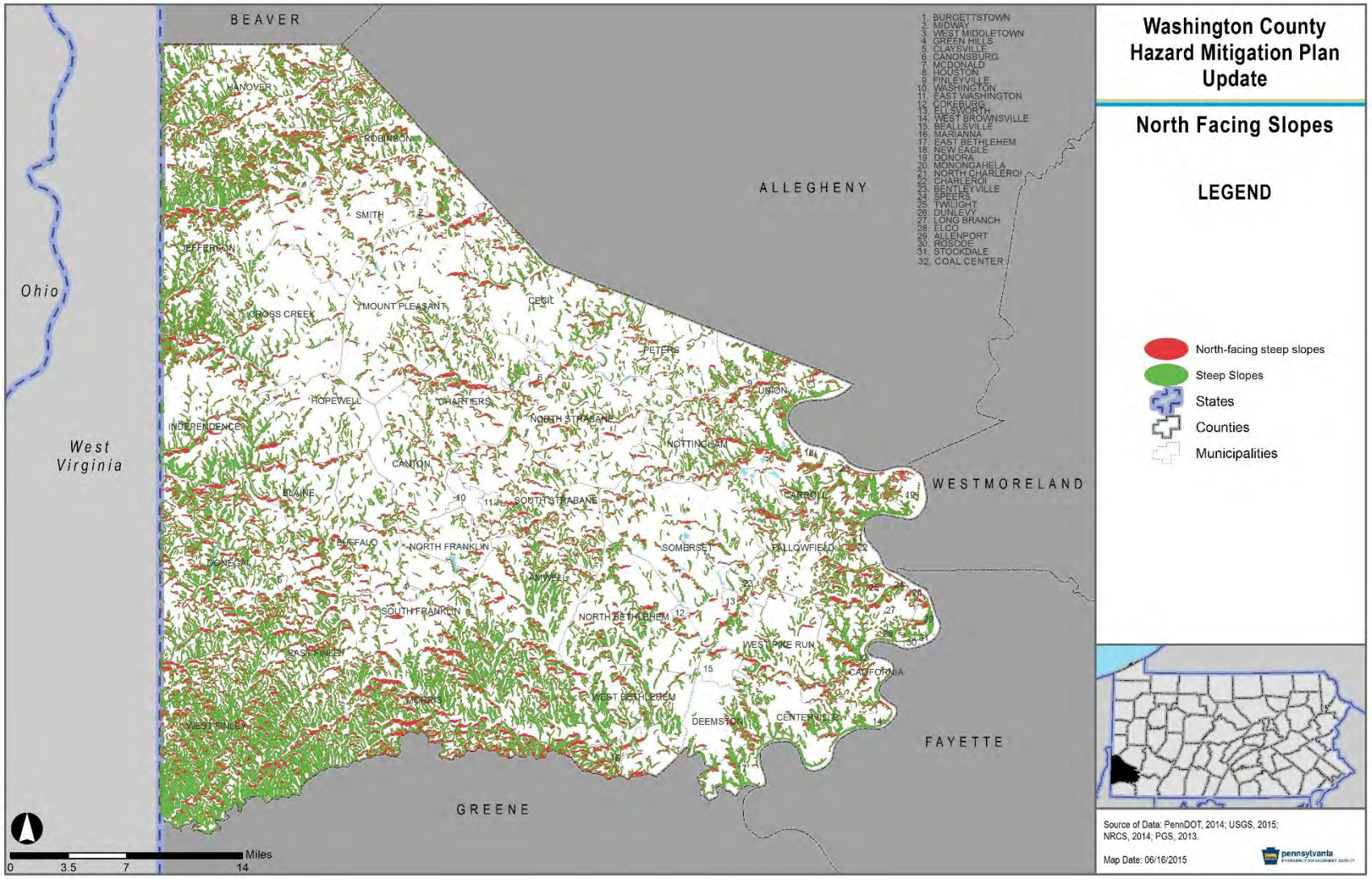


Table 4.3.4-3 Map of north-facing steep slopes in Washington County (NRCS, 2014).



4.3.4.2. 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. 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. In Washington County, landslides may occur because of strip mining. As residential and recreational development increases on and near steep mountain slopes, the hazard from these rapid events will also increase. Most Pennsylvania landslides are moderate to slow moving and damage things rather than people.

The Pennsylvania Department of Transportation and large municipalities incur substantial costs due to landslide damage and to extra construction costs for new roads in known landslide-prone areas. A 1991 estimate showed an average of $10 million per year is spent on landslide repair contracts across the Commonwealth and a similar amount is spent on mitigation costs for grading projects (DCNR, 2014).

The impact of landslides on the environment depends on the size and specific location of the event. In general, impacts include:

- Changes to topography
- Damage or destruction of vegetation
- Potential diversion or blockage of water in the vicinity of streams, rivers, etc…
- Increased sediment runoff both during and after event

Beyond the environmental impacts, landslides can have serious impacts on transportation routes, utilities, and buildings depending on their location. Landslides may decrease property values, and the costs of litigation may be significant to local communities.

The worst set of landslides occurring in Washington County occurred in 2004-2005, when flood-related landslides caused major damage (see Section 4.3.4.3).

4.3.4.3. Past Occurrence

In recent decades, there have been several major landslides. In September 2004, Washington County roads sustained millions of dollars in damage from the associated landslides of Hurricane Ivan passing over the County. Several homes were destroyed and others were at risk. A second, less significant storm in January 2005 exacerbated the damage done by the remnants of Hurricane Ivan in September. However, none of the landslide damage was covered under the Federal Disaster Declaration. A more recent incident occurred in January 2008 along Route 43 in Carroll Township (Grata, 2008). A man-made fill and part of a hillside gave way, putting several homes at the bottom of the slide at risk. This incident appeared to be a flaw in the man-made fill design, and not brought on by heavy rain or snow.

A comprehensive inventory of landslide events across the entire Commonwealth is not available, and the USGS does not maintain a formal inventory of landslides. However, the USGS completed a report on mass movement in southwestern Pennsylvania stating that,

"Reconnaissance studies of the six counties constituting the Greater Pittsburgh area have shown that Washington County is the most susceptible to landslides" (Pomeroy, 1982).

4.3.4.4. Future Occurrence

Based on historical events, landslide events are likely in the County. However, mismanaged intense development in steeply sloped areas could increase their frequency of occurrence. Additionally, periods of intense rain or snowmelt will heighten the risk of landslides. On the whole, the probability of future landslide events can be considered *highly likely* according to the Risk Factor Methodology (see Table 4.4.2-1).

4.3.4.5. Vulnerability Assessment

Future occurrence of landslides in Washington County is definitely possible and certainly also likely. Any events that do occur would take place in steeply sloped areas. In addition, places where landforms have been altered for purposes of highway construction or other development may be uniquely vulnerable to landslide hazards. This is especially true if development is located at the base or crest of cliffs or near large highway cut-outs. These areas should be considered vulnerable to landslides, particularly if mitigation measures have not been implemented.

Table 4.3.4-3 summarizes the number of existing buildings and critical facilities in the County that are located in areas with steep slopes identified by the NRCS and mapped in Figure 4.3.4-2.

Table 4.3.4-4 Structures and critical facilities located in steep slope areas.

MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES IN STEEP SLOPE AREAS	PERCENT OF STRUCTURES IN STEEP SLOPE AREAS	TOTAL CRITICAL FACILITIES IN MUNICIPALITY	TOTAL CRITICAL FACILITIES IN STEEP SLOPE AREAS	PERCENT CRITICAL FACILITIES IN STEEP SLOPE AREAS
Allenport Borough	270	52	19.3%	5	0	0.0%
Amwell Township	1,664	697	41.9%	24	6	25.0%
Beallsville Borough	227	6	2.6%	3	0	0.0%
Bentleyville Borough	1,088	520	47.8%	14	5	35.7%
Blaine Township	273	77	28.2%	5	0	0.0%
Buffalo Township	869	317	36.5%	14	2	14.3%
Burgettstown Borough	668	240	35.9%	4	1	25.0%
California Borough	1,789	409	22.9%	23	2	8.7%
Canonsburg Borough	4,070	1,410	34.6%	20	5	25.0%
Canton Township	3,726	727	19.5%	25	2	8.0%
Carroll Township	2,439	906	37.1%	35	5	14.3%
Cecil Township	5,516	1,476	26.8%	42	6	14.3%
Centerville Borough	1,685	379	22.5%	11	1	9.1%
Charleroi Borough	2,099	538	25.6%	18	0	0.0%
Chartiers Township	3,600	1,010	28.1%	34	4	11.8%

Table 4.3.4-4 Structures and critical facilities located in steep slope areas.

MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES IN STEEP SLOPE AREAS	PERCENT OF STRUCTURES IN STEEP SLOPE AREAS	TOTAL CRITICAL FACILITIES IN MUNICIPALITY	TOTAL CRITICAL FACILITIES IN STEEP SLOPE AREAS	PERCENT CRITICAL FACILITIES IN STEEP SLOPE AREAS
Claysville Borough	337	85	25.2%	3	0	0.0%
Coal Center Borough	85	28	32.9%	1	0	0.0%
Cokeburg Borough	367	278	75.7%	4	1	25.0%
Cross Creek Township	761	230	30.2%	8	2	25.0%
Deemston Borough	362	70	19.3%	5	1	20.0%
Donegal Township	1,244	391	31.4%	20	1	5.0%
Donora Borough	2,553	578	22.6%	23	4	17.4%
Dunlevy Borough	216	78	36.1%	2	0	0.0%
East Bethlehem Township	1,258	215	17.1%	12	3	25.0%
East Finley Township	639	345	54.0%	8	4	50.0%
East Washington Borough	653	48	7.4%	4	0	0.0%
Elco Borough	149	8	5.4%	3	0	0.0%
Ellsworth Borough	460	176	38.3%	4	0	0.0%
Fallowfield Township	2,048	797	38.9%	28	8	28.6%
Finleyville Borough	212	1	0.5%	4	0	0.0%
Green Hills Borough	8	0	0.0%	2	1	50.0%
Hanover Township	1,231	411	33.4%	22	7	31.8%
Hopewell Township	423	130	30.7%	4	2	50.0%
Houston Borough	569	105	18.5%	4	0	0.0%
Independence Township	759	134	17.7%	9	1	11.1%
Jefferson Township	536	156	29.1%	5	1	20.0%
Long Branch Borough	248	145	58.5%	4	0	0.0%
Marianna Borough	266	251	94.4%	1	1	100.0%
McDonald Borough	960	144	15.0%	6	0	0.0%
Midway Borough	416	90	21.6%	3	0	0.0%
Monongahela, City of	2,093	439	21.0%	13	0	0.0%
Morris Township	477	232	48.6%	5	1	20.0%
Mount Pleasant Township	1,676	556	33.2%	25	2	8.0%
New Eagle Borough	988	429	43.4%	7	1	14.3%
North Bethlehem Township	773	288	37.3%	10	3	30.0%
North Charleroi Borough	586	106	18.1%	2	0	0.0%
North Franklin Township	1,960	948	48.4%	22	8	36.4%
North Strabane Township	6,094	2,508	41.2%	46	16	34.8%

Table 4.3.4-4 Structures and critical facilities located in steep slope areas.						
MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES IN STEEP SLOPE AREAS	PERCENT OF STRUCTURES IN STEEP SLOPE AREAS	TOTAL CRITICAL FACILITIES IN MUNICIPALITY	TOTAL CRITICAL FACILITIES IN STEEP SLOPE AREAS	PERCENT CRITICAL FACILITIES IN STEEP SLOPE AREAS
Nottingham Township	1,287	534	41.5%	9	1	11.1%
Peters Township	8,286	3,017	36.4%	50	13	26.0%
Robinson Township	903	300	33.2%	12	2	16.7%
Roscoe Borough	403	0	0.0%	3	0	0.0%
Smith Township	2,173	490	22.5%	27	6	22.2%
Somerset Township	1,308	440	33.6%	20	5	25.0%
South Franklin Township	1,458	602	41.3%	12	4	33.3%
South Strabane Township	3,934	1,641	41.7%	43	8	18.6%
Speers Borough	606	81	13.4%	7	2	28.6%
Stockdale Borough	252	0	0.0%	5	0	0.0%
Twilight Borough	106	39	36.8%	1	0	0.0%
Union Township	2,797	1,160	41.5%	30	4	13.3%
Washington, City of	5,585	750	13.4%	37	4	10.8%
West Bethlehem Township	697	230	33.0%	8	1	12.5%
West Brownsville Borough	529	113	21.4%	6	2	33.3%
West Finley Township	425	187	44.0%	11	4	36.4%
West Middletown Borough	85	32	37.6%	3	0	0.0%
West Pike Run Township	826	300	36.3%	5	2	40.0%
TOTAL	**93,050**	**29,080**	**31.3%**	**885**	**165**	**18.6%**

Table 4.3.4-4 shows the number of structures in each municipality located in areas susceptible to landslide by land use type. The land use type displaying the greatest vulnerability to landslide hazards is residential.

Table 4.3.4-5 Structures in steep slope areas areas by generalized type.

MUNICIPALITY	TOTAL STRUCTURES	ANIMAL	COMMERCIAL	EDUCATION	GOVERNMENT	MEDICAL	RECREATION	RELIGIOUS	RESIDENTIAL	TRANSPOR-TATION	UNKNOWN	UTILITY	TOTAL IN HAZARD AREA
Allenport Borough	270	0	0	0	0	0	0	0	49	0	0	3	**52**
Amwell Township	1,664	0	14	1	0	0	0	1	664	1	7	9	**697**
Beallsville Borough	227	0	0	0	0	0	0	0	6	0	0	0	**6**
Bentleyville Borough	1,088	0	16	2	0	0	3	2	490	0	7	0	**520**
Blaine Township	273	0	0	0	0	0	0	0	76	0	0	1	**77**
Buffalo Township	869	0	8	0	0	0	0	1	301	0	4	3	**317**
Burgettstown Borough	668	0	12	2	0	0	2	0	223	0	0	1	**240**
California Borough	1,789	0	14	3	0	1	0	1	383	0	4	1	**409**
Canonsburg Borough	4,070	0	22	1	0	1	2	1	1,381	0	2	0	**1,410**
Canton Township	3,726	0	14	0	0	0	3	4	704	1	1	0	**727**
Carroll Township	2,439	0	25	1	0	2	1	0	870	0	5	2	**906**
Cecil Township	5,516	0	42	0	0	1	1	4	1,402	0	22	3	**1,476**
Centerville Borough	1,685	0	11	0	0	1	4	0	359	0	3	1	**379**
Charleroi Borough	2,099	0	2	0	0	0	5	3	528	0	0	0	**538**
Chartiers Township	3,600	0	18	0	0	0	2	0	975	0	3	12	**1,010**
Claysville Borough	337	0	2	1	0	0	0	0	81	0	1	0	**85**
Coal Center Borough	85	0	0	0	0	0	0	0	28	0	0	0	**28**
Cokeburg Borough	367	0	4	0	1	0	1	1	269	0	1	1	**278**
Cross Creek Township	761	0	8	2	0	0	1	1	209	0	2	7	**230**
Deemston Borough	362	0	2	0	0	0	0	1	62	0	1	4	**70**
Donegal Township	1,244	0	16	0	0	0	3	2	351	0	13	3	**391**
Donora Borough	2,553	0	3	2	1	0	4	2	565	0	1	0	**578**
Dunlevy Borough	216	0	3	0	0	0	0	0	75	0	0	0	**78**

Table 4.3.4-5 Structures in steep slope areas areas by generalized type.

MUNICIPALITY	TOTAL STRUCTURES	ANIMAL	COMMERCIAL	EDUCATION	GOVERNMENT	MEDICAL	RECREATION	RELIGIOUS	RESIDENTIAL	TRANSPOR-TATION	UNKNOWN	UTILITY	TOTAL IN HAZARD AREA
East Bethlehem Township	1,258	0	12	4	0	0	2	4	191	0	2	0	**215**
East Finley Township	639	0	8	0	1	0	0	0	326	0	8	2	**345**
East Washington Borough	653	0	0	0	0	0	0	0	48	0	0	0	**48**
Elco Borough	149	0	0	0	0	0	0	0	7	0	1	0	**8**
Ellsworth Borough	460	0	2	0	0	0	2	0	171	0	1	0	**176**
Fallowfield Township	2,048	0	21	1	0	0	0	1	764	0	8	2	**797**
Finleyville Borough	212	0	0	0	0	0	0	0	1	0	0	0	**1**
Green Hills Borough	8	0	0	0	0	0	0	0	0	0	0	0	**0**
Hanover Township	1,231	0	15	0	0	0	1	1	386	0	7	1	**411**
Hopewell Township	423	0	4	0	1	0	0	1	122	0	0	2	**130**
Houston Borough	569	0	1	0	0	0	0	0	103	0	1	0	**105**
Independence Township	759	0	3	0	0	0	0	0	125	0	3	3	**134**
Jefferson Township	536	0	1	0	1	0	1	0	150	0	3	0	**156**
Long Branch Borough	248	0	5	1	0	0	1	0	138	0	0	0	**145**
Marianna Borough	266	0	2	0	1	0	0	2	246	0	0	0	**251**
McDonald Borough	960	0	5	0	0	0	1	0	138	0	0	0	**144**
Midway Borough	416	0	2	0	0	0	0	0	88	0	0	0	**90**
Monongahela, City of	2,093	0	5	0	0	0	0	4	429	0	0	1	**439**
Morris Township	477	0	4	0	1	0	1	0	220	0	0	6	**232**
Mount Pleasant Township	1,676	0	23	1	0	0	1	0	482	0	18	31	**556**
New Eagle Borough	988	0	6	0	0	0	0	1	422	0	0	0	**429**
North Bethlehem Township	773	0	8	0	0	0	0	0	272	0	4	4	**288**
North Charleroi Borough	586	0	0	0	0	0	1	0	105	0	0	0	**106**

Table 4.3.4-5 Structures in steep slope areas areas by generalized type.

MUNICIPALITY	TOTAL STRUCTURES	ANIMAL	COMMERCIAL	EDUCATION	GOVERNMENT	MEDICAL	RECREATION	RELIGIOUS	RESIDENTIAL	TRANSPOR-TATION	UNKNOWN	UTILITY	TOTAL IN HAZARD AREA
North Franklin Township	1,960	0	8	3	1	13	2	2	918	1	0	0	**948**
North Strabane Township	6,094	0	109	1	1	6	0	1	2,348	0	40	2	**2,508**
Nottingham Township	1,287	0	4	0	0	0	1	0	517	0	11	1	**534**
Peters Township	8,286	0	58	2	0	1	0	4	2,892	0	59	0	**3,017**
Robinson Township	903	0	11	0	0	0	2	0	280	0	3	4	**300**
Roscoe Borough	403	0	0	0	0	0	0	0	0	0	0	0	**0**
Smith Township	2,173	0	15	1	0	0	2	0	462	0	4	5	**490**
Somerset Township	1,308	0	22	1	0	0	0	0	412	0	1	4	**440**
South Franklin Township	1,458	0	23	1	1	0	2	1	568	0	5	1	**602**
South Strabane Township	3,934	0	55	0	0	4	1	1	1,529	0	49	2	**1,641**
Speers Borough	606	0	4	0	1	0	0	0	76	0	0	0	**81**
Stockdale Borough	252	0	0	0	0	0	0	0	0	0	0	0	**0**
Twilight Borough	106	0	2	0	0	0	0	0	35	0	0	2	**39**
Union Township	2,797	0	19	0	0	0	1	0	1,136	0	4	0	**1,160**
Washington, City of	5,585	0	27	0	0	0	4	3	713	1	2	0	**750**
West Bethlehem Township	697	0	10	1	0	0	2	0	215	0	1	1	**230**
West Brownsville Borough	529	0	1	0	1	0	0	0	110	0	1	0	**113**
West Finley Township	425	0	11	0	0	0	0	0	168	0	5	3	**187**
West Middletown Borough	85	0	2	1	0	0	1	0	28	0	0	0	**32**
West Pike Run Township	826	0	13	0	0	1	0	0	281	0	1	4	**300**
TOTAL	**93,050**	**0**	**757**	**33**	**12**	**31**	**61**	**50**	**27,673**	**4**	**319**	**132**	**29,080**

4.3.5. Radon Exposure

4.3.5.1. Location and Extent

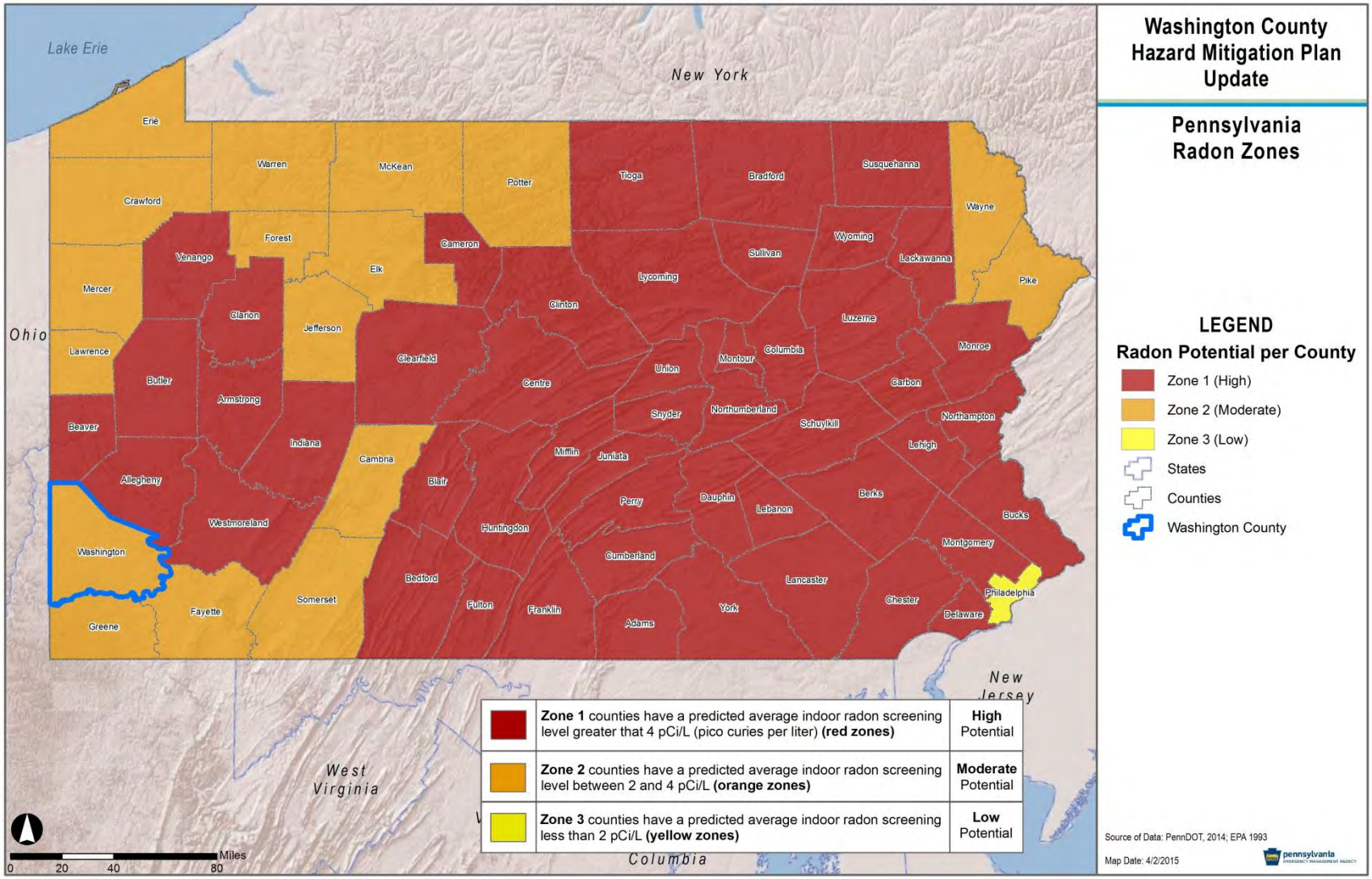
Radioactivity caused by airborne radon has been recognized for many years as an important component in the natural background radioactivity exposure of humans, but it was not until the 1980s that the wide geographic distribution of elevated values in houses and the possibility of extremely high radon values in houses were recognized. In 1984, routine monitoring of employees leaving the Limerick nuclear power plant near Reading, PA while it was still under construction and not yet functional, showed that readings on a construction worker at the plant frequently exceeded expected radiation levels. However, only natural, nonfission-product radioactivity was detected on him.

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

Radon is a gas that cannot be seen or smelled. It is a noble gas that originates by the natural radioactive decay of uranium and thorium. Like other noble gases (e.g., helium, neon, and argon), radon forms essentially no chemical compounds and tends to exist as a gas or as a dissolved atomic constituent in groundwater. Two isotopes of radon are significant in nature, 222Rn and 220Rn, formed in the radioactive decay series of 238U and 232Th, respectively. The isotope thoron (i.e. 220Rn) has a half-life (time for decay of half of a given group of atoms) of 55 seconds, barely long enough for it to migrate from its source to the air inside a house and pose a health risk. However, radon (i.e. 222Rn), 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. 226Ra), 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.

Each county in Pennsylvania is classified as having a *low*, *moderate*, or *high* radon hazard potential. Washington County is classified as having a moderate hazard, meaning there is a predicted indoor radon level between 2 and 4 pCi/L (see Figure 4.3.5-1).

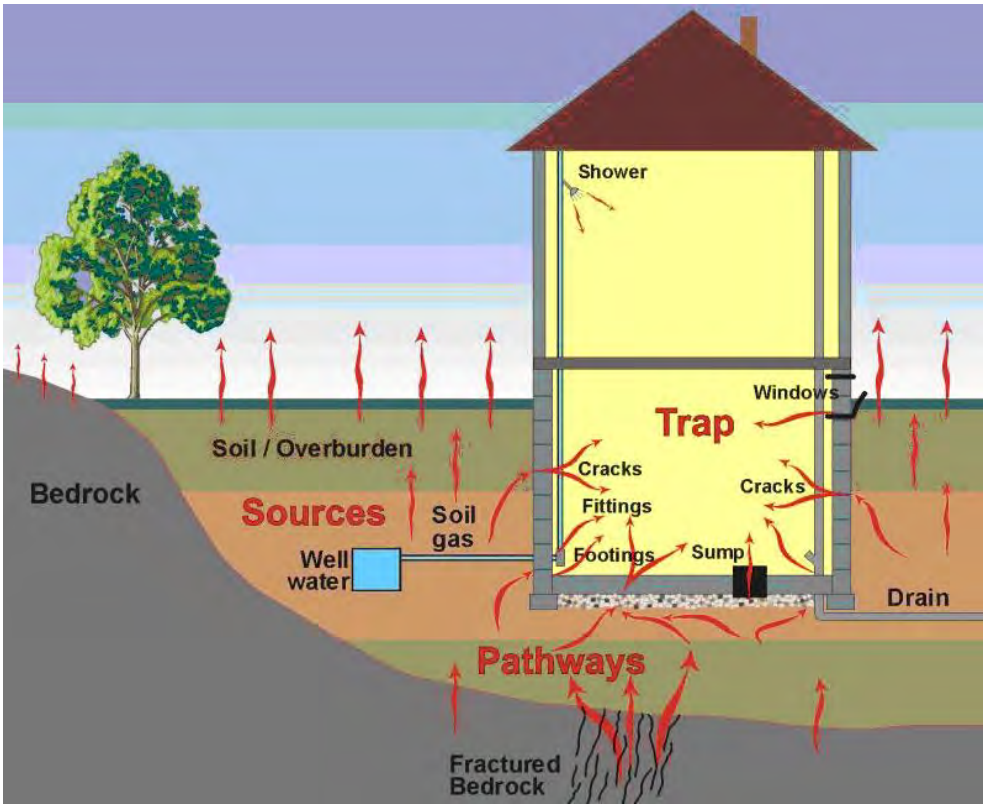
Figure 4.3.5-1 Radon Hazard Zones in Pennsylvania (USEPA, 1993)



Three sources of radon in houses are now recognized (shown in Figure 4.3.5-2):

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

Figure 4.3.5-2 Sketch of radon entry points into a house (Arizona Geological Survey, 2006).



High radon levels were initially thought to be exacerbated in houses that are tightly sealed, but it is now recognized that rates of air flow into and out of houses, plus the location of air inflow and the radon content of air in the surrounding soil, are key factors in radon concentrations. Outflows of air from a house, caused by a furnace, fan, thermal “chimney” effect, or wind effects, require that air be drawn into the house to compensate. If the upper part of the house is tight enough to impede influx of outdoor air (radon concentration generally <0.1 pCi/L), then an appreciable fraction of the air may be drawn in from the soil or fractured bedrock through the foundation and slab beneath the house, or through cracks and openings for pipes, sumps, and similar features (see Figure 4.3.4-2). Soil gas typically contains from a few hundred to a few thousand pCi/L of radon; therefore, even a small rate of soil gas inflow can lead to elevated radon concentrations in a house.

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

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

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

It is possible that the second factor listed above is the cause of radon levels in Washington County, although multiple explanations must be considered. Twenty six areas of Washington County have given high radon level test results. The test results are shown in more detail in Table 4.3.5-2.

4.3.5.2. Range of Magnitude

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

Table 4.3.5-1 Radon risk for smokers and non-smokers (EPA, March 2010).

RADON LEVEL (cCi/L)	IF 1,000 PEOPLE WERE EXPOSED TO THIS LEVEL OVER A LIFETIME…*	RISK OF CANCER FROM RADON EXPOSURE COMPARES TO…**	ACTION THRESHOLD
SMOKERS			
20	About 260 people could get lung cancer	250 times the risk of drowning	Fix Structure
10	About 150 people could get lung cancer	200 times the risk of dying in a home fire	
8	About 120 people could get lung cancer	30 times the risk of dying in a fall	
4	About 62 people could get lung cancer	5 times the risk of dying in a car crash	
2	About 32 people could get lung cancer	6 times the risk of dying from poison	Consider fixing structure between 2 and 4 pCi/L
1.3	About 20 people could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2pCi/L is difficult
0.4	About 3 people could get lung cancer	(Average outdoor radon level)	
NON-SMOKERS			
20	About 36 people could get lung cancer	35 times the risk of drowning	Fix Structure
10	About 18 people could get lung cancer	20 times the risk of dying in a home fire	
8	About 15 people could get lung cancer	4 times the risk of dying in a fall	
4	About 7 people could get lung cancer	The risk of dying in a car crash	
2	About 4 people could get lung cancer	The risk of dying from poison	Consider fixing structure between 2 and 4 pCi/L
1.3	About 2 people could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2pCi/L is difficult
0.4	-	(Average outdoor radon level)	

NOTE: Risk may be lower for former smokers.
** Lifetime risk of lung cancer deaths from EPA Assessment of Risks from Radon in Homes (EPA 402-R-03-003).*
*** Comparison data calculated using the Centers for Disease Control and Prevention's 1999-2001 National Center for Injury Prevention and Control Reports.*

According to the EPA, the average radon concentration in the indoor air of homes nationwide is about 1.3 pCi/L. The EPA recommends homes be fixed if the radon level is 4 pCi/L or more. However, because there is no known safe level of exposure to radon, the EPA also recommends that Americans consider fixing their home for radon levels between 2 pCi/L and 4 pCi/L. Table 4.3.4-1 shows the relationship between various radon levels, probability of lung cancer, comparable risks from other hazards, and action thresholds. As is shown in Table 4.3.4-1, 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.

4.3.5.3. Past Occurrence

Current data on abundance and distribution of radon as it affects individual houses in the state of Pennsylvania in general is considered incomplete and potentially biased. This is also true of counties such as Washington. The EPA has estimated that the national average indoor radon concentration is 1.3 pCi/L and the level for action is 4.0 pCi/L; however they have estimated that the average indoor concentration in Pennsylvania basements is about 7.1 pCi/L and 3.6 pCi/L on the first floor (PADEP, 2011).

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

In Washington County, 26 zip codes had sufficient tests reported to the Bureau to list their findings, which are shown in Table 4.3.5-2. This table does not include the 42 ZIP codes for which insufficient data was collected. The spatial distribution of this data across all ZIP codes is illustrated in Figures 4.3.5-3 and 4.3.5-4.

Table 4.3.5-2 Radon level tests and results in Washington County zip codes (PADEP, 2015).

ZIP CODE	MUNICIPALITY	LOCATION OF TEST	NUMBER OF TESTS	MAXIMUM RESULT (pCi/L)	AVERAGE RESULT (pCi/L)
15317	Canonsburg	Basement	3673	117.5	4.1
15301	Washington	Basement	1681	505	5.6
15367	Venetia	Basement	1044	91.8	4.3
15057	McDonald	Basement	561	94.3	4.4
15063	Monongahela	Basement	382	76	5

Table 4.3.5-2 Radon level tests and results in Washington County zip codes (PADEP, 2015).

ZIP CODE	MUNICIPALITY	LOCATION OF TEST	NUMBER OF TESTS	MAXIMUM RESULT (pCi/L)	AVERAGE RESULT (pCi/L)
15317	Canonsburg	First floor	321	50.2	2.9
15332	Finleyville	Basement	295	45.8	5.1
15022	Charleroi	Basement	281	114.7	5
15330	Eighty Four	Basement	268	63	5.9
15342	Houston	Basement	168	69.7	4.8
15055	Lawrence	Basement	165	27.3	3.1
15021	Burgettstown	Basement	147	127.1	7.7
15321	Cecil	Basement	114	31.1	4.6
15301	Washington	First floor	102	81.9	4.5
15312	Avella	Basement	72	21.3	5
15323	Claysville	Basement	72	79.5	7.1
15367	Venetia	First Floor	68	16.7	2.6
15067	New Eagle	Basement	65	64.3	4.9
15419	California	Basement	57	10.7	3.2
15033	Donora	Basement	50	36.5	5.4
15360	Scenery Hill	Basement	50	33.8	8
15314	Bentleyville	Basement	49	101.8	12
15340	Hickory	Basement	48	72.1	7
15363	Strabane	Basement	41	107.3	8.5
15423	Coal Center	Basement	33	10.9	3.4
15311	Amity	Basement	32	9.1	3.5

Figure 4.3.5-3 Pennsylvania Average Basement Radon Test Results from 1990-2010 (PADEP, 2013)

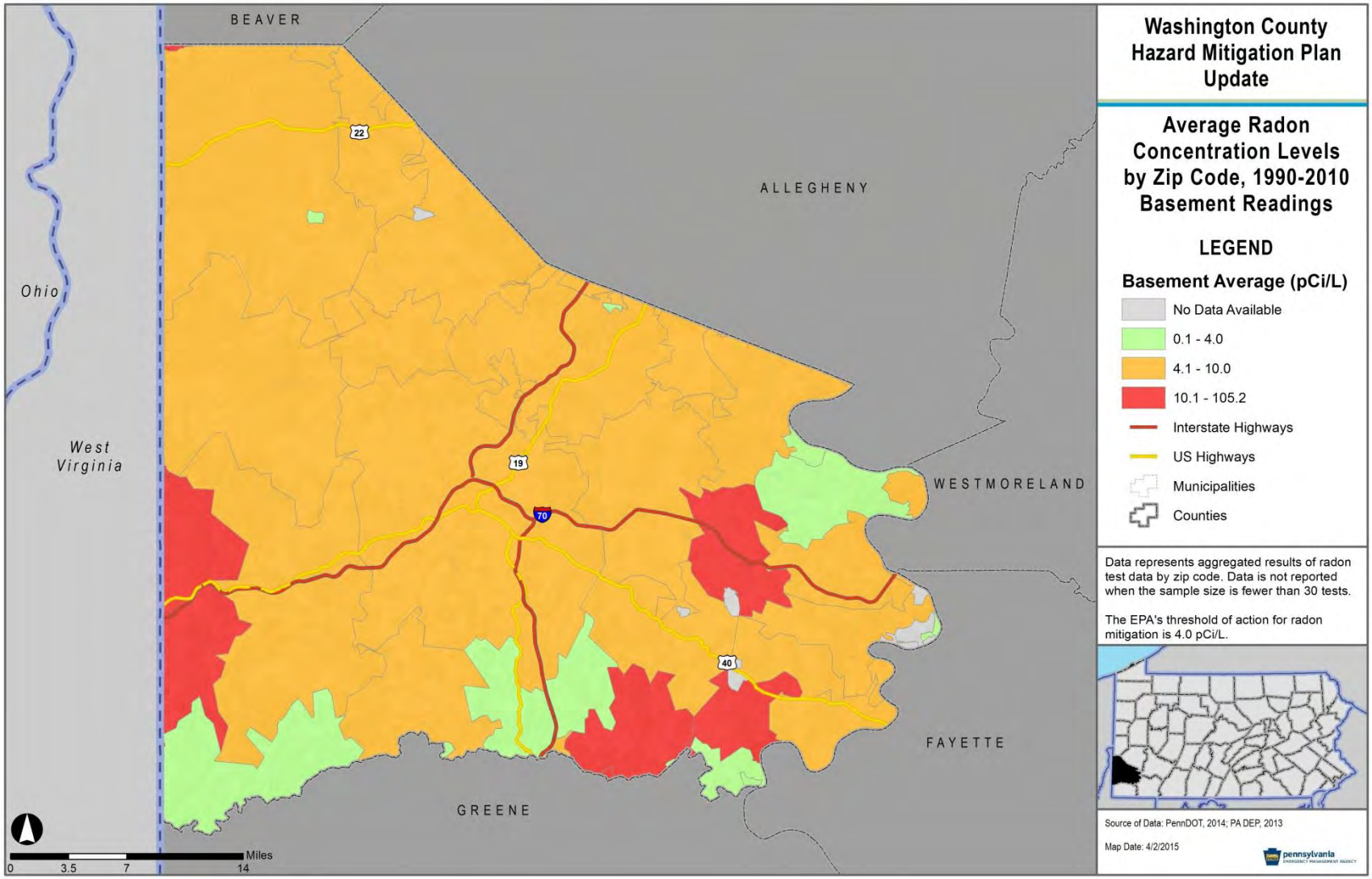
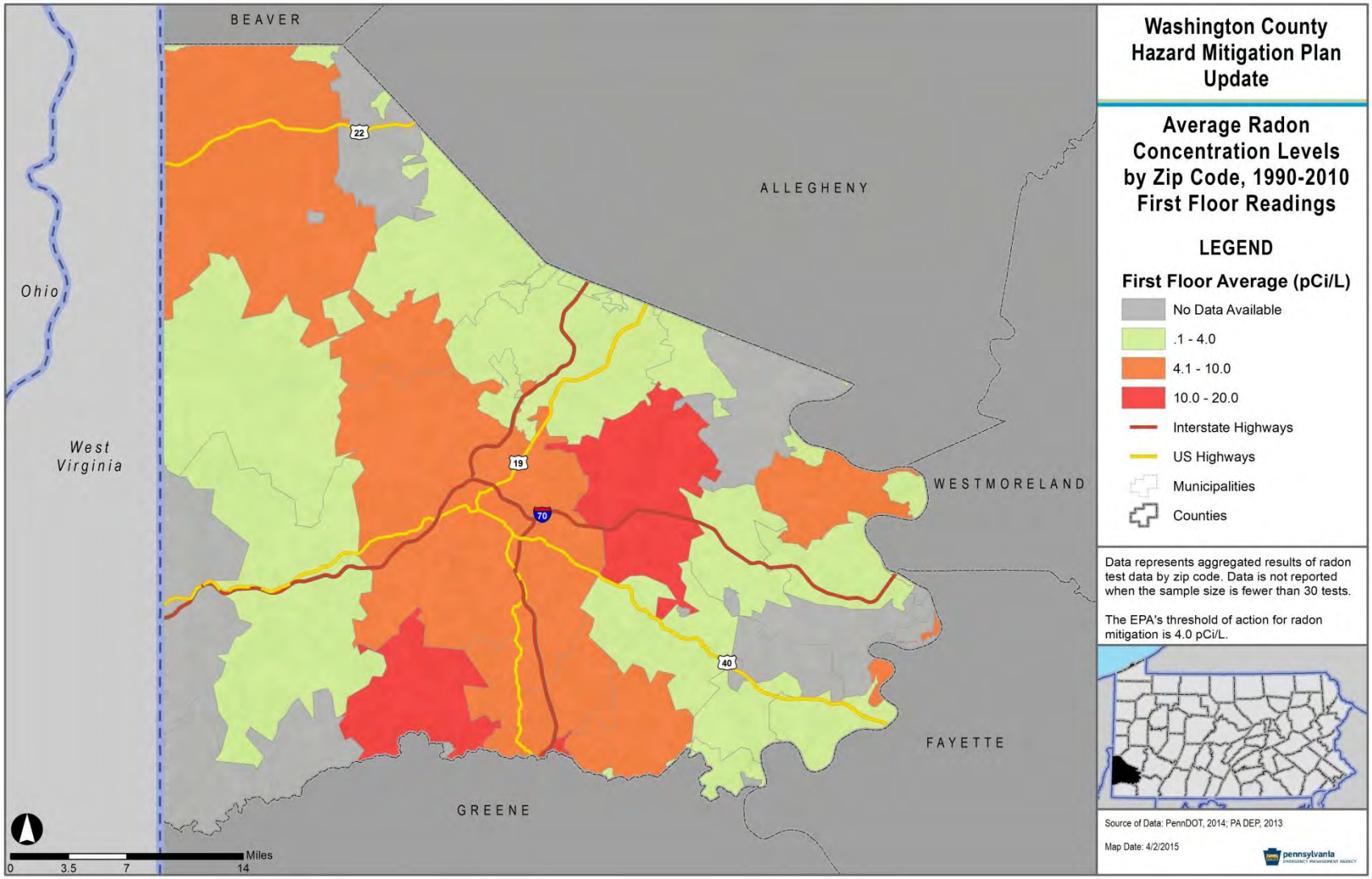


Figure 4.3.5-4 Pennsylvania Average First Floor Radon Test Results from 1990-2010 (PADEP, 2013)



4.3.5.4. Future Occurrence

Radon exposure retains a significant probability given present soil, geologic, and geomorphic factors in Washington County. Future occurrence of high radon level hazards can be considered *possible* as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1).

