Hazard Mitigation Plan 2023

Prepared for:
Jefferson County Office of
Homeland Security and
Emergency Management

Prepared by:
Michael Baker International
&
Smith Planning and Design

RECORD OF CHANGES

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

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

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Acknowledgements

Recognition and special thanks is hereby extended to the following project partners for their leadership, expertise, resources, and dedication devoted to the preparation of this 2023 hazard mitigation plan update.

Jefferson County Hazard Mitigation Planning Committee

Jefferson County Commission
Jefferson County Office of Homeland Security and Emergency Management
Jefferson County Board of Education
Jefferson County Development Authority
Jefferson County Emergency Communications
Jefferson County Engineering Department
Jefferson County Health Department
Jefferson County Planning Department
Jefferson County Sheriff's Office
Jefferson County Solid Waste Authority
Jefferson County Utilities
American Red Cross
Region 9
Shepherd University
US Fish and Wildlife
West Virginia Health Department
Town of Bolivar
City of Charles Town
Town of Harpers Ferry
City of Ranson
Shepherdstown

Consultants:

Michael Baker International
Smith Planning and Design

Funding for this project was made available through the Hazard Mitigation Assistance (HMA) grant administered by the West Virginia Emergency Management Division (WVEMD). In addition, funding and in-kind services were also provided by the Jefferson County Office of Homeland Security and Emergency Management.

Executive Summary

Jefferson County and its five municipalities (Bolivar, Charles Town, Harpers Ferry, Ranson, and Shepherdstown) have been and will continue to be committed to a long-term strategy for reducing the risks of hazards.

The intention of this Hazard Mitigation Plan (HMP) update is to serve as a blueprint for coordinating and implementing hazard mitigation policies, programs, and projects. It provides a list of mitigation goals, objectives, and related actions that may assist Jefferson County and its five municipalities (Bolivar, Charles Town, Harpers Ferry, Ranson, and Shepherdstown) in reducing risk and preventing loss from future natural hazard events. The impacts of hazards can be lessened and sometimes avoided altogether if appropriate actions are taken before hazardous events occur. By avoiding unnecessary exposure to known hazard risks, communities will save lives and preserve property and minimize the social, economic, and environmental disruptions that commonly follow hazard events. Jefferson County and its municipalities agree that hazard mitigation makes sense.

Communities face significant challenges during post-disaster redevelopment in balancing the driving need for rapid recovery with implementing long-term hazard mitigation. The necessity to meet basic needs and resettle displaced populations immediately following a disaster often overshadows the more abstract, longer-term sustainability considerations. Once full-scale reconstruction is initiated, it is difficult to modify projects in progress to meet sustainability objectives. This trend highlights the need for pre-disaster mitigation planning that incorporates principles of sustainable development within the context of reconstruction, so that communities can more easily rebuild in a manner that will make them less vulnerable to future hazard events while improving the quality of life.

It is imperative that local decision makers become and stay involved in this planning process to provide new ideas and insight for future updates to the HMP. Now that a mitigation strategy has been developed for 2023 and beyond it will remain a challenge and a goal for Jefferson County and its municipalities to provide necessary updates as mitigation techniques are implemented. It remains imperative that all local agencies, units of government, non-profit organizations, businesses and industries, and private citizens continue their involvement and dedication to hazard mitigation.

It is our long-term goal that the Hazard Mitigation Plan and the strategies identified will be fully integrated into daily decisions and routines of government and business. This will continue to require dedication and hard work, and this Plan update will continue to lay the building blocks in order to further strengthen the sustainability and resiliency of Jefferson County and its municipalities.

Introduction

1.1. Background

Hazard Mitigation is defined by the Federal Emergency Management Agency (FEMA) as "any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards ". The hazard mitigation planning process involves the coordination of actions taken to reduce injuries, deaths, property damage, economic losses, and degradation of natural resources caused by natural and human-caused disasters. Hazard mitigation is considered one of four phases in the emergency management cycle. Others include emergency preparedness, emergency response, and recovery.

- Hazard mitigation activities involve actions that reduce or eliminate the probability of an occurrence or reduce the impact of a disaster. The goal of the mitigation phase is to make communities more resistant to disasters and thereby decrease the need for a response. Mitigation occurs long before a disaster.
- Preparedness activities include planning and preparing for when a disaster strikes and includes response capability actions to ensure an effective and efficient use of resources and efforts to minimize damage. Preparedness occurs just before a disaster.
- Emergency response activities include providing emergency assistance to victims and minimizing property loss. The response phase begins during or immediately after the onset of a disaster.
- Recovery activities include short and long-term activities that help return individuals and communities to normalcy as soon as possible. Recovery actions involve clean-up efforts, temporary housing, and replacement of infrastructure. Recovery activities typically commence several days or weeks after a disaster and are long-term.

The Jefferson County Hazard Mitigation Committees (HMC), composed of government leaders from County departments and agencies, in cooperation with the elected officials of its municipalities, have prepared this Hazard Mitigation Plan 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 each community.

1.2. Purpose

This project will update the 2018 Jefferson County Hazard Mitigation Plan, which was approved by FEMA in 2018. As part of this process the County and its municipalities will evaluate the previously identified natural hazards and risk assessments to determine if any revisions or additions are needed. The consultant will provide an updated asset inventory, risk assessment, and mapping of critical facilities within the plan area. The consultant will also provide Hazus Flood Analysis reports and loss estimates for each identified hazard in Jefferson County.

This Hazard Mitigation Plan was developed for the purpose of:

- Providing a blueprint for reducing property damage and saving lives from the effects of future natural and human-caused disasters in Jefferson County.
- Identifying, introducing, and implementing cost-effective hazard mitigation measures in order to accomplish county goals and objectives and to raise awareness and acceptance of hazard mitigation.
- Complying with state and federal legislative requirements for county mitigation in order for Jefferson County to be eligible for federal and technical assistance from state and federal hazard mitigation programs; and
- Demonstrating a firm local commitment to hazard mitigation principles; and improving community resiliency following a disaster event.

Adoption of this plan ensures that Jefferson County and participating municipalities continue to be eligible to apply for and receive certain federal grant funds that are administered by the State of West Virginia for FEMA. This plan complies with the requirements of the Disaster Mitigation Act of 2000 and its implementing regulations published in Title 44 of the Code of Federal Regulations (CFR) Section 201.6.

1.3. Scope

This 2023 Hazard Mitigation Plan Update has been prepared to meet requirements set forth by the Federal Emergency Management Agency (FEMA) and the West Virginia Emergency Management Division (WVEMD) in order for Jefferson County to be eligible for funding and technical assistance from state and federal hazard mitigation programs. It will be updated and maintained to address both natural and human-caused hazards determined to be probable and/or present a risk for multiple deaths/injuries and property damages to the local municipalities within the region. Updates will take place following significant disasters or at a minimum this plan will be subject to review and update on an annual basis.

In April of 2023, Jefferson County contracted with Michael Baker International, Inc. and Smith Planning and Design to support the Hazard Mitigation Plan Update development in compliance with the requirements of the Disaster Mitigation Act of 2000. The Plan Update was funded by Hazard Mitigation Assistance (HMA) funds from FEMA and administered by the WVEMDD. The Plan Update is a multi-jurisdictional plan that covers Jefferson County and their 5 municipalities.

It should be noted that future funding for certain mitigation projects will be contingent upon having each jurisdiction in Jefferson County adopt the plan after the County adopt the Update. Any jurisdiction that does not adopt the 2023 Plan Update will become ineligible for FEMA pre- and post-disaster mitigation funds.

Organization of the Plan

The 2023 Hazard Mitigation Plan Update consists of 7 chapters, each focusing on a different aspect of the planning process. Chapter 1 includes the prerequisites of the Plan including its purpose and scope. Chapter

2 introduces the plan update process and includes an overview of the socio-economic and demographic characteristics. Chapter 3 discusses the planning process. Chapter 4 comprises the hazard identification and risk assessment and examines vulnerability and the potential losses from the top priority hazards. Chapter 4 also includes a historic profile of hazard types and associated losses, and a vulnerability assessment, which analyzes the potential for future damages due to the hazards identified. Chapter 5 contains a capability assessment including a review of existing plans and ordinances from the County and municipalities. Chapter 6 discusses the mitigation strategy including updated mitigation goals and objectives, mitigation actions, and the method for prioritization and implementation of mitigation actions. Chapter 7 outlines how Jefferson County and its municipalities will implement the Plan once it is adopted and ways to monitor progress and ensure continued public involvement. Chapter 8 includes letters of adoption by the County's Commission and the individual municipalities.

1.4. NATIONAL MITIGATION INVESTMENT STRATEGY

The National Mitigation Investment Strategy is a single national strategy for advancing mitigation investment to reduce risks posed by natural hazards and increasing the nation's resilience to natural hazards. The Investment Strategy encourages the whole community, including individuals, to invest in pre- and post-disaster mitigation by adopting three shared goals:

Goal 1: Show How Mitigation Investments Reduce Risk

Build a shared understanding of mitigation investment and its value. Create a shared vocabulary and common measures to communicate information about risk and find opportunities to educate, hire, train and develop a base of qualified mitigation professionals.

Goal 2: Coordinate Mitigation Investments to Reduce Risk

Coordinate mitigation investments through shared risk information, reinforced strategies for risk reduction, and easier access to existing funding. Justify mitigation investments and choose the most cost-effective and reasonable actions.