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

4.3.5.5. Vulnerability Assessment

Houses in Washington County, particularly in high vulnerability areas as shown in Figures 4.3.5-3 and 4.3.5-4, could be susceptible to moderate levels of radon. Smokers can be up to ten times more vulnerable to lung cancer from high levels of radon depending on the level of radon they are exposed to (see Table 4.3.5-1). Older houses that have crawl spaces or unfinished basements are more vulnerable as well because of the increased exposure to soils which could be releasing higher levels of radon gas. Additionally, houses that rely on wells for their water may face an additional risk, although this type of exposure is low and rare in Pennsylvania.

Proper testing for radon levels should be completed across Washington County, especially in the areas of higher incidence levels and for vulnerable populations that face the contributing risks described above. This testing will determine the level of vulnerability that residents face in their homes, as well as in their businesses and schools. The Pennsylvania Department of Environmental Protection Bureau of Radiation Protection provides short and long term tests to determine radon levels as well as information on how to mitigate high levels of radon in a building. According to the EPA, repairs to protect against radon can cost on average the same as routine house repairs (EPA, October 2010). As seen in Figures 4.3.5-3 and 4.3.5-4, areas with the highest reported tests were primarily located in the southern portions of the County, while much of the northern portion of the county has moderate basement radon levels. However, first floor radon levels were highest throughout the south-central portion of the County.

4.3.6. Subsidence, Sinkhole

4.3.6.1. Location and Extent

Subsidence in Washington County may be natural or mine-related. Natural subsidence occurs when water passing through naturally occurring fractures and bedding planes dissolves the bedrock, leaving voids below the surface (DCNR, 2009). Eventually, overburden on top of the voids collapses, leaving surface depressions resulting in karst topography. Characteristic structures associated with karst topography include sinkholes, linear depressions, and caves. Often, sub-surface solution of limestone will not result in the immediate formation of karst features. Collapse sometimes occurs only after a large amount of activity, or when a heavy burden is placed on the overlying material. Abrupt or long-term changes in the ground surface may also occur following sub-surface fluid extraction (e.g. water). Figure 4.3.5-1 shows that a

large portion of Washington County lies in an area of Pennsylvania where limestone/dolomite bedrock is present near ground surface, thus making those areas more susceptible to natural sinkhole development.

Mine-related subsidence can occur in areas of Pennsylvania underlain with coal or other minerals that use deep mining techniques, making these areas more susceptible to subsidence. Figure 4.3.5-1 also displays the large areas of Washington County with subsurface coal mines. Coal mining started in Washington County in the 18th century, before extensive records and environmental assessment was required from the industry. In addition to these numerous, abandoned mines from generations past, there are current, active mining operations in Washington County today which contribute to coal mining being a top industry. Since the opening of the first recorded coal mine in 1781 to the present, Washington County has produced over a billion tons of coal. It still has an estimated eight billion tons in reserve. There are a total of 253 coal mining operations within Washington County. Of these 253 mining operations, 168 are active. Most of these operations are both surface and underground mines, and predominately located in Robinson, Smith, and Somerset Townships. See Table 4.3.5-1 for the full breakdown of mining operations by municipality, status, and type. Figure 4.3.5-2 shows these two types of mining operations based on their activity status. Though there are other types of mining operations, only the surface and underground operations are shown as they are the ones most likely to impact subsidence and sinkhole risk.

Other human activities can accelerate the creation of subsidence or sinkhole events. 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. Poorly managed stormwater may be an exacerbating factor in subsidence events. In some cases, construction, land grading or earthmoving activities that cause changes in stormwater flow can trigger sinkhole events. However, the most substantial human activity within Washington County that puts the county at risk for subsidence and sinkholes is coal mining.

Figure 4.3.6-1 Map showing areas of Washington County subject to both natural and mining-related subsidence.

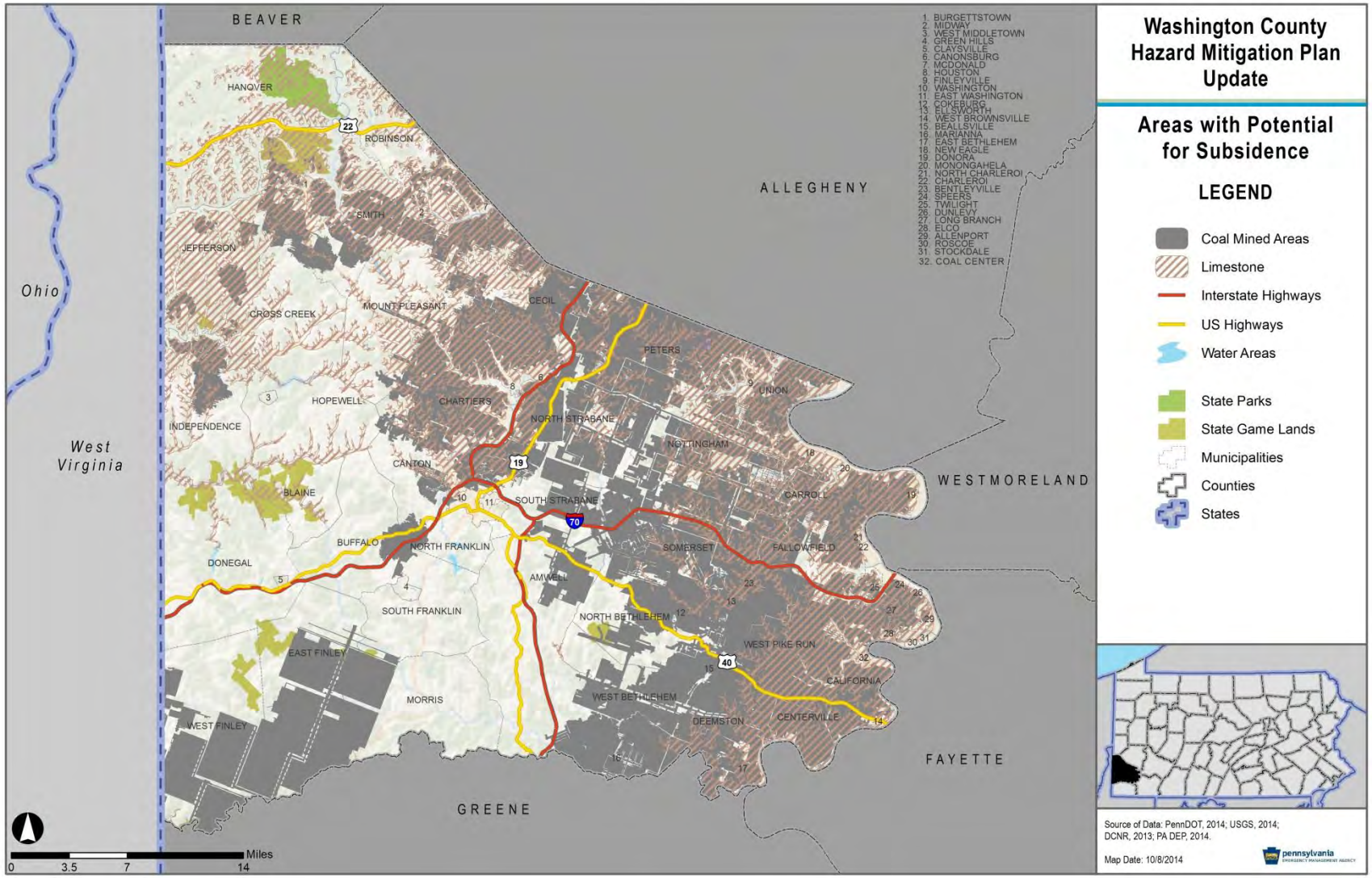


Figure 4.3.6-2 Map showing underground and surface mining locations in Washington County.

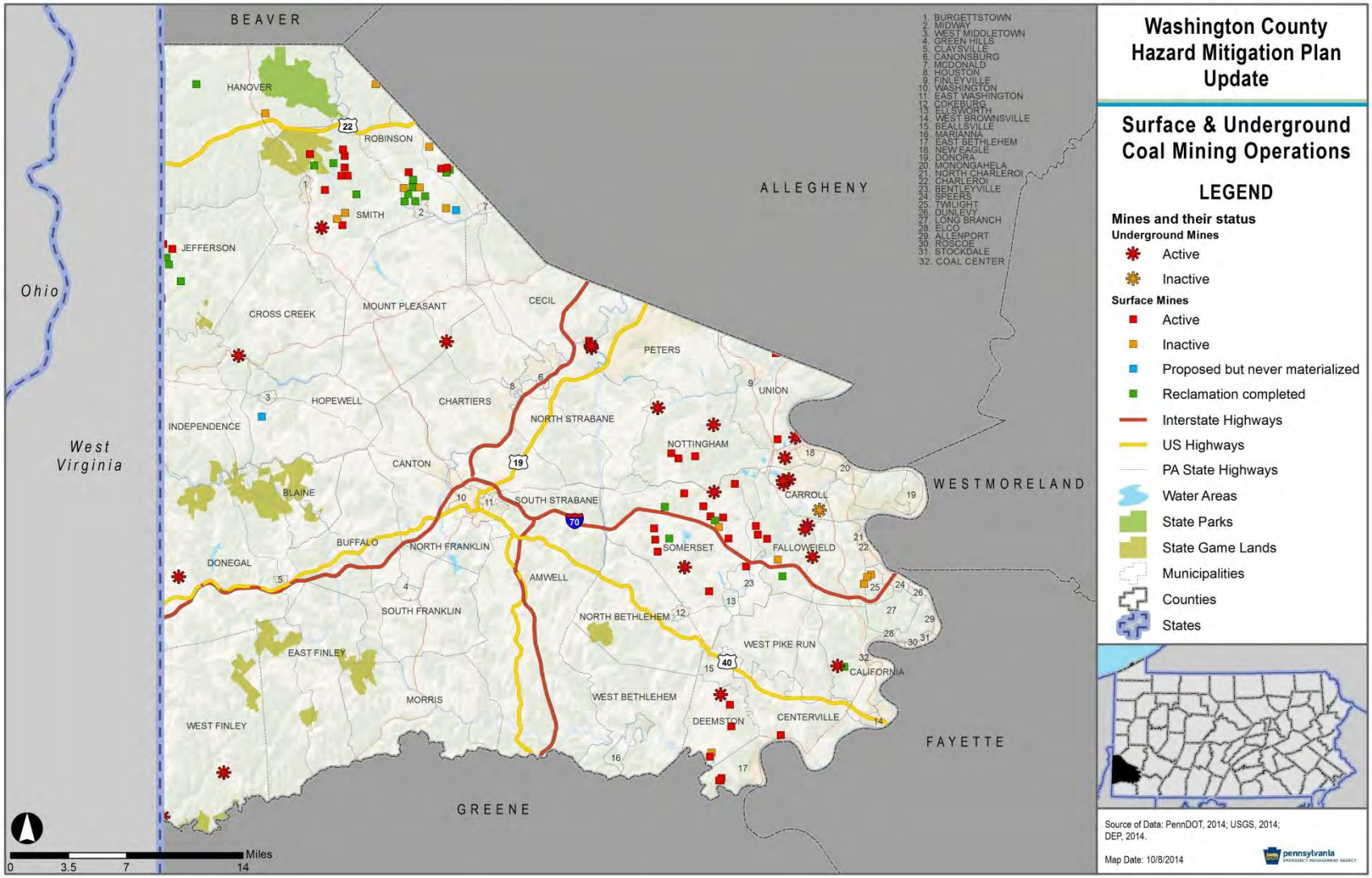


Table 4.3.6-1 Coal Mining Operations in Washington County as of July 2014.

	BY TYPE								BY STATUS					
MUNICIPALITY	SURFACE	UNDERGROUND	REFUSE DISPOSAL	POST MINING IW DISCHARGE	REFUSE REPROCESSING	GFCC	PREP PLANT	STORAGE & HANDLINGING	ACTIVE	INACTIVE	ABANDONED	PROPOSED BUT NEVER MATERIALIZED	RECLAMATION COMPLETED	TOTAL
Bentleyville Borough	2	0	0	0	0	0	0	0	2	0	0	0	0	2
California Borough	2	1	0	0	0	0	0	0	1	0	0	0	2	3
Carroll Township	0	6	5	0	0	0	0	0	9	2	0	0	0	11
Cecil Township	2	1	1	0	0	0	0	0	3	1	0	0	0	4
Centerville Borough	2	0	0	0	0	0	0	0	2	0	0	0	0	2
Chartiers Township	0	0	0	4	0	0	0	0	4	0	0	0	0	4
Cross Creek Township	0	2	0	0	0	0	0	0	2	0	0	0	0	2
Deemston Borough	8	3	1	0	2	0	0	0	11	2	1	0	0	14
Donegal Township	0	1	0	0	0	0	0	0	1	0	0	0	0	1
East Bethlehem Township	3	0	0	0	0	0	3	0	6	0	0	0	0	6
Fallowfield Township	18	4	1	0	2	1	0	0	18	6	0	1	1	26
Hanover Township	4	0	0	0	0	0	0	0	0	2	0	0	2	4
Hopewell Township	2	0	0	0	0	0	0	0	0	0	0	2	0	2
Independence Township	0	0	0	0	0	0	2	0	2	0	0	0	0	2
Jefferson Township	11	0	0	0	0	2	0	0	8	0	0	0	5	13
Midway Borough	2	0	0	0	0	0	0	0	0	0	0	0	2	2
Mount Pleasant Township	0	1	0	0	0	0	0	0	1	0	0	0	0	1
North Strabane Township	0	1	0	0	0	0	0	0	1	0	0	0	0	1
Nottingham Township	6	4	1	0	0	0	0	0	11	0	0	0	0	11
Robinson Township	32	0	4	0	2	8	0	0	12	10	0	2	22	46
Smith Township	30	2	2	0	1	0	0	2	26	4	1	0	6	37
Somerset Township	26	6	3	0	0	0	0	0	27	2	0	0	6	35
Twilight Borough	3	0	0	0	0	0	0	0	0	3	0	0	0	3
Union Township	5	3	4	0	2	0	0	0	14	0	0	0	0	14
West Bethlehem Township	0	0	2	0	0	0	0	0	2	0	0	0	0	2
West Finley Township	0	3	0	0	0	0	0	0	3	0	0	0	0	3
West Pike Run Township	0	0	0	0	2	0	0	0	2	0	0	0	0	2
STATUS														
Active	88	36	22	4	8	3	5	2						168
Inactive	27	2	1	0	2	0	0	0						32
Abandoned	0	0	1	0	1	0	0	0						2
Proposed but never materialized	4	0	0	0	0	1	0	0						5
Reclamation completed	39	0	0	0	0	7	0	0						46
TOTAL	**158**	**38**	**24**	**4**	**11**	**11**	**5**	**2**	**168**	**32**	**2**	**5**	**46**	**253**

4.3.6.2. Range of Magnitude

No two subsidence areas or sinkholes are exactly alike. Variations in size and shape, time period under which they occur (i.e. gradually or abruptly), and their proximity to development ultimately determines the magnitude of damage incurred. Based on the geologic formations underlying parts of Washington County, 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. Primarily, problems related to subsidence include the disruption of utility services and damages to private and public property including buildings, roads, and underground infrastructure. 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. If mitigation measures are not taken, the cost to fill in and stabilize sinkholes can be significant although sinkholes are limited in extent.

General recommendations have been published for site investigations prior to construction of buildings due to the potential for karst-related subsidence. These recommendations vary depending on the rock type immediately underlying soil cover. The recommendations include thorough geotechnical investigations to identify un-collapsed karst features and potential excavation to solid rock prior to construction.

With respect to mine subsidence, voids in the earth's subsurface are created where coal was mined. The condition removes a significant portion of the support of the overlying rock strata that usually causes the rock strata to fall or subside into the voids that may damage dwellings or other surface structures above the affected areas. Mining locations across the county should be carefully noted and avoided as site for new construction, unless the proper measures are taken to ensure the mine's soundness. The degree of surface subsidence or disturbance depends on a number of factors. These include:

1. The vertical distance and the coal;
2. The real extent of mining;
3. The nature of soil and rock strata overlying the mine;
4. The time elapsed since mining was completed; and
5. The loading conditions at the ground surface.

In general, the deeper the mine, the lower the risk of damage due to subsidence. Significant subsidence usually will occur when the depth of the soil and rock strata above the mined out area is less than 100 feet and more than 20 percent of the coal has been removed. Subsidence will occur quite rapidly if all the coal is removed, though subsidence will usually cease within one year after the coal has been removed particularly when modern mining methods are employed. If the mined out area is supported by pillars of coal, subsidence may not occur for several years or may not occur at all. Longwall mining, where a broad face of coal is removed at once, has also become prevalent. The associated subsidence is generally not as severe, and more predictable.

The worst subsidence event in Washington County occurred in January 2005, McDonald Borough, and was related to the blowout of an abandoned mine. This resulted in the flooding of several street and severe damage to several. At one point, the flow rate was estimated at six million gallons per minute. The Bureau of Mines stated this was probably the first in a series of events that will probably occur regionally.

In terms of environmental impacts, 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 also of concern. Other concerns related to subsidence include the loss of domestic water wells where proximity to a mine causes the well to go dry. Finally, subsidence of mines may cause dangerous accumulations of natural gas in wells and pump houses that may result in fires and explosions.

4.3.6.3. Past Occurrence

There have been no naturally-occurring incidents of sinkholes or surface depressions reported to the Pennsylvania Department of Conservation and Natural Resources (DCNR) for Washington County; however that does not mean they have not occurred. In addition, there is no comprehensive inventory of mine-related subsidence and sinkholes in Pennsylvania. However, poor engineering practices at the time of withdrawal or progressive degradation in geological stability contribute to subsidence. Mine subsidence has caused severe structural damage to homes, buildings, roads, and utility lines in Washington County. This type of damage has occurred most frequently over the abandoned underground coal mines located in the eastern part of the county. Lengths of local streets and highways, and countless building foundations have been damaged.

Many records and maps of the old inactive mine workings lave been lost, were not accurately recorded, or in many cases, not recorded at all. Consequently, development occurred over unsuspected subsidence prone areas. Pillars of coal, often of only intermediate size and strength support the roof. When the supports deteriorate and weaken over an undetermined period, the roof collapses, and subsidence occurs. This non-uniform subsidence causes the most damage on the surface. Because Pennsylvania's coal regions suffer more subsidence damage from abandoned underground mines than any other state and because such damage is not covered by homeowners insurance, the Commonwealth initiated a mine subsidence insurance program in 1961. This voluntary program covers damage to insured structures caused by vertical or lateral earth movement from mine subsidence. Repair costs on recent subsidence claims have been between $5,000 and $10,000.

In August 2009, a sinkhole roughly 12 feet wide and 20 feet deep opened up along Route 88 in Allenport Borough, temporarily shutting down the road, and restricting its use for several weeks (Pittsburgh Post-Gazette 2009). The sinkhole was believed to be caused by mine subsidence. Several other reports of subsidence and sinkholes in Washington County have occurred in the past ten years. The Department of Environmental Protection's Bureau of Abandoned Mine Reclamation (BAMR) conducted an investigation, and measures were taken to secure the sites. There have also been several instances of abandoned mine shafts that were sealed, having the

covers collapse into the shaft, resulting open shafts, several hundred feet deep. These were filled the Bureau of Mines. Given this areas mining history, there will probably be similar occurrences in other municipalities.

4.3.6.4. Future Occurrence

Based on geological conditions, subsidence events may possibly occur in the future for the areas of Washington County underlain by carbonate rock such as limestone but are more likely to occur over mined-out or deep mined areas. Sinkholes and surface depressions are dependent on a number of variables, including land use, water management, and coal mining oversight. With the extensive areas underlain by limestone and mine operations, the probability of future subsidence and sinkhole events can be considered *likely* according to the Risk Factor Methodology (see Table 4.4.2-1).

4.3.6.5. Vulnerability Assessment

Most of Washington County's 66 municipalities have identified near-surface limestone, and are therefore vulnerable to sinkholes. The only municipalities that do *not* have any near-surface limestone include: West Finley Township, East Finley Township, Morris Township, Green Hills Borough, South Franklin Township, Marianna Borough, Buffalo Township, Claysville Borough, and East Washington Borough. The secondary effects of sinkhole formation (other than the hole or depression itself) have the potential to cause significant impacts in communities underlain by surface-level limestone, including structural damage, damage to transportation systems, and damage to subsurface utility systems. Structures and critical facilities located over limestone and dolomite bedrock are considered vulnerable to sinkholes and are inventoried by community in Table 4.3.5-2 and in Table 4.3.5-3.

Fifty-five of the 66 municipalities in Washington County have structures located in areas that have been mined, and nearly half of all structures and half of all critical facilities in the county are underlain by coal mining operations. This is particularly prevalent in the eastern side of the county. Tables 4.3.5-4 and 4.3.5-5 inventory structures and critical facilities vulnerable to mine-related subsidence.

There are a few measures that can reduce the overall vulnerability to subsidence and sinkholes. Municipal governments may determine guidelines for construction in high-subsidence areas. A community can reduce its vulnerability to subsidence or sinkholes by implementing solutions such as land use controls, insurance programs, subsidence-resistant designs, or in the case of mine-related subsidence, conduct selective support or mine filling. If a sinkhole occurs on private property, it is normally the responsibility of the property owner to initiate repairs. Homeowners' insurance often does not cover damages attributed to sinkholes. Since 1987, sinkhole insurance has been available within Pennsylvania and may serve to eliminate the financial burdens placed on the homeowner. Insurance coverage is available to both residential and commercial structures in amounts up to $50,000 for a single structure.

Careful planning is the least-costly and most effective method for reducing vulnerability to subsidence hazards. Local and county officials should follow some of the following hazard mitigation measures: encourage local awareness of the subsidence hazards; compliance with or enactment of building codes and regulations that consider geologic factors; preparedness to

respond to and cope with a geologic hazard occurrence; and encourage local property owners to purchase subsidence insurance. Municipalities could minimize the potential for sinkhole development through proper maintenance and updating of water utility lines. Zoning laws can also be enacted to regulate development within highly karst areas or former mining areas.

Table 4.3.6-2 Natural subsidence (karst) vulnerability for Washington County.

MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES OVER LIMESTONE	PERCENT OF STRUCTURES OVER LIMESTONE	TOTAL CRITICAL FACILITIES IN MUNICIPALITY	TOTAL CRITICAL FACILITIES OVER LIMESTONE	PERCENT CRITICAL FACILITIES OVER LIMESTONE
Allenport Borough	270	43	15.9%	5	1	20.0%
Amwell Township	1,664	18	1.1%	24	1	4.2%
Beallsville Borough	227	0	0.0%	3	0	0.0%
Bentleyville Borough	1,088	820	75.4%	14	6	42.9%
Blaine Township	273	15	5.5%	5	1	20.0%
Buffalo Township	869	1	0.1%	14	0	0.0%
Burgettstown Borough	668	317	47.5%	4	1	25.0%
California Borough	1,789	1,513	84.6%	23	14	60.9%
Canonsburg Borough	4,070	3,647	89.6%	20	17	85.0%
Canton Township	3,726	835	22.4%	25	8	32.0%
Carroll Township	2,439	1,261	51.7%	35	14	40.0%
Cecil Township	5,516	3,470	62.9%	42	29	69.0%
Centerville Borough	1,685	1,118	66.4%	11	7	63.6%
Charleroi Borough	2,099	143	6.8%	18	1	5.6%
Chartiers Township	3,600	2,438	67.7%	34	22	64.7%
Claysville Borough	337	0	0.0%	3	0	0.0%
Coal Center Borough	85	32	37.6%	1	0	0.0%
Cokeburg Borough	367	0	0.0%	4	0	0.0%
Cross Creek Township	761	340	44.7%	8	6	75.0%
Deemston Borough	362	86	23.8%	5	0	0.0%
Donegal Township	1,244	19	1.5%	20	1	5.0%
Donora Borough	2,553	1,440	56.4%	23	6	26.1%
Dunlevy Borough	216	55	25.5%	2	0	0.0%
East Bethlehem Township	1,258	1,096	87.1%	12	8	66.7%
East Finley Township	639	0	0.0%	8	0	0.0%
East Washington Borough	653	0	0.0%	4	0	0.0%
Elco Borough	149	31	20.8%	3	1	33.3%
Ellsworth Borough	460	171	37.2%	4	3	75.0%
Fallowfield Township	2,048	1,271	62.1%	28	18	64.3%
Finleyville Borough	212	202	95.3%	4	4	100.0%
Green Hills Borough	8	0	0.0%	2	0	0.0%

Table 4.3.6-2 Natural subsidence (karst) vulnerability for Washington County.

MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES OVER LIMESTONE	PERCENT OF STRUCTURES OVER LIMESTONE	TOTAL CRITICAL FACILITIES IN MUNICIPALITY	TOTAL CRITICAL FACILITIES OVER LIMESTONE	PERCENT CRITICAL FACILITIES OVER LIMESTONE
Hanover Township	1,231	346	28.1%	22	13	59.1%
Hopewell Township	423	50	11.8%	4	0	0.0%
Houston Borough	569	18	3.2%	4	0	0.0%
Independence Township	759	273	36.0%	9	3	33.3%
Jefferson Township	536	385	71.8%	5	2	40.0%
Long Branch Borough	248	187	75.4%	4	3	75.0%
Marianna Borough	266	0	0.0%	1	0	0.0%
McDonald Borough	960	398	41.5%	6	0	0.0%
Midway Borough	416	321	77.2%	3	1	33.3%
Monongahela, City of	2,093	1,290	61.6%	13	4	30.8%
Morris Township	477	0	0.0%	5	0	0.0%
Mount Pleasant Township	1,676	852	50.8%	25	10	40.0%
New Eagle Borough	988	777	78.6%	7	2	28.6%
North Bethlehem Township	773	1	0.1%	10	0	0.0%
North Charleroi Borough	586	371	63.3%	2	1	50.0%
North Franklin Township	1,960	0	0.0%	22	0	0.0%
North Strabane Township	6,094	1,672	27.4%	46	20	43.5%
Nottingham Township	1,287	414	32.2%	9	4	44.4%
Peters Township	8,286	2,906	35.1%	50	31	62.0%
Robinson Township	903	405	44.9%	12	5	41.7%
Roscoe Borough	403	0	0.0%	3	0	0.0%
Smith Township	2,173	1,441	66.3%	27	20	74.1%
Somerset Township	1,308	324	24.8%	20	2	10.0%
South Franklin Township	1,458	0	0.0%	12	0	0.0%
South Strabane Township	3,934	581	14.8%	43	6	14.0%
Speers Borough	606	202	33.3%	7	1	14.3%
Stockdale Borough	252	6	2.4%	5	0	0.0%
Twilight Borough	106	59	55.7%	1	0	0.0%
Union Township	2,797	2,037	72.8%	30	17	56.7%
Washington, City of	5,585	811	14.5%	37	5	13.5%
West Bethlehem Township	697	44	6.3%	8	0	0.0%
West Brownsville Borough	529	481	90.9%	6	5	83.3%
West Finley Township	425	4	0.9%	11	2	18.2%

Table 4.3.6-2 Natural subsidence (karst) vulnerability for Washington County.						
MUNICIPALITY	**TOTAL STRUCTURES**	**STRUCTURES OVER LIMESTONE**	**PERCENT OF STRUCTURES OVER LIMESTONE**	**TOTAL CRITICAL FACILITIES IN MUNICIPALITY**	**TOTAL CRITICAL FACILITIES OVER LIMESTONE**	**PERCENT CRITICAL FACILITIES OVER LIMESTONE**
West Middletown Borough	85	0	0.0%	3	0	0.0%
West Pike Run Township	826	549	66.5%	5	4	80.0%
TOTAL	**93,050**	**37,587**	**40.4%**	**885**	**330**	**37.3%**

Table 4.3.6-3 Structures in natural subsidence areas by generalized type.

MUNICIPALITY	TOTAL STRUCTURES	ANIMAL	COMMERCIAL	EDUCATION	GOVERNMENT	MEDICAL	RECREATION	RELIGIOUS	RESIDENTIAL	TRANSPOR-TATION	UNKNOWN	UTILITY	TOTAL IN LIMESTONE AREA
Allenport Borough	270	0	0	0	0	0	0	0	43	0	0	0	**43**
Amwell Township	1,664	0	0	0	0	0	0	0	17	0	1	0	**18**
Beallsville Borough	227	0	0	0	0	0	0	0	0	0	0	0	**0**
Bentleyville Borough	1,088	0	78	4	1	3	13	7	698	0	15	1	**820**
Blaine Township	273	0	0	0	0	0	0	0	14	0	0	1	**15**
Buffalo Township	869	0	0	0	0	0	0	0	1	0	0	0	**1**
Burgettstown Borough	668	0	17	2	0	0	2	4	290	0	2	0	**317**
California Borough	1,789	2	103	37	1	8	2	9	1,331	1	18	1	**1,513**
Canonsburg Borough	4,070	0	242	10	2	17	7	13	3,340	1	15	0	**3,647**
Canton Township	3,726	0	73	0	0	2	3	2	750	3	1	1	**835**
Carroll Township	2,439	0	39	1	0	4	2	0	1,206	0	5	4	**1,261**
Cecil Township	5,516	2	184	8	1	1	4	7	3,223	0	36	4	**3,470**
Centerville Borough	1,685	0	45	0	1	1	21	4	1,037	0	7	2	**1,118**
Charleroi Borough	2,099	0	2	0	0	0	0	0	140	0	1	0	**143**
Chartiers Township	3,600	0	80	4	2	0	9	3	2,310	0	14	16	**2,438**
Claysville Borough	337	0	0	0	0	0	0	0	0	0	0	0	**0**
Coal Center Borough	85	0	0	0	0	0	0	0	32	0	0	0	**32**
Cokeburg Borough	367	0	0	0	0	0	0	0	0	0	0	0	**0**
Cross Creek Township	761	0	17	2	1	0	2	1	310	0	0	7	**340**
Deemston Borough	362	0	3	0	0	0	0	1	80	0	2	0	**86**
Donegal Township	1,244	0	0	0	0	0	0	1	18	0	0	0	**19**
Donora Borough	2,553	0	19	1	1	0	3	4	1,411	0	1	0	**1,440**
Dunlevy Borough	216	0	2	0	0	0	0	0	53	0	0	0	**55**

Table 4.3.6-3 Structures in natural subsidence areas by generalized type.

MUNICIPALITY	TOTAL STRUCTURES	ANIMAL	COMMERCIAL	EDUCATION	GOVERNMENT	MEDICAL	RECREATION	RELIGIOUS	RESIDENTIAL	TRANSPOR-TATION	UNKNOWN	UTILITY	TOTAL IN LIMESTONE AREA
East Bethlehem Township	1,258	0	46	6	0	1	11	6	1,015	0	9	2	**1,096**
East Finley Township	639	0	0	0	0	0	0	0	0	0	0	0	**0**
East Washington Borough	653	0	0	0	0	0	0	0	0	0	0	0	**0**
Elco Borough	149	0	1	0	1	0	1	0	27	0	1	0	**31**
Ellsworth Borough	460	0	4	0	1	0	6	0	159	0	1	0	**171**
Fallowfield Township	2,048	1	45	1	1	0	3	2	1,205	1	10	2	**1,271**
Finleyville Borough	212	0	54	1	1	7	3	3	132	0	1	0	**202**
Green Hills Borough	8	0	0	0	0	0	0	0	0	0	0	0	**0**
Hanover Township	1,231	0	53	3	1	1	3	3	273	1	7	1	**346**
Hopewell Township	423	0	0	0	0	0	1	0	49	0	0	0	**50**
Houston Borough	569	0	0	0	0	0	0	0	18	0	0	0	**18**
Independence Township	759	0	3	0	0	0	1	0	263	0	1	5	**273**
Jefferson Township	536	0	4	1	0	0	3	2	369	0	3	3	**385**
Long Branch Borough	248	0	8	1	1	0	0	0	176	1	0	0	**187**
Marianna Borough	266	0	0	0	0	0	0	0	0	0	0	0	**0**
McDonald Borough	960	0	4	0	0	0	1	0	393	0	0	0	**398**
Midway Borough	416	0	10	2	0	0	1	2	305	1	0	0	**321**
Monongahela, City of	2,093	0	12	1	0	4	1	2	1,268	0	1	1	**1,290**
Morris Township	477	0	0	0	0	0	0	0	0	0	0	0	**0**
Mount Pleasant Township	1,676	1	30	1	1	0	7	1	781	0	8	22	**852**
New Eagle Borough	988	0	19	0	0	0	0	1	757	0	0	0	**777**
North Bethlehem Township	773	0	0	0	0	0	0	0	1	0	0	0	**1**
North Charleroi Borough	586	0	4	2	0	0	2	0	363	0	0	0	**371**

Table 4.3.6-3 Structures in natural subsidence areas by generalized type.

MUNICIPALITY	TOTAL STRUCTURES	ANIMAL	COMMERCIAL	EDUCATION	GOVERNMENT	MEDICAL	RECREATION	RELIGIOUS	RESIDENTIAL	TRANSPOR-TATION	UNKNOWN	UTILITY	TOTAL IN LIMESTONE AREA
North Franklin Township	1,960	0	0	0	0	0	0	0	0	0	0	0	**0**
North Strabane Township	6,094	1	149	2	0	5	2	1	1,503	0	5	4	**1,672**
Nottingham Township	1,287	0	11	0	0	0	0	0	393	0	8	2	**414**
Peters Township	8,286	0	217	5	1	16	3	4	2,595	1	64	0	**2,906**
Robinson Township	903	0	12	0	0	0	3	2	380	0	2	6	**405**
Roscoe Borough	403	0	0	0	0	0	0	0	0	0	0	0	**0**
Smith Township	2,173	1	74	4	1	0	16	4	1,326	0	7	8	**1,441**
Somerset Township	1,308	0	28	0	0	0	0	0	293	1	1	1	**324**
South Franklin Township	1,458	0	0	0	0	0	0	0	0	0	0	0	**0**
South Strabane Township	3,934	0	30	2	0	5	1	1	533	0	8	1	**581**
Speers Borough	606	0	2	0	0	0	0	0	200	0	0	0	**202**
Stockdale Borough	252	0	0	0	0	0	0	0	6	0	0	0	**6**
Twilight Borough	106	0	3	0	0	0	0	0	53	0	1	2	**59**
Union Township	2,797	0	43	2	1	1	2	5	1,971	1	11	0	**2,037**
Washington, City of	5,585	0	103	5	0	2	11	5	684	0	1	0	**811**
West Bethlehem Township	697	0	2	0	0	0	0	1	41	0	0	0	**44**
West Brownsville Borough	529	0	21	1	1	0	1	2	451	0	4	0	**481**
West Finley Township	425	0	1	0	0	0	1	0	1	0	0	1	**4**
West Middletown Borough	85	0	0	0	0	0	0	0	0	0	0	0	**0**
West Pike Run Township	826	0	23	1	1	1	4	4	510	0	0	5	**549**
TOTAL	**93,050**	**8**	**1,920**	**110**	**22**	**79**	**156**	**107**	**34,798**	**12**	**272**	**103**	**37,587**

Table 4.3.6-4 Mine subsidence vulnerability for Washington County.

MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES OVER COAL MINED AREAS	PERCENT OF STRUCTURES OVER COAL MINED AREAS	TOTAL CRITICAL FACILITIES IN MUNICIPALITY	TOTAL CRITICAL FACILITIES OVER COAL MINED AREAS	PERCENT CRITICAL FACILITIES OVER COAL MINED AREAS
Allenport Borough	270	8	3.0%	5	0	0.0%
Amwell Township	1,664	201	12.1%	24	1	4.2%
Beallsville Borough	227	222	97.8%	3	2	66.7%
Bentleyville Borough	1,088	1,075	98.8%	14	14	100.0%
Blaine Township	273	0	0.0%	5	0	0.0%
Buffalo Township	869	106	12.2%	14	1	7.1%
Burgettstown Borough	668	6	0.9%	4	3	75.0%
California Borough	1,789	1,086	60.7%	23	15	65.2%
Canonsburg Borough	4,070	2,327	57.2%	20	5	25.0%
Canton Township	3,726	1,258	33.8%	25	12	48.0%
Carroll Township	2,439	1,998	81.9%	35	24	68.6%
Cecil Township	5,516	4,178	75.7%	42	32	76.2%
Centerville Borough	1,685	1,562	92.7%	11	10	90.9%
Charleroi Borough	2,099	16	0.8%	18	0	0.0%
Chartiers Township	3,600	1,626	45.2%	34	14	41.2%
Claysville Borough	337	0	0.0%	3	0	0.0%
Coal Center Borough	85	1	1.2%	1	0	0.0%
Cokeburg Borough	367	366	99.7%	4	4	100.0%
Cross Creek Township	761	45	5.9%	8	2	25.0%
Deemston Borough	362	337	93.1%	5	5	100.0%
Donegal Township	1,244	0	0.0%	20	8	40.0%
Donora Borough	2,553	323	12.7%	23	7	30.4%
Dunlevy Borough	216	24	11.1%	2	0	0.0%
East Bethlehem Township	1,258	922	73.3%	12	5	41.7%
East Finley Township	639	327	51.2%	8	6	75.0%
East Washington Borough	653	0	0.0%	4	0	0.0%
Elco Borough	149	0	0.0%	3	0	0.0%
Ellsworth Borough	460	460	100.0%	4	4	100.0%
Fallowfield Township	2,048	1,387	67.7%	28	16	57.1%
Finleyville Borough	212	0	0.0%	4	0	0.0%
Green Hills Borough	8	0	0.0%	2	0	0.0%
Hanover Township	1,231	0	0.0%	22	4	18.2%
Hopewell Township	423	9	2.1%	4	0	0.0%
Houston Borough	569	2	0.4%	4	0	0.0%

Table 4.3.6-4 Mine subsidence vulnerability for Washington County.

MUNICIPALITY	TOTAL STRUCTURES	STRUCTURES OVER COAL MINED AREAS	PERCENT OF STRUCTURES OVER COAL MINED AREAS	TOTAL CRITICAL FACILITIES IN MUNICIPALITY	TOTAL CRITICAL FACILITIES OVER COAL MINED AREAS	PERCENT CRITICAL FACILITIES OVER COAL MINED AREAS
Independence Township	759	260	34.3%	9	5	55.6%
Jefferson Township	536	96	17.9%	5	2	40.0%
Long Branch Borough	248	228	91.9%	4	4	100.0%
Marianna Borough	266	265	99.6%	1	1	100.0%
McDonald Borough	960	104	10.8%	6	0	0.0%
Midway Borough	416	33	7.9%	3	0	0.0%
Monongahela, City of	2,093	260	12.4%	13	1	7.7%
Morris Township	477	76	15.9%	5	0	0.0%
Mount Pleasant Township	1,676	346	20.6%	25	13	52.0%
New Eagle Borough	988	93	9.4%	7	1	14.3%
North Bethlehem Township	773	439	56.8%	10	4	40.0%
North Charleroi Borough	586	114	19.5%	2	0	0.0%
North Franklin Township	1,960	223	11.4%	22	3	13.6%
North Strabane Township	6,094	4,815	79.0%	46	33	71.7%
Nottingham Township	1,287	877	68.1%	9	6	66.7%
Peters Township	8,286	7,543	91.0%	50	46	92.0%
Robinson Township	903	214	23.7%	12	4	33.3%
Roscoe Borough	403	0	0.0%	3	0	0.0%
Smith Township	2,173	1,056	48.6%	27	17	63.0%
Somerset Township	1,308	1,089	83.3%	20	19	95.0%
South Franklin Township	1,458	158	10.8%	12	2	16.7%
South Strabane Township	3,934	1,959	49.8%	43	20	46.5%
Speers Borough	606	291	48.0%	7	1	14.3%
Stockdale Borough	252	0	0.0%	5	0	0.0%
Twilight Borough	106	22	20.8%	1	0	0.0%
Union Township	2,797	1,288	46.0%	30	15	50.0%
Washington, City of	5,585	227	4.1%	37	3	8.1%
West Bethlehem Township	697	531	76.2%	8	7	87.5%
West Brownsville Borough	529	233	44.0%	6	0	0.0%
West Finley Township	425	191	44.9%	11	7	63.6%
West Middletown Borough	85	0	0.0%	3	3	100.0%
West Pike Run Township	826	710	86.0%	5	5	100.0%
TOTAL	**93,050**	**43,613**	**46.9%**	**885**	**416**	**47.0%**

Table 4.3.6-5 Structures in mine subsidence areas by generalized type.