Goal 3: Make Mitigation Investment Standard Practice

Factor mitigation into investment decisions and expand financial products and approaches for mitigation investment. Make mitigation standard professional practice critical to safeguarding lifelines, services, and national safety and security.

Local hazard mitigation plans are the opportunity for local governments to discuss, apply, and meet the three shared goals of the Investment Strategy. A plan based on an equitable and comprehensive engagement strategy, inclusive risk communication, and understanding community needs and capabilities sets the foundation for guiding investment decisions to reduce risk using a wide range of public and private resources.

1.5. COMMUNITY RATING SYSTEM (CRS)

The Community Rating System (CRS) is a voluntary program that provides flood insurance premium discounts to communities that implement programs and measures that exceed the minimum floodplain management requirements of the National Flood Insurance Program (NFIP). The Community Rating System program determines discounts based on credit points provided for floodplain management activities in participating communities. To achieve certain CRS Class ratings, communities must meet certain program prerequisites in addition to obtaining the credit points.

Jefferson County is one of thirteen communities in West Virginia that participate in the Community Rating System (CRS), along with Berkeley, Fayette, Greenbrier, Hampshire, Kanawha, Morgan, and Putnam Counties as well as the cities of Buckhannon, Charleston, Martinsburg, Parsons, and Philippi. As such, this hazard mitigation plan follows the necessary steps for CRS planning. The following table illustrates how this hazard mitigation plan and CRS planning cross-reference with the regulatory guide and the corresponding section of this plan.

Over the course of this past planning cycle, 2018-2023, Jefferson County went from a CRS class rating of 6 to a class 7. The total points awarded for the 2022 cycle were 1,673 points, whereas the total points awarded for the 2016 cycle was 2,007 points: a difference of 334 points. In preparation of this plan update, additional information has been included within Chapter 2: Planning Process, Chapter 3: Risk Assessment, and Chapter 5: Mitigation Strategy to coincide more closely with the "CRS Planning Steps" shown on the figure above. New mitigation actions included in this plan update that will result in the award of points under CRS have been denoted with a flag icon .

1.6. Authority and Reference

Authority for this plan originates from the following federal sources:

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

Authority for this plan originates from the following State of West Virginia source:

- West Virginia Code § 15-5 Public Safety
- WVEMDD: *West Virginia Statewide Standard Hazard Mitigation Plan Update 2018*

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

- FEMA 206-1-0002: Local Mitigation Planning Policy Guide. April 2022
- 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 2011.
- FEMA: *National Fire Incident Reporting System 5.0: Complete Reference Guide*. January 2008.
- FEMA: *Hazard Mitigation Assistance Unified Guidance*. February 2015.
- FEMA: *Integrating Hazard Mitigation into Local Planning: Case Studies and Tools for Community Officials*. March 2013
- FEMA: *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards.* January 2013.
- FEMA: *National Flood Insurance Program Fact Sheet*. May 2016.
- FEMA P-758: *Substantial Improvement / Substantial Damage Desk Reference*. May 2010.

The following additional guidance documents were used to update this plan:

- NFPA 1600: *Standard on Disaster/Emergency Management and Business Continuity Programs*. 2007
- WVEMDD. *West Virginia Statewide Standard Hazard Mitigation Plan, 2018 & 2023 Update.*
- Jefferson County Council. Envision *Jefferson 2035 Comprehensive Plan, Update (2023anticipated).*
- Jefferson County Council*. US 340 East Gateway Plan.* 2012
- Jefferson County Council. *Urban Tree Canopy Plan and Goals.* 2011
- Jefferson County Council*. Jefferson County Parks and Recreation, 2026 Master Plan*. 2016

2. Community Profile

The planning area for the hazard mitigation plan includes the incorporated municipalities and unincorporated areas within the geographical boundaries of Jefferson County, West Virginia. This section describes the geographic profile, climate, demographic profile, employment and industry profile, and unique characteristics of the planning area; these are important to understand in relation to natural, technological, and human-caused hazards because they can inform the type of vulnerabilities different locations or populations could experience. While some information such as the study area boundaries and geography have remained unchanged, and derived from the 2018 Plan, other information such as the demographic, employment, and industry information have been developed using the latest U.S. Census, the Comprehensive Plans, and other planning documents.

2.1. Geography and Environment

Jefferson County is one of 55 counties in the State of West Virginia and is located in the midst of the Blue Ridge and Appalachian Mountains in the eastern-most portion of the state's eastern panhandle. The Potomac River and Washington County, MD border the county on the north, the Potomac and Shenandoah Rivers and Loudoun County, VA on the east, Clarke County, VA on the south, and Opequon Creek and Berkeley County, WV on the west. A series of parallel ridges and valleys pierced by occasional water gaps characterizes the topography of Jefferson County. Significant areas of the Eastern portion of the county are comprised of karst topography that indicates dissolution of underlying rocks by surface water or groundwater. This geography can be seen in Figure 2-1.

The county contains five incorporated municipalities, as seen in Figure 2-2, including the Towns of Bolivar and Harpers Ferry, the Corporation of Shepherdstown, and the Cities of Ranson and Charles Town, the latter of which functions as the county seat. The county has a total land area of 212 square miles and varies in elevation from a low of 247 feet above sea level at Harpers Ferry to a high of 1,553 feet east of Shannondale. Metropolitan cities located within close proximity to Jefferson County include Washington, D.C. (58 miles), and Baltimore, MD (67 miles).

Table 2-1: Municipalities Covered Under 2023 HMP

Name	Type	County
Bolivar	Town	Jefferson
Harpers Ferry	Town	Jefferson
Shepherdstown	Corporation	Jefferson
Ranson	City	Jefferson
Charles Town	City	Jefferson

The county's rolling topography separates Jefferson County into three major drainage divides. The Shenandoah River has a drainage area of 105 square miles at the downstream county boundary; the Potomac River has a drainage area of 62 square miles; and Opequon Creek has a drainage area of 44 square miles. The majority of the streams in the county flow in a northwest-southeast direction toward Opequon Creek or the Shenandoah River. Ultimately, they flow into the lower Potomac River and the Chesapeake Bay. It is notable that the Karst rock under the county maintains significant aquifers that are important source of water for the county. In general, the aquifers flow from south to northeast. Figure 2-2 displays the watersheds and major water areas in Jefferson County.

Jefferson County has a continental-type climate, predominantly influenced by air from the west. The climate of Jefferson County is seasonal in nature, with warm summers, cold winters, stormy springs and mild fall seasons. The average temperatures have increased since the last plan update; average January temperatures five years ago were 29°F and are now 31°F, average July temperatures were 73°F five years ago and are now 74.7°F, creating a mean average temperature of 51°F five years ago and 52.9°F currently.

Figure 2-3 shows the average annual precipitation in Jefferson County. Precipitation is evenly distributed throughout the year, with an annual average of approximately 37 inches as of the last plan update and 40 inches according to current data (NCEI, n.d.). Data from the Martinsburg weather station indicates that the area experiences approximately 26 inches of snowfall per year. Southeast Jefferson County appears to receive the most precipitation, while an area along the western border with Berkeley County appears to receive the least.

Jefferson County is part of the Washington metropolitan area that comprises several counties from Virginia and Maryland, and D.C. This metropolitan area is home to more than six million people, surpassing the population of the Philadelphia metropolitan area in 2015 (Freed, 2016).

Per the 2023 West Virginia State Hazard Mitigation Plan, the state has experienced an average temperature increase of 0.1 degrees Fahrenheit per decade since 1985, as the effects of climate change become more severe. Similarly, the average amount of precipitation in the state has increased around 0.2 inches per decades since 1985.