MUNICIPALITY	TOTAL STRUCTURES	ANIMAL	COMMERCIAL	EDUCATION	GOVERNMENT	MEDICAL	RECREATION	RELIGIOUS	RESIDENTIAL	TRANSPOR-TATION	UNKNOWN	UTILITY	TOTAL IN HAZARD AREA
Allenport Borough	270	0	0	0	0	0	0	0	8	0	0	0	**8**
Amwell Township	1,664	0	7	1	0	0	1	0	190	0	1	1	**201**
Beallsville Borough	227	0	15	1	1	1	1	2	200	0	0	1	**222**
Bentleyville Borough	1,088	0	77	6	1	3	13	7	950	1	16	1	**1,075**
Blaine Township	273	0	0	0	0	0	0	0	0	0	0	0	**0**
Buffalo Township	869	0	0	0	0	0	0	1	105	0	0	0	**106**
Burgettstown Borough	668	0	0	0	0	0	0	0	5	0	1	0	**6**
California Borough	1,789	1	40	8	0	2	0	3	1,016	0	14	2	**1,086**
Canonsburg Borough	4,070	0	57	1	0	1	1	0	2,260	0	7	0	**2,327**
Canton Township	3,726	0	46	2	1	0	4	5	1,189	0	8	3	**1,258**
Carroll Township	2,439	0	44	3	1	10	2	1	1,922	0	8	7	**1,998**
Cecil Township	5,516	1	155	7	0	1	4	8	3,952	0	45	5	**4,178**
Centerville Borough	1,685	0	59	1	1	1	26	7	1,451	0	10	6	**1,562**
Charleroi Borough	2,099	0	0	0	0	0	0	0	16	0	0	0	**16**
Chartiers Township	3,600	1	35	0	0	0	6	2	1,550	0	7	25	**1,626**
Claysville Borough	337	0	0	0	0	0	0	0	0	0	0	0	**0**
Coal Center Borough	85	0	0	0	0	0	0	0	1	0	0	0	**1**
Cokeburg Borough	367	0	18	0	1	1	1	1	340	0	2	2	**366**
Cross Creek Township	761	0	2	0	0	0	0	0	42	0	1	0	**45**
Deemston Borough	362	0	7	3	1	0	0	1	307	0	7	11	**337**
Donegal Township	1,244	0	0	0	0	0	0	0	0	0	0	0	**0**
Donora Borough	2,553	0	3	2	0	0	0	1	317	0	0	0	**323**
Dunlevy Borough	216	0	2	0	0	0	0	0	22	0	0	0	**24**

Table 4.3.6-5 Structures in mine subsidence areas by generalized type.

MUNICIPALITY	TOTAL STRUCTURES	ANIMAL	COMMERCIAL	EDUCATION	GOVERNMENT	MEDICAL	RECREATION	RELIGIOUS	RESIDENTIAL	TRANSPOR-TATION	UNKNOWN	UTILITY	TOTAL IN HAZARD AREA
East Bethlehem Township	1,258	0	17	4	0	0	6	1	888	0	5	1	**922**
East Finley Township	639	0	7	0	1	0	3	2	302	0	10	2	**327**
East Washington Borough	653	0	0	0	0	0	0	0	0	0	0	0	**0**
Elco Borough	149	0	0	0	0	0	0	0	0	0	0	0	**0**
Ellsworth Borough	460	0	8	2	1	0	7	0	440	0	2	0	**460**
Fallowfield Township	2,048	1	38	2	0	0	3	3	1,315	0	21	4	**1,387**
Finleyville Borough	212	0	0	0	0	0	0	0	0	0	0	0	**0**
Green Hills Borough	8	0	0	0	0	0	0	0	0	0	0	0	**0**
Hanover Township	1,231	0	0	0	0	0	0	0	0	0	0	0	**0**
Hopewell Township	423	0	0	0	0	0	0	0	9	0	0	0	**9**
Houston Borough	569	0	0	0	0	0	0	0	2	0	0	0	**2**
Independence Township	759	0	4	0	0	0	1	0	245	0	2	8	**260**
Jefferson Township	536	0	0	0	0	0	0	0	94	0	1	1	**96**
Long Branch Borough	248	0	8	1	1	0	1	0	216	1	0	0	**228**
Marianna Borough	266	0	3	1	1	0	0	3	257	0	0	0	**265**
McDonald Borough	960	0	1	0	0	0	1	0	102	0	0	0	**104**
Midway Borough	416	0	0	0	0	0	0	0	33	0	0	0	**33**
Monongahela, City of	2,093	0	3	0	0	4	0	0	253	0	0	0	**260**
Morris Township	477	0	1	0	0	0	0	0	74	0	1	0	**76**
Mount Pleasant Township	1,676	1	11	3	0	0	3	0	313	0	6	9	**346**
New Eagle Borough	988	0	0	0	0	0	0	0	93	0	0	0	**93**
North Bethlehem Township	773	0	22	0	0	0	1	0	408	1	2	5	**439**
North Charleroi Borough	586	0	0	0	0	0	0	0	114	0	0	0	**114**

Table 4.3.6-5 Structures in mine subsidence areas by generalized type.

MUNICIPALITY	TOTAL STRUCTURES	ANIMAL	COMMERCIAL	EDUCATION	GOVERNMENT	MEDICAL	RECREATION	RELIGIOUS	RESIDENTIAL	TRANSPOR-TATION	UNKNOWN	UTILITY	TOTAL IN HAZARD AREA
North Franklin Township	1,960	0	5	0	0	25	0	2	191	0	0	0	**223**
North Strabane Township	6,094	2	196	5	1	11	5	6	4,476	0	110	3	**4,815**
Nottingham Township	1,287	0	15	0	2	0	3	2	839	0	14	2	**877**
Peters Township	8,286	1	332	11	1	15	2	9	7,073	1	98	0	**7,543**
Robinson Township	903	0	3	0	0	0	1	0	206	0	1	3	**214**
Roscoe Borough	403	0	0	0	0	0	0	0	0	0	0	0	**0**
Smith Township	2,173	0	39	3	1	0	8	4	995	0	2	4	**1,056**
Somerset Township	1,308	0	65	1	1	0	1	1	1,008	1	7	4	**1,089**
South Franklin Township	1,458	0	19	0	0	0	0	0	139	0	0	0	**158**
South Strabane Township	3,934	0	117	3	1	12	5	5	1,734	1	78	3	**1,959**
Speers Borough	606	0	2	0	0	0	0	1	288	0	0	0	**291**
Stockdale Borough	252	0	0	0	0	0	0	0	0	0	0	0	**0**
Twilight Borough	106	0	0	0	0	0	0	0	21	0	1	0	**22**
Union Township	2,797	0	22	0	1	0	2	3	1,251	0	9	0	**1,288**
Washington, City of	5,585	0	10	1	0	2	1	3	209	0	1	0	**227**
West Bethlehem Township	697	1	26	2	1	0	2	3	489	0	1	6	**531**
West Brownsville Borough	529	0	3	0	0	0	0	0	228	0	2	0	**233**
West Finley Township	425	0	17	0	1	0	1	1	164	0	2	5	**191**
West Middletown Borough	85	0	0	0	0	0	0	0	0	0	0	0	**0**
West Pike Run Township	826	0	26	1	1	1	3	5	665	0	2	6	**710**
TOTAL	**93,050**	**9**	**1,587**	**75**	**22**	**90**	**119**	**93**	**40,977**	**6**	**505**	**130**	**43,613**

4.3.7. Tornado, Windstorm

4.3.7.1. Location and Extent

Tornadoes and windstorms can affect any area of the County. Straight-line winds create movement of air from areas of higher pressure to areas of lower pressure – the greater the difference in pressure, the stronger the winds. 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, a violently rotating funnel-like vortex, is an extraordinary feature of severe thunderstorms. 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. 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.

The enhanced Fujita Tornado Scale (or the -EF-Scale) classifies U.S. tornadoes into six intensity categories, named EF0 to EF5, based upon the estimated maximum winds occurring within the funnel. The EF-Scale has subsequently become the definitive metric for estimating wind speeds within tornadoes based upon the damage done to buildings and structures.

Tornadoes can occur at any time during the day or night, but are most frequent during late afternoon into early evening, the warmest hours of the day. 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.

Tornadoes have occurred in every state, but they frequently occur in the Midwest, southeast, and southwest. Although tornado season runs from March through August, tornadoes can occur any time, often accompanying tropical storms and hurricanes as they move onto land. The National Weather Service estimates that about 43 people are killed because of tornadoes each year. Areas in the Commonwealth most prone to tornadoes and windstorms are the southeast, southwest, and northwest sectors. Tornado events are not limited to any particular geographic or physiographic area of the County, and neither the duration of the storm nor the extent of area affected by such an occurrence can be predicted.

High winds and tornadoes can affect any area of the County. Figure 4.3.6-2 shows tornadoes that have affected (touch-downed or passed through) the County.

4.3.7.2. Range of Magnitude

Tornadoes are considered a countywide hazard because their path is unpredictable and can affect everyone in the county. On May 31, 1985, multiple Tornadoes swept through the counties north of Washington County. These tornadoes resulted in 65 dead, 700 injured, 1,000 homes destroyed, and hundreds of millions of dollars in property damage. The southernmost tornado struck Beaver County, just twenty air miles north of the Washington County border. In 2002, the City of Pittsburgh suffered significant damage from a Class 3 tornado. This tornado was approximately thirty air miles from Washington County. Although Washington County has not suffered significant damage from a tornado, based on the proximity of significant tornados, there is obviously great potential.

Washington County experiences thunderstorms every year and over the years, people have learned how to prepare when thunderstorms are predicted. Most County residents prepare by obtaining battery-operated radios, a non-electric residential telephone, a wireless telephone, and emergency supply of water and non-perishable food, etc.

Many times severe storms, such as thunderstorms, can produce smaller, more localized storms. Tornadoes, typically, the by-product of a larger storm, are violently rotating columns of air that come in contact with the ground. Tornadoes have a more localized impact and generally produce a narrow path of concentrated destruction from 0.01 mile wide to greater than 1 mile wide. Tornadoes may also produce paths of destruction from less than 1 mile in length to greater than 100 miles in length. The destruction caused by tornadoes may range from light to severe depending on the path of travel. Typically, structures of light construction, such as mobile homes and some residential homes, suffer the greatest damage from tornadoes.

Each year, tornadoes account for $1.1 billion in damages and cause over 80 deaths nationally (NCAR, 2001). While the extent of tornado damage is usually localized, the vortex of extreme wind associated with a tornado can result in some of the most destructive forces on Earth. Rotational wind speeds can range from 100 mph to more than 250 mph. In addition, the speed of forward motion can range from 0 to 50 mph. Therefore, some estimates place the maximum velocity (combination of ground speed, wind speed and upper winds) of tornadoes at about 300 mph. The damage caused by a tornado is a result of the high wind velocity and wind-blown debris, also accompanied by lightning or large hail. The most violent tornadoes have rotating winds of 250 miles per hour or more and are capable of causing extreme destruction and turning normally harmless objects into deadly missiles.

Damages and deaths can be especially significant when tornadoes and windstorms move through populated, developed areas. 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. The destruction caused by tornadoes ranges from light to inconceivable depending on the intensity, size and duration of the storm. Typically, tornadoes cause the greatest damages to structures of light construction such as mobile homes. The Enhanced Fujita Scale, also known as the “EF-Scale,” measures tornado strength and associated damages. The EF-Scale is an update to the earlier Fujita Scale, also known as the “F-Scale,” which was published in 1971. The EF-Scale provides engineered wind estimates and better damage descriptions. It classifies

United States tornadoes into six intensity categories, as shown in Table 4.3.7-1, based upon the estimated maximum winds occurring within the wind vortex. Since its implementation by the National Weather Service in 2007, the EF-Scale has become the definitive metric for estimating wind speeds within tornadoes based upon damage to buildings and structures. F-Scale categories with corresponding EF-Scale wind speeds are also provided since previous tornado occurrences are described based on the F-Scale.

Table 4.3.7-1 Enhanced Fujita Scale (EF-Scale) categories with associated wind speeds and description of damages.

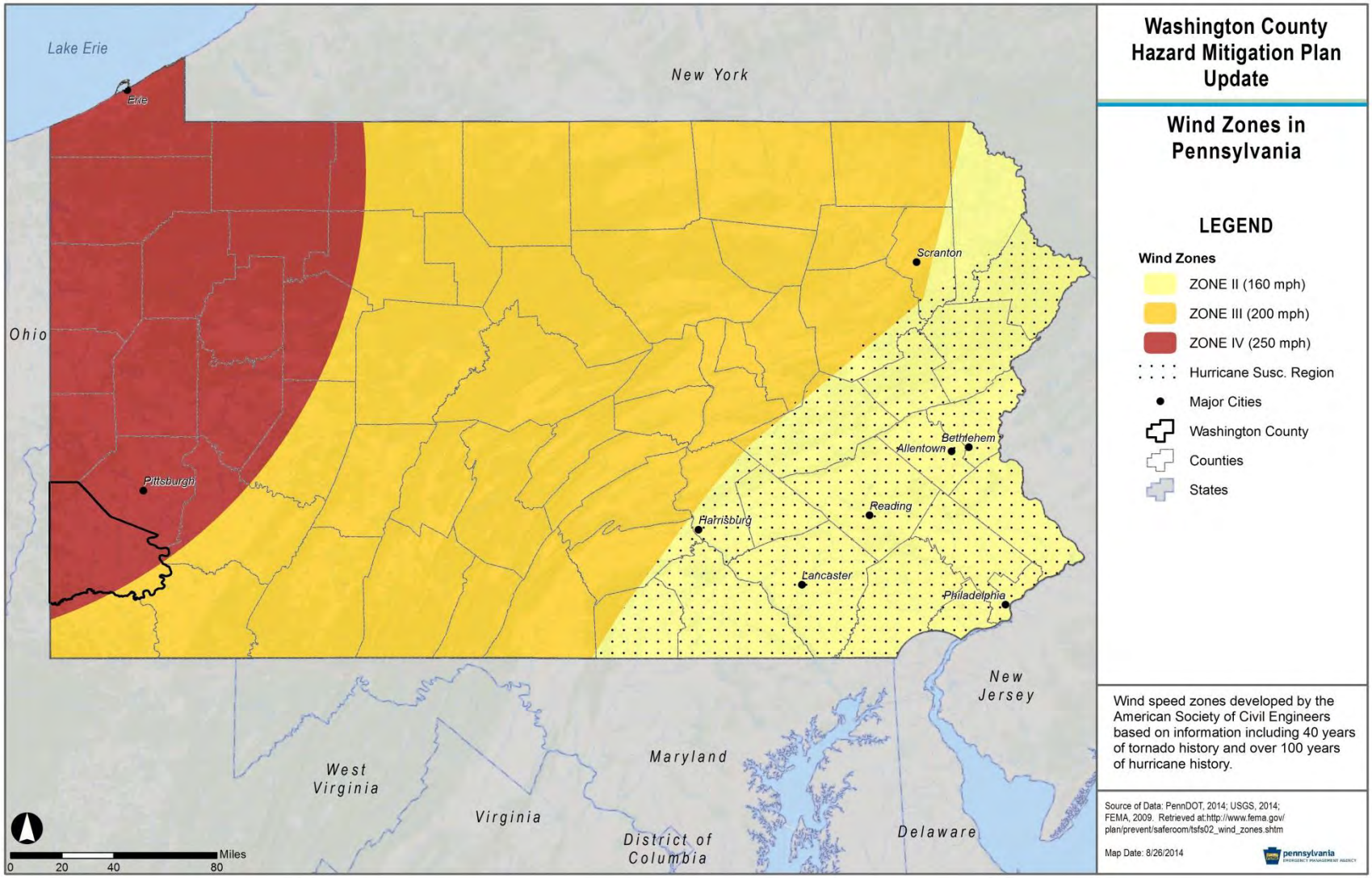
EF-SCALE NUMBER	WIND SPEED (mph)	F-SCALE NUMBER	TYPE OF DAMAGE POSSIBLE
EF0	65–85	F0-F1	**Minor damage**: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in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

As shown in Figure 4.3.6-1, Washington County can expect winds up to 250 miles per hour, and should implement construction regulations requiring that structures be designed to withstand winds of that magnitude. Since tornado and windstorm events are typically localized, environmental impacts of these events are rarely widespread. The impacts of windstorms on the environment typically take place over a larger area. In either case, where these events occur, severe damage to plant species is likely. This includes uprooting or total destruction of trees and an increased threat of wildfire in areas where dead trees are not removed. Hazardous material

facilities should meet design requirements for the wind zones identified in Figure 4.3.6-1 in order to prevent release of hazardous materials into the environment.

The worst tornado event in Washington County occurred on June 29, 1987. While not the highest F-Scale event ever experienced in Washington County, this event did cause both significant damage and at least one reported injury. In this event, an F1 tornado touched down for one half mile near Paris, Washington County. The tornado lifted roofs off houses and uprooted a number of trees. NCDC reports indicate 50 homes were damaged, ten heavily, with property damage of approximately $250,000. The injury during this event was due to flying glass.

Figure 4.3.7-1 Map showing wind zones to guide design standards and shelter construction.



4.3.7.3. Past Occurrence

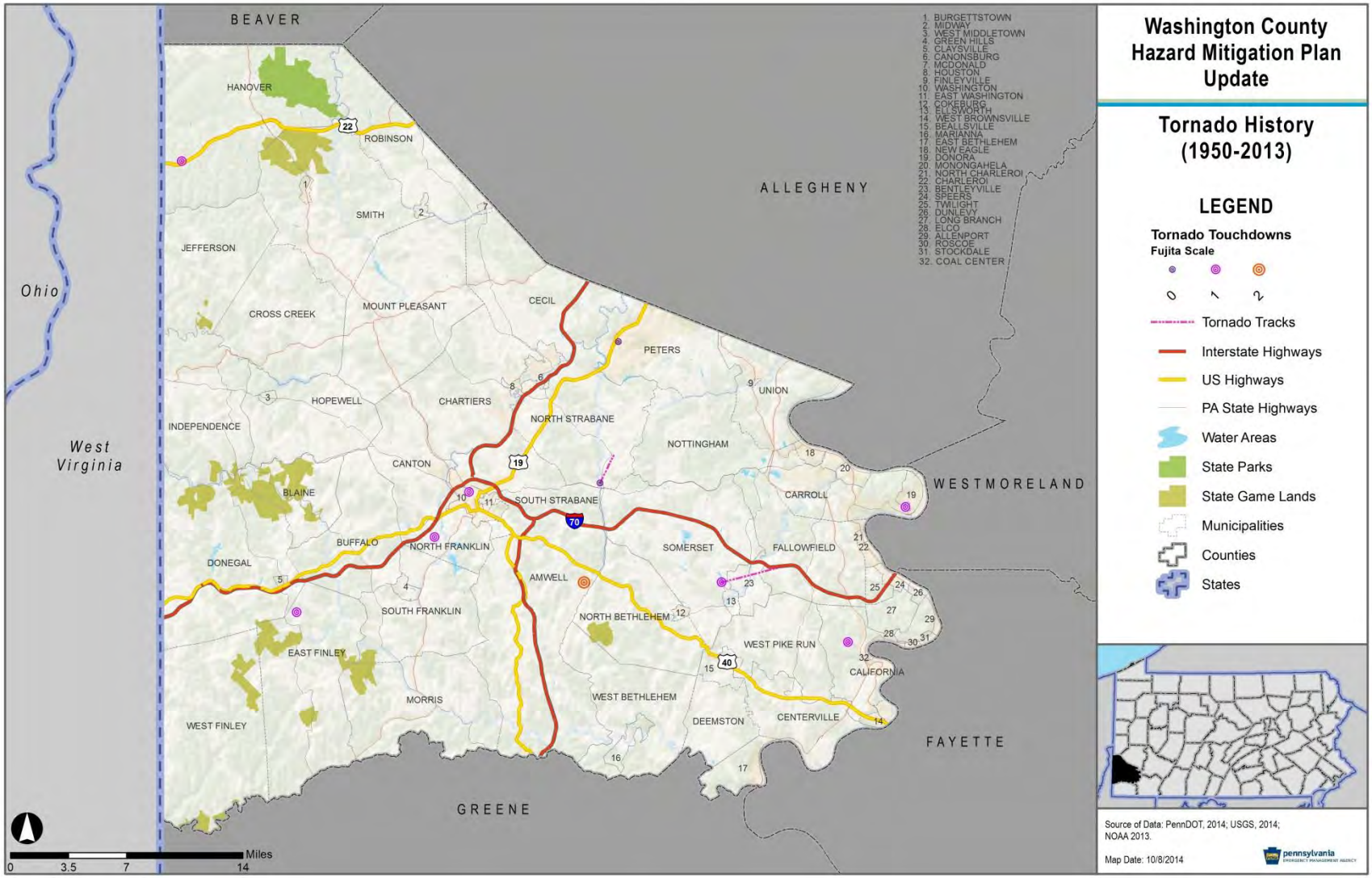
Historically, between 1950 and 2011, there were seven tornadoes in Washington County. According to the National Oceanic Atmospheric Administration (NOAA), there were just four injuries and no deaths in Washington County resulting from these seven tornados. However, there was additional damage from the tornadoes' associated winds have damaged power lines, uprooting trees, structures, motor vehicles, and crops.

As can be seen from the Table 4.3.6-2, the magnitude of reported and confirmed tornadoes in the County over the last five years is in the F0 to F1 range. While this is the lowest range to be classified as a tornado, such events can nevertheless be devastating to human life and property in the affected areas. The first recorded tornado in Washington County was in May 1973. In the vicinity of Claysville, the funnel cloud touched down intermittently along a two-mile path, clipping off tops of trees, damaging small buildings, and rolling one mobile home. The three occupants suffered minor injuries (NOAA, 1973). The next tornado that was reported to have resulted in an injury was in June 1987. The tornado lifted roofs off of houses and uprooted trees, in total fifty homes were damaged (10 heavily) and one woman was injured by flying glass.

Table 4.3.7-2 Previous tornado events between 1950 and 2014 in Washington County (NCDC, 2014).

LOCATION	DATE	MAGNITUDE	DEATHS	INJURIES	ESTIMATED PROPERTY DAMAGE ($)
County-wide	5/10/1973	F1	0	3	25,000
County-wide	6/24/1976	F1	0	0	25,000
County-wide	5/31/1980	F1	0	0	25,000
County-wide	6/29/1987	F1	0	1	250,000
County-wide	8/9/1987	F1	0	0	250,000
County-wide	6/30/1990	F2	0	0	25,000
County-wide	9/27/2012	EF0	0	0	75,000
		TOTAL	**0**	**4**	**675,000**

Figure 4.3.7-2 Map showing tornado events and tracks in Washington County.



There have also been several high wind events over the past twenty years that have caused damage within the County. Windstorm events may be the result of thunderstorms, hurricanes, tropical storms, winter storms, or nor'easters. From 1950 to September 2014, there have been 188 events with wind speeds of greater than 50 knots, as shown in Table 4.3.6-3. These events frequently occurred in conjunction with thunderstorms and caused significant damage to the tune of nearly $3 million in property damage.

Table 4.3.7-3 Previous wind events over 50 knots (NCDC, 2014).

LOCATION	DATE	TYPE	WIND SPEED	DEATHS/ INJURIES	PROPERTY DAMAGE ($)
Washington County	9/5/1975	Thunderstorm Wind	52	0	0
Washington County	8/8/1979	Thunderstorm Wind	56	0	0
Washington County	9/14/1990	Thunderstorm Wind	50	0	0
Finleyville	5/12/1993	Thunderstorm Wind	52	0	0
Roscoe	5/12/1993	Thunderstorm Wind	52	0	0
Beallsville	7/15/1995	Thunderstorm Wind	52	0	0
Washington (Zone)	4/30/1996	High Wind	51	0	0
Washington (Zone)	1/18/1999	High Wind	60	0	25,000
Washington, City of	4/9/1999	Thunderstorm Wind	50	0	2,000
Washington (Zone)	4/16/1999	High Wind	50	0	0
Marianna	5/18/1999	Thunderstorm Wind	50	0	3,000
Strabane	8/13/1999	Thunderstorm Wind	70	0	50,000
Washington (Zone)	1/10/2000	High Wind	50	0	4,000
Washington (Zone)	1/10/2000	High Wind	50	0	2,000
Washington (Zone)	12/14/2001	High Wind	50	0	5,000
Washington (Zone)	3/8/2003	High Wind	55	0	0
Claysville	4/4/2003	Thunderstorm Wind	55	0	1,000
Prosperity	4/4/2003	Thunderstorm Wind	55	0	1,000
McMurray	6/8/2003	Thunderstorm Wind	52	0	1,000
McMurray	6/8/2003	Thunderstorm Wind	55	0	5,000
Hickory	6/8/2003	Thunderstorm Wind	53	0	10,000
Ellsworth	7/4/2003	Thunderstorm Wind	52	0	2,000
McMurray	7/7/2003	Thunderstorm Wind	50	0	1,000
Fredericktown	7/8/2003	Thunderstorm Wind	50	0	1,000
Washington, City of	7/8/2003	Thunderstorm Wind	50	0	1,000
Washington, City of	7/8/2003	Thunderstorm Wind	50	0	1,000
Midland	7/8/2003	Thunderstorm Wind	50	0	1,000
Washington County	7/8/2003	Thunderstorm Wind	52	0	2,000
Independence	7/10/2003	Thunderstorm Wind	50	0	5,000
Hickory	7/18/2003	Thunderstorm Wind	50	0	1,000
Washington, City of	7/18/2003	Thunderstorm Wind	50	0	1,000
Burgettstown	7/18/2003	Thunderstorm Wind	50	0	1,000
Washington (Zone)	7/21/2003	High Wind	50	0	1,000

Table 4.3.7-3 Previous wind events over 50 knots (NCDC, 2014).

LOCATION	DATE	TYPE	WIND SPEED	DEATHS/ INJURIES	PROPERTY DAMAGE ($)
Washington, City of	8/26/2003	Thunderstorm Wind	50	0	1,000
Centerville	8/27/2003	Thunderstorm Wind	50	0	0
Cecil	8/27/2003	Thunderstorm Wind	50	0	2,000
Avella	8/27/2003	Thunderstorm Wind	50	0	2,000
Washington, City of	8/27/2003	Thunderstorm Wind	50	0	2,000
Burgettstown	11/12/2003	Thunderstorm Wind	50	0	1,000
Claysville	4/25/2004	Thunderstorm Wind	50	0	0
North Charleroi	5/17/2004	Thunderstorm Wind	50	0	10,000
Fredericktown	5/21/2004	Thunderstorm Wind	50	0	0
Claysville	5/21/2004	Thunderstorm Wind	50	0	0
Burgettstown	6/14/2004	Thunderstorm Wind	50	0	2,000
Canonsburg	6/15/2004	Thunderstorm Wind	50	0	3,000
Washington, City of	6/17/2004	Thunderstorm Wind	50	0	2,000
Washington, City of	8/4/2004	Thunderstorm Wind	50	0	0
Washington, City of	8/19/2004	Thunderstorm Wind	50	0	0
Washington, City of	8/20/2004	Thunderstorm Wind	52	0	2,000
Washington (Zone)	12/1/2004	High Wind	50	0	8,000
Burgettstown	6/14/2005	Thunderstorm Wind	52	0	5,000
Burgettstown	6/28/2005	Thunderstorm Wind	50	0	8,000
Deemstown	6/28/2005	Thunderstorm Wind	50	0	3,000
Bentleyville	6/30/2005	Thunderstorm Wind	50	0	15,000
Charleroi	7/12/2005	Thunderstorm Wind	50	0	6,000
Bentleyville	7/13/2005	Thunderstorm Wind	50	0	3,000
West Alexander	7/25/2005	Thunderstorm Wind	80	0	80,000
Canonsburg	8/7/2005	Thunderstorm Wind	50	0	6,000
Cecil	8/20/2005	Thunderstorm Wind	50	0	4,000
Canonsburg	8/20/2005	Thunderstorm Wind	52	0	30,000
California	8/20/2005	Thunderstorm Wind	50	0	1,000
County-wide	11/6/2005	Thunderstorm Wind	50	0	15,000
County-wide	11/6/2005	Thunderstorm Wind	50	0	20,000
Washington, City of	11/9/2005	Thunderstorm Wind	50	0	8,000
California	4/14/2006	Thunderstorm Wind	50	0	3,000
Washington, City of	4/14/2006	Thunderstorm Wind	50	0	5,000
McDonald	7/30/2006	Thunderstorm Wind	50	0	2,000
County-wide	8/3/2006	Thunderstorm Wind	50	0	14,000
Bishop	10/4/2006	Thunderstorm Wind	50	0	0
Washington (Zone)	12/1/2006	High Wind	55	0	30,000
Washington, City of	3/14/2007	Thunderstorm Wind	50	0	15,000
Marianna	6/8/2007	Thunderstorm Wind	50	0	3,000
Washington County	6/19/2007	Thunderstorm Wind	50	0	3,000

Table 4.3.7-3 Previous wind events over 50 knots (NCDC, 2014).

LOCATION	DATE	TYPE	WIND SPEED	DEATHS/ INJURIES	PROPERTY DAMAGE ($)
Claysville	6/21/2007	Thunderstorm Wind	50	0	3,000
Burgettstown	6/27/2007	Thunderstorm Wind	50	0	2,000
Cecil	8/9/2007	Thunderstorm Wind	50	0	50,000
Washington, City of	8/9/2007	Thunderstorm Wind	50	0	75,000
Mt Herman	8/9/2007	Thunderstorm Wind	50	0	50,000
Marianna	8/9/2007	Thunderstorm Wind	50	0	50,000
Washington (Zone)	1/30/2008	High Wind	50	0	50,000
Washington (Zone)	2/6/2008	High Wind	50	0	50,000
Canonsburg	6/13/2008	Thunderstorm Wind	50	0	75,000
McMurray	6/13/2008	Thunderstorm Wind	50	0	50,000
Canonsburg	6/29/2008	Thunderstorm Wind	50	0	125,000
South Strabane	6/29/2008	Thunderstorm Wind	50	0	75,000
Bentleyville	6/29/2008	Thunderstorm Wind	50	0	50,000
Independence	7/21/2008	Thunderstorm Wind	50	0	75,000
Gretna	7/31/2008	Thunderstorm Wind	50	0	50,000
Washington (Zone)	9/14/2008	High Wind	50	0	150,000
West Finley	2/11/2009	Thunderstorm Wind	50	0	10,000
Washington, City of	2/11/2009	Thunderstorm Wind	50	0	0
Washington (Zone)	2/12/2009	High Wind	50	0	100,000
Donora	5/28/2009	Thunderstorm Wind	50	0	35,000
Denningsville	6/26/2009	Thunderstorm Wind	50	0	25,000
Washington (Zone)	12/9/2009	High Wind	50	0	0
McDonald	4/16/2010	Thunderstorm Wind	50	0	75,000
Bentleyville	4/16/2010	Thunderstorm Wind	55	0	75,000
Finleyville	6/4/2010	Thunderstorm Wind	50	0	50,000
West Middletown	6/4/2010	Thunderstorm Wind	50	0	25,000
Strabane	6/4/2010	Thunderstorm Wind	50	0	10,000
Thomas	6/4/2010	Thunderstorm Wind	50	0	50,000
West Alexander	8/4/2010	Thunderstorm Wind	55	0	50,000
Donora	8/4/2010	Thunderstorm Wind	55	0	30,000
Charleroi	8/4/2010	Thunderstorm Wind	50	0	35,000
Canonsburg	9/22/2010	Thunderstorm Wind	50	0	5,000
Linden	2/28/2011	Thunderstorm Wind	50	0	25,000
Canonsburg	2/28/2011	Thunderstorm Wind	50	0	50,000
Jewell	2/28/2011	Thunderstorm Wind	50	0	15,000
Wylandville	2/28/2011	Thunderstorm Wind	50	0	15,000
Charleroi	3/23/2011	Thunderstorm Wind	50	0	15,000
Charleroi	3/23/2011	Thunderstorm Wind	50	0	10,000
Monongahela	4/26/2011	Thunderstorm Wind	50	0	50,000
Washington, City of	7/11/2011	Thunderstorm Wind	50	0	15,000

Table 4.3.7-3 Previous wind events over 50 knots (NCDC, 2014).

LOCATION	DATE	TYPE	WIND SPEED	DEATHS/ INJURIES	PROPERTY DAMAGE ($)
Donaldsons Crossroads	7/11/2011	Thunderstorm Wind	50	0	10,000
Ginger Hill	7/18/2011	Thunderstorm Wind	50	0	2,000
Bower Hill	8/19/2011	Thunderstorm Wind	50	0	0
Venetia	8/19/2011	Thunderstorm Wind	50	0	25,000
Monongahela	8/19/2011	Thunderstorm Wind	50	0	50,000
Finleyville	8/19/2011	Thunderstorm Wind	50	0	25,000
Finleyville	8/19/2011	Thunderstorm Wind	50	0	25,000
Donora	8/19/2011	Thunderstorm Wind	50	0	35,000
Monongahela	8/19/2011	Thunderstorm Wind	50	0	25,000
Washington (Zone)	2/24/2012	High Wind	50	0	0
Claysville	6/18/2012	Thunderstorm Wind	50	0	5,000
Washington, City of	6/29/2012	Thunderstorm Wind	60	0	2,500
Joffre	8/9/2012	Thunderstorm Wind	50	0	500
Atlasburg	1/30/2013	Thunderstorm Wind	50	0	10,000
Banetown	1/30/2013	Thunderstorm Wind	50	0	10,000
Joffre	1/30/2013	Thunderstorm Wind	50	0	10,000
Cecil	1/30/2013	Thunderstorm Wind	50	0	10,000
Bissell	1/30/2013	Thunderstorm Wind	50	0	10,000
Bower Hill	1/30/2013	Thunderstorm Wind	50	0	0
Walkertown	1/30/2013	Thunderstorm Wind	50	0	10,000
Buffalo	5/21/2013	Thunderstorm Wind	50	0	2,000
Purdy	5/22/2013	Thunderstorm Wind	50	0	1,000
Washington Co. Airport	6/13/2013	Thunderstorm Wind	50	0	1,000
Washington County	6/13/2013	Thunderstorm Wind	50	0	2,000
Glyde	6/18/2013	Thunderstorm Wind	50	0	500
Langeloth	6/25/2013	Thunderstorm Wind	50	0	2,000
Glyde	6/25/2013	Thunderstorm Wind	50	0	2,000
Independence	6/25/2013	Thunderstorm Wind	50	0	2,000
Linden	6/25/2013	Thunderstorm Wind	50	0	2,000
Canonsburg	6/25/2013	Thunderstorm Wind	50	0	2,000
McAdams	6/25/2013	Thunderstorm Wind	50	0	2,000
Gale	6/25/2013	Thunderstorm Wind	50	0	5,000
Dunlevy	6/28/2013	Thunderstorm Wind	50	0	1,000
South Strabane	6/28/2013	Thunderstorm Wind	50	0	2,000
Venice	7/8/2013	Thunderstorm Wind	50	0	15,000
Canonsburg	7/8/2013	Thunderstorm Wind	50	0	15,000
West Alexander	7/10/2013	Thunderstorm Wind	71	0	0
Avella	7/10/2013	Thunderstorm Wind	50	0	10,000
Washington, City of	7/10/2013	Thunderstorm Wind	50	0	2,000
Finney	7/10/2013	Thunderstorm Wind	50	0	15,000

Table 4.3.7-3 Previous wind events over 50 knots (NCDC, 2014).

LOCATION	DATE	TYPE	WIND SPEED	DEATHS/ INJURIES	PROPERTY DAMAGE ($)
Claysville	7/10/2013	Thunderstorm Wind	50	0	10,000
West Alexander	7/10/2013	Thunderstorm Wind	50	0	25,000
Avella	7/23/2013	Thunderstorm Wind	50	0	5,000
Washington County	7/23/2013	Thunderstorm Wind	50	0	5,000
Donora	7/23/2013	Thunderstorm Wind	50	0	10,000
Strabane	11/1/2013	Thunderstorm Wind	50	0	40,000
Roscoe	11/1/2013	Thunderstorm Wind	50	0	50,000
Hamilton	11/17/2013	Thunderstorm Wind	50	0	25,000
Washington, City of	11/17/2013	Thunderstorm Wind	50	0	10,000
Banetwon	11/17/2013	Thunderstorm Wind	50	0	25,000
Washington, City of	12/22/2013	Thunderstorm Wind	50	0	1,000
Van Voorhis	5/7/2014	Thunderstorm Wind	50	0	2,000
Coal Center	5/7/2014	Thunderstorm Wind	50	0	1,500
JEWELL	5/7/2014	Thunderstorm Wind	50	0	500
East Finley	6/11/2014	Thunderstorm Wind	50	0	10,000
Good Intent	6/11/2014	Thunderstorm Wind	50	0	10,000
Pleasant Grove	6/11/2014	Thunderstorm Wind	50	0	5,000
Washington, City of	6/11/2014	Thunderstorm Wind	50	0	20,000
Washington West	6/11/2014	Thunderstorm Wind	50	0	5,000
McConnells Mill	6/11/2014	Thunderstorm Wind	50	0	10,000
Morganza	6/11/2014	Thunderstorm Wind	50	0	3,000
Hendersonville	6/11/2014	Thunderstorm Wind	50	0	3,000
Lawrence Hills	6/11/2014	Thunderstorm Wind	50	0	5,000
Lowhill	6/11/2014	Thunderstorm Wind	50	0	3,000
Lover	6/11/2014	Thunderstorm Wind	50	0	2,000
West Brownsville	6/11/2014	Thunderstorm Wind	50	0	3,000
Roscoe	6/11/2014	Thunderstorm Wind	50	0	5,000
Sudan	6/11/2014	Thunderstorm Wind	50	0	2,000
Frye	6/11/2014	Thunderstorm Wind	50	0	2,000
Speers	6/11/2014	Thunderstorm Wind	50	0	0
Glennes Heights	6/11/2014	Thunderstorm Wind	50	0	5,000
Roscoe	6/11/2014	Thunderstorm Wind	50	0	15,000
Donora	6/11/2014	Thunderstorm Wind	50	0	15,000
Allenport	6/11/2014	Thunderstorm Wind	50	0	15,000
Burgettstown	6/18/2014	Thunderstorm Wind	50	0	2,000
			TOTAL	**0**	**2,889,500**

4.3.7.4. Future Occurrence

The probability of the County and its municipalities experiencing severe winds is difficult to quantify, but is considered high. The County experiences strong winds on frequent basis, and when those winds do strike, it can result in significant property damage, trees down, and utility outages.

Those that have occurred were relatively weak and caused little destruction. Most of Pennsylvania is susceptible to tornadoes of a magnitude of at most an EF-3. It can reasonably be assumed that future tornadoes will be similar in nature to those that have affected the County in the past, and will strike the County once or twice a decade. On the whole, though, the probability of future tornado and windstorm events can be considered *likely* according to the Risk Factor Methodology (see Table 4.4.2-1).

4.3.7.5. Vulnerability Assessment

All critical facilities in Washington County are at least somewhat vulnerable to tornadoes and windstorms. Since high wind events may affect the entire County, it is important to identify specific critical facilities and assets that are most vulnerable to the hazard. Evaluation criteria include age of the building (and what building codes may have been in effect at the time), type of construction, and condition of the structure (i.e., how well has the structure been maintained). Detailed structure attributes were not available for this study, so it was difficult to determine the exact number and types of structures within Washington County that have heightened vulnerability to wind hazards. However, mobile homes and commercial trailers are extremely vulnerable to high winds, especially if they are not well anchored.

Table 4.3.6-4 shows the number of structures on mobile home structures in Washington County. The municipalities with the highest percentage of trailer park structures (relative to total structures) are: Hanover and South Franklin Townships, and Dunlevy, Midway, Beallsville, Stockdale, and New Eagle Boroughs. There may be individual mobile homes or trailers elsewhere in the county, but this information is not captured in the structures GIS database provided for this HMP.