Figure 2-1: Multi-Jurisdictional Hazard Mitigation Plan Update Base Map

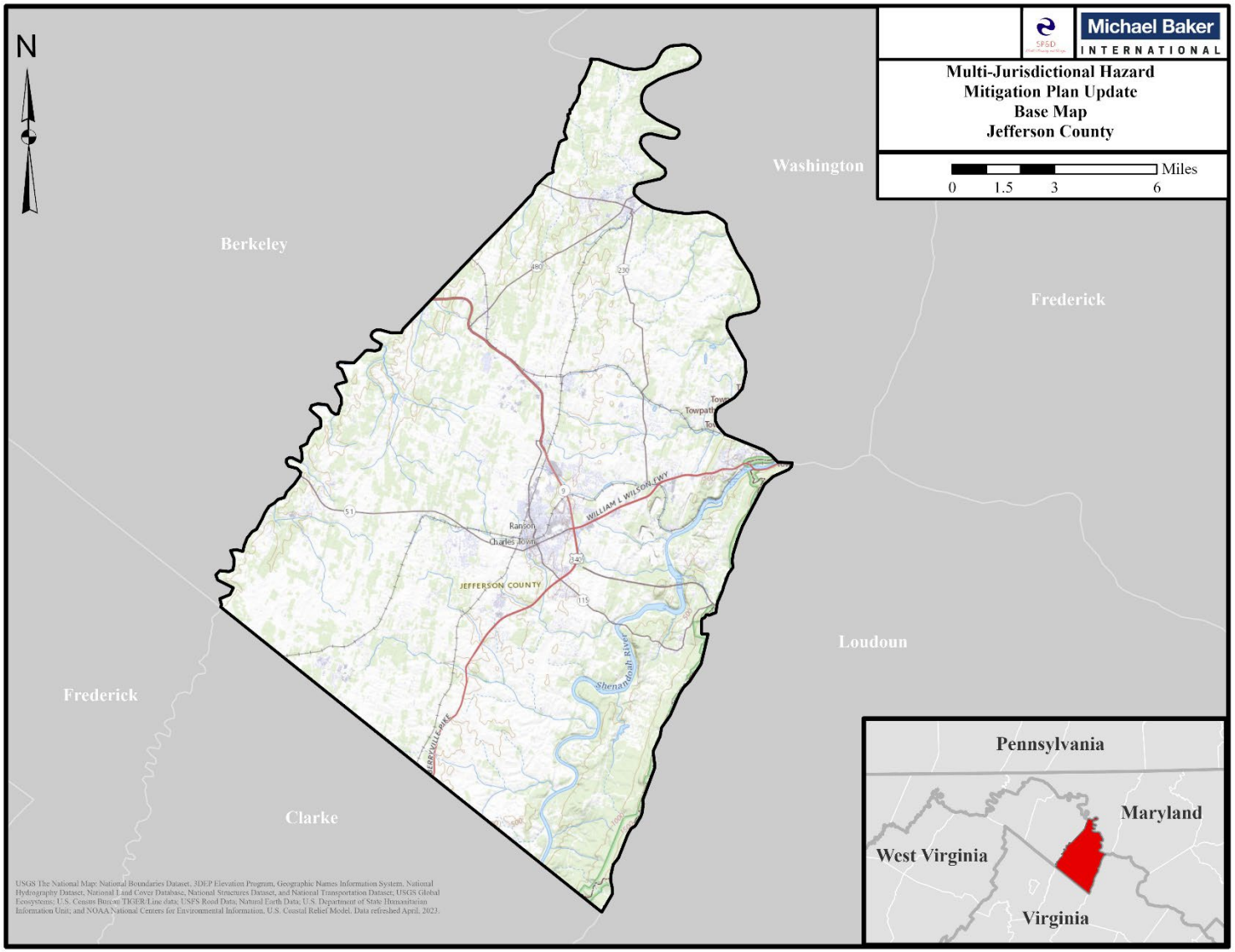


Figure 2-2: Jefferson County USGS HUC8 Watersheds

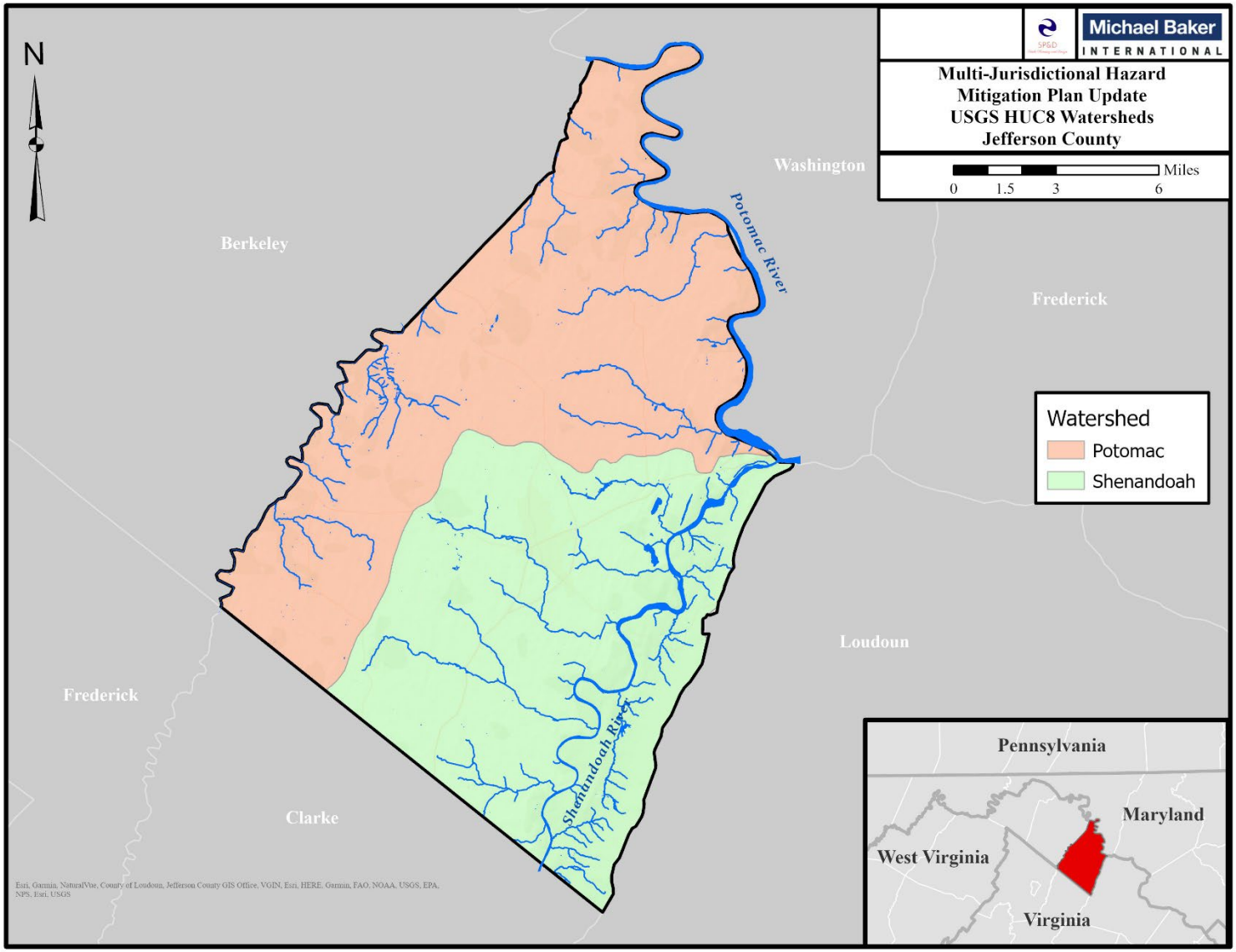
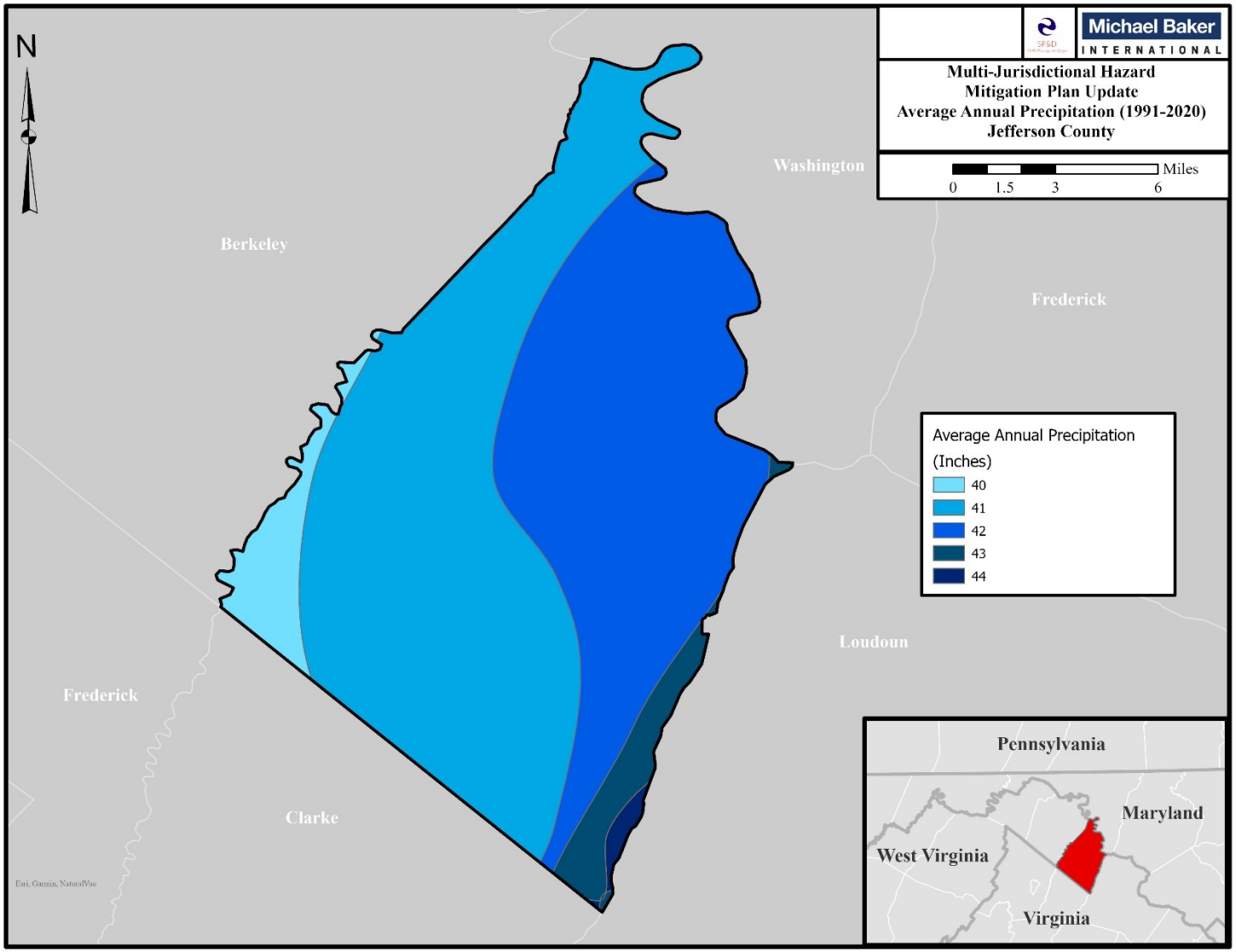