Table 4.3.7-4 Mobile homes per jurisdiction (Washington County GIS)

MUNICIPALITY	TOTAL STRUCTURES	NUMBER OF TRAILER PARK STRUCTURES	PERCENT TRAILER PARK STRUCTURES
Allenport Borough	270	0	0.0%
Amwell Township	1,664	2	0.1%
Beallsville Borough	227	1	0.4%
Bentleyville Borough	1,088	3	0.3%
Blaine Township	273	0	0.0%
Buffalo Township	869	1	0.1%
Burgettstown Borough	668	0	0.0%

Table 4.3.7-4 Mobile homes per jurisdiction (Washington County GIS)

MUNICIPALITY	TOTAL STRUCTURES	NUMBER OF TRAILER PARK STRUCTURES	PERCENT TRAILER PARK STRUCTURES
California Borough	1,789	0	0.0%
Canonsburg Borough	4,070	0	0.0%
Canton Township	3,726	6	0.2%
Carroll Township	2,439	2	0.1%
Cecil Township	5,516	0	0.0%
Centerville Borough	1,685	0	0.0%
Charleroi Borough	2,099	0	0.0%
Chartiers Township	3,600	1	0.0%
Claysville Borough	337	0	0.0%
Coal Center Borough	85	0	0.0%
Cokeburg Borough	367	0	0.0%
Cross Creek Township	761	0	0.0%
Deemston Borough	362	0	0.0%
Donegal Township	1,244	1	0.1%
Donora Borough	2,553	0	0.0%
Dunlevy Borough	216	2	0.9%
East Bethlehem Township	1,258	0	0.0%
East Finley Township	639	0	0.0%
East Washington Borough	653	0	0.0%
Elco Borough	149	0	0.0%
Ellsworth Borough	460	0	0.0%
Fallowfield Township	2,048	2	0.1%
Finleyville Borough	212	0	0.0%
Green Hills Borough	8	0	0.0%
Hanover Township	1,231	6	0.5%
Hopewell Township	423	0	0.0%
Houston Borough	569	0	0.0%
Independence Township	759	0	0.0%
Jefferson Township	536	0	0.0%
Long Branch Borough	248	0	0.0%
Marianna Borough	266	0	0.0%
McDonald Borough	960	0	0.0%
Midway Borough	416	2	0.5%

Table 4.3.7-4 Mobile homes per jurisdiction (Washington County GIS)			
MUNICIPALITY	**TOTAL STRUCTURES**	**NUMBER OF TRAILER PARK STRUCTURES**	**PERCENT TRAILER PARK STRUCTURES**
Monongahela, City of	2,093	0	0.0%
Morris Township	477	0	0.0%
Mount Pleasant Township	1,676	0	0.0%
New Eagle Borough	988	4	0.4%
North Bethlehem Township	773	1	0.1%
North Charleroi Borough	586	0	0.0%
North Franklin Township	1,960	0	0.0%
North Strabane Township	6,094	1	0.0%
Nottingham Township	1,287	1	0.1%
Peters Township	8,286	0	0.0%
Robinson Township	903	0	0.0%
Roscoe Borough	403	0	0.0%
Smith Township	2,173	0	0.0%
Somerset Township	1,308	3	0.2%
South Franklin Township	1,458	6	0.4%
South Strabane Township	3,934	0	0.0%
Speers Borough	606	0	0.0%
Stockdale Borough	252	1	0.4%
Twilight Borough	106	0	0.0%
Union Township	2,797	1	0.0%
Washington, City of	5,585	1	0.0%
West Bethlehem Township	697	0	0.0%
West Brownsville Borough	529	0	0.0%
West Finley Township	425	0	0.0%
West Middletown Borough	85	0	0.0%
West Pike Run Township	826	0	0.0%
TOTAL	**93,050**	**48**	**0.1%**

4.3.8. Winter Storm

4.3.8.1. Location and Extent

Winter storms consist of cold temperatures and heavy snow or ice. Because winter storms are regular annual occurrences in Pennsylvania, they are considered hazards only when they result in damage to specific structures and/or overwhelm local capabilities to handle disruptions to traffic, communications, and electric power.

Winter storms occur on the average of five times a year in Pennsylvania. From November through March, the commonwealth is subjected to winter storms moving up the Atlantic Seaboard, or sweeping in from the West.

Average annual snowfall in Washington County ranges from 30 to 50 inches, with the higher snowfall occurring in the northwest portion of the County. See Figure 4.3.8-1 for the mean annual snowfall in Pennsylvania.

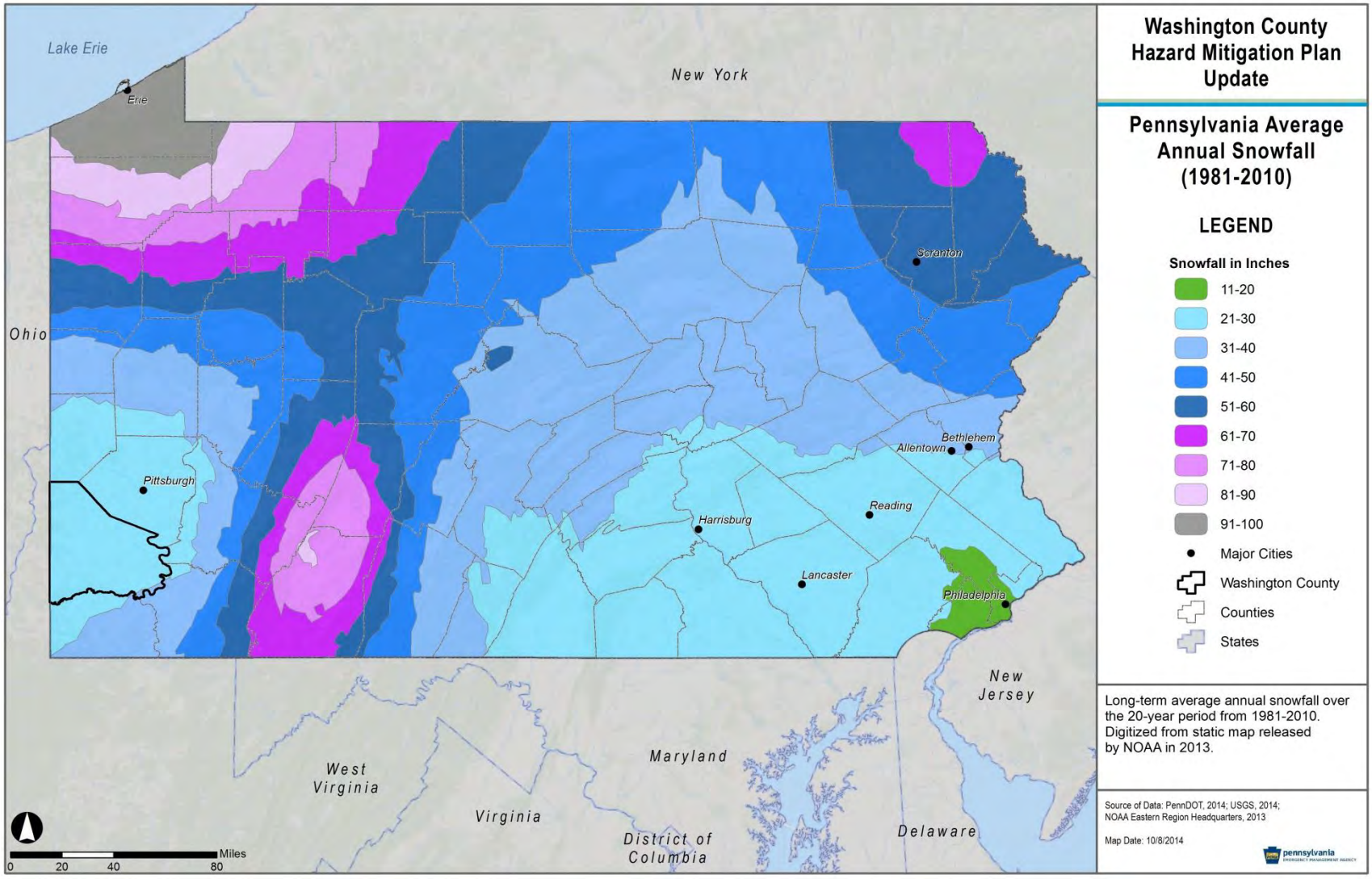
4.3.8.2. Range of Magnitude

Winter storms can produce more damage than any other severe weather event, including tornadoes. These storms cause damage to communication networks, kill vegetation, collapse structures as a result of ice loading and falling tree limbs, and cause traffic accidents. The Weather Bureau estimates that 85 percent of ice storm deaths are traffic related. Flooding can also be a damaging by-product of winter storms, due to a rapid thaw.

Winter storms consist of cold temperatures, heavy snow or ice and sometimes strong winds. They begin as low-pressure systems that move through Pennsylvania usually following the jet stream. A winter storm can adversely affect roadways, utilities, business activities, and can cause loss of life, frostbite and freezing conditions. They can result in the closing of secondary roads, particularly in rural locations, loss of utility services and depletion of oil heating supplies. These storms typically fall into one of the following categories:

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

Figure 4.3.8-1 Pennsylvania mean annual snowfall (NOAA NWS, 2012).



Storms tracking up the east coast tap into Atlantic moisture, whereas the Great Lakes supply the moisture and instability for heavy snow squalls in the northwest. Orographic lift enhances snowfall over higher elevations (note particularly higher average snowfall in Somerset County in the Allegheny Mountains). The snowfall season is November through April, and amounts are generally below one inch during October and May. The greatest monthly snowfalls occur in March as moisture supply begins to increase with rising temperatures.

Some rural areas of the County are susceptible to isolation during winter storms due to power and communication loss as well as road closings. Emergency medical, food, and fuel supplies are sometimes required during these storms.

The worst winter storm in Washington County occurred in January 1977, when bitter cold coupled with ice and snowstorms and a fuel shortage resulted in a state of emergency. Many county resources were diverted into the effort to ensure the health and safety of county residents. For a period of approximately 10 days, the Civil Defense office utilized the services of hundreds of volunteers as well as the Pennsylvania National Guard to man telephones and deliver fuel to residents in isolated areas.

Environmental impacts often include damage shrubbery and trees due to heavy snow loading, ice build-up and/or high winds which can break limbs or even bring down large trees. An indirect effect of winter storms is the treatment of roadway surfaces with salt, chemicals, and other de-icing materials which can impair adjacent surface and ground waters. Another important secondary impact for winter storms is building or structure collapses; if there is a heavy snowfall or a significant accumulation over time, the weight of the snow may cause building damage or even collapse.

Winter storms have a positive environmental impact as well; gradual melting of snow and ice provides excellent groundwater recharge. However, abrupt high temperatures following a heavy snowfall can cause rapid surface water runoff and severe flooding.

4.3.8.3. Past Occurrence

Washington County has experienced many major winter storms. In January 1977, January and February 1994, January 1996, and February 2003, statewide Emergency Declarations and Presidential Disaster Declarations were issued because of heavy snow and severe winter storms. Emergency Declarations was also issued in March 1993 due to blizzard conditions – high winds and snow. In January 1999, January 1996, January 1994, and March 1993, deep snows, high winds, and cold temperatures resulted in a state of emergency in Washington County. Many county residents were without power for several days. Some residents even lost natural gas service. Many county roads and highways were impassable for as long as a week. The Department of Public Safety utilized the services of volunteers, county employees, and the Pennsylvania National Guard to help clear roads and relocate residents. The Department of Public Safety also has had to coordinate fuel delivery to residents during snow events.

One of the most severe winter weather seasons occurred in the winter of 1993-1994, when the state was hit by a series of protracted winter storms. The severity and nature of these storms, combined with record-breaking frigid temperatures, posed a major threat to the lives, safety, and

well-being of Commonwealth residents and caused major disruptions to the activities of schools, businesses, hospitals, and nursing homes. Washington County was

The first of these devastating winter storms occurred in early January, with record snowfall depths (in excess of 33 inches in the southwest and south-central portions of the Commonwealth), strong winds, and sleet/freezing rain. Numerous storm-related power outages were reported, and as many as 600,000 residents were without electricity, in some cases for several days at a time. A ravaging ice storm followed, affecting the southeastern portion of the Commonwealth, which closed major arterial roads and downed trees and power lines. Utility crews from a five-state area were called to assist in power restoration repairs. Officials from PP&L stated that this was the worst winter storm in the history of the company, and related damage-repair costs exceeded $5,000,000.

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

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

During January and February 1994, Pennsylvania experienced at least 17 regional or statewide winter storms. The consequences of these disasters resulted in the need for intervention by the president in an effort to alleviate the severity of the hardship and to aid the recovery of the hardest-hit counties.

In January 1996, another series of severe winter storms with 27- and 24-inch accumulated snow depths was followed by 50 to 60 degree temperatures, resulting in rapid melting and flooding (as described in the preceding section on flood hazard vulnerability assessment). Washington County documented its greatest snowfall in history that year: 87.7 inches. Included in these storms was the blizzard of 1996, which dumped as much as 40 inches of snow on some parts of Pennsylvania. Many communities could not maintain emergency corridors necessary to sustain operations at critical health and safety facilities. President Clinton included the state in a list of federally declared disaster areas to receive funding for emergency snow removal.

Tables 4.3.7-1 presents a history of the winter storms that have affected Washington County prior to 1996, when NCDC began keeping comprehensive winter storm event records.

Table 4.3.8-1 Previous winter storms events in Washington County from 1972-1995 (Washington County Department of Public Safety)			
DATE	**TYPE OF STORM**	**AREAS AFFECTED**	**EMERGENCY DECLARED**
1/20/1972	Heavy Snow	Statewide	Governor
12/2/1974	Heavy Snow and Power Outage	Southwestern Counties	Governor
1/9/1977	Fuel Shortage and Severe Weather	Washington and 20 other PA counties	President and Governor
1/20/1978	Heavy Snow	Statewide	Governor
2/6/1978	Blizzard	Statewide	Governor
3/1993	Blizzard	Statewide	President and Governor
1/1994	Severe Winter Storms	Statewide	President and Governor
1/1995	Heavy Snow	Statewide	None

Events occurring in 1996 and after are presented in Table 4.3.7-2. Since 2010 alone, Washington County has witnessed 9 heavy snow events and 8 winter storms.

Table 4.3.8-2 Previous winter storms events in Washington County from 1996-2014 (NCDC, 2014).				
LOCATION	**DATE**	**TYPE**	**DEATHS/ INJURIES**	**PROPERTY DAMAGE ($)**
Washington (zone)	1/6/1996	Heavy Snow	0	$0
Washington (zone)	2/13/1997	Ice Storm	0	$0
Washington (zone)	1/2/1999	Winter Storm	0	$0
Washington (zone)	1/8/1999	Winter Storm	0	$0
Washington (zone)	1/13/1999	Winter Storm	0	$0
Washington (zone)	3/9/1999	Heavy Snow	2	$0
Washington (zone)	12/13/2000	Winter Storm	0	$0
Washington (zone)	1/20/2001	Heavy Snow	0	$0
Washington (zone)	1/7/2002	Heavy Snow	0	$0
Washington (zone)	12/11/2002	Ice Storm	0	$0
Washington (zone)	2/16/2003	Heavy Snow	0	$0
Washington (zone)	12/5/2003	Heavy Snow	0	$0
Washington (zone)	12/14/2003	Heavy Snow	0	$0
Washington (zone)	2/5/2004	Ice Storm	0	$0
Washington (zone)	1/22/2005	Heavy Snow	0	$0
Washington (zone)	3/1/2005	Heavy Snow	0	$0
Washington (zone)	12/15/2005	Ice Storm	0	$0
Washington (zone)	2/13/2007	Ice Storm	0	$0
Washington (zone)	1/27/2009	Ice Storm	0	$0

Table 4.3.8-2 Previous winter storms events in Washington County from 1996-2014 (NCDC, 2014).				
LOCATION	**DATE**	**TYPE**	**DEATHS/ INJURIES**	**PROPERTY DAMAGE ($)**
Washington (zone)	2/5/2010	Heavy Snow	0	$0
Washington (zone)	2/21/2011	Heavy Snow	0	$0
Washington (zone)	1/20/2012	Ice Storm	0	$0
Washington (zone)	12/26/2012	Ice Storm	0	$0
Washington (zone)	3/5/2013	Heavy Snow	0	$0
Washington (zone)	2/4/2014	Winter Storm	0	$0
		TOTAL	**2**	**$0**

4.3.8.4. Future Occurrence

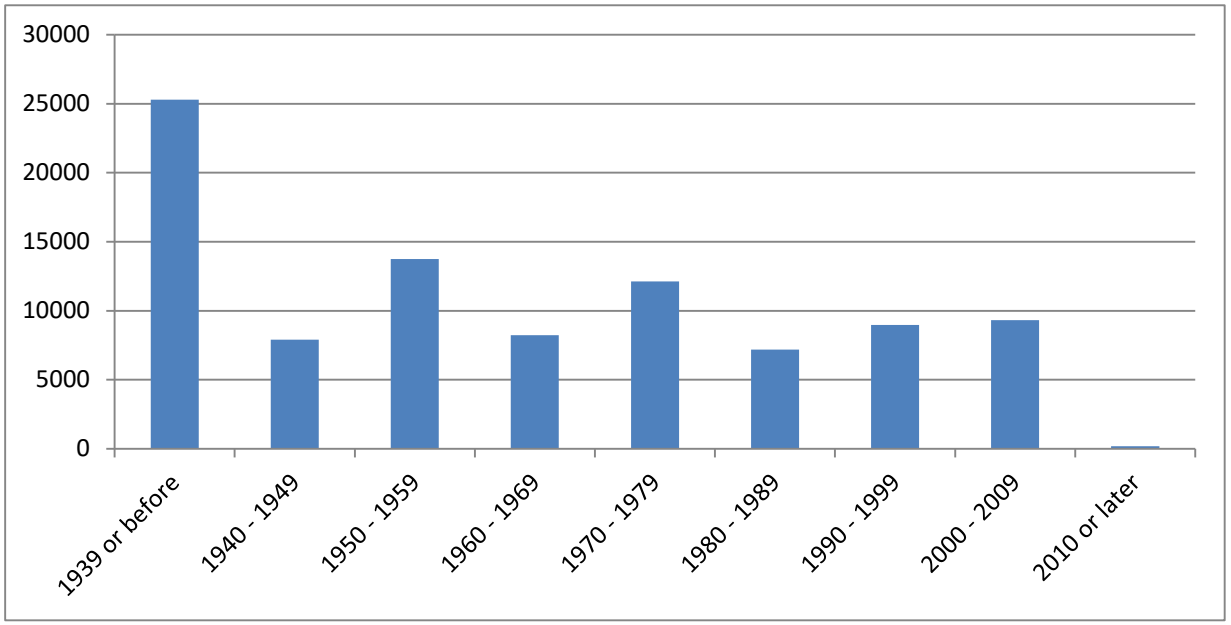
The severity and frequency of major winter storms is expected to remain fairly constant. However, due to increased dependence on various modes of transportation and use of public utilities for light, heat, and power, the disruption from these storms is more significant today than in the past.

The future occurrence of climatic events cannot be predicted exactly. As noted in the table above, the County has only been affected by four winter storm events in one year - 1999. Given this record of reported events, it is safe for planning purposes to assume that in an average year the County can expect to experience one or two winter storm events. On the whole, though, the probability of future winter storm events can be considered *highly likely* according to the Risk Factor Methodology (see Table 4.4.2-1).

4.3.8.5. Vulnerability Assessment

In Washington County, wintertime snow accumulations are expected and normal. The most common, but potentially serious, effects of very heavy snowstorms with accumulations exceeding six or more inches in a 12-hour period are snow drifts causing road closures, traffic accidents, interruptions in power supply and communications, and the failure of inadequately designed and/or maintained roofing systems. Some rural areas of the County are susceptible to isolation due to the loss of telephone communications and road closings. Power failure and interruption of water supplies are common from ice storms, heavy snow, and blizzard conditions. All critical facilities in Washington County are vulnerable to winter storms. Vulnerability to the effects of winter storms on buildings is dependent on the age of the building (and what building codes may have been in effect at the time), type of construction, and condition of the structure (i.e., how well the structure has been maintained). It is assumed that older structures are more vulnerable, but additional information on construction type and building codes enforced at time of construction would allow a more thorough assessment of the vulnerability of structures to winter storm impacts such as severe wind and heavy snow loading. Figure 4.3.7-2 shows the distribution of building ages in Washington County; just over a quarter of all buildings were constructed prior to 1939 in Washington County.

Figure 4.3.8-2 Age of structures for buildings with known ages (2012 ACS – US Census).



Pennsylvania and Washington County experience several winter storms every year that can create power loss, among other obvious adverse effects. The series of storms in early 1994 and 1996 were presidentially declared disasters. Heavy snowstorm, sleet storm, ice storm, blizzard, and severe blizzard are the types of winter storms possible in Washington County. Due to the frequency of past events and a relatively high annual probability for high snow depths, winter storms are very likely to continue affecting normal activity in the County in the coming years.

HUMAN-MADE HAZARDS

4.3.9. Dam Failure

Due to data sensitivity, for the Dam Failure Profile, please see Appendix G.

4.3.10. Environmental Hazards: Conventional and Unconventional Well Drilling

4.3.10.1. Location and Extent

One of the dominant industries in Washington County is extraction; both coal mining and (conventional and unconventional) oil and gas well drilling. Coal mining has occurred in Washington County since the 1700s, with conventional drilling and unconventional drilling becoming more prevalent in recent decades. Since the primary impact of coal mining is land failure and subsidence, it is addressed in Section 4.3.5.

The growth of well drilling poses a much larger threat to Washington County's public and environmental safety, so this section will largely explore the hazard posed by the two types of well. Conventional wells are traditional vertical wells, while unconventional wells are typically horizontally drilled wells commonly associated with the Marcellus Shale. Both types pose similar risks in the case of an incident and impacts on the surrounding infrastructure, however unconventional drilling can have more wide-spread impacts on the environmental.

In recent years, the advancement in drilling technology and capability has allowed for natural gas extraction from the Marcellus Shale formation which exists at a depth of 5,000 to 8,000 feet (PA DEP-BOGM, 2010a). Marcellus Shale natural gas extraction presents new and unique challenges and hazards in the Commonwealth. The Marcellus Shale and the Utica Shale formations are located underneath the all of Washington County, which has led to an explosion of natural gas well drilling in the County, in addition to the traditional drilling. Activities associated with Marcellus Shale gas drilling can cause fire and pollute streams and drinking water. Additional hazards from oil and gas well drilling or particular concern to Washington County exist in stray methane gas in the subsurface, which can migrate to wells and homes and ignite.

Washington County has 1,225 active natural gas drilling sites, and approximately another 408 well permits for sites that have not yet been drilled or have not materialized yet (as of July 2014). Additionally, the County has 4,187 active conventional wells, with an additional 877 that have been proposed and issues permits, but have not yet materialized. In just five years, between 2009 and 2013, 1,289 permits for natural gas drilling were issued. See Table 4.3.8-1 for the status of the well permits for both conventional and unconventional wells, Table 4.3.8-2 shows a breakdown of unconventional permits issued per year, and Table 4.3.8-3 shows the number of (conventional and unconventional) permits per municipality. The industry is highly regulated by the Pennsylvania DEP, and local response agencies have been trained to deal with accidents at the sites, but the threat of releases, fire, and explosions remains.

Table 4.3.10-1 Number of well per year from 2006-2014 (DCNR).

PERMIT STATUS	NUMBER OF CONVENTIONAL WELLS	NUMBER OF UNCONVENTIONAL WELLS
Active	4,187	1,225
Plugged OG Well	-	37
Operator Reported Not Drilled	-	311
Regulatory Inactive Status	-	25
Proposed But Never Materialized	877	97
Abandoned	201	-
Inactive	1,139	-
Total	**6,404**	**1,695**

Table 4.3.10-2 Number of well permits issued per year from 2006-2014 (DCNR).

YEAR	PERMITS
1982	1
2002	1
2003	2
2005	10
2006	0
2007	12
2008	50

Table 4.3.10-2 Number of well permits issued per year from 2006-2014 (DCNR).	
YEAR	**PERMITS**
2009	105
2010	224
2012	306
2013	297
2014	266

Table 4.3.10-3 Number of well permits in Washington County by municipality as of July 2014 (DCNR).		
MUNICIPALITY	**NUMBER OF CONVENTIONAL PERMITS ISSUED**	**NUMBER OF UNCONVENTIONAL PERMITS ISSUED**
Allenport Borough	7	0
Amwell Township	419	192
Beallsville Borough	30	0
Bentleyville Borough	24	0
Blaine Township	205	15
Buffalo Township	180	44
Burgettstown Borough	0	0
California Borough	113	0
Canonsburg Borough	2	0
Canton Township	75	33
Carroll Township	207	25
Cecil Township	184	20
Centerville Borough	156	5
Charleroi Borough	13	0
Chartiers Township	193	87
Claysville Borough	0	0
Coal Center Borough	0	0
Cokeburg Borough	0	0
Cross Creek Township	186	142
Deemston Borough	178	14
Donegal Township	283	82
Donora Borough	3	0
Dunlevy Borough	4	0
East Bethlehem Township	68	5
East Finley Township	298	22
East Washington Borough	1	0
Elco Borough	2	0
Ellsworth Borough	0	0

Table 4.3.10-3 Number of well permits in Washington County by municipality as of July 2014 (DCNR).		
MUNICIPALITY	**NUMBER OF CONVENTIONAL PERMITS ISSUED**	**NUMBER OF UNCONVENTIONAL PERMITS ISSUED**
Fallowfield Township	302	7
Finleyville Borough	0	0
Green Hills Borough	2	0
Hanover Township	157	43
Hopewell Township	170	147
Houston Borough	1	0
Independence Township	147	113
Jefferson Township	50	21
Long Branch Borough	30	0
Marianna Borough	4	0
McDonald Borough	1	0
Midway Borough	1	0
Monongahela, City of	8	0
Morris Township	347	104
Mount Pleasant Township	267	130
New Eagle Borough	5	0
North Bethlehem Township	155	36
North Charleroi Borough	3	0
North Franklin Township	54	19
North Strabane Township	99	13
Nottingham Township	121	4
Peters Township	45	0
Robinson Township	80	55
Roscoe Borough	1	0
Smith Township	141	58
Somerset Township	306	62
South Franklin Township	192	42
South Strabane Township	99	6
Speers Borough	7	0
Stockdale Borough	0	0
Twilight Borough	12	0
Union Township	134	19
Washington, City of	0	0
West Bethlehem Township	165	41
West Brownsville Borough	1	0
West Finley Township	200	62
West Middletown Borough	0	0

Table 4.3.10-3 Number of well permits in Washington County by municipality as of July 2014 (DCNR).		
MUNICIPALITY	**NUMBER OF CONVENTIONAL PERMITS ISSUED**	**NUMBER OF UNCONVENTIONAL PERMITS ISSUED**
West Pike Run Township	263	27
TOTAL	**6,404**	**1,695**

Figure 4.3.8-1 shows the location of the conventional gas wells and permits in Washington County. While, Figure 4.3.8-2 shows the location of the unconventional gas wells and permits in Washington County.

4.3.10.2. Range of Magnitude

With traditional, conventional wells, water supplies, both groundwater and surface are at risk of contamination from brine and other pollutants including methane which can also pose a fire hazard. This can happen at any time during the extraction (and production) process or transport, but also if an abandoned well is not properly plugged. Marcellus Shale play drilling has introduced a new set of hazards to the oil and gas industry in addition to the normal risks associated with the industry. The Marcellus Shale formation exists at a depth normally between 5,000 and 8,000 feet and holds trillions of cubic feet of natural gas. Extraction from this depth was previously not feasible, but as drilling technology has improved over the years, recovering natural gas from Marcellus Shale is now possible (PA DEP-BOGM, 2010a).

This extraction process is different from traditional natural gas extraction in that it often requires horizontal drilling. Horizontal drilling is accomplished by hydraulic fracturing, which involves pumping one to eight million gallons of water, mixed with sand and other additives, including hydrochloric or muriatic acid, into the shale formation. The fluid or “frac fluid” that is recovered from this process must be properly treated as the water quality is very poor.

Frac fluid is extremely saline and can be three to six times as salty as sea water. Other contaminants can include barium, bromine, lithium strontium, sulfate, ammonium, and very high concentrations of total dissolved solids (TDS). There is also some concern about normally occurring radioactive materials present in shale and potentially present in recovered drilling fluid, but there is very little data available on the radioactivity of frac fluid in Pennsylvania (Kirby, 2010). Currently there is no known technology to treat water with this level of salinity (Vidic, 2010). High levels of TDSs, though not harmful to humans, can be extremely harmful to aquatic life and can damage industrial equipment. Often recovered frac fluid is stored in earthen impoundments and after treatment is taken to a sewage treatment facility. There is concern surrounding the toxic solid waste that remains after frac fluid is treated.

Marcellus gas well drilling can have a variety of effects on the environment. For example, some areas have experienced stray methane gas in the subsurface; under certain conditions, this methane can migrate to private water supply wells and ultimately into a house or structure. Unmitigated methane can build to explosive concentrations. A proper well vent allows methane

to vent to the atmosphere rather than build up to explosive levels. The risk of an explosion from stray methane varies from location to location based on site-specific conditions.

Surface waters and soil are sometimes polluted by brine, a salty wastewater product of gas well drilling, and from spills occurring at the drilling site or from a pipeline breach. This can spoil public drinking water supplies and be particularly detrimental to vegetation and aquatic animals.

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

In addition to the traditional hazards associated with oil and gas well drilling, potential impacts from Marcellus Shale gas well drilling include the following:

- Surface water depletion from high consumptive use with low return rates affecting drinking water supplies and aquatic ecosystems and organisms;
- Contaminated surface and groundwater resulting from hydraulic fracturing and the recovery of contaminated hydraulic fracturing fluid;
- Mishandling of solid toxic waste.

Figure 4.3.10-1 Conventional oil & gas well locations in Washington County.

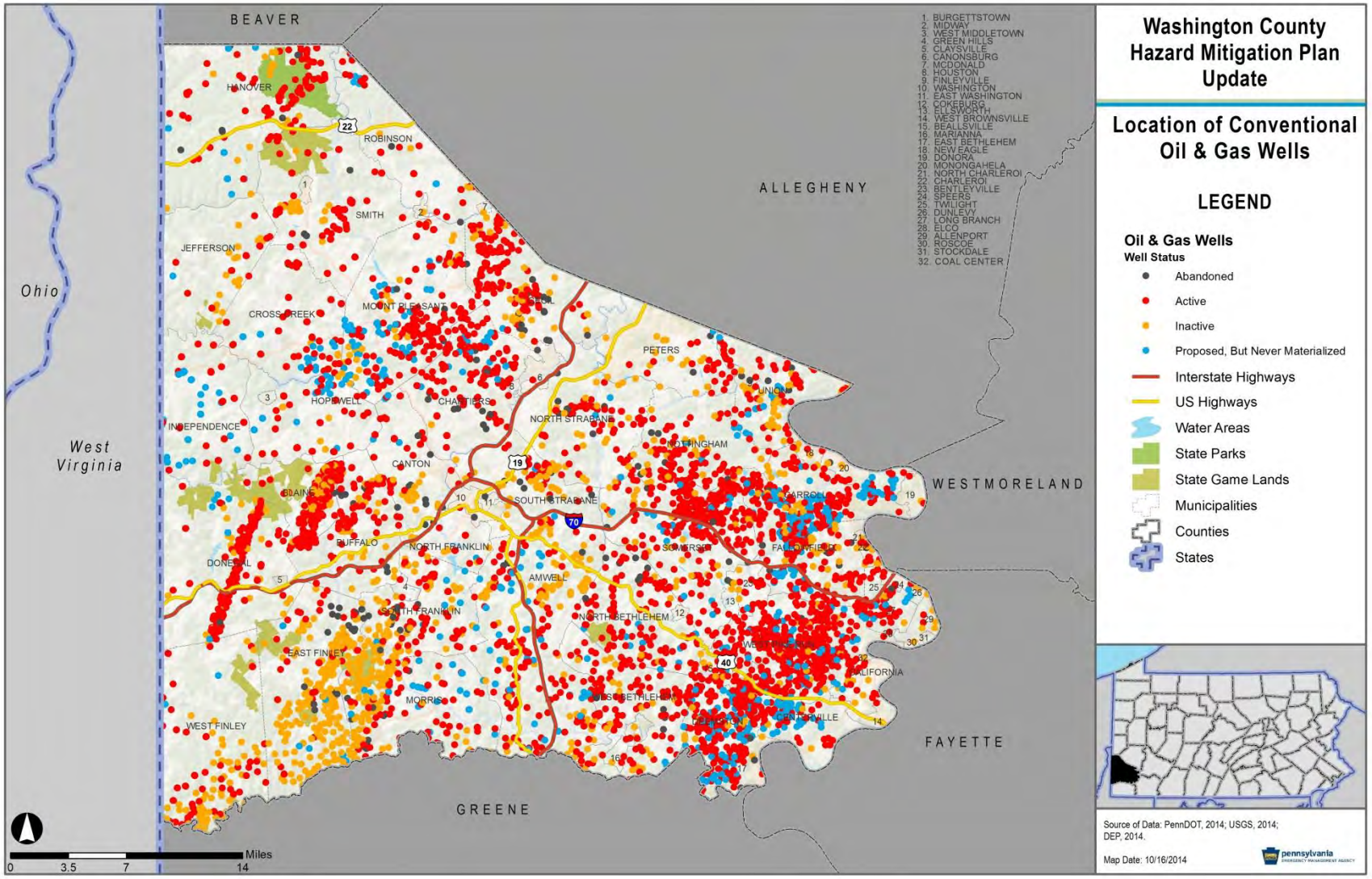
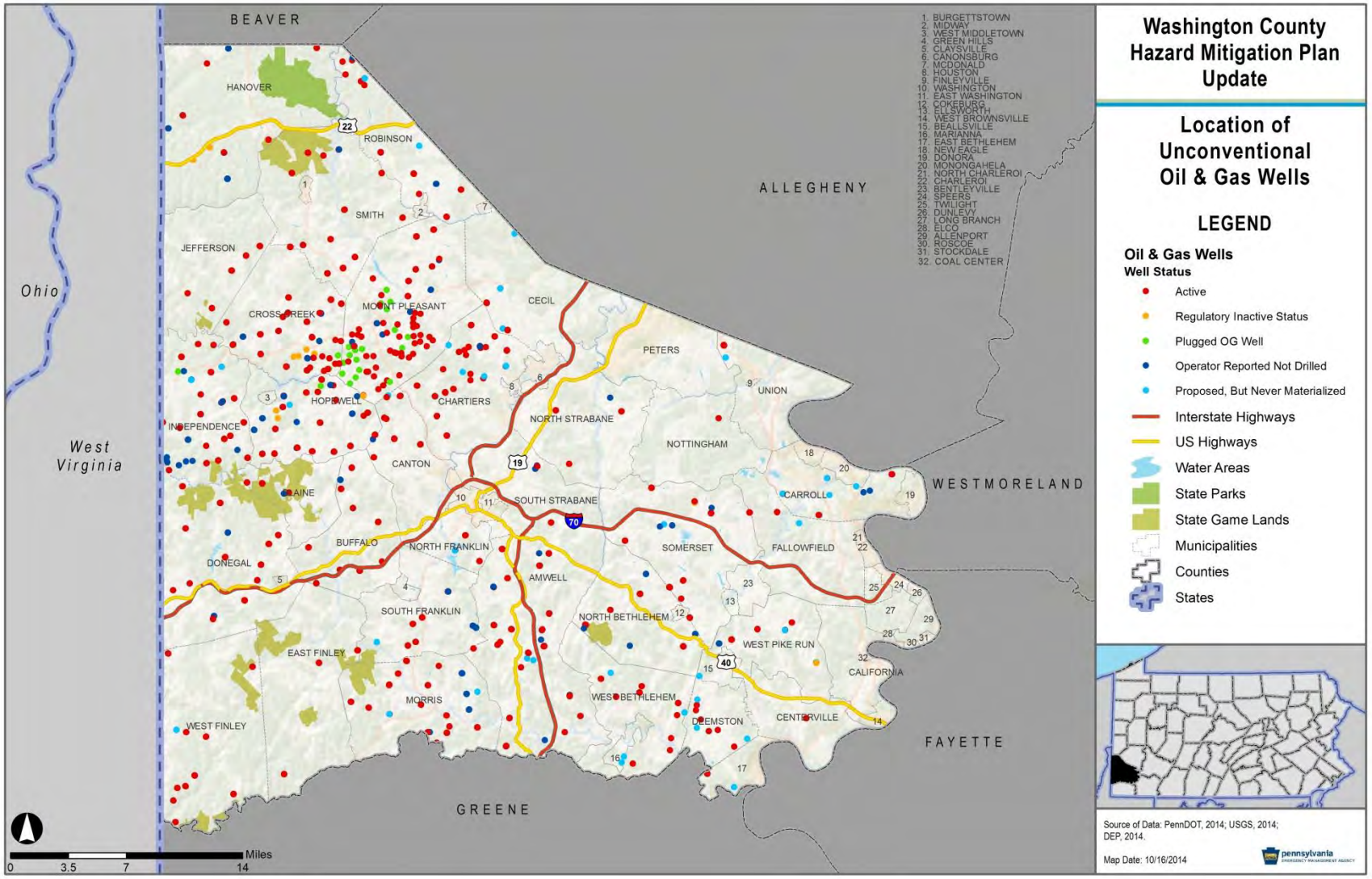


Figure 4.3.10-2 Unconventional oil & gas well locations in Washington County.



With a natural gas release, whether accidental or intentional, there are several potentially exacerbating or mitigating circumstances that will affect its severity or impact. Exacerbating conditions are characteristics that can enhance or magnify the effects of a hazard. Mitigating conditions, on the other hand, are characteristics of the target and its physical environment that can reduce the effects of a hazard. These conditions include the following:

- **Weather conditions:** affects how the hazard occurs and develops
- **Micro-meteorological effects of buildings and terrain:** alters dispersion of hazardous materials
- **Shielding in the form of sheltering-in-place**: protects people and property from harmful effects
- **Non-compliance with applicable codes (e.g. building or fire codes) and maintenance failures (e.g. fire protection and containment features):** can substantially increase the damage to the facility itself and to surrounding buildings

The severity of the incident varies with concentration of natural gas released and the distance and related response time for emergency response teams. The areas within closest proximity to the releases are generally at greatest risk, yet a release can travel great distances, resulting in far-reaching effects on people and the environment.

Impacts of incidents at natural gas drilling sites can vary from relatively minor to catastrophic. If a large volume of natural gas escapes from a well at the surface, it will expand and spread over a large area. The potential for a major explosion of the gas exists; this explosion could kill hundreds of people, destroy property, spark wildland and urban fires, overwhelm the local EMS services and hospitals with the influx of casualties, force evacuations, close roads, cause utility outages (if a power or telephone transmission line is damaged), etc.

The worst-case scenario for an oil or gas well incident would be if there was a discharge of pollutant material like frac fluid into the waterways of Washington County. This is particularly and issue in the northwestern portion of the county, where residents rely on domestic water wells for their potable water supply.

The impacts of oil and natural gas wells range in magnitude and extent. There are several potential impacts, including those on water, land, and air. Common accidents involving gas well sites include “blowouts,” which are an explosion or failure of the rig, as well as the potential for chemical contamination. The water used for hydraulic fracturing is composed of 87 chemicals, some of which have the potential to cause a danger to health of life (PA DEP, 2010). Beyond the purely environmental impacts of drilling, Washington County is likely to be see significant indirect effects on its transportation infrastructure and land cover. These indirect effects are explored in Section 4.3.8.4 as they are likely to impact Washington County as a whole and over the long-term, rather than in the case of a specific incident.

4.3.10.3. Past Occurrence

Pennsylvania has a long history of oil and gas well drilling and though infrequent, many accidents and incidents have occurred related to the extraction of these natural resources. While no comprehensive list of oil and gas related incidents exists for the area, the PA DEP has made oil and gas well compliance information available to the public. Since January 1, 2000,

there have been 395 environmental health and safety violations at oil and gas wells in Washington County. Of these violations, 253 occurred at unconventional wells and the remaining 142 were conventional well violations. These violations range in severity, from failure to implement protective plans like erosion and sedimentation control plans and encroachment plans to more serious infractions like discharging pollutional materials into the waters of the Commonwealth. The most common infractions were:

1. Failure to minimize accelerated erosion, implement Erosion & Sedimentation (E&S) plan, maintain E&S controls, and failure to stabilize site until total site restoration (88 violations).
2. Failure to properly control or dispose of industrial or residual waste to prevent water pollution (69 violations).

There are limited qualitative details on oil and gas incidents and violations. One known incident in Washington County was in March 2010, an impoundment used to collect waste water from natural gas drilling ignited. There were no injuries, or damage reported. Additionally, FracTracker Alliance, a non-profit organization dedicated to enhancing the public's understanding of the oil and gas industry, has made data available ton incidences where DEP has confirmed causality between an incident and an oil and gas well. Of the 48 groundwater complaints reported to the PADEP, four have been proven to show causality between the oil and gas activity and the water complaint. For the other 44 complaints, causality is not determined (FracTracker, 2014).

4.3.10.4. Future Occurrence

The likelihood of a conventional well drilling incident or an emergency at a natural gas drilling site in Washington County cannot be determined at this time, as there is little historical data to analyze. However, the likelihood of an incident within the County is expected to increase with the dramatic increase in the number of well sites.

Future emergencies will occur at well sites as well as along the natural gas transportation network. The following table illustrates the increase in truck traffic from a single well. As more permits are issued, this traffic will increase further. Also, the County will face an increased risk of pipeline emergencies as the related infrastructure is put in place.