Figure 2-3: Jefferson County Average Annual Precipitation (1991 – 2020)



2.2. Community Facts

2.2.1. History

Jefferson County was created by an act of the Virginia General Assembly on January 8, 1801 from parts of Berkeley County. It was named in honor of Thomas Jefferson, who was then President-elect of the United States, the author of the Declaration of Independence and one of America's greatest statesmen. For most of its history, Jefferson County's economy has been primarily agricultural, producing grain and other crops in the 18th and 19th centuries and orchard fruit in the late 19th and early 20th centuries.

Two important events that shaped the future of Jefferson County were the establishment of the federal armory at Harpers Ferry in 1799 and the arrival of the Baltimore & Ohio Railroad in 1834. John Brown's raid on Harpers Ferry was prompted by the presence of the armory, the town's proximity to defensible positions in the mountains, and the belief that the surrounding slave population would rise up and support the insurgents. The presence of the B&O influenced the decision in 1863 to include Jefferson County in the new state of West Virginia, although most residents had sided with Virginia when the mother state seceded from the Union.

Jefferson County's population grew slowly from the end of the Civil War until World War II, to nearly 16,000. Agriculture remained the major source of revenue, with corn and wheat being the major crops. The orchard industry was introduced in the 1880s, and many dairy farms were established in the 1920s and 1930s. During the 1980s and 1990s, the number of farms declined, partly because of the decreased profitability of farming and partly because of the pressure exerted by residential development. By the year 2000, raising beef cattle and horse breeding were the most promising areas for agricultural growth. With the opening of the Charles Town Racetrack in 1933, Jefferson County became the first track in the state to offer parimutuel betting. The racetrack is still one of the major employers in the area.

Like much of the neighboring area, Jefferson County began to grow more rapidly in the 1970s. Between 1970 and 2000, the number of residents increased from 21,280 to 42,190. During this period, the county experienced much residential growth without a proportionate increase in its business and industrial base, as the majority of its people commuted outside of the county to work. The county is part of the metropolitan Washington area (Jefferson County, 2023).

2.2.2. Highways

Jefferson County is connected to the region's cultural, financial, and industrial centers by numerous interstate, state, and county highways. The region's dense network of roadways makes every corner of Jefferson County readily accessible.

I-70 and I-81 connect Jefferson County to Washington, D.C., Baltimore, and several cities throughout the East Coast, the Upper South, and the Ohio Valley. I-70 is 30 miles away, accessible via U.S. Route 340, and connects Jefferson County to Maryland and Virginia. I-81 is only 10 miles away and accessible via State Route 9, a major east-west state highway that gives Jefferson County quick access to Manassas, Virginia.

S.R. 45 joins northern Jefferson County to nearby Martinsburg, at the interchange of I-81, U.S. Route 11, and S.R. 9. S.R. 51 passes through the county from Charles Town in the east to I-81 and beyond in Berkeley County, West Virginia. S.R. 115 runs east-west through Jefferson County for 20 miles and parallels S.R. 9. S.R. 230 is a north-south state highway in Jefferson County joining U.S. Route 340 just west of Bolivar to S.R. 45 and S.R. 480 in Shepherdstown.

2.2.3. Economy

In Jefferson County, the economy (i.e., local work force) is driven by educational services, health care, professional, retail trade and arts, entertainment industries. Table 2-2 shows the top four industries in Jefferson County, with the number of individuals employed.

Table 2-2: Top Industries by County, 2017-2021 American Community Survey 5-Year Estimates

County (# of total employed)	Industry 1 (# of employees)	Industry 2 (# of employees)	Industry 3 (# of employees)	Industry 4 (# of employees)
Jefferson (28,446)	Educational services, and health care and social assistance (6181)	Professional, scientific, and management, and administrative and waste management services (3730)	Retail trade (3604)	Arts, entertainment, and recreation, and accommodation and food services (3280)

US Census Bureau, 2023

The Jefferson County Development Authority (JCDA) works to bring development and jobs to the county. The top employers, by jurisdiction, are as follows.