The conventional and unconventional well drilling in Washington County not only implies the increased risk of an incident (that can include a chemical release, a fire, and/or an explosion) as well as the likelihood of a spill and ground (or surface) water contamination, but also increased development and deforestation, both which result in significantly more stress on the existing (transportation) infrastructure and impervious surface. The implications of the increased use of the transportation infrastructure are rather straightforward. The natural gas drilling process requires 2,300 to 4,000 truck trips per well (Cassidy, 2014), so that not only are there more trucks on the roads, but they are using roads often designed for heavy use. Increased use of the roads by heavy trucks can significantly increase the wear-and-tear on the roads (which were, in most cases, not designed for that type of traffic) and subsequently increase the likelihood of traffic accidents.

Careful consideration of which roads are actually suitable for heavy, industrial use and improved safety measures (including more traffic signals and officers, or a planned trucking schedule) could help reduce traffic accidents and infrastructure degradation (Cassidy, 2014). Additionally, the industry could take responsibility for improving maintenance of the infrastructure and scheduling of their traffic so as to keep heavy truck flow to certain hours and thereby minimize accidents.

Impervious surfaces can increase the risk of flooding (as rain or run-off can no longer readily seep into the ground) and can prove exceedingly detrimental to maintaining a balanced ecosystem. Estimates vary slightly (based on location, technology, etc.), but the average footprint of a well pad is 1.3 hectares and the associated infrastructure is 10.3 hectares (Evans and Kiesecker, 2014; Environment America, 2013). If the indirect impact are considered as well, this then the total land disturbance, and impact on the permeability of the ground, is 20.2 hectares, or about 50 acres (Evans and Kiesecker, 2014). If this unit is applied to the number of new wells in the past five years in Washington County, then about 26,038 hectares (101 square miles), roughly 12% of the total area of the County, was disturbed by or converted to a fracking use.

If continued investment and development in the natural gas industry is inevitable, then the County should take measures to plan for future development to help mitigate the impacts of well drilling on transportation infrastructure and impervious surfaces. One major component of this is the regulation of new well pads siting locations. The design and process of a shale, horizontal well, is such that the placement of the well pad is much more flexible (as there are multiple lateral wells that extend to a greater area), and the siting has the ability to take impacts to natural habitats into account. In determining more ecologically appropriate locations that reduce potential runoff, the County could require a setback from streams and wetlands, as well as avoidance of development on areas with a steep slope. Additionally, greater care and oversight could be taken to balance future well development with watershed needs and conservation goals.

On the whole, the probability of future natural gas drilling incident events can be considered *likely* according to the Risk Factor Methodology (see Table 4.4.2-1).

4.3.10.5. Vulnerability Assessment

Vulnerability to oil and gas well incidents is defined as being located within 1,000 yards of an unconventional oil or gas well. This buffer is what DEP uses as its “zone of culpability” for oil and gas well incidents. While explosions or other catastrophic incidents at an oil or gas well could cause property damage, of primary concern is the population living near these wells. Table 4.3.8-4 enumerates the populations living within 1,000 yards of a conventional oil and gas well, while Table 4.3.8-5 enumerates the populations living within 1,000 yards of an unconventional oil and gas well. These were calculated by intersecting the 2010 Census Block centroids with the zone of culpability as defined by DEP. This analysis indicates 81.2% of the County’s population is vulnerable (within 1,000 yards) to impacts of a conventional oil or gas well incident (including 40 municipalities with 90% or more of their population living in the zone of culpability). Additionally, over half of the population of Independence, Hopewell, Cross Creek,

Morris, and Mount Pleasant Townships, and Cokeburg and Stockdale Boroughs are vulnerable to experiencing the impacts of an unconventional oil or gas well incident.

Table 4.3.10-4 Populations Vulnerable to Conventional Oil and Gas Drilling Incidents.

MUNICIPALITY	TOTAL 2010 POPULATION	2010 POPULATION WITHIN 1,000 YARDS OF UNCONVENTIONAL OIL/GAS WELL	PERCENT POPULATION WITHIN 1,000 YARDS OF CONVENTIONAL OIL/GAS WELL
Allenport Borough	537	537	100.0%
Amwell Township	3,751	3,275	87.3%
Beallsville Borough	466	466	100.0%
Bentleyville Borough	2,581	2,581	100.0%
Blaine Township	690	688	99.7%
Buffalo Township	2,069	1,952	94.3%
Burgettstown Borough	1,388	412	29.7%
California Borough	6,795	4,107	60.4%
Canonsburg Borough	8,992	6,072	67.5%
Canton Township	8,375	6,835	81.6%
Carroll Township	5,640	5,525	98.0%
Cecil Township	11,271	8,863	78.6%
Centerville Borough	3,263	2,774	85.0%
Charleroi Borough	4,120	4,091	99.3%
Chartiers Township	7,818	7,240	92.6%
Claysville Borough	829	426	51.4%
Coal Center Borough	139	139	100.0%
Cokeburg Borough	630	630	100.0%
Cross Creek Township	1,556	1,053	67.7%
Deemston Borough	722	722	100.0%
Donegal Township	2,465	1,438	58.3%
Donora Borough	4,781	4,258	89.1%
Dunlevy Borough	381	381	100.0%
East Bethlehem Township	2,354	2,352	99.9%
East Finley Township	1,392	1,310	94.1%
East Washington Borough	2,234	1,811	81.1%
Elco Borough	323	292	90.4%
Ellsworth Borough	1,027	1,027	100.0%
Fallowfield Township	4,321	4,321	100.0%
Finleyville Borough	461	452	98.0%
Green Hills Borough	29	29	100.0%
Hanover Township	2,673	1,966	73.6%
Hopewell Township	957	872	91.1%
Houston Borough	1,296	1,228	94.8%

Table 4.3.10-4 Populations Vulnerable to Conventional Oil and Gas Drilling Incidents.			
MUNICIPALITY	**TOTAL 2010 POPULATION**	**2010 POPULATION WITHIN 1,000 YARDS OF UNCONVENTIONAL OIL/GAS WELL**	**PERCENT POPULATION WITHIN 1,000 YARDS OF CONVENTIONAL OIL/GAS WELL**
Independence Township	1,557	1,470	94.4%
Jefferson Township	1,162	399	34.3%
Long Branch Borough	447	423	94.6%
Marianna Borough	494	478	96.8%
McDonald Borough	1,766	1,752	99.2%
Midway Borough	913	913	100.0%
Monongahela, City of	4,300	4,284	99.6%
Morris Township	1,105	1,105	100.0%
Mount Pleasant Township	3,515	3,083	87.7%
New Eagle Borough	2,184	2,184	100.0%
North Bethlehem Township	1,631	1,469	90.1%
North Charleroi Borough	1,313	1,313	100.0%
North Franklin Township	4,583	3,879	84.6%
North Strabane Township	13,408	7,181	53.6%
Nottingham Township	3,036	2,339	77.0%
Peters Township	21,213	13,157	62.0%
Robinson Township	1,931	1,399	72.4%
Roscoe Borough	812	812	100.0%
Smith Township	4,476	3,156	70.5%
Somerset Township	2,684	2,684	100.0%
South Franklin Township	3,310	3,310	100.0%
South Strabane Township	9,346	8,200	87.7%
Speers Borough	1,154	1,154	100.0%
Stockdale Borough	502	493	98.2%
Twilight Borough	233	233	100.0%
Union Township	5,700	5,593	98.1%
Washington, City of	13,663	11,566	84.7%
West Bethlehem Township	1,460	1,363	93.4%
West Brownsville Borough	992	912	62.5%
West Finley Township	878	615	62.0%
West Middletown Borough	139	58	6.6%
West Pike Run Township	1587	1,571	99.0%
TOTAL	**207,820**	**168,673**	**81.2%**

Table 4.3.10-5 Populations Vulnerable to Unconventional Oil and Gas Drilling Incidents.			
MUNICIPALITY	**TOTAL 2010 POPULATION**	**2010 POPULATION WITHIN 1,000 YARDS OF UNCONVENTIONAL OIL/GAS WELL***	**PERCENT POPULATION WITHIN 1,000 YARDS OF UNCONVENTIONAL OIL/GAS WELL**
Allenport Borough	537	12	2.2%
Amwell Township	3,751	1,633	43.5%
Beallsville Borough	466	30	6.4%
Bentleyville Borough	2,581	0	0.0%
Blaine Township	690	105	15.2%
Buffalo Township	2,069	803	38.8%
Burgettstown Borough	1,388	0	0.0%
California Borough	6,795	0	0.0%
Canonsburg Borough	8,992	0	0.0%
Canton Township	8,375	632	7.5%
Carroll Township	5,640	1,640	29.1%
Cecil Township	11,271	690	6.1%
Centerville Borough	3,263	108	3.3%
Charleroi Borough	4,120	0	0.0%
Chartiers Township	7,818	2,087	26.7%
Claysville Borough	829	0	0.0%
Coal Center Borough	139	0	0.0%
Cokeburg Borough	630	522	82.9%
Cross Creek Township	1,556	827	53.1%
Deemston Borough	722	334	46.3%
Donegal Township	2,465	501	20.3%
Donora Borough	4,781	0	0.0%
Dunlevy Borough	381	0	0.0%
East Bethlehem Township	2,354	392	16.7%
East Finley Township	1,392	144	10.3%
East Washington Borough	2,234	0	0.0%
Elco Borough	323	0	0.0%
Ellsworth Borough	1,027	0	0.0%
Fallowfield Township	4,321	410	9.5%
Finleyville Borough	461	0	0.0%
Green Hills Borough	29	0	0.0%
Hanover Township	2,673	504	18.9%
Hopewell Township	957	828	86.5%
Houston Borough	1,296	0	0.0%
Independence Township	1,557	1,460	93.8%
Jefferson Township	1,162	212	18.2%

Table 4.3.10-5 Populations Vulnerable to Unconventional Oil and Gas Drilling Incidents.			
MUNICIPALITY	**TOTAL 2010 POPULATION**	**2010 POPULATION WITHIN 1,000 YARDS OF UNCONVENTIONAL OIL/GAS WELL***	**PERCENT POPULATION WITHIN 1,000 YARDS OF UNCONVENTIONAL OIL/GAS WELL**
Long Branch Borough	447	0	0.0%
Marianna Borough	494	10	2.0%
McDonald Borough	1,766	0	0.0%
Midway Borough	913	177	19.4%
Monongahela, City of	4,300	444	10.3%
Morris Township	1,105	724	65.5%
Mount Pleasant Township	3,515	2,394	68.1%
New Eagle Borough	2,184	0	0.0%
North Bethlehem Township	1,631	342	21.0%
North Charleroi Borough	1,313	0	0.0%
North Franklin Township	4,583	1,266	27.6%
North Strabane Township	13,408	689	5.1%
Nottingham Township	3,036	46	1.5%
Peters Township	21,213	47	0.2%
Robinson Township	1,931	696	36.0%
Roscoe Borough	812	0	0.0%
Smith Township	4,476	881	19.7%
Somerset Township	2,684	681	25.4%
South Franklin Township	3,310	651	19.7%
South Strabane Township	9,346	64	0.7%
Speers Borough	1,154	0	0.0%
Stockdale Borough	502	318	63.3%
Twilight Borough	233	0	0.0%
Union Township	5,700	90	1.6%
Washington, City of	13,663	0	0.0%
West Bethlehem Township	1,460	562	38.5%
West Brownsville Borough	992	0	0.0%
West Finley Township	878	174	17.5%
West Middletown Borough	139	58	6.6%
West Pike Run Township	1587	641	40.4%
TOTAL	**207,820**	**24,829**	**11.9%**

4.4. Hazard Vulnerability Summary

Risk and vulnerability to natural and human-made hazard events are not static. Risk will increase or decrease as states, counties, and municipalities see changes in land use and development as well as changes in population. For Pennsylvania, these changes in risk and vulnerability are likely to differ greatly from one area of the Commonwealth to another. Ranking hazards helps communities set goals and priorities for mitigation based on their vulnerabilities.

4.4.1. Methodology

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

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

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

Table 4.4.1-1 summarizes each of the five categories used for calculating a RF for each hazard. According to the weighting scheme applied, the highest possible RF value is 4.0.

Table 4.4.1-1 Summary of Risk Factor approach used to rank hazard risk.

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

4.4.2. Ranking Results

Using the methodology described in Section 4.4.1, Table 4.4.2-1 lists the Risk Factor calculated for each of the seventeen potential hazards identified in the 2015 HMP. Hazards identified as *high* risk have risk factors greater than 2.5. Risk Factors ranging from 2.0 to 2.4 were deemed *moderate* risk hazards. Hazards with Risk Factors 1.9 and less are considered *low* risk.

Table 4.4.2-1 Ranking of hazard types based on Risk Factor methodology.

HAZARD RISK	HAZARD NATURAL (N) or MAN-MADE (M)	RISK ASSESSMENT CATEGORY					RISK FACTOR
		PROBABILITY (1-4)	IMPACT (1-4)	SPATIAL EXTENT (1-4)	WARNING TIME (1-4)	DURATION (1-4)	
HIGH	Flood, Flash Flood, Ice Jam (N)	4	3	3	3	3	3.3
	Winter Storm (N)	4	2	4	2	3	3.1
	Environmental Hazard (M)	3	3	3	2	2	2.8
MODERATE	Landslide (N)	4	1	2	4	1	2.4
	Tornado, Windstorm (N)	3	2	1	4	1	2.2
	Drought (N)	2	1	3	1	4	2
	Dam Failure (M)	1	3	1	4	2	2
LOW	Subsidence, Sinkhole (N)	3	1	2	2	1	1.9
	Radon Exposure (N)	2	1	2	1	4	1.8
	Earthquake (N)	1	2	1	4	1	1.6

Based on these results, there are three *high* risk hazards, four *moderate* risk hazards and three *low* risk hazards in Washington County. Mitigation actions were developed for all hazards (see Section 6.4) with an emphasis on the higher-ranked hazards.

A risk assessment result for the entire county does not mean that each municipality is at the same amount of risk to each hazard. Table 4.4.2-2 shows the different municipalities in Washington County and whether their risk is greater than (>), less than (<), or equal to (=) the risk factor assigned to the County as a whole. This table was developed based on the findings in the hazard profiles of Section 4.3 and municipal input from the “Hazards in Your Community” worksheet distributed at the September 4, 2014 HMP update meeting. Those changes are reflected in the table.

Table 4.4.2-2 Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk

JURISDICTION	IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
	Flood, Flash Flood, Ice Jam (N)	Winter Storm (N)	Environmental Hazard (M)	Landslide (N)	Tornado, Windstorm (N)	Drought (N)	Dam Failure (M)	Subsidence, Sinkhole (M)	Radon exposure (N)	Earthquake (N)
	3.3	*3.1*	*2.8*	*2.4*	*2.2*	*2*	*2*	*1.9*	*1.8*	*1.6*
Allenport Borough	>	=	=	=	=	=	=	=	=	=
Amwell Township	=	=	=	=	=	=	=	=	>	=
Beallsville Borough	<	=	=	=	=	=	=	=	>	=
Bentleyville Borough	=	=	=	=	=	=	=	>	=	=
Blaine Township	=	=	=	=	=	=	=	=	=	=
Buffalo Township	=	=	=	=	=	=	=	=	=	=
Burgettstown Borough	=	=	=	=	=	=	=	=	=	=
California Borough	>	=	=	=	=	=	=	>	=	=
Canonsburg Borough	=	=	=	=	=	=	=	>	=	=
Canton Township	=	=	=	=	=	=	=	=	=	=
Carroll Township	=	=	=	=	=	=	>	>	=	=
Cecil Township	=	=	=	=	=	=	=	=	=	=
Centerville Borough	=	=	=	=	=	=	=	>	>	=
Charleroi Borough	=	=	=	=	=	<	=	=	=	=
Chartiers Township	=	=	=	=	=	=	=	=	=	=
Claysville Borough	<	=	=	=	=	=	=	=	=	=
Coal Center Borough	>	=	=	=	=	=	=	=	=	=
Cokeburg Borough	<	=	=	=	=	=	=	=	=	=
Cross Creek Township	=	=	=	=	=	=	=	=	=	=
Deemston Borough	=	=	=	=	=	=	=	>	>	=
Donegal Township	<	=	=	=	=	=	=	=	>	=
Donora Borough	<	=	=	=	=	<	=	=	=	=
Dunlevy Borough	>	=	=	=	=	=	=	=	=	=
East Bethlehem Township	=	=	=	=	=	=	=	=	=	=
East Finley Township	=	=	=	=	=	=	=	=	=	=
East Washington Borough	<	=	=	=	=	=	=	=	=	=
Elco Borough	>	=	=	=	=	=	=	=	=	=

Table 4.4.2-2 Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk

JURISDICTION	IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
	Flood, Flash Flood, Ice Jam (N)	Winter Storm (N)	Environmental Hazard (M)	Landslide (N)	Tornado, Windstorm (N)	Drought (N)	Dam Failure (M)	Subsidence, Sinkhole (M)	Radon exposure (N)	Earthquake (N)
	3.3	*3.1*	*2.8*	*2.4*	*2.2*	*2*	*2*	*1.9*	*1.8*	*1.6*
Ellsworth Borough	<	=	=	=	=	=	=	=	=	=
Fallowfield Township	=	=	=	<	=	=	=	>	>	=
Finleyville Borough	=	=	=	=	=	=	=	=	=	=
Green Hills Borough	<	=	=	=	=	=	=	=	=	=
Hanover Township	=	=	=	=	=	=	=	=	=	=
Hopewell Township	=	=	=	=	=	=	=	=	=	=
Houston Borough	>	=	=	=	=	=	=	=	=	=
Independence Township	=	=	=	=	=	=	=	=	=	=
Jefferson Township	<	=	=	=	=	=	=	>	=	=
Long Branch Borough	<	=	=	=	=	=	=	=	=	=
Marianna Borough	<	=	=	=	=	<	>	=	>	=
McDonald Borough	<	=	=	<	=	<	=	=	=	=
Midway Borough	=	=	=	=	=	=	=	>	=	=
Monongahela, City of	=	=	=	=	=	<	=	>	=	=
Morris Township	=	=	=	=	=	=	=	=	=	=
Mount Pleasant Township	<	=	=	=	=	=	=	=	=	=
New Eagle Borough	=	=	=	=	=	=	>	=	=	=
North Bethlehem Township	<	=	=	=	=	=	=	=	=	=
North Charleroi Borough	=	=	=	=	=	=	=	=	=	=
North Franklin Township	=	=	=	=	=	=	=	=	=	=
North Strabane Township	<	=	=	=	=	=	=	=	=	=
Nottingham Township	=	=	=	=	=	=	>	>	>	=
Peters Township	<	=	=	=	=	=	=	=	=	=
Robinson Township	<	=	=	=	=	=	=	=	=	=
Roscoe Borough	>	=	=	=	=	=	=	=	=	=
Smith Township	=	=	=	=	=	=	=	>	=	=
Somerset Township	<	=	=	=	=	=	>	=	>	=

Table 4.4.2-2 Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk

JURISDICTION	IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
	Flood, Flash Flood, Ice Jam (N)	Winter Storm (N)	Environmental Hazard (M)	Landslide (N)	Tornado, Windstorm (N)	Drought (N)	Dam Failure (M)	Subsidence, Sinkhole (M)	Radon exposure (N)	Earthquake (N)
	3.3	*3.1*	*2.8*	*2.4*	*2.2*	*2*	*2*	*1.9*	*1.8*	*1.6*
South Franklin Township	=	=	=	=	=	=	=	=	=	=
South Strabane Township	<	=	=	=	=	<	=	=	=	=
Speers Borough	=	=	=	=	=	=	=	=	=	=
Stockdale Borough	>	=	=	=	=	=	=	=	=	=
Twilight Borough	=	=	=	=	=	=	=	>	=	=
Union Township	=	=	=	=	=	=	>	=	=	=
Washington, City of	=	=	=	=	=	<	=	=	=	=
West Bethlehem Township	=	=	=	=	=	=	>	=	>	=
West Brownsville Borough	>	=	=	=	=	<	=	=	=	=
West Finley Township	=	=	=	=	=	=	=	=	>	=
West Middletown Borough	<	=	=	=	=	=	=	=	=	=
West Pike Run Township	=	=	=	=	=	=	=	>	>	=

4.4.3. Potential Loss Estimates

Potential loss estimates for hazard events help a community understand the monetary value of what might be at stake during a hazard event. Estimates are considered *potential* in that they generally represent losses that could occur in a countywide hazard scenario. In events that are localized, losses may be lower, while regional events could yield higher losses.

Potential loss estimates have four basic components, including:

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

Historical losses were able to be determined for drought, flooding, tornado and windstorms, and winter storms from NCDC and the NFIP. NCDC reports include property and crop damage estimates with their incident reports. As noted in many of the hazard profiles, though, many of the events have no damages reported. This does not mean that there were no damage; rather, it indicates that no damages were reported to NCDC. As a result, these should be considered low-end estimates of losses. For example, the flood and flash flood events reported in NCDC list $14,349,000 in property damage and one fatality over the history of (recorded) flooding in the county. Property damage estimates for tornado were reported at $675,000, with a range of property damage from $25,000 to $250,000 and four reported injuries. Wind events of over 50 knots had no injuries or fatalities, but almost $3 million in property damage. Historical losses for winter storms, including ice storms, freezing rain, sleet, and heavy snow, have no reported property damage, and two injuries reported.

Other historic losses relate solely to prior flood losses and come from the NFIP's records of claims paid. Table 4.4.3-1 shows the total amount of claims paid in each municipality according to CIS. Nottingham and Cecil Townships have had the highest total amount of claims paid with over $1 million, followed by Beallsville, Donora, and Roscoe Boroughs (with half as much paid in total). Additionally, there are eleven communities that have never had a claim paid despite having policies in force in the community.

Table 4.4.3-1 Washington County Historic Flood Losses (FEMA CIS, 2014).

COMMUNITY	PARTICIPATING IN NFIP?	TOTAL AMOUNT OF NFIP-PAID CLAIMS
Allenport Borough	Y	$117,476.66
Amwell Township	Y	$6,759.19
Beallsville Borough	Y	$0.00
Bentleyville Borough	Y	$38,912.51
Blaine Township	Y	$5,243.68
Buffalo Township	Y	$29,034.22
Burgettstown Borough	Y	$277,258.37
California Borough	Y	$251,613.42
Canonsburg Borough	Y	$146,712.21
Canton Township	Y	$692,688.40
Carroll Township	Y	$138,794.72
Cecil Township	Y	$444,427.12
Centerville Borough	Y	$80,734.87
Charleroi Borough	Y	$391,338.58
Chartiers Township	Y	$560,216.16
Claysville Borough	NP	NA
Coal Center Borough	Y	$71,557.79
Cokeburg Borough	NP	NA
Cross Creek Township	Y	$92,326.75

Table 4.4.3-1 Washington County Historic Flood Losses (FEMA CIS, 2014).		
COMMUNITY	**PARTICIPATING IN NFIP?**	**TOTAL AMOUNT OF NFIP-PAID CLAIMS**
Deemston Borough	Y	$0.00
Donegal Township	Y	$0.00
Donora Borough	Y	$2,712.30
Dunlevy Borough	Y	$33,095.13
East Bethlehem Township	Y	$955,284.16
East Finley Township	Y	$24,453.45
East Washington Borough	Y	$0.00
Elco Borough	Y	$220,590.85
Ellsworth Borough	Y	$0.00
Fallowfield Township	Y	$16,945.54
Finleyville Borough	Y	$49,429.60
Green Hills Borough	NP	NA
Hanover Township	Y	$0.00
Hopewell Township	Y	$19,219.16
Houston Borough	Y	$554,464.24
Independence Township	Y	$43,475.59
Jefferson Township	Y	$0.00
Long Branch Borough	Y	$0.00
Marianna Borough	Y	$0.00
McDonald Borough	Y	$309,461.08
Midway Borough	Y	$9,323.59
Monongahela, City of	Y	$122,731.40
Morris Township	Y	$31,997.34
Mount Pleasant Township	Y	$0.00
New Eagle Borough	Y	$9,934.19
North Bethlehem Township	Y	$0.00
North Charleroi Borough	Y	$376,324.53
North Franklin Township	Y	$97,689.15
North Strabane Township	Y	$73,043.29
Nottingham Township	Y	$2,592.63
Peters Township	Y	$73,747.75
Robinson Township	Y	$2,864.52
Roscoe Borough	Y	$303,900.38
Smith Township	Y	$10,349.72
Somerset Township	Y	$0.00
South Franklin Township	Y	$14,274.79
South Strabane Township	Y	$81,620.80

Table 4.4.3-1 Washington County Historic Flood Losses (FEMA CIS, 2014).		
COMMUNITY	**PARTICIPATING IN NFIP?**	**TOTAL AMOUNT OF NFIP-PAID CLAIMS**
Speers Borough	Y	$256,668.72
Stockdale Borough	Y	$203,980.75
Twilight Borough	Y	$0.00
Union Township	Y	$131,158.30
Washington, City of	Y	$1,132,416.65
West Bethlehem Township	Y	$7,941.04
West Brownsville Borough	Y	$250,704.66
West Finley Township	Y	$0.00
West Middletown Borough	NP	NA
West Pike Run Township	Y	$0.00
TOTAL		**$8,767,489.95**

Finally, losses were generated using HAZUS-MH, version 2.1. This plan employed an enhanced HAZUS analysis for floods. As opposed to basic analysis using only default data, enhanced analysis incorporates some kind of more recent, up-to-date, or specific data for inclusion in the hazard models. The enhanced data incorporated into this HMP update include:

- Updated demographic data from the 2010 Census,
- Updated essential facilities data from the County and other sources, and
- The 1%-annual-chance depth grid generated as a part of Washington County's Risk MAP process.

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

Total economic loss, including replacement value, content loss, functional loss and displacement cost, from a countywide 1%-annual-chance flood are estimated to equal $419 million. Residential occupancies make up 67% of the total estimated building-related losses, and a further 30% of the damages are incurred by commercial uses. Figure 4.4.3-2 shows a distribution of building-related losses by census block across Washington County. In this scenario, an expected 237 buildings would be at least moderately damaged, and 111 would be substantially damaged. Of the substantially damaged structures, all are residential properties. In addition, and estimated 3,353 households would be displaced, and 6,224 people would require temporary shelter. None of the essential facilities would experience substantial damage, but five (four fire stations and one police station) would have at least moderate damage. Five of the essential facilities with damage are expected to experience at least some loss of use. Figure 4.4.3-3 shows the inset of where HAZUS predicted to be the highest damage in Canonsburg Borough and Chartiers Township

Figure 4.4-1 Total economic losses estimated by HAZUS-MH for Washington County.

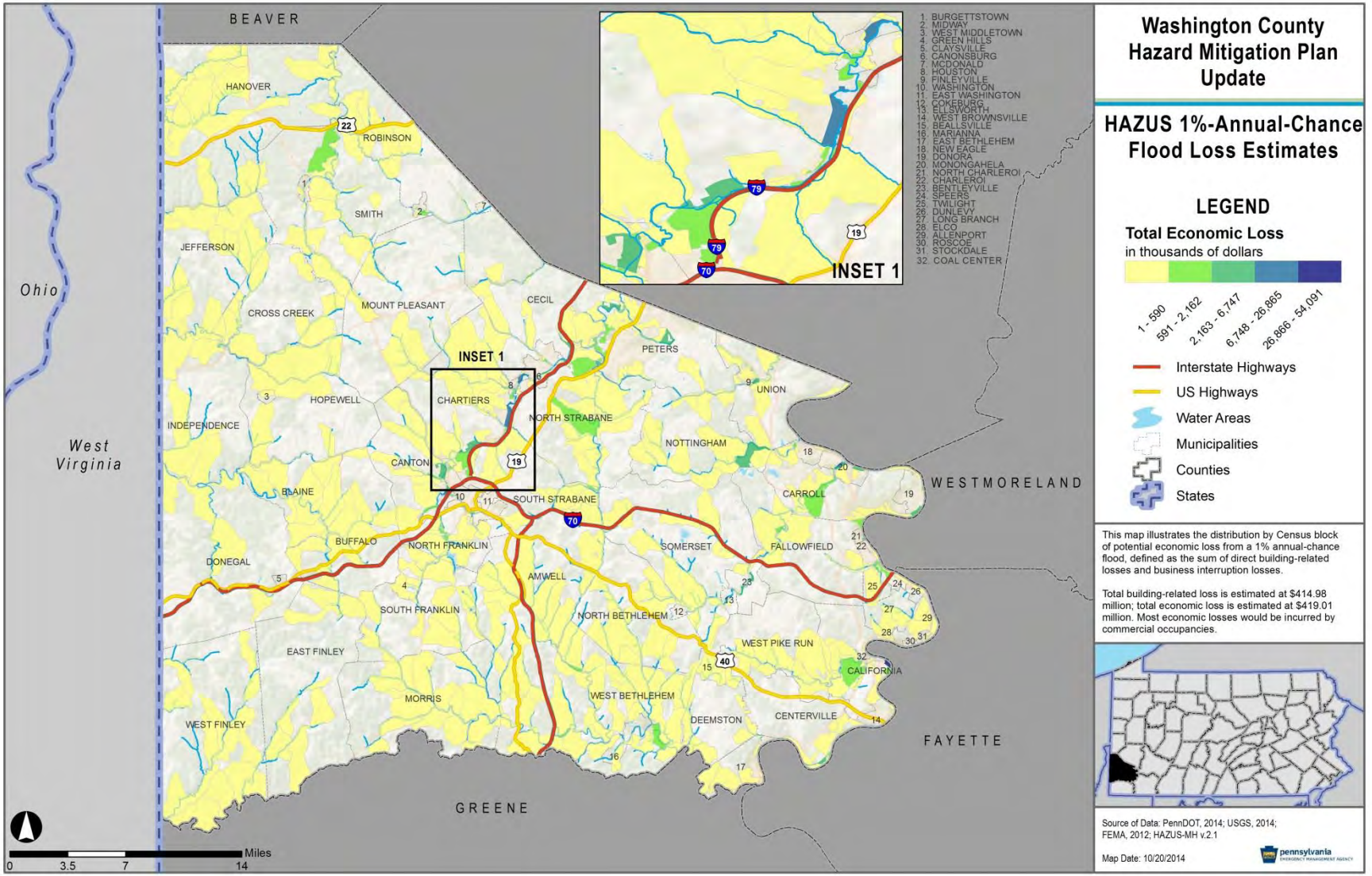
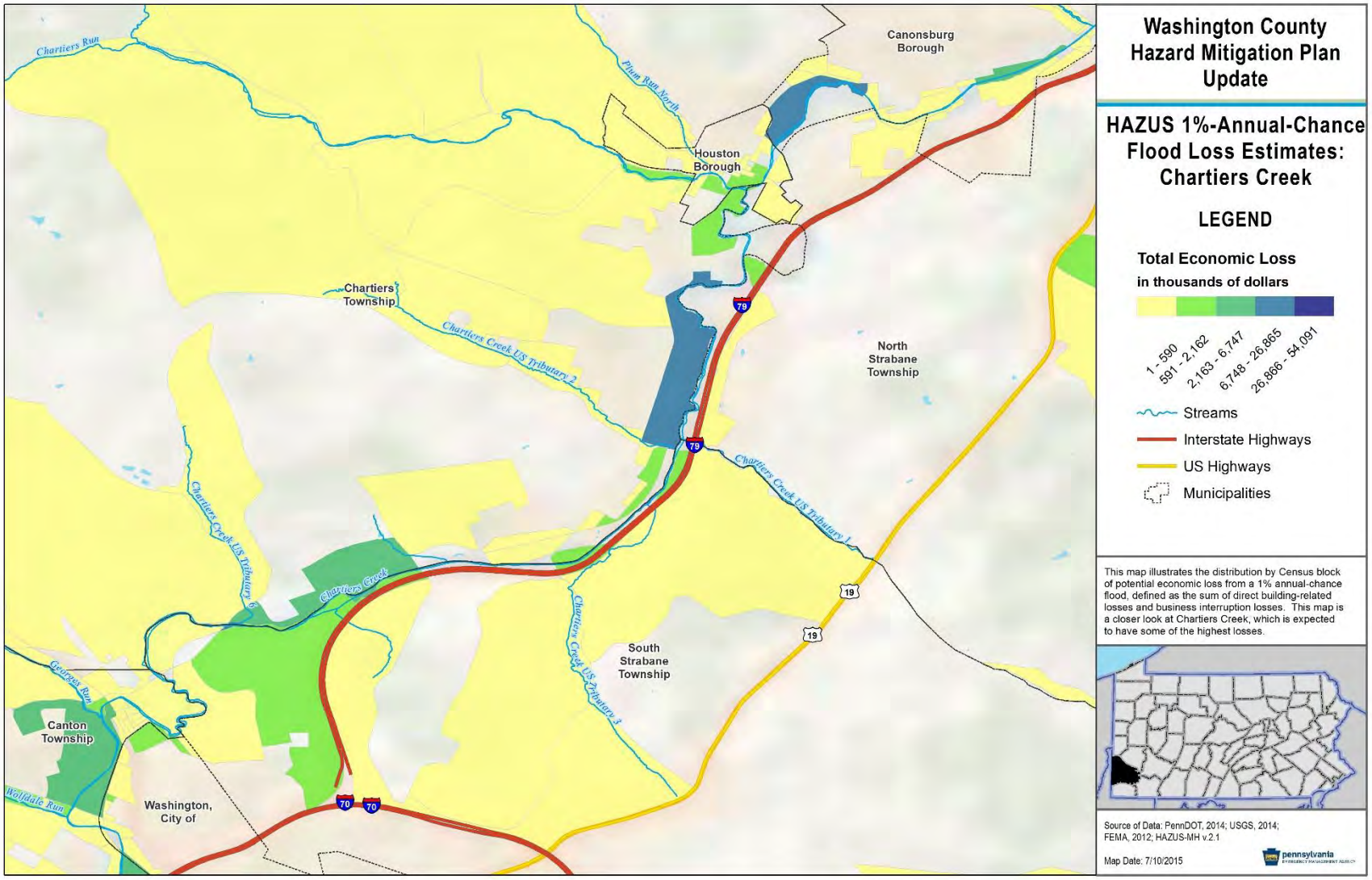


Figure 4.4-2 Total economic losses estimated by HAZUS-MH enlarged to inset of highest damage.



4.4.4. Future Development and Vulnerability

Population change is perhaps the most significant indicator of changes in vulnerability and risk in the future. A rise or decrease in population not only impacts the level of risk (as to how many individuals could be affected), but also foreshadows development and land use changes for the County and its municipalities. Washington County is expected to experience a variety of factors that will, in some areas, increase vulnerability to hazards while in other areas, vulnerability may stay static or even be reduced. Much of this is dependent on future population and land use and development patterns.

Population projections are useful in determining if a given area's population trends will continue into the future. The PA DEP produces county and municipal population projections based on U.S. Census data from the 2000 and 2010 to aid both county and municipality comprehensive planning. Projections developed for each of Washington County's municipalities are shown in Table 4.4.4-1. These projections are mapped in Figure 4.4.4-3.

Table 4.4.4-1 Municipal 2010 Population and Population Projections (PA DEP 2014).

MUNICIPALITY	BASELINE POPULATION 2010 US CENSUS	POPULATION PROJECTIONS			PERCENT CHANGE, 2010-2040
		2020	2030	2040	
Allenport	537	506	485	459	-14.5%
Beallsville	466	436	397	363	-22.1%
Bentleyville	2,581	2,517	2,535	2,506	-2.9%
Burgettstown	1,388	1,274	1,160	1,045	-24.7%
California	6,795	7,176	8,208	8,869	30.5%
Canonsburg	8,992	8,818	8,964	8,927	-0.7%
Centerville	3,263	2,969	2,771	2,518	-22.8%
Charleroi	4,120	3,749	3,412	3,055	-25.8%
Claysville	829	754	782	752	-9.3%
Coal Center	139	126	124	116	-16.5%
Cokeburg	630	587	534	487	-22.7%
Deemston	722	707	651	618	-14.4%
Donora	4,781	4,351	3,959	3,545	-25.9%
Dunlevy	381	363	346	328	-13.9%
East Washington	2,234	2,252	2,434	2,522	12.9%
Elco	323	300	273	248	-23.2%
Ellsworth	1,027	1,023	989	973	-5.3%
Finleyville	461	469	474	481	4.3%
Green Hills	29	32	38	42	44.8%
Houston	1,296	1,213	1,168	1,101	-15.0%
Long Branch	447	440	401	380	-15.0%
Marianna	494	450	409	366	-25.9%
McDonald	1,766	1,756	1,694	1,662	-5.9%

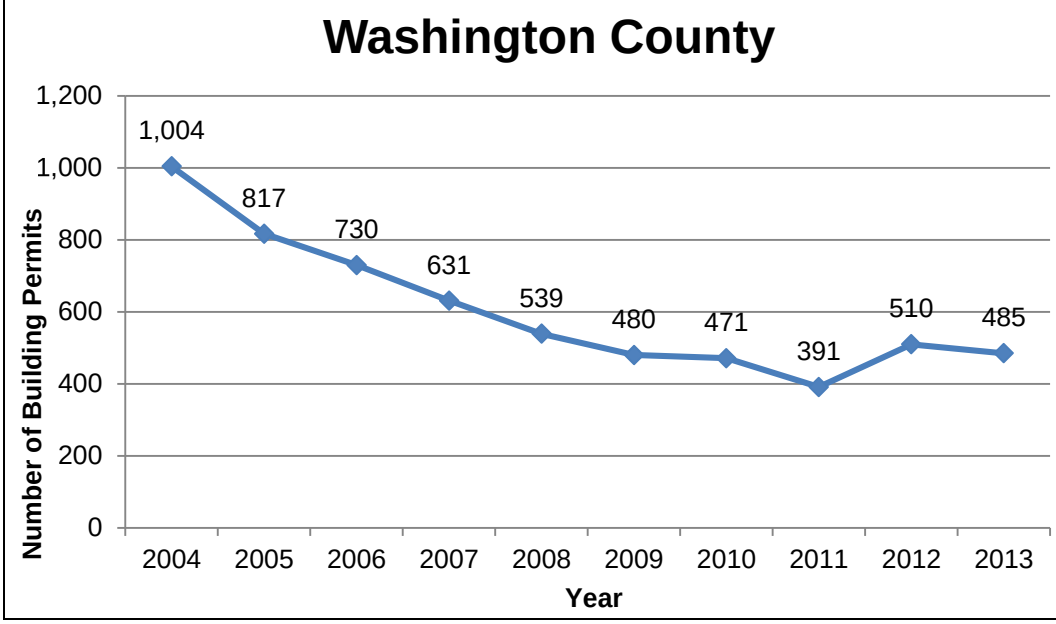
Table 4.4.4-1 Municipal 2010 Population and Population Projections (PA DEP 2014).					
MUNICIPALITY	BASELINE POPULATION 2010 US CENSUS	POPULATION PROJECTIONS			PERCENT CHANGE, 2010-2040
		2020	2030	2040	
Midway	913	849	782	716	-21.6%
New Eagle	2,184	2,202	2,165	2,160	-1.1%
North Charleroi	1,313	1,195	1,087	974	-25.8%
Roscoe	812	783	750	719	-11.5%
Speers	1,154	1,092	1,016	948	-17.9%
Stockdale	502	457	416	372	-25.9%
Twilight	233	223	215	205	-12.0%
West Brownsville	992	903	821	736	-25.8%
West Middletown	139	126	118	108	-22.3%
Monongahela, City of	4,300	4,007	3,646	3,324	-22.7%
Washington, City of	13,663	12,635	11,497	10,422	-23.7%
TOTAL: Boroughs	*72,685*	*69,906*	*66,740*	*64,721*	*-11.2%*
Amwell	3,751	3,538	3,327	3,115	-17.0%
Blaine	690	681	731	747	8.3%
Buffalo	2,069	2,028	1,993	1,955	-5.5%
Canton	8,375	7,936	7,490	7,048	-15.8%
Carroll	5,640	5,320	5,161	4,910	-12.9%
Cecil	11,271	12,382	13,724	14,934	32.5%
Chartiers	7,818	7,846	8,237	8,421	7.7%
Cross Creek	1,556	1,477	1,369	1,278	-17.9%
Donegal	2,465	2,527	2,575	2,631	6.7%
East Bethlehem	2,354	2,142	1,949	1,746	-25.8%
East Finley	1,392	1,356	1,285	1,235	-11.3%
Fallowfield	4,321	3,969	3,738	3,438	-20.4%
Hanover	2,673	2,570	2,457	2,349	-12.1%
Hopewell	957	971	956	958	0.1%
Independence	1,557	1,417	1,289	1,155	-25.8%
Jefferson	1,162	1,141	1,101	1,071	-7.8%
Morris	1,105	1,106	1,006	964	-12.8%
Mount Pleasant	3,515	3,479	3,517	3,512	-0.1%
North Bethlehem	1,631	1,512	1,395	1,277	-21.7%
North Franklin	4,583	4,380	4,159	3,948	-13.9%
North Strabane	13,408	15,774	18,558	21,103	57.4%
Nottingham	3,036	3,381	3,823	4,210	38.7%
Peters	21,213	24,547	28,060	31,470	48.4%

Table 4.4.4-1 Municipal 2010 Population and Population Projections (PA DEP 2014).					
MUNICIPALITY	**BASELINE POPULATION 2010 US CENSUS**	**POPULATION PROJECTIONS**			**PERCENT CHANGE, 2010-2040**
		2020	**2030**	**2040**	
Robinson	1,931	1,838	1,672	1,548	-19.8%
Smith	4,476	4,279	4,142	3,971	-11.3%
Somerset	2,684	2,536	2,463	2,347	-12.6%
South Franklin	3,310	3,177	2,891	2,692	-18.7%
South Strabane	9,346	10,106	11,208	12,115	29.6%
Union	5,700	5,330	5,229	4,975	-12.7%
West Bethlehem	1,460	1,373	1,352	1,293	-11.4%
West Finley	878	835	774	724	-17.5%
West Pike Run	1,587	1,503	1,368	1,262	-20.5%
TOTAL: Townships	*129,892*	*137,914*	*142,457*	*148,999*	*12.0%*
Washington County	**207,820**	**209,197**	**213,720**	**216,449**	**4.2%**

As shown in Table 4.4.4-1 the County is expecting a population loss in the boroughs and cities, with growth only expected in the townships. As a whole, the County is expected to slightly gain population, with 4.2% increase by 2040. The five fastest growing townships, according to DEP's projections, will be North Strabane, Peters, Nottingham, Cecil, and South Strabane townships.

Data for subdivision and land development plans is unavailable for the County. However, Pittsburgh Today, a group that analyzes the Pittsburgh region, includes Washington County in their analysis of new building permits between 2004 and 2013 for the region. The number of new building permits for Washington County has been on a decline since 2004 (the data was collected from the Census Bureau's building permit survey and the 2013 data was preliminary at the time). In 2004, the County had 1,004 new building permits, but by 2013, there were only 485 permits, this is a marked decline in new development and growth. Figure 4.4.4-2 displays the change in the number of new building permits for Washington County from 2004 to 2013.

Figure 4.4.4-2 Number of new building permits in Washington County from 2004 to 2013 (Pittsburgh Today 2013).



Development can often change the hazard threat level of an area by placing additional critical facilities, businesses, transportation networks, and populations within vulnerable areas. Any development along transportation routes can increase the vulnerability to transportation incidents and hazardous material spills. Most often, development occurs along these transportation networks because of access and increased demand for travel and access to services. Therefore, the impact of these hazards can increase along with their frequency. While it can be difficult to curb development, it is to the municipality's advantage to be aware of development trends in order to successfully mitigate future hazards as risks increase.

The 2005 Washington County Comprehensive Plan identifies an economic strategy for development of the County's resources within its borders, and as a part of the larger region, namely the Southwestern Pennsylvania Commission. In conjunction with the Comprehensive Plan, several additional plans layout a strategy for coordinating growth with preservation. The Greenways Plan of 2007 acts to ensure the documentation of the County's environmental resources, and to create guidelines for establishing a greenway network not only in the municipalities and County, but as a larger part of a statewide system. The County has also taken steps to ensure the preservation of agricultural lands, as of 2005, roughly 11 percent of the County's total land area (60,000 acres) was protected as agricultural security areas under the Agricultural Area Security Law of 1981. Finally, the Stormwater Management Plan of 2008 aims to identify the stresses to stormwater infrastructure that are created by continued growth and development. Combined, these plans begin to address the challenges inherent in future development and growth, and how they can be balanced and mitigated through planning measures, and as a result reduce potential vulnerability.

The Washington County Comprehensive Plan also designates growth areas for development, see Figure 2.4-2. Some of the growth areas overlap with areas at risk for flooding, dam failure, and subsidence as shown in Table 4.4.4-2. These risks will be addressed as development is targeted to specific locations that are reviewed for plans, building permits and local ordinances. Also, Action 6 addresses the larger picture issue of reconsidering target areas for investment and planning for investment and development is safer areas.

Table 4.4.4-2 Calculated Countywide Risk Factor by Hazard and Comparative Target Area for Investment Risk

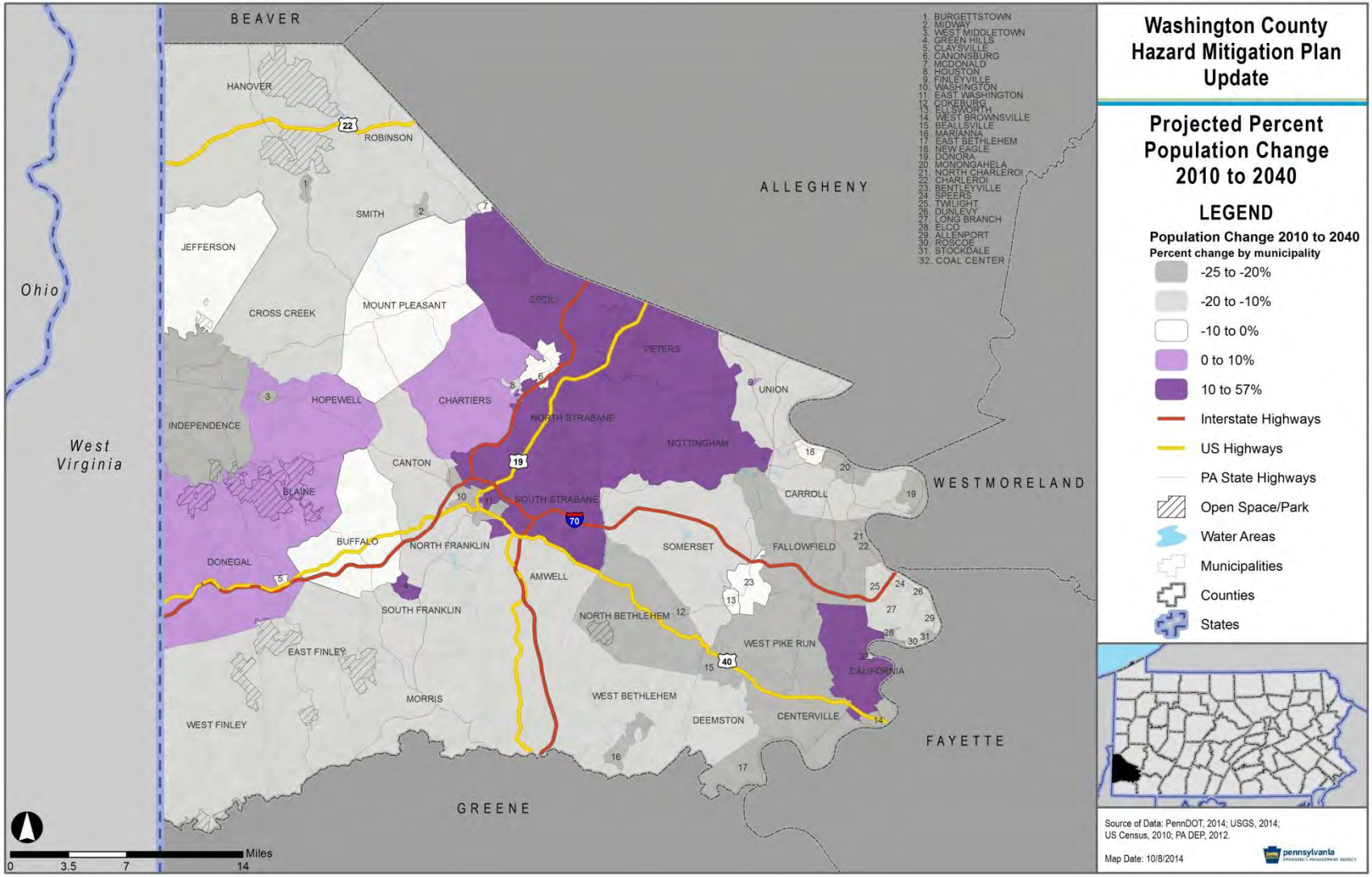
TARGET AREAS FOR INVESTMENT	IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
	Flood, Flash Flood, Ice Jam (N)	Winter Storm (N)	Environmental Hazard (M)	Landslide (N)	Tornado, Windstorm (N)	Drought (N)	Dam Failure (M)	Subsidence, Sinkhole (M)	Radon exposure (N)	Earthquake (N)
	3.3	***3.1***	***2.8***	***2.4***	***2.2***	***2***	***2***	***1.9***	***1.8***	***1.6***
City of Washington / County Airport	=	=	=	=	=	=	=	=	=	=
I-70 Corridor	>	=	=	<	=	=	>	>	=	=
I-79 / US 19 Corridor	>	=	=	=	=	=	=	>	=	=
Mon Valley Corridor	>	=	=	<	=	=	>	>	=	=
PA 50 Corridor	=	=	=	=	=	=	=	=	=	=
Southern Beltway Corridor	>	=	=	<	=	=	>	>	=	=
US 22/ PA 18 Corridor	=	=	=	=	=	=	=	>	=	=

Since there is only a slight population increase and the number of new building permits has been in decline, it would be expected that vulnerability and risk would be unlikely to drastically increase in the future. However, there is one significant development change in Washington County that has occurred in the last five years, and is expected to continue; the natural gas industry (as well as conventional drilling). Though there is no data available data on the amount of additional development of late that has occurred due to (conventional and unconventional) drilling in Washington County, it can still be expected to be one of the most influential variables in Washington County's future vulnerability and risk.

The expansion of the natural gas industry in Washington County, as well continued growth in conventional drilling can have cumulative and longer-lasting environmental impacts, some of which aren't fully known. As explored in Section 4.3.8.4, 12% of the County was converted to impervious surface within the past five years, due to the natural gas industry alone. Additionally, this industry is spread across the entirety of the County, with most of the population in close proximity to a drilling site. This is a significant amount of development that affects flooding, transportation, as well as water supply, and larger environmental concerns.

When planning for future development, there are several measures the County could take to help mitigate the impacts of natural gas drilling on transportation infrastructure and impervious surfaces. If continued investment and development in the natural gas industry is inevitable, then how the County regulates new well pads siting locations and the industry as whole will become important in shaping Washington County's future vulnerabilities and risk, greater care and oversight could be taken to balance future well development with watershed needs and conservation goals.

Figure 4.4.4-3 Projected Percent Population Change from 2010 – 2040 by Municipality.



5. Capability Assessment

5.1. Update Process Summary

The purpose of the Capability Assessment is to identify strengths and weaknesses that will affect the ability of the county and its jurisdictions to implement the mitigation strategy. Washington County has a number of resources to access to implement hazard mitigation initiatives including planning and regulatory tools; administrative assistance and technical expertise; fiscal resources; use of local, regional, state, and federal funding sources; and educational outreach methods. These resources facilitate community resiliency through actions taken before, during, and after a hazard event.

The 2010 HMP provided an overview of Washington County's capabilities, discussing the planning and regulatory tools in use in the county as well as emergency operations capabilities, non-profit and volunteer advocacy partnerships, and state and federal assistance programs. The 2015 Capability Assessment follows the PEMA Standard Operating Guidance and provides an updated inventory of the most critical local planning and regulatory tools available within each municipality, a summary of the fiscal and technical capabilities available through programs and organizations outside of the County, and provides an opportunity to discuss any plan integration opportunities with the hazard mitigation plan. It also identifies emergency management capabilities and the processes used for implementation of the National Flood Insurance Program.

For the 2015 HMP update, a revised Capability Assessment Survey was developed based on the most recent FEMA and PEMA guidance. The survey contained 5 sections including: planning and regulatory capability, administrative and technical capability, financial capability, education and outreach, and self-assessment of capability. The community political and resiliency capabilities were removed from the Capability Assessment Survey and replaced with education and outreach capability which identified existing outreach initiatives or programs that could be used to implement hazard mitigation activities.

In addition, communities completed FEMA's National Flood Insurance Program (NFIP) Worksheet as a part of assessing their capabilities. The NFIP Worksheet was developed to obtain information on participation in and compliance with the NFIP as well as to identify areas for potential mitigation actions. A number of the data points and statistics available via FEMA's Community Information System (CIS) were pre-populated on the worksheet, allowing municipalities to focus their comments on how they implement the NFIP in their community. Copies of these worksheets can be viewed in Appendix C.

While the capability assessment serves as a good instrument for identifying local capabilities, it also provides a means for recognizing gaps and weaknesses that can be resolved through future mitigation actions. The results of this assessment lend critical information for developing an effective mitigation strategy.

5.2. Capability Assessment Findings

5.2.1. Planning and Regulatory Capability

Some of the most important planning and regulatory capabilities that can be utilized for hazard mitigation include comprehensive plans, building codes, floodplain ordinances, stormwater management ordinances, subdivision and land development ordinances (SALDOs), and zoning ordinances. These planning tools provide mechanisms for the implementation of adopted mitigation strategies. Table 5.2-1 summarizes major planning tools in each Washington County municipality.

Table 5.2-1 Summary of Major Plans and Regulations in Washington County.

Municipality	Comprehensive Land Use Plan	NFIP/FP Regulations	Subdivision Regulations	Zoning Regulations	Stormwater Management Plan and Ordinance	Uniform Construction Code Opt-In
Allenport Borough	X	X	X	X		X
Amwell Township		X	X	X	X	X
Beallsville Borough		X				
Bentleyville Borough	X	X	X	X		X
Blaine Township	X	X	X	X	X	X
Buffalo Township		X	X	X	X	X
Burgettstown Borough	X	X	X	X	X	X
California Borough	X	X	X	X	X	X
Canonsburg Borough	X	X	X	X	X	X
Canton Township	X	X	X	X		X
Carroll Township	X	X	X	X	X	X
Cecil Township	X	X	X	X		X
Centerville Borough	X	X	X	X	X	X
Charleroi Borough	In Development (with North Charleroi Borough)	X	X	X	X	X
Chartiers Township	X	X	X	X	X	X
Claysville Borough	X	N/A, not in NFIP		X	X	X
Coal Center Borough	X	X		X	X	X
Cokeburg Borough		N/A, not in NFIP	X	X	X	
Cross Creek Township	X	X	X	X		X
Deemston Borough	X	X				X
Donegal Township	X	X	X			X
Donora Borough		X	X	X		X
Dunlevy Borough	X	X		X	X	X

Table 5.2-1 Summary of Major Plans and Regulations in Washington County.						
Municipality	**Comprehensive Land Use Plan**	**NFIP/FP Regulations**	**Subdivision Regulations**	**Zoning Regulations**	**Stormwater Management Plan and Ordinance**	**Uniform Construction Code Opt-In**
East Bethlehem Township	X	X	X	X		X
East Finley Township		X		X	X	X
East Washington Borough	X	X		X	X	X
Elco Borough	X	X		X		X
Ellsworth Borough		X		X	X	
Fallowfield Township	In Progress (with Speers Borough)	X	X	X	X	X
Finleyville Borough	X	X			X	X
Green Hills Borough	X	N/A, not in NFIP	X	X		
Hanover Township	X	X	X	X		X
Hopewell Township	X	X	X	X		X
Houston Borough	X	X		X	X	X
Independence Township	X	X	X	X	X	X
Jefferson Township	X	X	X	X		X
Long Branch Borough		X	X			X
Marianna Borough	In Development (with West Bethlehem Twp)	X	X	X	X	X
McDonald Borough	X	X	X	X	X	X
Midway Borough	X	X	X	X	X	X
Monongahela, City of	X	X	X	X		X
Morris Township		X	X	X	X	X
Mount Pleasant Township	X	X	X	X		X
New Eagle Borough	X	X	X			
North Bethlehem Township		X	X			X
North Charleroi Borough	In Development (with Charleroi Borough)	X		X		X
North Franklin Township	X	X	X	X		X

Table 5.2-1 Summary of Major Plans and Regulations in Washington County.

Municipality	Comprehensive Land Use Plan	NFIP/FP Regulations	Subdivision Regulations	Zoning Regulations	Stormwater Management Plan and Ordinance	Uniform Construction Code Opt-In
North Strabane Township	X	X	X	X		X
Nottingham Township	X	X	X	X	X	X
Peters Township	X	X	X	X	X	X
Robinson Township	X	X	X	X	X	X
Roscoe Borough	X	X		X	X	X
Smith Township	X	X	X	X		X
Somerset Township	X	X	X	X		X
South Franklin Township	X	X	X	X		X
South Strabane Township	X	X	X	X	X	X
Speers Borough	In Development (with Fallowfield Twp)	X	X	X	X	X
Stockdale Borough	X	X		X	X	X
Twilight Borough		X	X	X	X	
Union Township	X	X	X	X	X	X
Washington, City of	X	X	X	X		X
West Bethlehem Township	In Development (with Marianna Borough)	X	X	X	X	X
West Brownsville Borough	X	X		X	X	X
West Finley Township		X	X			X
West Middletown Borough	X	N/A, not in NFIP	X	X		
West Pike Run Township		X	X	X		X

The following sections take a more in-depth look at the plans and regulations, emergency management, and NFIP participation in Washington County.

5.2.1.1. Plans and Regulations

Pennsylvania municipalities have the authority to govern more restrictively than state and county minimum requirements, provided municipalities are in compliance with criteria established in the Pennsylvania Municipalities Planning Code (MPC) and respective municipal codes. Municipalities can develop their own policies and programs and implement their own

rules and regulations to protect and serve their local residents. Local policies are typically identified in a Comprehensive Plan, implemented via a local ordinance, and enforced through the governmental body or its appointee.

The Washington **County Comprehensive Plan** was adopted in 2005. The Comprehensive Plan is a policy document that identifies the county's goals and objectives for future development with an emphasis on how and at what pace Washington County will develop. The comprehensive plan is a blueprint for housing, transportation, community facilities, utilities, and land use. It examines how the past led to the present and charts the community's future path. Pennsylvania's MPC (Act 247 of 1968), as reauthorized and amended, requires counties to prepare and maintain a county comprehensive plan and to update it every 10 years. In addition to the County Comprehensive Plan, 53 of the 66 municipalities have an adopted or in progress municipal comprehensive plan, as shown in Table 5.2-1. Washington County also has a Greenways Plan, adopted January 2007 as an amendment to the comprehensive plan to proactively balance development and preservation of green space.

Beyond the county and municipal comprehensive plans, there are a number of key land development ordinances intended to enable orderly growth and development. **Zoning ordinances** specify the type and intensity of development that occur in particular locations and directly affects land use patterns. Of the 66 municipalities, 58 have enacted a local zoning ordinance. The local municipalities are responsible for reviewing all development applications for concurrency with local zoning regulations.

SALDOs further specify how development can occur by regulating the way raw land is physically prepared for development. Fifty-one of the 66 municipalities in Washington County have a SALDO in place. Like zoning ordinances, SALDO regulations are administered at the local level, but the Washington County Planning Commission reviews subdivision applications with particular attention paid to whether there is a chance that the property will be affected by landslides, presence of wetlands, flooding, mine subsidence, and natural heritage areas.

Stormwater management regulations provide for the conveyance of stormwater to decrease flooding. Washington County adopted Phase I of its Act 167 stormwater management plan in 2008 and Phase II in 2010. The **County Stormwater Management Plan** is a policy document to manage stormwater runoff; together with its accompanying model ordinance, this planning and regulatory effort will ensure that water quality will not worsen with future growth. The key provisions of the Stormwater Management Model Ordinance are the development of riparian buffer standards and optional Existing Resources and Site Analysis specifications for special protection watersheds. Municipal adoption of the Stormwater Management Plan and Model Ordinance stands at 36 of 66 municipalities, or just over half.

Building codes regulate standards for new construction and substantially renovated buildings. Standards can be adopted that require resistant or resilient building design practices to address hazard impacts common to a given community. Enforcement of Pennsylvania's statewide building code, generally known as the Uniform Construction Code, began in 2004. The UCC establishes minimum regulations for most new construction, including additions and renovations to existing structures. Current UCC Regulations took effect on December 31, 2012 and include

the 2009 International Codes issued by the International Code Council (ICC) and Chapter 11 and Appendix E of the 2012 International Building Code with exceptions identified by the Department of Labor & Industry (L&I). Over 90% of Pennsylvania's municipalities administer and enforce the UCC locally (known as Opt-ins), using their own employees or a certified third party agencies (private code enforcement agencies) they have retained. Opt-outs are those municipalities that have handed over UCC enforcement authority to either L&I (for non-residential buildings and structures) or certified third-party agencies (hired by a property owner for residential code enforcement). All but seven Washington County communities are opt-in municipalities; Beallsville, Cokeburg, Ellsworth, Green Hills, New Eagle, Twilight, and West Middletown Boroughs are the opt-out municipalities.

5.2.1.2. Participation in the National Flood Insurance Program

The Pennsylvania Floodplain Management Act (Act 166 of 1978) requires every municipality identified by the Federal Emergency Management Agency (FEMA) to participate in the NFIP and permits all municipalities to adopt floodplain management regulations. It is in the interest of all property owners in the floodplain to keep development and land usage within the scope of the floodplain regulations for their community. This helps keep insurance rates low and makes sure that the risk of flood damage is not increased by property development.

There are 62 municipalities with identified SFHAs, and all of these communities participate in the NFIP; Claysville, Cokeburg, Green Hills, and West Middletown Borough do not participate in the NFIP, have no SFHAs, and have never been mapped. All participating communities are in good standing with the program, and there are no outstanding compliance issues. The current map effective dates for most Washington County municipalities range from the late 1970s through 1996. Washington County is currently undergoing a countywide restudy with 2nd Revised Preliminary data released in June 2014.

Table 5.2-2 NFIP Participation and Policies in Washington County. FEMA CIS 2014.

MUNICIPALITY	PARTICIPATION STATUS	# POLICIES	TOTAL PREMIUM AND COVERAGE	INITIAL FIRM IDENTIFIED	CURRENT EFFECTIVE MAP DATE
Allenport Borough	Participating	32	$3,368,500.00	7/16/1981	11/5/1986
Amwell Township	Participating	12	$2,580,400.00	9/15/1989	9/15/1989
Beallsville Borough	Participating	0	$0.00	9/24/1984	9/24/1984
Bentleyville Borough	Participating	6	$902,000.00	6/17/1986	6/17/1986
Blaine Township	Participating	1	$350,000.00	7/2/1982	7/2/1982
Buffalo Township	Participating	2	$368,100.00	6/11/1982	6/11/1982
Burgettstown Borough	Participating	11	$2,998,100.00	2/17/1989	2/17/1989
California Borough	Participating	72	$10,934,400.00	6/15/1981	9/6/1995
Canonsburg Borough	Participating	15	$3,882,400.00	4/1/1980	4/1/1980
Canton Township	Participating	19	$5,673,700.00	11/5/1986	11/5/1986
Carroll Township	Participating	19	$2,061,300.00	3/8/1980	12/5/1995

Table 5.2-2 NFIP Participation and Policies in Washington County. FEMA CIS 2014.					
MUNICIPALITY	**PARTICIPATION STATUS**	**# POLICIES**	**TOTAL PREMIUM AND COVERAGE**	**INITIAL FIRM IDENTIFIED**	**CURRENT EFFECTIVE MAP DATE**
Cecil Township	Participating	48	$8,707,100.00	9/5/1979	9/5/1979
Centerville Borough	Participating	25	$2,038,600.00	6/15/1981	12/5/1995
Charleroi Borough	Participating	23	$5,809,300.00	7/16/1981	1/19/1996
Chartiers Township	Participating	27	$8,089,000.00	2/1/1980	2/1/1980
Claysville Borough	Not Participating	NP	NP	NP	NP
Coal Center Borough	Participating	8	$113,200.00	9/30/1981	9/3/1995
Cokeburg Borough	Not Participating	NP	NP	NP	NP
Cross Creek Township	Participating	12	$1,611,300.00	2/1/1987	2/1/1987
Deemston Borough	Participating	2	$328,000.00	5/1/1985	5/1/1985
Donegal Township	Participating	1	$105,000.00	10/15/1982	10/15/1982
Donora Borough	Participating	2	$27,500.00	6/10/1980	9/30/1995
Dunlevy Borough	Participating	4	$427,500.00	7/16/1981	10/18/1995
East Bethlehem Township	Participating	40	$5,761,200.00	7/16/1981	10/18/1995
East Finley Township	Participating	3	$585,200.00	5/1/1985	5/1/1985
East Washington Borough	Participating	2	$210,000.00	10/30/1978	11/5/1986
Elco Borough	Participating	15	$1,966,200.00	7/16/1981	10/18/1995
Ellsworth Borough	Participating	0	$0.00	9/10/1984	9/10/1984
Fallowfield Township	Participating	11	$3,487,000.00	2/17/1989	2/17/1989
Finleyville Borough	Participating	6	$1,045,600.00	9/1/1986	9/1/1986
Green Hills Borough	Not Participating	NP	NP	NP	NP
Hanover Township	Participating	6	$1,005,000.00	9/24/1984	9/24/1984
Hopewell Township	Participating	0	$0.00	8/6/1982	8/6/1982
Houston Borough	Participating	43	$54,777,000.00	12/18/1979	12/18/1979
Independence Township	Participating	9	$1,653,000.00	2/1/1987	2/1/1987
Jefferson Township	Participating	1	$65,000.00	6/30/1976	6/30/1976
Long Branch Borough	Participating	3	$288,300.00	9/1/1986	9/1/1986
Marianna Borough	Participating	0	$0.00	6/19/1989	6/19/1989
McDonald Borough	Participating	14	$2,734,900.00	8/15/1983	9/26/2014
Midway Borough	Participating	3	$375,000.00	8/15/1989	8/15/1989
Monongahela, City of	Participating	44	$4,644,700.00	7/3/1986	9/20/1995

Table 5.2-2 NFIP Participation and Policies in Washington County. FEMA CIS 2014.					
MUNICIPALITY	**PARTICIPATION STATUS**	**# POLICIES**	**TOTAL PREMIUM AND COVERAGE**	**INITIAL FIRM IDENTIFIED**	**CURRENT EFFECTIVE MAP DATE**
Morris Township	Participating	1	$280,000.00	8/5/1985	8/5/1985
Mount Pleasant Township	Participating	5	$958,000.00	10/8/1982	10/8/1982
New Eagle Borough	Participating	3	$914,400.00	3/18/1980	2/2/1996
North Bethlehem Township	Participating	2	$396,300.00	10/15/1985	10/15/1985
North Charleroi Borough	Participating	13	$1,316,200.00	7/16/1981	12/19/1995
North Franklin Township	Participating	20	$3,308,400.00	7/4/1989	7/4/1989
North Strabane Township	Participating	21	$5,762,300.00	2/15/1980	2/15/1980
Nottingham Township	Participating	6	$1,249,600.00	9/10/1984	9/10/1984
Peters Township	Participating	46	$11,493,000.00	11/1/1979	11/1/1979
Robinson Township	Participating	1	$210,000.00	2/25/1983	2/25/1983
Roscoe Borough	Participating	87	$7,434,300.00	7/16/1981	10/18/1995
Smith Township	Participating	8	$1,187,800.00	7/1/1986	7/1/1986
Somerset Township	Participating	8	$1,092,600.00	7/1/1986	7/1/1986
South Franklin Township	Participating	14	$877,700.00	7/17/1989	7/17/1989
South Strabane Township	Participating	15	$3,999,200.00	4/15/1980	4/15/1980
Speers Borough	Participating	18	$5,283,200.00	7/16/1981	12/19/1995
Stockdale Borough	Participating	62	$6,549,200.00	7/16/1981	12/19/1995
Twilight Borough	Participating	1	$202,000.00	9/28/1979	9/28/1979
Union Township	Participating	24	$3,993,500.00	2/2/1977	12/19/1995
Washington, City of	Participating	56	$12,535,000.00	11/5/1986	11/5/1986
West Bethlehem Township	Participating	9	$712,900.00	9/1/1986	9/1/1986
West Brownsville Borough	Participating	18	$1,763,900.00	4/27/1973	9/6/1995
West Finley Township	Participating	3	$327,000.00	9/24/1984	9/24/1984
West Middletown Borough	Not Participating	NP	NP	NP	NP
West Pike Run Township	Participating	3	$742,300.00	9/1/1986	9/1/1986

FEMA Region III makes available to communities, an ordinance review checklist which lists required provisions for floodplain management ordinances. This checklist helps communities develop an effective floodplain management ordinance that meets federal requirements for participation in the NFIP. The Pennsylvania Department of Community and Economic Development (DCED) provides communities, based on their 44 CFR 60.3 level of regulations, with a suggested ordinance document to assist municipalities in meeting the minimum requirements of the NFIP and the Pennsylvania Flood Plain Management Act (Act 166). Act 166 mandates municipal participation in and compliance with the NFIP. It also establishes higher regulatory standards for hazardous materials and high risk land uses. As new Digital Flood Insurance Rate Maps (DFIRMs) are published for Washington County, the Pennsylvania State NFIP Coordinator at DCED will work with each community to ensure the timely and successful adoption of an updated floodplain management ordinance by reviewing and providing feedback on existing and draft ordinances. In addition, DCED provides guidance and technical support through Community Assistance Contacts (CAC) and Community Assistance Visits (CAV). Thirteen communities have had CAVs since entering the program, but the most recent CAVs were in 1994 in California Borough, Mount Pleasant Township, and West Brownsville Borough. Significantly more participating communities have had at least one CAC (41 of 62 participating communities), with all occurring in 1989 and 1990.

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

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

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

- Reduce flood losses
- Reduce damage to property
- Protect public health and safety
- Prevent increases in flood damage from new construction
- Reduce the risk of erosion damage
- Protect natural and beneficial floodplain functions
- Facilitate accurate insurance rating
- Promote the awareness of flood insurance

There are 10 CRS classes that provide varied reduction in insurance premiums. Class 1 requires the most credit points and gives the largest premium reduction; Class 10 receives no premium reduction. CRS premium discounts on flood insurance range from 5 percent for Class 9 communities up to 45 percent for Class 1 communities. The CRS recognizes 18 creditable activities that are organized under four categories: Public Information, Mapping and Regulations, Flood Damage Reduction, and Flood Preparedness.

Washington County does not have any participating communities in the CRS. However, recognizing the benefits of program participation, Action 10 in the Mitigation Action Plan seeks to encourage CRS participation through training for municipal officials.

5.2.1.3. Emergency Management

Emergency Operations Plan

The Pennsylvania Emergency Management Services Code, Title 35, requires all political jurisdictions in the Commonwealth to have an emergency operations plan (EOP), an emergency management coordinator (EMC), and an emergency operations center (EOC). The Washington County EOP was revised in January 2012.

Washington County's EOP is an all-hazards plan that complies with the National Incident Management System (NIMS) and is the basis for a coordinated and effective response to any disaster that may affect lives and property in Washington County. The EOP, or portions thereof, would be implemented when emergency circumstances warrant it.

Washington County's EOP is administered by the County's Department of Public Safety. It assigns responsibility to all response organizations, not only for training and preparedness, but also for response and recovery. Incident-specific annexes have been developed to address individual natural and technological hazards that may require an added level of coordination.

Continuity of Operations/Continuity of Government Plan

Continuity of Operations (COOP) or Continuity of Government Plans are a critically important planning principle for emergency managers as well as for municipal officials. The National Fire Protection Association's *Standard on Disaster/Emergency Management and Business Continuity Programs* (NFPA 1600) provides those with the responsibility for disaster and emergency management and COOP planning programs with the criteria to assess current programs or to develop, implement, and maintain a program to mitigate, prepare for, respond to, and recover from disasters and emergencies. Continuity of Government procedures are included in the County EOP; they address the line of succession (elected officials, emergency management, and county offices), alternative locations, and preservation of records.

Evacuation Plan

Evacuation is one of the most widely used methods of protecting the public from hazard impacts. The easiest way to minimize death and injury due to a hazard event is to remove as many people as possible from its path. Evacuation plans include descriptions of the area(s) being evacuated, the demographics and characteristics of people within those area(s), transportation routes to safe areas, and how the community will support those individuals who do not have access to their own transportation. The County EOP noted addresses various

evacuation situations under ESF 6, and numerous communities noted that their EOP also included evacuation procedures.

StormReady

StormReady is a program administered by the National Weather Service (NWS). To be certified as StormReady, a community must establish links to the NWS's warning systems and relationships with NWS staff, establish a 24-hour warning point, ensure sufficient capability to respond to severe weather events, and provide public outreach and education.

The County of Washington was certified as Storm Ready in 2005 under this national program. The County also plans on implementing two Skywarn training classes offered by the NWS and implementing a yearly damage assessment/reporting class related to the adverse weather training and preparation system offered by PEMA.

5.2.2. Administrative and Technical Capability

Administrative capability is described by an adequacy of departmental and personnel resources for the implementation of mitigation-related activities. Technical capability relates to an adequacy of knowledge and technical expertise of local government employees or the ability to contract outside resources for this expertise in order to effectively execute mitigation activities. Common examples of skill sets and technical personnel needed for hazard mitigation include: planners with knowledge of land development/management practices, engineers or professionals trained in construction practices related to buildings and/or infrastructure (e.g. building inspectors), planners or engineers with an understanding of natural and/or human caused hazards, emergency managers, floodplain managers, land surveyors, scientists familiar with hazards in the community, staff with the education or expertise to assess community vulnerability to hazards, personnel skilled in geographic information systems, resource development staff or grant writers, fiscal staff to handle complex grant application processes.

Based on Capability Assessment Survey results, Washington County municipalities have moderate levels of administrative and technical staff needed to conduct hazard mitigation-activities. There appear to be sufficient emergency management and land use planning staff across the County. The Washington County Planning Commission is a significant source of administrative and technical assistance.

The purpose of the Washington County Planning Commission has a variety of responsibilities that include mapping of the county, the review of land development and subdivisions, and the orderly development of land. The commission also maintains extensive population and demographic data for the county and provides comprehensive information to potential developers and the general public.

The Planning Commission conducts and prepares numerous studies regarding environmental, economic, and general issues that impact county development and natural resources of the county. The commission also coordinates the development and preparation of various public affairs, information, and educational programs concerning county government. The Bridge Department, Department of Parks and Recreation, and flood control projects all fall under the Planning Commission's jurisdiction.

In Pennsylvania, planning responsibilities traditionally have been delegated to each county and local municipality through the municipal planning commission (MPC). The MPC conveys the planning authority and establishes the requirements that a municipality must follow. Thirty-one municipalities indicated that they have planners with appropriate knowledge of land development and management practices. In addition, 28 of the municipalities responding to the capability assessment indicated that they have such capabilities. Although some individual municipalities do not have a staff member with an understanding of hazards (natural or otherwise), the County Planning Department will provide consultation in many facets of planning and employ a hazard reduction planner whose focus is the mitigation of natural hazards. The County's Department of Public Safety functions in much the same way. In addition, all 66 municipalities in Washington County have EMCs. It is not uncommon that one EMC covers multiple municipal jurisdictions.

Floodplain managers are experts in the rules and regulations of development in a floodplain, and can provide vast amounts of information on the risks and impacts of building within those hazard areas. They are an integral part of the mitigation planning team, and can make recommendations based on the needs and conditions of the community. All 66 municipalities participate in the NFIP and have a designated Floodplain Manager. Those municipalities that are under the County Zoning Ordinance utilize the County Floodplain Manager.

Spatial and tabular data are linked in a computerized, visual format through the use of sophisticated GIS technology. Through GIS projects, it is possible to accomplish environmental restoration, economic development, Smart Growth land use planning, infrastructure development, and training to use GIS for decision support. Washington County has GIS capabilities that can assist the municipalities.

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

- Pennsylvania Department of Community and Economic Development,
- Pennsylvania Department of Conservation and Natural Resources,
- Pennsylvania Department of Environmental Protection, and
- Pennsylvania Department of Transportation.

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

- Army Corp of Engineers,
- Department of Housing and Urban Development,
- Department of Agriculture,
- Economic Development Administration,
- Emergency Management Institute,
- Environmental Protection Agency,
- FEMA, and
- The Small Business Administration.

5.2.3. Financial Capability

Financial capability is important to the implementation of hazard mitigation activities. Every jurisdiction must operate within the constraints of limited financial resources. During the 1960s and 1970s, state and federal grants-in-aid were available to finance a large number of programs, including street improvements, water and sewer facilities, airports, and parks and playgrounds. During the early 1980s, there was a significant change in federal policy, based on rising deficits and a political philosophy that encouraged states and local governments to raise their own revenues for capital programs resulting in the need to identify alternate means to augment revenue.

The decision and capacity to implement hazard mitigation activities is often highly dependent on available local financial resources. While some mitigation actions are less costly than others and can be accomplished using existing staff resources, it is important that funding is available locally to implement policies and projects.

Financial resources are particularly important if communities are trying to take advantage of state or federal mitigation grant funding opportunities that require local match contributions. Based on Capability Assessment Survey results, most municipalities within the County perceive financial capability to be limited to moderate. The most common type of fiscal capability is not a funding source, but rather partnering agreements between municipalities that enable resource sharing.

With state funding levels decreasing, the amount of state programs available to fund hazard mitigation activities as well as associated dollar amounts has decreased significantly since the 2010 HMP Update. Current state funding sources that may be available for hazard mitigation planning activities include, but are not limited to:

- CFA/DCED Flood Mitigation Program,
- CFA/DCED H2O PA Flood Control Projects,
- CFA/DCED H2O PA High Hazard Unsafe Dam Projects,
- CFA/DCED H2O PA Water Supply, Sanitary Sewer and Storm Water Projects,
- CFA/DCED PA Small Water and Sewer,
- DCED Business Financing
- DCED Keystone Communities Program,
- DCED Local Government Capital Project Loan Program,
- DCED Municipal Assistance Program ,
- DCNR Community Conservation Partnerships Program,
- DEP Growing Greener Program,
- PennDOT Pennsylvania Infrastructure Bank (PIB) Loan,
- Pennsylvania Infrastructure Investment Authority (PENNVEST), and
- Pennsylvania Redevelopment Assistance Capital Program (RACP).

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

- Department of Commerce (DOC)/Economic Development Authority (EDA) Construction Grant Program
- Department of Energy Weatherization Assistance Program
- Department of Homeland Security Grant Program (HSGP)
- Department of Transportation/Federal Highway Administration Emergency Relief Program
- DOC/EDA Planning Grants
- DOC/EDA Revolving Loan Fund
- DOC/EDA Technical Assistance Grants
- FEMA Community Assistance Program – State Support Services Element (CAP-SSSE)
- FEMA Community Disaster Loan Program
- FEMA Community Rating System
- FEMA Emergency Management Performance Grants (EMPG)
- FEMA Environmental Planning and Historic Preservation Program (EHP)
- FEMA Flood Mitigation Assistance Program
- FEMA Hazard Mitigation Grant Program (HMGP)
- FEMA Individuals and Households Program (IHAP)
- FEMA National Dam Safety Program
- FEMA National Flood Insurance Program
- FEMA Pre-Disaster Mitigation Program
- FEMA Public Assistance Program (PA)
- FEMA Regional Catastrophic Preparedness Grant Program
- Housing and Urban Development (HUD) 5-H Homeownership Program
- HUD Community Development Block Grants (CDBG)
- HUD Disaster Housing Assistance Program
- HUD/Federal Housing Administration (FHA) Title 1 Home Repair Loan Program
- HUD/FHA Section 203(h) Mortgage Insurance for Disaster Victims
- HUD/FHA Section 203(k) Rehabilitation Mortgage Insurance Program
- HUD Partnership for Advancing Technology in Housing
- HUD Section 108 Loan Guarantee Programs
- Internal Revenue Service Casualty Loss-Special Disaster Provisions
- National Oceanic and Atmosphere Administration (NOAA) StormReady Program
- Natural Resources Conservation Service (NRCS) easement programs
- Small Business Administration Disaster Loan Programs
- United States Army Corps of Engineers (USACE) General Investigation (GI)
- USACE Continuing Authorities Program
- USACE Flood Plain Management Services Program (FPMS)
- USACE Inspection of Completed Works Program (ICW)
- USACE National Levee Safety Program
- USACE Planning Assistance to States
- USACE Rehabilitation and Inspection Program (RIP)

- United States Department of Agriculture (USDA)/Farm Service Agency (FSA) Emergency Conservation Program
- USDA/FSA Emergency Farm Loans
- USDA Non-insured Crop Disaster Assistance Program (NAP)
- USDA/NRCS Emergency Watershed Protection Program
- USDA Repair and Rehabilitation Loan
- USDA/Rural Housing Service (RHS) Community Facilities Loans and Grants
- USDA/RHS Rural Rental Loans
- USDA/RHS Section 502 Single-Family Housing Direct and Guaranteed Loans
- USDA/RHS Section 504 Repair Loans and Grants
- USDA/RHS Self-Help Housing Loans
- USDA/Risk Management Agency Federal Multi-Peril Crop Insurance
- USDA/Rural Business Service Business and Industrial Loans
- USDA Watershed Protection and Flood Prevention Program

In addition to these state and federal funding sources, there are a few other key financial capabilities in use in the county. First, the capital improvement plan is a multiyear policy guide that identifies needed capital projects and is used to coordinate the financing and timing of public improvements. Capital improvements relate to streets, stormwater systems, water distribution, sewage treatment, and other major public facilities. A capital improvement plan should be prepared by the respective county's planning commission and should include a capital budget. This budget identifies the highest priority projects recommended for funding in the next annual budget. The capital improvement plan is dynamic and can be tailored to specific circumstances.

Washington County identified capital improvement projects within their Comprehensive Plan. These projects are estimated to be completed by 2019. They center around transportation issues but could be employed for hazard mitigation in the future.

Municipal authorities are most often used when major capital investments are required. In addition to sewage treatment, municipal authorities have been formed for water supply, airports, bus transit systems, swimming pools, and other purposes. Municipal authorities have powers to receive grants, borrow money, and operate revenue-generating programs, and are authorized to sell bonds, acquire property, sign contracts, and take similar actions. Authorities are governed by authority board members who are appointed by the elected officials of the member municipalities. Washington County and its municipalities have numerous special purpose authorities dealing with such things as water and sewer infrastructure, industrial development, and housing.

Community Development Block Grants (CDBGs) are designed to assist the vulnerable populations within the community by ensuring affordable housing, creating jobs, and providing direct services. The amount of each grant is determined by a formula that accounts for the community's need, poverty, population, housing, and comparison to other areas. The annual appropriation is divided among the states and local jurisdictions (referred to as "non-entitlement communities" and "entitlement communities"). The following are entitlement communities:

- Central cities of Metropolitan Statistical Areas (MSAs)
- Cities with at least 50,000 people
- Some urban counties with at least 200,000 people
- States provide CDBG funds to non-entitlement jurisdictions.

The majority of CDBG funds are required to be spent to benefit low- and moderate-income people. Also, there is a set of national objectives for the program, including addressing existing conditions that pose a threat to the health and welfare of the community (e.g., low-income housing in a floodplain). All municipalities within Washington County have access to CDBG funding, be it directly through the federal or state government or through a competitive county selection process.

Development impact fees are one-time fees assessed to offset the cost of providing public services to a new development. In Pennsylvania, impact fee programs may be established for capital improvements associated with transportation infrastructure in accordance with section 505-A of the Pennsylvania Municipalities Planning Code and the Pennsylvania Transportation Partnership Act. This program would allow for investments in highway infrastructure to reduce hazard risks. In addition, Pennsylvania Act 203 of 1990: Municipalities Authorities Act Amendments, allows water and sewer authorities to charge tapping fees for infrastructure improvements to connect adjacent properties to systems. However, this authorization would only have limited value in addressing hazards. In other states, such impact fees may be dedicated to providing the related new water or sewer infrastructure, roads, parks and recreational areas, libraries, schools, etc. The new infrastructure may be less vulnerable to hazard impacts.

The Oil and Gas Act (Act 13 of 2012) presented major changes to the oil and gas industry in Pennsylvania, including the authorization for local governments to adopt an impact fee and the provision of stronger environmental protections. For example, oil and gas well pad setbacks from private water wells, streams, and buildings increased; bond amounts for catastrophic accidents increased; and public accessibility of information related to chemicals used onsite improved (Pittsburg Post-Gazette, 2012). A portion of the impact fees goes to county conservation districts, the Pennsylvania Fish and Boat Commission, the Pennsylvania Public Utility Commission, the Pennsylvania Department of Environmental Protection, the PEMA, the Pennsylvania Office of State Fire Commissioner, and the Pennsylvania Department of Transportation in order to address statewide issues (PA PUC, 2012). A portion of the impact fees goes to local municipalities to address water, wastewater, and road infrastructure maintenance and improvements; emergency preparedness; environmental programs; tax reductions; increased safe/affordable housing; employee training; or planning initiatives

5.2.4. Education and Outreach Capability

Education and outreach programs and methods are used to implement mitigation activities and communicate hazard-related information. Examples include fire safety programs that fire departments deliver to students at local schools; participation in community programs, such as Firewise Communities Certification or StormReady Certification; and activities conducted as part

of hazard awareness campaigns, such as Hurricane Preparedness Week. Some communities have their own public information or communications office to handle outreach initiatives.

Perhaps the largest and most extensive education and outreach opportunity is the Washington County Public Safety website. This site provides a variety of educational resources. These include a severe weather presentation, information on the NWS rain gauges and the automated flood warning system, and a course registration system that allows both individual users and groups to register for public safety courses.

5.2.5. Plan Integration

Plan integration ensures that hazard mitigation planning is woven into each jurisdiction's planning and regulatory documents. Per FEMA, plan integration is described as the regular consideration and management of hazard risks in a community's existing planning framework. The planning framework is the collection of plans, policies, codes, and programs that guide land use and development, how those are maintained and implemented, and the roles of a range of stakeholders to evaluate and update them. Effective integration of hazard mitigation occurs when the planning framework fosters development that does not increase risks from known hazards or leads to redevelopment that reduces risk from known hazards (FEMA, 2013).

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

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

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

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

Washington County Comprehensive Plan

The Washington County Planning Commission is responsible for maintaining and updating the County Comprehensive Plan and the County Subdivision and Land Development Ordinance. The Planning Commission's meetings are open to the public and are advertised according to the Pennsylvania Sunshine Act (65 PA C.S.A.).

Article III of the Pennsylvania Municipalities Planning Code (Act 247 of 1968, as reenacted and amended) requires all Pennsylvania counties (except Philadelphia) to adopt a comprehensive plan and update it at least every 10 years. Coupling this requirement with the DMA 2000-required five-year update cycle for HMPs, when possible, will allow the County to better integrate the County Comprehensive Plan and Multi-Jurisdictional HMP planning processes and strengthen public participation for both efforts.

Washington County's current Comprehensive Plan was adopted on November 23, 2005. This plan provides general direction and a blueprint for the future of Washington County and constituent communities. As required by the Municipalities Planning Code, the Comprehensive Plan currently needs to be updated. Recommendations from the HMP can be incorporated into the document, especially in defining environmentally sensitive or high-risk areas. There is also an opportunity to use the HMP's risk assessment to help define where future growth and development should be directed.

Washington County Emergency Operations Plan

The Pennsylvania Emergency Management Services Code (35 PA C.S. Sections 7701-7707, as amended) requires each county and municipality to prepare, maintain, and keep current an Emergency Operations Plan (EOP). The Washington County Emergency Management Agency is responsible for preparing and maintaining the County EOP. The risk assessment information presented in the existing HMP was used to update the hazard vulnerability assessment section of the County EOP. The updated risk assessment information will affect subsequent updates to the EOP.

The EOP is reviewed at least biennially. Whenever portions of the plan are implemented in an emergency event or training exercise, a review is performed and changes are made where necessary. These changes are then distributed to the County's 66 local Emergency Management Coordinators (EMCs) for safekeeping.

The Washington County Emergency Management Agency should consider the County's HMP during its biennial review of the County EOP. Recommended changes to the HMP will then be coordinated with the Steering Committee.

Washington County Act 167 Stormwater Management Plan

Act 167 requires that all stormwater management plans include an analysis of present and projected land development in flood hazard areas, and its sensitivity to damages from future flooding or increased runoff. In drafting the Washington County Act 167 Stormwater Management Plan, this HMP's hazard profile on floods, flash floods, and ice jams was consulted to identify the location and extent of flooding, range of magnitude, past occurrences, likelihood

of future occurrences, and vulnerability assessment due to flooding events. The floodplain maps included in this HMP were also used as a reference to meet Act 167 requirements.

In addition, Act 167 requires the identification of existing and proposed state, federal, and local flood control projects located in the watershed and their design capacities. Appendix I of this HMP, which contains maps and summaries of federal, state, and local flood control projects, was referenced in the drafting of the Plan.

Like the HMP, stormwater management plans must be reviewed (and revised, if necessary) every five years. The stormwater management plan was adopted in June 2010. Information developed in the revision of one plan can be incorporated into the revision of the other.

Washington County and its municipalities must ensure that the components of the HMP are integrated into existing community planning mechanisms and are generally consistent with goals, policies, or recommended actions. Washington County and the Hazard Mitigation Steering Committee will utilize the existing maintenance schedule of each plan to incorporate the goals, policies, or recommended actions as each plan is updated.

6. Mitigation Strategy

6.1. Update Process Summary

This section of the Washington County Hazard Mitigation Plan (HMP) identifies the goals, objectives, actions, and mitigation action plan for mitigating against the impacts of hazards.

Goals are general guidelines that explain what you want to achieve. Goals are usually expressed as broad policy statements representing desired long-term results.

Objectives describe strategies or implementation steps to attain the identified goals. Objectives are more specific statements than goals; the described steps are usually measurable and can have a defined completion date.

Actions provide more detailed descriptions of specific work tasks to help a community achieve the goals and objectives. For each objective statement, there are alternatives for mitigation actions that must be evaluated to determine the best choices for each situation (see Section 3: Alternative Mitigation Actions).

The **Mitigation Action Plan** includes a listing and description of the preferred mitigation actions and the strategy for implementation (e.g., who is responsible, how will they proceed, when should action be initiated and/or completed, etc.).

The goals and objectives listed in the HMP were first examined during the five-year plan review held as part of the Kick-off Meeting. During this review, the Steering Committee members were afforded the opportunity to comment on the goals, objectives, and actions that were listed in the existing HMP. In addition, throughout the course of the plan update, the HMP was posted on the County's Web site. All correspondence that was distributed to the municipalities referenced the Web site and welcomed comments on the HMP.

In 2010, Washington County chose mitigation goals that were meant to prevent future losses from hazards. These goals were:

1. Attempt to reduce the current and future risk of damage from floods, subsidence, and other hazards within Washington County
2. Reduce the potential impact of natural and man-made disasters on public and private property
3. Improve upon the protection of the citizens of Washington County from all natural and man-made hazards
4. Reduce or redirect the impact of natural disasters, especially floods, away from at risk population areas
5. Protect Washington County's natural resources through the implementation of cost-effective and technically feasible mitigation projects
6. Protect public health, safety, and welfare by increasing the public awareness of existing and potential hazards and by fostering both individual and public responsibility in mitigating risks due to those hazards

Since Washington County completed the 2010 HMP, they have been working to achieve the goals and objectives, and associated actions, that they defined in this plan. The following goal and objectives are related to defining the risk to properties and population from flooding and protecting these from future flooding hazards:

- Goal 1: Attempt to reduce the current and future risk of damage from floods, subsidence, and other hazards within Washington County.
    - Objective 1.1: Washington County will attempt to reduce the current and future risk of flood and subsidence damage in Washington County by directing new development away from high hazard areas by review existing regulations to ensure adequacy in reducing the amount of future development in identified hazard areas.
    - Objective 1.2: Review all comprehensive plans to ensure that designated growth areas are not in hazard areas.
    - Objective 1.4: Review all capital improvement plans to ensure that infrastructure improvements are not directed towards hazardous areas.
    - Objective 1.5: Evaluate and update existing floodplain ordinances to meet or exceed the NFIP standards.
- Goal 2: Reduce the potential impact of natural and man-made disasters on public and private property.
- Goal 4: Reduce or redirect the impact of natural disasters, especially floods, away from at risk population areas.
- Goal 5: Protect Washington County's natural resources through the implementation of cost-effective and technically feasible mitigation projects.

As a part of their efforts to achieve this goal and these objectives, Washington County has been working with the FEMA Region III Risk Mapping, Assessment, and Planning (Risk MAP) program to complete the revisions to their Digital Flood Insurance Rate Map (DFIRM) to account for the effects of development and any changes in drainage or topography in Washington County. Through this process, sixteen municipalities received maps with base flood elevations, and some of these also received floodway information. These municipalities have increased their floodplain ordinances in accordance with NFIP regulations, in direct relation to Objective 1.5. Washington County is also working towards Objectives 1.1, 1.2, and 1.4, and associated actions, through this effort by better defining the areas of flooding risk. Additionally, by better defining the hazardous areas related to flooding, this effort also benefits the intent of objectives in Goal 2, Goal 4, and Goal 5, and associated actions.

Through the process to update their DFIRM, Washington County worked with the Risk MAP program to hold two public meetings. The meetings were held on the following dates:

- March 25, 2010: First Community Coordination and Outreach Meeting
- January 8, 2014: Second Community Coordination and Outreach Meeting

These were Community Coordination and Outreach Meetings, with the Risk MAP partners met with the public to present the new DFIRM and associated products, explain how the information

was gathered and revised, present how to ensure the products are adopted, discuss the NFIP, and ensure the community information is current. Through this process, Washington County was able to ensure that they had the information gathered to inform their progress on the four mitigation goals discussed above.

In addition to the work that Washington County has done on their flood preparedness, they have also had many successes in their work to achieve Goal 6, and associated actions. Washington County has a number of resources to educate the public about the risks in the community and the actions they should take in response to these risks. The Washington County Public Safety Department has a Severe Weather Preparedness Presentation available online for public reference. This resource presents a number of storm related hazards which the population of Washington County is at risk of, including flooding and tornadoes and their associated risks. The presentation includes information about the need for property owners to be aware of the risks in their community and to mitigate the effects of these risks, see Figure 6.1-1.

Figure 6.1-1 Mitigation information from Severe Weather Preparedness Presentation (Washington County Public Safety, 2013).

Washington County has also achieved a lot of success towards Goal 3, and associated objectives and actions, between 2010 and 2015 when the goal was removed. The Public Safety Department has worked to increase their rescue capabilities, including through preparedness activities with the municipal firefighters and department resources. Additionally, the Public Safety Department has held multiple firefighting, hazardous materials, and rescue related trainings throughout these four years.

The Steering Committee considered the successes that they experienced in achieving their hazard mitigation goals, as listed above, as well as the guidance presented in validating the goals and objectives for the 2015 HMP update. The Steering Committee also used comments received from the planning team and stakeholders who completed 5-Year Mitigation Strategy Evaluation Form, presented in Table 6.1-1. Based on this information the Steering Committee developed recommendations to continue, change, or delete goals and objectives.

The Steering Committee determined that each of the goals and objectives listed in the 2010 version of the HMP will be continued with the exception of Goal 3. Goal 3 was focused on emergency management; while related to mitigating the impact of hazards on the people and property of the county they were tasks that were not sustained action that would reduce or eliminate long-term risk. The Washington County Department of Public Safety will track these tasks through other planning mechanisms and prefers that the mitigation plan focus on mitigation actions and implementation.

A summary of the review of goals and objectives received via the 5-Year Mitigation Strategy Evaluation Form is included in Table 6.1-1. This review includes recommendations to continue, change, or delete goals and objectives; reason for the continuation, change, or deletion; and status of the goal/objective. A compilation of the 5-Year Mitigation Strategy Evaluation Forms completed as part of the hazard mitigation planning process is included in Appendix C - Meeting and Other Participation Documentation.

Table 6.1-1 Review of 2010 Mitigation Strategy Goals and Objectives

GOALS AND OBJECTIVES	Continue	Change	Delete	REASON/STATUS
Goal 1 Attempt to reduce the current and future risk of damage from floods, subsidence, and other hazards within Washington County.	X	X		Re-word to all-hazard language.
Objective 1.1 Washington County will attempt to reduce the current and future risk of flood and subsidence damage in Washington County by directing new development away from high hazard areas by review existing regulations to ensure adequacy in reducing the amount of future development in identified hazard areas.	X	X		Re-word to be less repetitive. Washington County is working towards the objective of reducing risk to flood damage through the DFIRM update process.
Objective 1.2 Review all comprehensive plans to ensure that designated growth areas are not in hazard areas.	X			Washington County is working towards better defining the areas at risk to flooding hazards through the DFIRM update process.
Objective 1.3 The Commonwealth of Pennsylvania recently adopted the statewide Uniform Construction Code (UCC) and the majority of municipalities are expected to adopt said building code as well. Review and enforcement of the building codes are strongly advised.	X	X		Re-word to be current.

Table 6.1-1 Review of 2010 Mitigation Strategy Goals and Objectives				
GOALS AND OBJECTIVES	**Continue**	**Change**	**Delete**	**REASON/STATUS**
Objective 1.4 Review all capital improvement plans to ensure that infrastructure improvements are not directed towards hazardous areas.	X			Washington County is working towards better defining the areas at risk to flooding hazards through the DFIRM update process.
Objective 1.5 Evaluate and update existing floodplain ordinances to meet or exceed the NFIP standards.	X			Washington County evaluated their ordinances through the DFIRM update process; sixteen municipalities increased their ordinances in accordance with NFIP regulations.
Objective 1.6 Improve the enforcement of existing floodplain regulations.	X			
Objective 1.7 Recommend that flood insurance policies remain affordable through county and municipal government programs.	X	X		Re-word to focus on what is within local and county control.
Objective 1.8 Evaluate existing shelters to determine adequacy for current and future populations.	X			
Goal 2 Reduce the potential impact of natural and man-made disasters on public and private property.	X			
Objective 2.1 Encourage municipal participation in the National Flood Insurance Program and encourage property owners to purchase subsidence insurance.	X	X		Re-word to make objective generally about insurance and leave actions more specific.
Objective 2.2 Protect Washington County's most vulnerable populations, buildings, and critical facilities through the implementation of cost-effective and technically feasible mitigation projects.	X			Re-word since Washington County does not need to be restated here. Washington County is working towards better defining the areas at risk to flooding hazards through the DFIRM update process, which will help define the areas for mitigation projects.
Goal 3 Improve upon the protection of the citizens of Washington County from all natural and man-made hazards.			X	Goal 3, its objectives, and actions are emergency management focused. They will be removed from the HMP and addressed in in other planning processes, so that the HMP focuses on mitigation. One "Storm Ready" action that is mitigation focused will be moved to new Goal 5.
Objective 3.1 Ensure adequate training and resources for emergency organizations and personnel.			X	
Objective 3.2 Improve emergency preparedness in Washington County and its municipalities.			X	

Table 6.1-1 Review of 2010 Mitigation Strategy Goals and Objectives				
GOALS AND OBJECTIVES	**Continue**	**Change**	**Delete**	**REASON/STATUS**
Objective 3.3 Improve coordination and communication among disaster response organizations, local, and county governments.			X	Washington County has held numerous training and preparedness activities for their response officials.
Objective 3.4 Evaluate cost-effective ways of augmenting existing broadcast and communication systems to monitor warning information continuously and to disseminate appropriate warnings.			X	
Goal 4 Reduce or redirect the impact of natural disasters, especially floods, away from at risk population areas	X			
Objective 4.1 Research possible mitigation projects to reduce flooding, reduce/eliminate sewage leakage and inflow/infiltration problems. Some projects may include reservoirs, levees, floodwalls, diversions, channel modification, and storm sewers	X			Washington County is working towards better defining the areas at risk to flooding hazards through the DFIRM update process, which will help define the areas for mitigation projects.
Objective 4.2 Gather information on any structures previously studied that may have design information that could possibly be implemented to reduce flood hazards. (Example: A dam that may have been previously proposed, for which data exists, could be used as a potential project to construct a dam that would reduce flooding.	X	X		Re-word to address integration more specifically.
Goal 5 Protect existing natural resources and open space, including parks and wetlands, within the floodplain and watershed to improve their flood control function.	X			
Objective 5.1 Protect Washington County's natural resources through the implementation of cost-effective and technically feasible mitigation projects.	X	X		Re-word since Washington County does not need to be restated here. Washington County is working towards better defining the areas at risk to flooding hazards through the DFIRM update process, which will help define the areas for mitigation projects.
Objective 5.2 Protect Washington County's natural resources through the implementation of recreation planning and storm water management planning	X	X		Re-word since Washington County does not need to be restated here.

Table 6.1-1 Review of 2010 Mitigation Strategy Goals and Objectives				
GOALS AND OBJECTIVES	**Continue**	**Change**	**Delete**	**REASON/STATUS**
Goal 6 Protect public health, safety, and welfare by increasing the public awareness of existing and potential hazards and by fostering both individual and public responsibility in mitigating risks due to those hazards.	X			
Objective 6.1 Develop and distribute public awareness materials about natural hazard risks, preparedness, and mitigation.	X			Washington County has released materials for the public to use to be more aware of the hazards in their area, the risks they face from these hazards, and the opportunity to mitigate these risks; includes online resources and presentations.
Objective 6.2 Target owners of properties within identified hazard areas for additional outreach regarding mitigation and disaster preparedness.	X			

Based on the successes achieved included at the beginning of this section and in the previous table, and the evaluation of the goals and objectives detailed above, the Steering Committee evaluated the actions identified in the 2010 HMP. The Steering Committee assessed these actions based on successes, as well as using information about the feasibility of the action given current circumstances, new information about the hazards, revisions in codes achieved, and any other available information.

Additionally, the planning team reviewed the Mitigation Opportunity Forms submitted in the 2010 HMP. Each of the projects identified in these forms was evaluated, and was incorporated into the actions in the 2015 HMP update. A majority of these actions were directly related to the educational actions under Goal 6. Additionally, the Steering Committee identified a community outreach and education action related to flood risk, which directly related to these Opportunity Forms. Many of the remaining Opportunity Forms were related to hazard specific actions, specifically flooding and landslides, most directly related to Goals 1, 2, and 4. Three additional actions were identified after this review to address residential and critical infrastructure flood protection specific projects and landslide specific projects.

Mitigation Opportunity Forms related to emergency response actions under Goal 3 were not incorporated into the actions in the 2015 HMP update, since the Steering Committee decided to remove this goal from the updated plan.

Table 6.1-2 provides further detail on how the actions were assessed and updated based on this information for the 2015 HMP update.

Table 6.1-2 Review of 2010 Mitigation Actions

ACTION TITLE	Complete	Canceled	Deferred	Ongoing	DESCRIPTION OF PROGRESS AND/OR REASON FOR DISCONTINUATION
Action 1.1.1 Encourage municipal offices to review regulations pertaining to their jurisdiction to make sure that adequate zoning regulations are in place to reduce future development in high hazard areas in their jurisdiction. The Washington County Planning Commission is to review Subdivision and Land Development Ordinance. The Washington County Comprehensive Plan addresses these issues, and places the onus at the municipal level.			X		Updated Action: Encourage the municipalities to conduct annual reviews of zoning regulations meant to ensure a reduction in development in high hazard areas. The Washington County Planning Commission is responsible for reviewing subdivision and land development ordinances.
Action 1.1.2 Obtain repetitive loss information from PA DCED to be included in next revision of the Washington County Hazard Mitigation Plan	X				Information was obtained and included in the 2015 plan update.
Action 1.2.1 Planning department and applicable municipal offices to review their comprehensive plans to ensure that designated growth areas are not in high hazard areas identified in this plan.			X		Updated Action: Use information developed in the mitigation plan update process to update county and municipal comprehensive plans, especially where it relates to high hazard areas identified in this plan.
Action 1.3.1 Encourage all municipal offices to review the statewide Uniform Construction Code to ensure the enforcement of these codes as a minimum standard.			X		
Action 1.4.1 Encourage applicable municipal offices to review their capital improvement plans to ensure that programmed infrastructure improvements are not in high hazard areas			X		
Action 1.5.1 Encourage applicable municipalities to review and update their floodplain ordinances to be sure that they are in full compliance with the NFIP.			X		Washington County's DFIRM is due effective September 2015 and municipalities will be updating ordinances over the course of the Summer 2015. Updated Action: Encourage annual reviews of county and municipal floodplain ordinances to ensure compliance with the NFIP.

Table 6.1-2 Review of 2010 Mitigation Actions					
ACTION TITLE	**Complete**	**Canceled**	**Deferred**	**Ongoing**	**DESCRIPTION OF PROGRESS AND/OR REASON FOR DISCONTINUATION**
Action 1.6.1 For Washington County Department of Public Safety to arrange with PEMA to hold training sessions with the County and the municipalities on the National Flood Insurance Program (NFIP) requirements.			X		Washington County, its municipalities and stakeholders [participated in a CCO meeting on 3/25/10 and a second CCO meeting on 1/8/14 to learn about role in recognizing updated DFIRMs. Updated Action: Conduct training as required to familiarize county and municipal staff with NFIP requirements, and the Community Rating System (CRS)
Action 1.6.2 Washington County Department of Public Safety to arrange with PEMA to hold training for Insurance Companies on the NFIP.		X			This action was revised to be an all-inclusive action related to flood education
Action 1.7.1 County Department of Public Safety to arrange with PEMA to conduct training on the Community Rating System (CRS) to municipalities.		X			This action was revised to be an all-inclusive action related to flood education
Action 1.8.1 Ensure that all shelters within Washington County have adequate emergency power resources. By working with the American Red Cross (ARC) towards upgrading all shelter resources.			X		Updated Action: Evaluate power requirements at shelters countywide with the help of the American Red Cross (ARC) and take necessary steps to provide adequate backup power to those that need it
Action 1.8.2 Develop adequate emergency shelter and evacuation plans for animals (domestic pets and livestock) by establishing a committee representative of all areas of the County that will include veterinarians, pet store owners, animal shelters and other to work on animal-specific evacuation and sheltering needs.			X		Updated Action: Create a committee to look at challenges associated with sheltering household pets in existing shelters
Action 2.1.1 County Department of Public Safety and PEMA to conduct outreach efforts to educate municipalities about the NFIP requirements and subsidence insurance.			X		Flood education addressed in action was revised to be an all-inclusive action related to flood education Updated Action: Undertake an education and outreach program meant to familiarize municipalities with subsidence insurance.
Action 2.1.2 County to obtain updated information on the number of NFIP policyholders in Washington County and its municipalities from PEMA.	X				Information was obtained to write the 2015 mitigation plan update

Table 6.1-2 Review of 2010 Mitigation Actions					
ACTION TITLE	**Complete**	**Canceled**	**Deferred**	**Ongoing**	**DESCRIPTION OF PROGRESS AND/OR REASON FOR DISCONTINUATION**
Action 2.1.3 Washington County Department of Public Safety and the Department of Environmental Protection Bureau of Mines to initiate an aggressive public relations program explaining both the need for and availability of subsidence insurance.		X			This is a repetitive action that was addressed in action 2.1.1
Action 2.2.1 WCDPS to work with municipalities and the county assessment office to collect information on the number, location and assessed value of all repetitive loss properties throughout the county in order to plan future mitigation activities; and create and maintain a current inventory asset list of all structures within the 100-year floodplain			X		Updated Action: Develop and maintain an asset list of repetitive loss properties, as well as structures located in the regulatory floodplain
Action 2.2.2 County to work with California University of Pennsylvania to develop a database in existing hazard GIS system of information on all repetitive loss properties including maps to be used in future mitigation activities			X		Updated Action: Work with California University to maintain hazard maps to be used for future mitigation activities
Action 2.2.3 When funds become available for hazard mitigation projects, the county recommends that the municipalities hold a series of public meetings with the owners of repetitive loss properties in high risk areas. These meetings will also be used to identify high-risk properties in the unincorporated areas of the County and to determine potential participation in future acquisition and relocation projects.			X		Updated Action: Conduct public outreach to determine the interest of homeowners with repetitive loss properties in selling their properties as a hazard reduction measure. Annually apply for funds to conduct buyouts for interested homeowners
Action 3.1.1 Washington County CERT Trainers to teach and equip Community Emergency Response Team (CERT) classes to interested citizens in Washington County to assist first responders at specified emergencies throughout the county. Additional trainers need to attend future Train-the-Trainer Courses.		X			Action removed as it is an emergency response function. These actions will be tracked through alternate planning mechanisms

Table 6.1-2 Review of 2010 Mitigation Actions					
ACTION TITLE	**Complete**	**Canceled**	**Deferred**	**Ongoing**	**DESCRIPTION OF PROGRESS AND/OR REASON FOR DISCONTINUATION**
Action 3.1.2 Department of Public Safety to work with the Washington County Firemen's Association, Washington County Hospitals, EMS, Police Departments, Local Emergency Management Coordinators, local elected officials, and the Sheriff's Department to increase the number of trained citizen emergency responders by meeting with groups of potential volunteers to attempt to increase the number of trained responders for all County Fire Departments, Emergency Medical Services, Law Enforcement, etc. All areas of Washington County will benefit.		X			Action removed as it is an emergency response function. These actions will be tracked through alternate planning mechanisms
Action No: 3.1.3 Department of Public Safety to conduct annual tabletop and functional disaster exercises with local law enforcement, emergency managers, county and local officials, and other disaster response agencies. Types of exercises to include: Flood Exercise, Weapons of Mass Destruction Exercise, Hazardous Materials Spill Exercise, Weather Exercise, and Bio-Terrorism Exercise		X			Action removed as it is an emergency response function. These actions will be tracked through alternate planning mechanisms
Action 3.1.4 Department of Public Safety to provide information about local, regional, state, and federal training opportunities to fire departments, ambulance services, and other emergency responders. Develop a list of training opportunities that are available and to distribute the list to all local emergency responders. Training should include preparedness to respond to geological & natural hazards as well as man-made and technological hazards. Will benefit all areas of Washington County. Training opportunities are advertised by direct mailing, email, and the Washington County web site, www.co.washington.pa.us.		X			Action removed as it is an emergency response function. These actions will be tracked through alternate planning mechanisms

Table 6.1-2 Review of 2010 Mitigation Actions					
ACTION TITLE	**Complete**	**Canceled**	**Deferred**	**Ongoing**	**DESCRIPTION OF PROGRESS AND/OR REASON FOR DISCONTINUATION**
Action 3.1.5 Continue to conduct National Weather Service Storm Spotter classes by partnering with the National Weather Service to provide training to people throughout Washington County on Storm Spotting in the areas of Flooding, High Winds, Basic I and II.		X			Action removed as it is an emergency response function. These actions will be tracked through alternate planning mechanisms
Action 3.1.6 Maintain the "Storm Ready" status awarded by the National Weather Service. This is a biennial review and certification.				X	This action will be moved under objective 6.1
Action 3.2.1 Review the existing Washington County Emergency Operations Plan (EOP) and update where necessary based on the recommendations of the Washington County Hazard Mitigation Plan. Include participation from all municipalities in the update process by ensuring that their Emergency Operations Plans are reviewed and updated annually.		X			Action removed as it is an emergency response function. These actions will be tracked through alternate planning mechanisms
Action 3.2.2 Washington County would like to obtain an emergency services rescue vehicle to respond to emergencies within the county. This would be a specialty vehicle designed to support structural collapse or trench rescue. These resources are not currently available in Washington County		X			Action removed as it is an emergency response function. These actions will be tracked through alternate planning mechanisms
Action 3.3.1 Expand the mission and membership of the Washington County Local Emergency Planning Committee (LEPC)/Disaster Preparedness Committee (DPC) to act as a countywide disaster task force by expanding their mission to include other disaster planning and response activities.		X			Action removed as it is an emergency response function. These actions will be tracked through alternate planning mechanisms

Table 6.1-2 Review of 2010 Mitigation Actions

ACTION TITLE	Complete	Canceled	Deferred	Ongoing	DESCRIPTION OF PROGRESS AND/OR REASON FOR DISCONTINUATION
Action 3.4.1 Develop a plan to update the Communications Center alerting and warning capability.		X			Washington County has been working with the NWS since Hurricane Ivan in 2004 to update local Emergency Alert System information Action removed as it is an emergency response function. These actions will be tracked through alternate planning mechanisms
Action 3.4.2 Research the possibility of installing Emergency Alert Warning Sirens and equipment to reach all populated areas throughout the County.		X			Action removed as it is an emergency response function. These actions will be tracked through alternate planning mechanisms
Action 3.4.3 Distribution of NOAA Weather Radios to Washington County businesses, municipalities, schools, hospitals, nursing homes, day care centers, and SARA facilities.		X			Action removed as it is an emergency response function. These actions will be tracked through alternate planning mechanisms
Action 4.1.1 Continue to review Hazard Mitigation Questionnaires and post-disaster reviews submitted by the municipalities.		X			This action falls under the plan maintenance section
Action 4.1.2 Continue to produce and submit Hazard Mitigation Project Opportunity Forms for high-risk structures/areas (especially post-disaster).			X		County determined that the Opportunity Forms were not efficient in collecting information for mitigation activities. Updated Action: Continue to collect information on potential mitigation grant applications projects including interested properties owners, to be ready to apply for mitigation when funding is available.
Action 4.2.1 Contact the United States Army Corp of Engineers (USACE) and other agencies for information pertaining to previous studies on structural projects. This information could be helpful in planning future mitigation projects			X		Updated Action: Coordinate with partner agencies to obtain relevant information for mitigation projects
Action 4.2.2 Renovate the Canonsburg Dam so that it will serve as a recreational area as well as a flood control dam. This will have a positive impact on both Washington and Allegheny Counties			X		Updated Action: Evaluate the feasibility and cost of renovating the Canonsburg dam to turn it into a recreational areas as well as a flood control measure

Table 6.1-2 Review of 2010 Mitigation Actions

ACTION TITLE	Complete	Canceled	Deferred	Ongoing	DESCRIPTION OF PROGRESS AND/OR REASON FOR DISCONTINUATION
Action 4.2.3 Survey Washington County Watersheds for potential flood control projects. Once identified, meet with local elected officials to discuss the feasibility of projects and seek funding where applicable.			X		Accomplishments on individual mitigation projects in municipalities found in Mitigation Opportunity Forms; expanded action to account for ongoing projects and for potential new projects. Updated Action: Coordinate potential flood mitigation projects with Washington County officials, including watershed groups, and present projects for approval and funding; ongoing projects include identified stormwater management projects, creek bed reclamation, etc.
Action 5.1.1 Work with DEP, conservation agencies, park and recreation organizations, wildlife groups, and other appropriate agencies to collect information of the number and location of natural resource areas throughout the county.			X		Updated Action: Develop and maintain a list detailing the location of natural resource areas throughout the county. Use list to create maps and other relevant data for future mitigation activities.
Action 5.1.2 Washington County to develop a database in existing GIS system of all natural resource areas including maps to be used in future mitigation activities.		X			Action combined with 5.1.1
Action 5.1.3 When funds become available for mitigation projects, the county plans to hold meetings to identify high-risk properties in the county and to determine potential participation in future acquisition and buy-out projects.		X			Repetitive Action – 2.2.3
Action 5.2.1 Planning Department to consider creating and implementing a County Recreation Plan and Storm Water Management Plan within the next five year			X		Updated Action: Conduct reviews of the 2010 stormwater management plan (phase II) and recreation plan for needed updates (if any)
Action 5.2.2 County to work with DEP, conservation agencies, watershed groups, etc., to research avenues for restoring degraded natural resources and open space to improve their flood control functions.			X		Updated Action: Coordinate with DEP, related conservation agencies, and watershed groups to research and identify flood control opportunities through restoration of reclaimed areas, i.e. open space, green space, etc.

Table 6.1-2 Review of 2010 Mitigation Actions					
ACTION TITLE	**Complete**	**Canceled**	**Deferred**	**Ongoing**	**DESCRIPTION OF PROGRESS AND/OR REASON FOR DISCONTINUATION**
Action 6.1.1 Create a "How To" Mitigation display for use at public events that would include information and pictures like that contained in FEMA's publications: Retrofitting for Homeowners Guide, Elevating Your Flood Prone Home, Elevating Residential Structures, and Information on the NFIP.			X		Washington County Public Safety regularly participates in Night Out events and Senior Care events at Malls. Updated Action: Create a variety of displays to be used at public events that cover topics including: mitigation, animals in disaster, business continuity, and children's programs. These displays will appeal to different audiences and different events, and can be supplemented with FEMA resources as handouts and giveaways.
Action 6.1.2 Planning to work with the Washington Cooperative Extension to develop Animals in Disaster Displays that will be used at 4-H Clubs, Agricultural Fairs, in Veterinarians Offices, and other places that animal owners may gather. The display will have information about preparing animals for disasters by making a disaster plan and a disaster supply kit for each animal. The display will encourage animal owners to decide ahead of time where animals will be sheltered and to familiarize them with the County's Animals in Disaster Annex of the Emergency Operations Plan.		X			This action was rolled into Action 6.1.1
Action 6.1.3 County to develop a Business Continuity Planning Display. The display will be designed to raise the awareness level of why it is important to have a Business Continuity Plan, how to develop a plan, and will encourage businesses to make sure that their plan fits in with the County's plan. This display will be appropriate for use at local Chamber of Commerce meetings and activities, civic group gatherings such as the Rotary Club or Kiwanis Club, and other business-related gatherings.		X			This action was rolled into Action 6.1.1

Table 6.1-2 Review of 2010 Mitigation Actions					
ACTION TITLE	**Complete**	**Canceled**	**Deferred**	**Ongoing**	**DESCRIPTION OF PROGRESS AND/OR REASON FOR DISCONTINUATION**
Action 6.1.4 Create displays for children's programs that teach safety. Examples of information to be used would be similar to that on the FEMA for Kids CD and/or the Sparky Fire Safety Program. The Washington County Firemen's Association has received funding to purchase a trailer for conducting community training on fire safety and other relevant trainings. The Department of Public Safety plans to assist with advertising and scheduling fire safety programs.		X			This action was rolled into Action 6.1.1
Action 6.1.5 Continue to utilize the media for the distribution and publication of hazard information by sending news releases and public service series to local newspapers, radio and TV stations about pre-disaster information.			X		Updated Action: Maintain a list of media contacts to be used when release of hazard information is necessary
Action 6.1.6 Continue to work with non-governmental organizations to promote mitigation education and awareness by creating public speaking series on hazard related topics such as types of natural disasters and risks, how to develop a family disaster plan and disaster supply kit, sheltering in place, how to develop a business continuity plan, simple types of mitigation projects for homeowners and businesses, etc. These speaking engagements will be offered to boys and girls clubs, scouting organizations, family centers, civic groups such as Rotary and Kiwanis Clubs, the Chamber of Commerce, Church and interfaith groups, etc.			X		Updated Action: Develop a series of presentations that explain the hazards facing Washington County and how to best protect oneself from their effects. These presentations should be able to be tailored to different groups.
Action 6.1.7 Ensure that the Red Cross citizen's disaster course is held on a frequent basis. The American Red Cross will hold a variety of courses, including: Adult and Child CPR, Basic First Aid, Introduction to Disaster Services, Mass Care, Shelter Operations, and others at the Red Cross Office and at other locations throughout Washington County.			X		Updated Action: Coordinate with the ARC to ensure that educational opportunities are presented on a regular basis

Table 6.1-2 Review of 2010 Mitigation Actions					
ACTION TITLE	**Complete**	**Canceled**	**Deferred**	**Ongoing**	**DESCRIPTION OF PROGRESS AND/OR REASON FOR DISCONTINUATION**
Action 6.1.8 Update the county website to provide hazard related information that is easily accessible. The Washington County Department of Public Safety website is to provide information about disaster preparedness and related activities. The plan is to expand and update the website as needed and as appropriate in a timely manner to benefit all County residents. It will also show current weather conditions, weather predictions, IFLOWs data, stream level data, Monongahela River data, and any other pertinent warning information.			X		Updated Action: Update the WCDPS website. Update is to include information on all 4 phases of emergency management, as well as presenting current weather, stream level data, iFLOWs data and any other pertinent warning information
Action 6.1.9 Continue to work with the Washington County school districts through the Intermediate Unit #1, California University of Pennsylvania, and the Washington and Jefferson College to promote hazard mitigation education and awareness, provide information on emergency alert systems, and discuss ways to better integrate mitigation into the curriculum such as science, math and other subjects		X			
Action 6.2.1 Continue working with representatives from NFIP to hold local course on the National Flood Insurance Program (NFIP) for realtors, bankers, insurers, and property owners to be attended from all areas of Washington County.		X			This action is repetitive to action 1.6.1

Table 6.1-2 Review of 2010 Mitigation Actions					
ACTION TITLE	**Complete**	**Canceled**	**Deferred**	**Ongoing**	**DESCRIPTION OF PROGRESS AND/OR REASON FOR DISCONTINUATION**
Action 6.2.2 Establish all-hazard resource centers to be located in the Washington County Courthouse Square Campus, Chamber of Commerce, municipalities, local libraries, and senior centers. The centers will act as a repository for information on local hazard identification, preparedness, and mitigation strategies for use by citizens, realtors, and lenders. Centers would display information about the National Flood Insurance Program, Flood Insurance Rate Maps, books about mitigation for homeowners, the "Are You Ready Guide", "Protecting Building Utilities from Flood Damage", "Seeking Shelter from the Storm" Books, etc.			X		Updated Action: Identify local spaces willing to display and distribute information to citizens on topics like: preparedness, NFIP, FIRMs, etc.
Action 6.2.3 Distribute letters to county property owners or renters within the 100-year floodplain regarding potential flood hazards. The content of the letters may include the following information: the local flood hazard, flood safety, flood insurance information, property protection measures, the natural and beneficial functions of the local floodplain, a map of the local flood hazard area, information about NOAA Weather radios used for local weather warnings, floodplain development permit requirements, and substantial improvement/damage requirements. It will also be important to contact all property owners with a history of significant flood damage and make them aware of the buyout and acquisition program			X		Updated Action: Establish a program that contacts those living in structures located within the regulatory floodplain and provides information related to flood safety, flood insurance, and property protection measures.
Action 6.2.4 The Tax Assessment office to continue collecting and updating information for structures within the 100-year floodplain and structures that are not in the floodplain, but are prone to flooding. This information will include map number, assessed value, and structure type.			X		Updated Action: Encourage the tax assessment office to continue compiling information on structures located in the regulatory floodplain, as well as those that have a history of flood losses.

6.2. Mitigation Goals and Objectives

Based on results of the goals and objectives evaluation exercise and input from the Steering Committee, five (5) goals and sixteen (16) corresponding objectives were developed for the 2015 HMP Update. Table 6.2-1 lists these mitigation goals and objectives.

Table 6.2-1	2015 Mitigation Strategy Goals and Objectives
Goal 1	**Plan to reduce current and future risk of damage from natural and man-made disasters.**
Objective 1.1	Using planning tools and regulation to direct development towards areas that are not identified hazard areas.
Objective 1.2	Review all comprehensive plans to ensure that designated growth areas are not in hazard areas.
Objective 1.3	Review adoption and enforcement of the Uniform Construction Code (UCC) building codes.
Objective 1.4	Review all capital improvement plans to ensure that infrastructure improvements are not directed towards hazardous areas.
Objective 1.5	Evaluate and update existing floodplain ordinances to meet or exceed the NFIP standards.
Objective 1.6	Improve the enforcement of existing floodplain regulations.
Objective 1.7	Advocate for policies that provide affordable and available flood insurance.
Objective 1.8	Evaluate existing shelters to determine adequacy for current and future populations.
Goal 2	**Reduce the potential impact of natural and man-made disasters on public and private property.**
Objective 2.1	Encourage municipal participation in the National Flood Insurance Program and encourage property owners, renters and businesses to purchase appropriate insurance.
Objective 2.2	Protect the County's most vulnerable populations, buildings, and critical facilities through the implementation of cost-effective and technically feasible mitigation projects.
Goal 3	**Reduce or redirect the impact of natural disasters, especially floods, away from at risk population areas**
Objective 3.1	Research possible mitigation projects to reduce flooding, reduce/eliminate sewage leakage and inflow/infiltration problems. Some projects may include reservoirs, levees, floodwalls, diversions, channel modification, and storm sewers
Objective 3.2	Gather existing studies for transportation, storm water and other infrastructure to further integration of mitigation into existing projects and use existing evaluations to support potential mitigation projects.
Goal 4	**Protect existing natural resources and open space, including parks and wetlands, within the floodplain and watershed to improve their flood control function.**
Objective 4.1	Protect natural resources through the implementation of cost-effective and technically feasible mitigation projects.
Objective 4.2	Protect natural resources through the implementation of recreation planning and storm water management planning
Goal 5	**Protect public health, safety, and welfare by increasing the public awareness of existing and potential hazards and by fostering both individual and public responsibility in mitigating risks due to those hazards.**
Objective 5.1	Develop and distribute public awareness materials about natural hazard risks, preparedness, and mitigation
Objective 5.2	Target owners of properties within identified hazard areas for additional outreach regarding mitigation and disaster preparedness.

6.3. Identification and Analysis of Mitigation Techniques

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

- **Local plans and regulations:** Government authorities, policies, or codes that influence the way land and buildings are developed and built. Examples include, but are not limited to: comprehensive plans, subdivision regulations, building codes and enforcement, and NFIP and CRS.
- **Structure and infrastructure**: Modifying existing structures and infrastructure or constructing new structures to reduce hazard vulnerability. Examples include, but are not limited to: acquisition and elevation of structures in flood prone areas, utility undergrounding, structural retrofits, floodwalls and retaining walls, detention and retention structures, and culverts.
- **Natural systems protection:** Actions that minimize damage and losses and also preserve or restore the functions of natural systems. Examples include, but are not limited to: sediment and erosion control, stream corridor restoration, forest management, conservation easements, and wetland restoration and preservation.
- **Education and awareness:** Actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate the hazards, and may also include participation in national programs. Examples include, but are not limited to: radio or television spots, websites with maps and information that provide information and training.

To identify possible mitigation actions a mitigation technique matrix was developed. Refer to Table 6.3-1. The matrix identifies mitigation techniques for each high and moderate risk hazards identified in the risk assessment. The matrix is used to help identify specific mitigation actions to be included in the mitigation action plan. Mitigation Techniques were reviewed during the Hazard Mitigation Workshop and at the Public Meeting.

Table 6.3-1 Mitigation Techniques Matrix

HAZARD	MITIGATION TECHNIQUES			
	LOCAL PLANS AND REGULATIONS	STRUCTURE AND INFRASTRUCTURE PROJECTS	NATURAL SYSTEMS PROTECTION	EDUCATION AND AWARENESS PROGRAMS
Drought	X			
Earthquake	X			
Flood, Flash Flood, Ice Jam	X	X	X	X
Landslide	X	X		X
Radon Exposure				X
Subsidence, Sinkhole	X			X
Tornado, Wind Storm	X			X
Winter Storm	X			X
Dam Failure	X	X		X
Environmental Hazard	X			X

6.4. Mitigation Action Plan

Table 6.3-1 lists the mitigation actions for the 2015 HMP update. A total of 34 mitigation actions were selected for the 2015 HMP Update. Actions that will contribute toward continued compliance with and participation in the NFIP are noted.

Figure 6.4-1 Mitigation Action Plan	
Action No: 1	**Action:** Identify, acquire, and demolish structure with the highest relative vulnerabilities.
Community(ies): Allenport Borough, Amwell Township, Beallsville Borough, Bentleyville Borough, Blaine Township, Buffalo Township, Burgettstown Borough, California Borough, Canonsburg Borough, Canton Township, Carroll Township, Cecil Township, Centerville Borough, Charleroi Borough, Chartiers Township, Coal Center Borough, Cross Creek Township, Deemston Borough, Donegal Township, Donora Borough, Dunlevy Borough, East Bethlehem Township, East Finley Township, East Washington Borough, Elco Borough, Ellsworth Borough, Fallowfield Township, Finleyville Borough, Hanover Township, Hopewell Township, Houston Borough, Independence Township, Jefferson Township, Long Branch Borough, Marianna Borough, McDonald Borough, Midway Borough, Monongahela, City of, Morris Township, Mount Pleasant Township, New Eagle Borough, North Bethlehem Township, North Charleroi Borough, North Franklin Township, North Strabane Township, Nottingham Township, Peters Township, Robinson Township, Roscoe Borough, Smith Township, Somerset Township, South Franklin Township, South Strabane Township, Speers Borough, Stockdale Borough, Twilight Borough, Union Township, Washington, City of, West Bethlehem Township, West Brownsville Borough, West Finley Township, West Pike Run Township	
Mitigation Technique Category	Structure and Infrastructure (NFIP)
Hazard(s) Addressed	Flood, Flash Flood, Ice Jam
Priority (High, Medium, Low)	High
Estimated Cost	$ 2.5M
Potential Funding Sources	HMGP
Lead Agency/Department	Washington County Department of Public Safety, municipalities
Implementation Schedule	Multi-year

Figure 6.4-1 Mitigation Action Plan	
Action No: 2	**Action:** Develop plans for potential hazards related to natural gas development
Community(ies): Deemston Borough, Houston Borough, Independence Township, South Strabane Township	
Mitigation Technique Category	Local Plans and Regulations
Hazard(s) Addressed	Environmental Hazards
Priority (High, Medium, Low)	High
Estimated Cost	$5,000
Potential Funding Sources	Deemston Borough, Houston Borough, Independence Township, South Strabane Township
Lead Agency/Department	Local EMC
Implementation Schedule	1 year
Action No: 3	**Action:** Community outreach and education regarding flood risk aimed at increasing individual mitigation actions including purchasing NFIP insurance and elevating utilities
Community(ies): All municipalities in Washington County	
Mitigation Technique Category	Education and Awareness
Hazard(s) Addressed	Flood, Flash Flood, Ice Jam, Dam Failure
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	Municipality funds, PDM Funds, HMGP Funds
Lead Agency/Department	Washington County Department of Public Safety, municipalities
Implementation Schedule	2 years

Figure 6.4-1 Mitigation Action Plan	
Action No: 4	**Action:** Drainage System Maintenance along Ten Mile Creek
Community(ies): West Bethlehem Township	
Mitigation Technique Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flood, Flash Flood, Ice Jam
Priority (High, Medium, Low)	Medium
Estimated Cost	$375,000
Potential Funding Sources	DCED
Lead Agency/Department	West Bethlehem Township
Implementation Schedule	1 year
Action No: 5	**Action:** Encourage the municipalities to conduct annual reviews of zoning regulations meant to ensure a reduction in development in high hazard areas. The Washington County Planning Commission is responsible for reviewing subdivision and land development ordinances.
Community(ies): All municipalities in Washington County	
Mitigation Technique Category	Local Plans and Regulations
Hazard(s) Addressed	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Landslide; Subsidence, Sinkhole; Tornado, Windstorm; Winter Storm
Priority (High, Medium, Low)	High
Estimated Cost	$0
Potential Funding Sources	Municipal Funds
Lead Agency/Department	Washington County Department of Public Safety, municipalities
Implementation Schedule	5 years

Figure 6.4-1 Mitigation Action Plan	
Action No: 6	**Action:** Use information developed in the mitigation plan update process to update county and municipal comprehensive plans, especially where it relates to high hazard areas identified in this plan and targeted growth areas.
Community(ies): All municipalities in Washington County	
Mitigation Technique Category	Local Plans and Regulations
Hazard(s) Addressed	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Landslide; Subsidence, Sinkhole; Tornado, Windstorm; Winter Storm; Dam Failure
Priority (High, Medium, Low)	Medium
Estimated Cost	$0
Potential Funding Sources	Municipal Funds
Lead Agency/Department	Washington County Planning Commission, municipalities
Implementation Schedule	5 years
Action No: 7	**Action:** Encourage all municipal offices to review the statewide Uniform Construction Code to ensure the enforcement of these codes as a minimum standard.
Community(ies): Claysville Borough, Washington County	
Mitigation Technique Category	Education and Awareness Programs
Hazard(s) Addressed	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Landslide; Subsidence, Sinkhole; Tornado, Windstorm; Winter Storm
Priority (High, Medium, Low)	Medium
Estimated Cost	$0
Potential Funding Sources	Staff Time and Resources
Lead Agency/Department	Claysville Borough, Washington County Planning Commission
Implementation Schedule	5 years

Figure 6.4-1 Mitigation Action Plan	
Action No: 8	**Action:** Encourage applicable municipal offices to review their capital improvement plans to ensure that programmed infrastructure improvements are not in high hazard areas
Community(ies): Claysville Borough, Canonsburg Borough, Washington County	
Mitigation Technique Category	Local Plans and Regulations
Hazard(s) Addressed	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Landslide; Subsidence, Sinkhole; Tornado, Windstorm; Winter Storm; Dam Failure
Priority (High, Medium, Low)	Medium
Estimated Cost	$0
Potential Funding Sources	Staff Time and Resources
Lead Agency/Department	Claysville Borough, Canonsburg Borough, Washington County Planning Commission
Implementation Schedule	5 years
Action No: 9	**Action:** Encourage annual reviews of county and municipal floodplain ordinances to ensure compliance with the NFIP.
Community(ies): Donora Borough, Washington, City of, Washington County	
Mitigation Technique Category	Local Plans and Regulations
Hazard(s) Addressed	Flood, Flash Flood, Ice Jam
Priority (High, Medium, Low)	Medium
Estimated Cost	$0
Potential Funding Sources	Municipal Funds
Lead Agency/Department	Donora Borough, Washington, City of, Washington County Planning Commission
Implementation Schedule	5 years

Figure 6.4-1 Mitigation Action Plan	
Action No: 10	**Action:** Conduct training as required to familiarize county and municipal staff with NFIP requirements and the Community Rating System (CRS)
Community(ies): Washington County	
Mitigation Technique Category	Education and Awareness Programs
Hazard(s) Addressed	Flood, Flash Flood, Ice Jam
Priority (High, Medium, Low)	Low
Estimated Cost	$5,000
Potential Funding Sources	TBD
Lead Agency/Department	Washington County
Implementation Schedule	5 years
Action No: 11	**Action:** Evaluate power requirements at shelters countywide with the help of the American Red Cross (ARC) and take necessary steps to provide adequate backup power to those that need it
Community(ies): Washington County	
Mitigation Technique Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Tornado, Windstorm; Winter Storm
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	TBD, FEMA HMGP, FEMA PDM
Lead Agency/Department	Washington County Department of Public Safety
Implementation Schedule	3 years

Figure 6.4-1 Mitigation Action Plan	
Action No: 12	**Action:** Create a committee to look at challenges associated with sheltering household pets in existing shelters
Community(ies): Washington County	
Mitigation Technique Category	Local Plans and Regulations
Hazard(s) Addressed	Tornado, Windstorm; Winter Storm
Priority (High, Medium, Low)	Low
Estimated Cost	TBD
Potential Funding Sources	TBD
Lead Agency/Department	Washington County Department of Public Safety
Implementation Schedule	3 years
Action No: 13	**Action:** Undertake an education and outreach program meant to familiarize municipalities with subsidence insurance.
Community(ies): Washington County	
Mitigation Technique Category	Education and Awareness Programs
Hazard(s) Addressed	Subsidence, Sinkholes
Priority (High, Medium, Low)	Low
Estimated Cost	$0
Potential Funding Sources	Staff Time and Resources
Lead Agency/Department	Washington County Department of Public Safety
Implementation Schedule	2 years

Figure 6.4-1 Mitigation Action Plan	
Action No: 14	**Action:** Develop and maintain an asset list of repetitive loss properties, as well as structures located in the regulatory floodplain
Community(ies): Washington County	
Mitigation Technique Category	Local Plans and Regulations
Hazard(s) Addressed	Flood, Flash Flood, Ice Jam
Priority (High, Medium, Low)	High
Estimated Cost	$0
Potential Funding Sources	Staff Time and Resources
Lead Agency/Department	Washington County Department of Public Safety, Washington County Planning Commission
Implementation Schedule	5 years
Action No: 15	**Action:** Work with California University to maintain hazard maps to be used for future mitigation activities
Community(ies): Washington County	
Mitigation Technique Category	Local Plans and Regulations
Hazard(s) Addressed	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Landslide; Subsidence, Sinkhole; Tornado, Windstorm; Winter Storm
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	TBD
Lead Agency/Department	Washington County Department of Public Safety
Implementation Schedule	5 years

Figure 6.4-1 Mitigation Action Plan	
Action No: 16	**Action:** Conduct public outreach to determine the interest of homeowners with repetitive loss properties in selling their properties as a hazard reduction measure. Annually apply for funds to conduct buyouts for interested homeowners
Community(ies): Carroll Township, Peters Township, Washington County	
Mitigation Technique Category	Education and Awareness Programs
Hazard(s) Addressed	Flood, Flash Flood, Ice Jam
Priority (High, Medium, Low)	Low
Estimated Cost	TBD
Potential Funding Sources	TBD, FEMA HMGP, FEMA PDM, FEMA FMA
Lead Agency/Department	Washington County Department of Public Safety, Carroll Township, Peters Township
Implementation Schedule	5 years
Action No: 17	**Action:** Maintain the "Storm Ready" status awarded by the National Weather Service. This is a biennial review and certification.
Community(ies): Washington County	
Mitigation Technique Category	Education and Awareness Programs
Hazard(s) Addressed	Tornado, Windstorm; Winter Storm
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	TBD, Staff Time and Resources
Lead Agency/Department	Washington County Department of Public Safety
Implementation Schedule	4 years

Figure 6.4-1 Mitigation Action Plan	
Action No: 18	**Action:** Continue to collect information on potential mitigation grant applications projects including interested properties owners, to be ready to apply for mitigation when funding is available.
Community(ies): Washington County	
Mitigation Technique Category	Education and Awareness Programs
Hazard(s) Addressed	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Landslide; Subsidence, Sinkhole; Tornado, Windstorm; Winter Storm
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	TBD, Staff Time and Resources
Lead Agency/Department	Washington County Department of Public Safety
Implementation Schedule	5 years
Action No: 19	**Action:** Coordinate with partner agencies to obtain relevant information for mitigation projects
Community(ies): Washington, City of, Washington County	
Mitigation Technique Category	Structure and Infrastructure Projects, Local Plans and Regulations
Hazard(s) Addressed	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Landslide; Subsidence, Sinkhole; Tornado, Windstorm; Winter Storm
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	TBD
Lead Agency/Department	Washington, City of, Washington County Department of Public Safety
Implementation Schedule	5 years

Figure 6.4-1 Mitigation Action Plan	
Action No: 20	**Action:** Evaluate the feasibility and cost of renovating the Canonsburg dam to turn it into a recreational areas as well as a flood control measure
Community(ies): Canonsburg Borough, Washington County	
Mitigation Technique Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flood, Flash Flood, Ice Jam, Dam Failure
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	TBD, FEMA HMGP, USACOE, FEMA PDM
Lead Agency/Department	Washington County Department of Public Safety Canonsburg Borough
Implementation Schedule	5 years
Action No: 21	**Action:** Coordinate potential flood mitigation projects with Washington County officials, including watershed groups, and present projects for approval and funding; ongoing projects include identified stormwater management projects, creek bed reclamation, etc.
Community(ies): Allenport Borough, Amwell Township, Beallsville Borough, Bentleyville Borough, Blaine Township, Buffalo Township, Burgettstown Borough, California Borough, Canonsburg Borough, Canton Township, Carroll Township, Cecil Township, Centerville Borough, Charleroi Borough, Chartiers Township, Coal Center Borough, Cross Creek Township, Deemston Borough, Donegal Township, Donora Borough, Dunlevy Borough, East Bethlehem Township, East Finley Township, East Washington Borough, Elco Borough, Ellsworth Borough, Fallowfield Township, Finleyville Borough, Hanover Township, Hopewell Township, Houston Borough, Independence Township, Jefferson Township, Long Branch Borough, Marianna Borough, McDonald Borough, Midway Borough, Monongahela, City of, Morris Township, Mount Pleasant Township, New Eagle Borough, North Bethlehem Township, North Charleroi Borough, North Franklin Township, North Strabane Township, Nottingham Township, Peters Township, Robinson Township, Roscoe Borough, Smith Township, Somerset Township, South Franklin Township, South Strabane Township, Speers Borough, Stockdale Borough, Twilight Borough, Union Township, Washington, City of, West Bethlehem Township, West Brownsville Borough, West Finley Township, West Pike Run Township	
Mitigation Technique Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flood, Flash Flood, Ice Jam
Priority (High, Medium, Low)	High

Figure 6.4-1 Mitigation Action Plan	
Estimated Cost	TBD
Potential Funding Sources	TBD, Staff Time and Resources
Lead Agency/Department	Washington County Department of Public Safety, Washington, City of, West Brownsville Borough, Watershed groups
Implementation Schedule	5 years
Action No: 22	**Action:** Develop and maintain a list detailing the location of natural resource areas throughout the county. Use list to create maps and other relevant data for future mitigation activities.
Community(ies): Washington County	
Mitigation Technique Category	Local Plans and Regulations
Hazard(s) Addressed	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Landslide; Subsidence, Sinkhole; Tornado, Windstorm; Winter Storm; Dam Failure
Priority (High, Medium, Low)	Medium
Estimated Cost	$0
Potential Funding Sources	Staff Time and Resources
Lead Agency/Department	Washington County Department of Public Safety, Washington County Planning Commission
Implementation Schedule	5 years

Figure 6.4-1 Mitigation Action Plan	
Action No: 23	**Action:** Conduct reviews of the 2010 stormwater management plan (phase II) and recreation plan for needed updates (if any)
Community(ies): West Brownsville Borough, Washington County	
Mitigation Technique Category	Local Plans and Regulations
Hazard(s) Addressed	Flood, Flash Flood, Ice Jam
Priority (High, Medium, Low)	Medium
Estimated Cost	$0
Potential Funding Sources	Staff Time and Resources
Lead Agency/Department	Washington County Planning Commission, West Brownsville Borough
Implementation Schedule	5 years
Action No: 24	**Action:** Coordinate with DEP, related conservation agencies, and watershed groups to research and identify flood control opportunities through restoration of reclaimed areas, i.e. open space, green space, etc.
Community(ies): Washington County	
Mitigation Technique Category	Structure and Infrastructure Projects, Natural Systems Protection
Hazard(s) Addressed	Flood, Flash Flood, Ice Jam
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	TBD, FEMA HMGP, FEMA PDM, FEMA FMA
Lead Agency/Department	Washington County Department of Public Safety, Washington County Planning Commission
Implementation Schedule	5 years

Figure 6.4-1 Mitigation Action Plan	
Action No: 25	**Action:** Create a variety of displays to be used at public events that cover topics including: mitigation, animals in disaster, business continuity, and children's programs. These displays will appeal to different audiences and different events, and can be supplemented with FEMA resources as handouts and giveaways.
Community(ies): South Strabane Township, Washington County	
Mitigation Technique Category	Education and Awareness Programs
Hazard(s) Addressed	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Landslide; Subsidence, Sinkhole; Tornado, Windstorm; Winter Storm; Radon Exposure
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	TBD, Staff Time and Resources, Municipal Funds
Lead Agency/Department	Washington County Department of Public Safety, South Strabane Township
Implementation Schedule	3 years
Action No: 26	**Action:** Maintain a list of media contacts to be used when release of hazard information is necessary
Community(ies): Washington County	
Mitigation Technique Category	Local Plans and Regulations
Hazard(s) Addressed	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Landslide; Subsidence, Sinkhole; Tornado, Windstorm; Winter Storm
Priority (High, Medium, Low)	Medium
Estimated Cost	$0
Potential Funding Sources	Staff Time and Resources
Lead Agency/Department	Washington County Department of Public Safety
Implementation Schedule	1 year

Figure 6.4-1 Mitigation Action Plan	
Action No: 27	**Action:** Develop a series of presentations that explain the hazards facing Washington County and how to best protect oneself from their effects. These presentations should be able to be tailored to different groups.
Community(ies): Washington County	
Mitigation Technique Category	Education and Awareness Programs
Hazard(s) Addressed	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Landslide; Radon Exposure; Subsidence, Sinkhole; Tornado, Windstorm; Winter Storm
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	Staff Time and Resources, County Funds
Lead Agency/Department	Washington County Department of Public Safety
Implementation Schedule	2 years
Action No: 28	**Action:** Coordinate with the ARC to ensure that educational opportunities are presented on a regular basis
Community(ies): South Strabane Township, Washington County	
Mitigation Technique Category	Education and Awareness Programs
Hazard(s) Addressed	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Landslide; Radon Exposure; Subsidence, Sinkhole; Tornado, Windstorm; Winter Storm
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	TBD, Municipal Funds, County Funds
Lead Agency/Department	Washington County Department of Public Safety, South Strabane Township, American Red Cross
Implementation Schedule	5 years

Figure 6.4-1 Mitigation Action Plan	
Action No: 29	**Action:** Update the WCDPS website. Update is to include information on all 4 phases of emergency management, as well as presenting current weather, stream level data, iFLOWs data and any other pertinent warning information
Community(ies): Washington County	
Mitigation Technique Category	Education and Awareness Programs
Hazard(s) Addressed	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Landslide; Subsidence, Sinkhole; Tornado, Windstorm; Winter Storm
Priority (High, Medium, Low)	High
Estimated Cost	TBD
Potential Funding Sources	TBD, Staff Time and Resource, County Funds
Lead Agency/Department	Washington County Department of Public Safety
Implementation Schedule	2 years
Action No: 30	**Action:** Identify local spaces willing to display and distribute information to citizens on topics like: preparedness, NFIP, FIRMs, etc.
Community(ies): Washington County	
Mitigation Technique Category	Education and Awareness Programs
Hazard(s) Addressed	Drought; Earthquake; Flood, Flash Flood, Ice Jam; Landslide; Subsidence, Sinkhole; Tornado, Windstorm; Winter Storm
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	Staff Time and Resources
Lead Agency/Department	Washington County Department of Public Safety
Implementation Schedule	2 years

Figure 6.4-1 Mitigation Action Plan	
Action No: 31	**Action:** Establish a program that contacts those living in structures located within the regulatory floodplain and provides information related to flood safety, flood insurance, and property protection measures, including elevation.
Community(ies): Washington County	
Mitigation Technique Category	Education and Awareness Programs
Hazard(s) Addressed	Flood, Flash Flood, Ice Jam
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	TBD, Staff Time and Resources
Lead Agency/Department	Washington County Department of Public Safety, Washington County Planning Commission
Implementation Schedule	4 years
Action No: 32	**Action:** Encourage the tax assessment office to continue compiling information on structures located in the regulatory floodplain, as well as those that have a history of flood losses.
Community(ies): Washington County	
Mitigation Technique Category	Local Plans and Regulations
Hazard(s) Addressed	Flood, Flash Flood, Ice Jam
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	TBD, Staff Time and Resources
Lead Agency/Department	Washington County Tax Assessment Office, Washington County Department of Public Safety
Implementation Schedule	5 years

Figure 6.4-1 Mitigation Action Plan	
Action No: 33	**Action:** Develop grant applications to suitably protect repetitive-loss properties 1% annual chance floodplain (for owners interested in FEMA mitigation funding), including through elevation.
Community(ies): Allenport Borough, Amwell Township, Beallsville Borough, Bentleyville Borough, Blaine Township, Buffalo Township, Burgettstown Borough, California Borough, Canonsburg Borough, Canton Township, Carroll Township, Cecil Township, Centerville Borough, Charleroi Borough, Chartiers Township, Coal Center Borough, Cross Creek Township, Deemston Borough, Donegal Township, Donora Borough, Dunlevy Borough, East Bethlehem Township, East Finley Township, East Washington Borough, Elco Borough, Ellsworth Borough, Fallowfield Township, Finleyville Borough, Hanover Township, Hopewell Township, Houston Borough, Independence Township, Jefferson Township, Long Branch Borough, Marianna Borough, McDonald Borough, Midway Borough, Monongahela, City of, Morris Township, Mount Pleasant Township, New Eagle Borough, North Bethlehem Township, North Charleroi Borough, North Franklin Township, North Strabane Township, Nottingham Township, Peters Township, Robinson Township, Roscoe Borough, Smith Township, Somerset Township, South Franklin Township, South Strabane Township, Speers Borough, Stockdale Borough, Twilight Borough, Union Township, Washington, City of, West Bethlehem Township, West Brownsville Borough, West Finley Township, West Pike Run Township	
Mitigation Technique Category	Structure and Infrastructure
Hazard(s) Addressed	Flood, Flash Flood, Ice Jam
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	HMGP
Lead Agency/Department	Washington County Department of Public Safety, municipalities
Implementation Schedule	Multi-year

Figure 6.4-1 Mitigation Action Plan	
Action No: 34	**Action:** Develop grant applications to suitably protect and continue operations of critical facilities in the 1% annual chance floodplain, including through wet and dry floodproofing.
Community(ies): Allenport Borough, Amwell Township, Beallsville Borough, Bentleyville Borough, Blaine Township, Buffalo Township, Burgettstown Borough, California Borough, Canonsburg Borough, Canton Township, Carroll Township, Cecil Township, Centerville Borough, Charleroi Borough, Chartiers Township, Coal Center Borough, Cross Creek Township, Deemston Borough, Donegal Township, Donora Borough, Dunlevy Borough, East Bethlehem Township, East Finley Township, East Washington Borough, Elco Borough, Ellsworth Borough, Fallowfield Township, Finleyville Borough, Hanover Township, Hopewell Township, Houston Borough, Independence Township, Jefferson Township, Long Branch Borough, Marianna Borough, McDonald Borough, Midway Borough, Monongahela, City of, Morris Township, Mount Pleasant Township, New Eagle Borough, North Bethlehem Township, North Charleroi Borough, North Franklin Township, North Strabane Township, Nottingham Township, Peters Township, Robinson Township, Roscoe Borough, Smith Township, Somerset Township, South Franklin Township, South Strabane Township, Speers Borough, Stockdale Borough, Twilight Borough, Union Township, Washington, City of, West Bethlehem Township, West Brownsville Borough, West Finley Township, West Pike Run Township	
Mitigation Technique Category	Structure and Infrastructure
Hazard(s) Addressed	Flood, Flash Flood, Ice Jam
Priority (High, Medium, Low)	High
Estimated Cost	TBD
Potential Funding Sources	HMGP
Lead Agency/Department	Washington County Department of Public Safety, municipalities
Implementation Schedule	Multi-year

Figure 6.4-1 Mitigation Action Plan	
Action No: 35	**Action:** Develop project inventory and grant applications to suitably protect infrastructure from the effects of rock slides and road slip.
Community(ies): All municipalities in Washington County	
Mitigation Technique Category	Structure and Infrastructure
Hazard(s) Addressed	Landslides
Priority (High, Medium, Low)	Medium
Estimated Cost	TBD
Potential Funding Sources	TBD
Lead Agency/Department	Washington County Department of Public Safety, municipalities
Implementation Schedule	Multi-year

Actions were then compared with one another to determine a ranking or priority by applying the Multi-Objective Mitigation Action Prioritization criteria. Using the following weighted, multi-objective mitigation action prioritization criteria each action was evaluated:

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

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

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

Table 6.4-1 Prioritization of Mitigation Action Results							
MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA					PRIORITY
ACTION NO.	NAME	EFFECTIVENESS	EFFICIENCY	MULTI-HAZARD MITIGATION	ADDRESSES HIGH RISK HAZARD	ADDRESSES CRITICAL COMMUNICATIONS/ INFRASTRUCTURE	
1	Identify, acquire, and demolish structure with the highest relative vulnerabilities.	3	3	1	3	2	2.5
2	Develop plans for potential hazards related to natural gas development	3	2.5	1	3	3	2.5
3	Community outreach and education regarding flood risk aimed at increasing individual mitigation actions including purchasing NFIP insurance and elevating utilities	3	2	1	3	2.5	2.2
4	Drainage System Maintenance along Ten Mile Creek	3	3	1	3	1.5	2.4
5	Encourage the municipalities to conduct annual reviews of zoning regulations meant to ensure a reduction in development in high hazard areas. The Washington County Planning Commission is responsible for reviewing subdivision and land development ordinances	3	3	3	3	1	2.7
6	Use information developed in the mitigation plan update process to update county and municipal comprehensive plans, especially where it relates to high hazard areas identified in this plan	3	2	3	2	1	2.3

Table 6.4-1 Prioritization of Mitigation Action Results							
MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA					PRIORITY
ACTION NO.	NAME	EFFECTIVENESS	EFFICIENCY	MULTI-HAZARD MITIGATION	ADDRESSES HIGH RISK HAZARD	ADDRESSES CRITICAL COMMUNICATIONS/ INFRASTRUCTURE	
7	Encourage all municipal offices to review the statewide Uniform Construction Code to ensure the enforcement of these codes as a minimum standard	2	2	3	2	1	2.1
8	Encourage applicable municipal offices to review their capital improvement plans to ensure that programmed infrastructure improvements are not in high hazard areas	3	2	3	2	2	2.4
9	Encourage annual reviews of county and municipal floodplain ordinances to ensure compliance with the NFIP	3	2	1	2	2	2.0
10	Conduct training as required to familiarize county and municipal staff with NFIP requirements, and the Community Rating System (CRS)	2	2	1	2	2	1.8
11	Evaluate power requirements at shelters countywide with the help of the American Red Cross (ARC) and take necessary steps to provide adequate backup power to those that need it	2	2	2	1	2	1.9
12	Create a committee to look at challenges associated with sheltering household pets in existing shelters	2	2	2	1	1	1.7
13	Undertake an education and outreach program meant to familiarize municipalities with subsidence insurance	2	2	1	1	2	1.7

Table 6.4-1 Prioritization of Mitigation Action Results							
MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA					PRIORITY
ACTION NO.	NAME	EFFECTIVENESS	EFFICIENCY	MULTI-HAZARD MITIGATION	ADDRESSES HIGH RISK HAZARD	ADDRESSES CRITICAL COMMUNICATIONS/ INFRASTRUCTURE	
14	Develop and maintain an asset list of repetitive loss properties, as well as structures located in the regulatory floodplain	3	3	1	3	2	2.5
15	Work with California University to maintain hazard maps to be used for future mitigation activities	2	2	3	2	1	2.1
16	Conduct public outreach to determine the interest of homeowners with repetitive loss properties in selling their properties as a hazard reduction measure. Annually apply for funds to conduct buyouts for interested homeowners	2	2	1	2	2	1.8
17	Maintain the “Storm Ready” status awarded by the National Weather Service. This is a biennial review and certification	3	3	2	2	1	2.4
18	Continue to collect information on potential mitigation grant applications projects including interested properties owners, to be ready to apply for mitigation when funding is available	3	2	3	3	1	2.4
19	Coordinate with partner agencies to obtain relevant information for mitigation projects	3	2	3	2	2	2.4
20	Evaluate the feasibility and cost of renovating the Canonsburg dam to turn it into a recreational areas as well as a flood control measure	2	2	1	3	3	2.1

Table 6.4-1 Prioritization of Mitigation Action Results							
MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA					PRIORITY
ACTION NO.	NAME	EFFECTIVENESS	EFFICIENCY	MULTI-HAZARD MITIGATION	ADDRESSES HIGH RISK HAZARD	ADDRESSES CRITICAL COMMUNICATIONS/ INFRASTRUCTURE	
21	Coordinate potential flood mitigation projects with Washington County officials, including watershed groups, and present projects for approval and funding; ongoing projects include identified stormwater management projects, creek bed reclamation, etc.	3	3	1	3	2	2.5
22	Develop and maintain a list detailing the location of natural resource areas throughout the county. Use list to create maps and other relevant data for future mitigation activities	2	2	3	2	2	2.2
23	Conduct reviews of the 2010 stormwater management plan (phase II) and recreation plan for needed updates (if any)	2	2	1	3	2	2.0
24	Coordinate with DEP, related conservation agencies, and watershed groups to research and identify flood control opportunities through restoration of reclaimed areas, i.e. open space, green space, etc.	2	2	1	3	2	2.0
25	Create a variety of displays to be used at public events that cover topics including: mitigation, animals in disaster, business continuity and children's programs. These displays will appeal to different audiences and different events, and can be supplemented with FEMA resources as handouts and giveaways	2	2	3	3	2	2.4

Table 6.4-1 Prioritization of Mitigation Action Results							
MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA					PRIORITY
ACTION NO.	NAME	EFFECTIVENESS	EFFICIENCY	MULTI-HAZARD MITIGATION	ADDRESSES HIGH RISK HAZARD	ADDRESSES CRITICAL COMMUNICATIONS/ INFRASTRUCTURE	
26	Maintain a list of media contacts to be used when release of hazard information is necessary	2	2	3	2	2	2.2
27	Develop a series of presentations that explain the hazards facing Washington County and how to best protect oneself from their effects. These presentations should be able to be tailored to different groups	2	2	3	2	2	2.2
28	Coordinate with the ARC to ensure that educational opportunities are presented on a regular basis	2	2	3	3	2	2.4
29	Update the WCDPS website. Update is to include information on all 4 phases of emergency management, as well as presenting current weather, stream level data, iFLOWs data and any other pertinent warning information	3	2	3	3	2	2.6
30	Identify local spaces willing to display and distribute information to citizens on topics like: preparedness, NFIP, FIRMs, etc.	2	2	3	2	2	2.2
31	Establish a program that contacts those living in structures located within the regulatory floodplain and provides information related to flood safety, flood insurance, and property protection measures.	2	2	1	3	2	2.0

Table 6.4-1 Prioritization of Mitigation Action Results							
MITIGATION ACTIONS		MULTI-OBJECTIVE MITIGATION ACTION PRIORITIZATION CRITERIA					PRIORITY
ACTION NO.	NAME	EFFECTIVENESS	EFFICIENCY	MULTI-HAZARD MITIGATION	ADDRESSES HIGH RISK HAZARD	ADDRESSES CRITICAL COMMUNICATIONS/ INFRASTRUCTURE	
32	Encourage the tax assessment office to continue compiling information on structures located in the regulatory floodplain, as well as those that have a history of flood losses	2	2	1	3	2	2.0
33	Develop grant applications to suitably protect repetitive-loss properties 1% annual chance floodplain (for owners interested in FEMA mitigation funding), including through elevation.	3	3	1	3	1	2.3
34	Develop grant applications to suitably protect and continue operations of critical facilities in the 1% annual chance floodplain, including through wet and dry floodproofing.	3	3	1	3	3	2.6
35	Develop project inventory and grant applications to suitably protect infrastructure from the effects of rock slides and road slip.	3	2	1	2	2	2.0

7. Plan Maintenance

7.1. Update Process Summary

This update to Washington County's Federal Emergency Management Agency (FEMA)-approved 2010 Hazard Mitigation Plan (HMP) was a comprehensive update that expanded the sources and amount of data for better trend analysis, updated the vulnerability and risk assessment for local hazards, created a more fluid process to streamline future updates to the HMP, and updated the hazard mitigation measures identified to limit the effects of local hazards.

The 2010 HMP states that it will be updated on a periodic basis, including in the aftermath of disasters or at least every five years. This is the first major revision to the 2010 HMP, although periodic reviews were conducted after disaster events. Any potential modifications to the HMP identified during the planning process for those other documents were noted by County planning staff and subsequently incorporated into the update of the HMP.

7.2. Monitoring, Evaluating and Updating the Plan

Hazard mitigation planning in Washington County is the responsibility of all levels of government (i.e., county and local), as well as the citizens of the County. The Washington County Hazard Mitigation Steering Committee (listed in Section 3.2), under the direction of the Washington County Department of Public Safety, will be responsible for maintaining this Multi-Jurisdictional HMP. The Steering Committee will meet annually and following each emergency declaration, with the purpose of reviewing the Plan. Ron Sicchitano, Deputy Director, Washington County Department of Public Safety, will lead the Steering Committee for annual reviews of the HMP. These meetings will be targeted for June of 2016, 2017, 2018, and 2019. At a minimum the annual review will be on the agenda of the Emergency Management Coordinators monthly meeting in June of each year; though Washington County Department of Public Safety will continue to reach out to other county departments and stakeholders to increase the participation in hazard mitigation. There was more robust participation in the 2010 plan update Steering Committee then in the 2015 plan update. Washington County Department of Public Safety will work to engage a larger more diverse group of county agencies and other stakeholders for the annual reviews and for the 2020 plan update. Washington County Department of Public Safety understands the importance of the HMP not being a stand-alone document but being used to inform other agencies plans and actions.

Each review process will ensure that the Hazard Vulnerability Analysis and Risk Assessment reflect current conditions in the County and the municipalities, the Capability Assessment accurately reflects local circumstances, and the hazard mitigation strategies are updated based on the County's damage assessment reports and local mitigation project priorities. The Steering Committee will complete a Progress Report to evaluate the status and accuracy of the HMP and record the Steering Committee's findings. The Washington County Department of Public Safety will maintain a copy of these records.

The Progress Report will include the following information: the hazard mitigation action's objectives; who the lead and supporting agencies responsible for implementation are; how long the project should take, including a delineation of the various stages of work along with timelines

(milestones should be included); whether the resources needed for implementation, funding, staff time, and technical assistance are available, or if other arrangements must be made to obtain them; the types of permits or approvals necessary to implement the action; details on the ways the actions will be accomplished within the organization, and whether the duties will be assigned to agency staff or contracted out; and the current status of the project, identifying any issues that may hinder implementation.

The HMP must be updated on a five-year cycle. This HMP will be updated and resubmitted to FEMA for approval within the five-year period. The monitoring, evaluating, and updating of the Plan every five years will rely heavily on the outcomes of the annual Steering Committee meetings. County anticipates a 5 year update to the HMP starting in 2019 and concluding in 2020.

7.3. Continued Public Involvement

The Washington County Department of Public Safety will ensure that the HMP is posted and maintained on the County Web site, and will continue to encourage public review and comment on the plan through information posted to the Web site and public notices in the local newspaper. The plan will be on the Public Safety section of www.co.washington.pa.us.

The citizens of Washington County are encouraged to submit their comments to elected officials and/or members of the Hazard Mitigation Steering Committee. To promote public participation, Washington County welcomed comments on the HMP for a 30-day period. This offered the public the opportunity to share their comments and observations. All comments received will be maintained and considered by the Hazard Mitigation Steering Committee when updating the HMP.

Washington County will continue to reach out to municipalities via telephone, mail, and e-mail regarding mitigation projects, especially those municipalities that did not submit projects for inclusion in this HMP.

8. Plan Adoption

The Plan will be submitted to the Pennsylvania Emergency Management Agency on March 23, 2015. It was forwarded to FEMA for final review and approval-pending-adoption on XXXX, 2015. FEMA granted approval-pending-adoption on XXXX, 2015. Washington County adopted the plan on XXXX, 2015. Full approval from FEMA was received on XXXX, 2015.

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

Washington County Hazard Mitigation Plan

County Adoption Resolution

Resolution No. _____

Washington County, Pennsylvania

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

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

WHEREAS, Washington County acknowledges the requirement 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 Washington County Hazard Mitigation Plan has been developed by the Washington County Planning and Community Development Department and the Washington County Emergency Management Agency, in cooperation with other County departments, local municipal officials, and the citizens of Washington County, and

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

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

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

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

ADOPTED, this _____ day of _____, 2015

ATTEST:

_____

WASHINGTON COUNTY COMMISSIONERS

By _____

By _____

By _____

Washington County Hazard Mitigation Plan

Municipal Adoption Resolution

Resolution No. _____

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

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

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

WHEREAS, the *<Borough/Township of Municipality Name>* acknowledges the requirement 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 Washington County Hazard Mitigation Plan has been developed by the Washington County Planning and Community Development Department and the Washington County Emergency Management Agency 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 Washington County Hazard Mitigation Plan, and

WHEREAS, the Washington County 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 Washington County 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 Washington County Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

ADOPTED, this _____ day of _____, 2015

ATTEST: ***<BOROUGH/TOWNSHIP OF MUNICIPALITY NAME>***

_____ By _____

By _____

By _____