Jefferson County (Jefferson County Development Authority, 2023):

- Jefferson County Schools
- PNGI Charles Town Gaming, LLC
- IRS Data Center
- Shepherd University
- American Public University System

2.2.4. Utilities

Jefferson County residents living in unincorporated and rural area are on private wells and septic. Utilities are provided by many different companies. Major utility provider breakdowns are as follows:

- Electricity: Potomac Edison
- Natural Gas: Mountaineer Gas

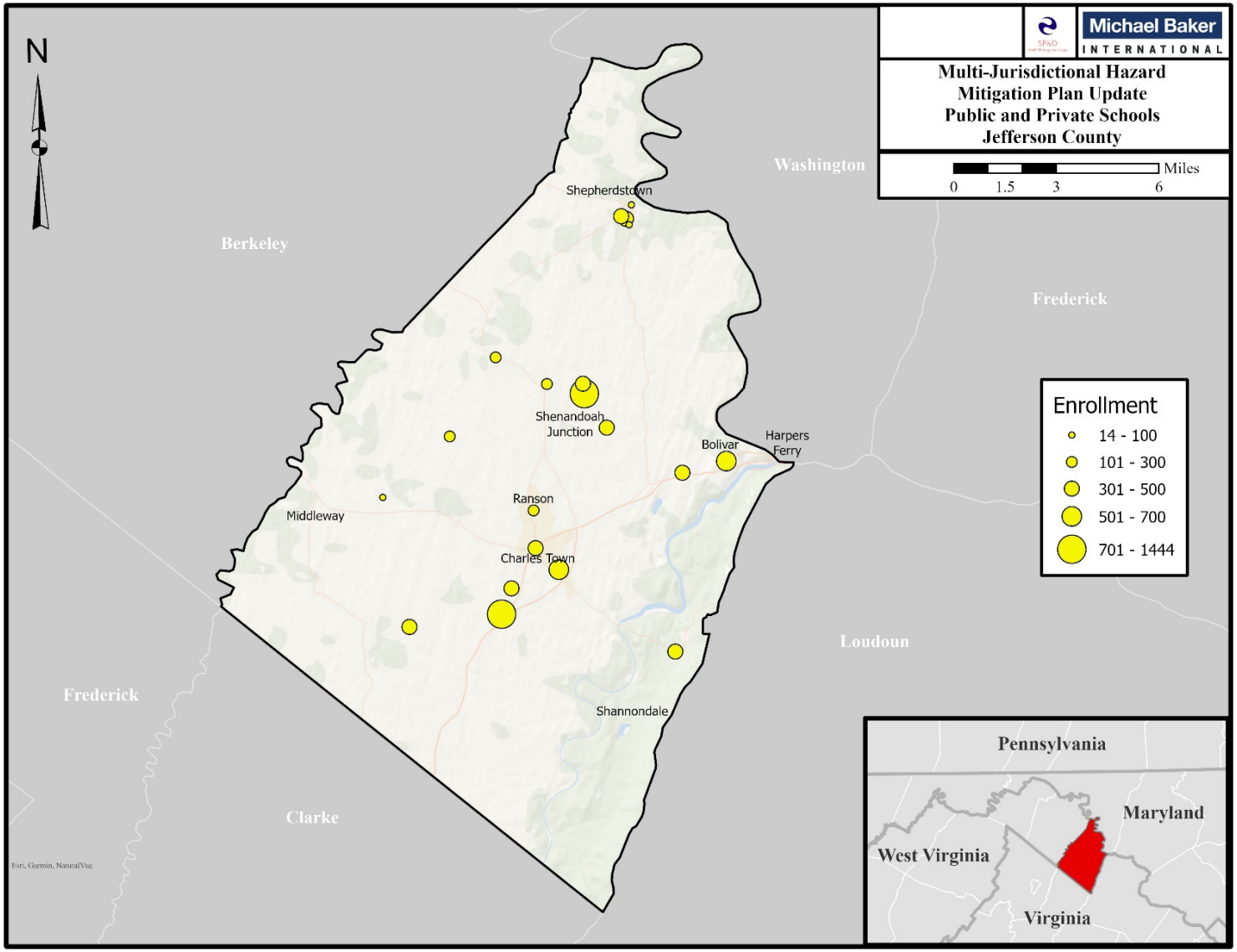
- Water: West Virginia American Water, the Jefferson County Public Service District, the City of Charles Town, the Corporation of Harpers Ferry, and the Corporation of Shepherdstown
- Wastewater: Jefferson County Public Service District, the City of Charles Town, the Harpers Ferry-Bolivar Public Service District, Jefferson Utilities, and the Corporation of Shepherdstown.
- Telephone: Comcast, and Frontier Communications
- Wireless Carriers: Verizon, AT&T, Sprint, T-Mobile, Comcast, and U.S. Cellular

2.2.5. Schools

The Jefferson County Public school system comprises 10 elementary schools, one intermediate school, four middle schools, and two high schools. Jefferson County Schools also runs an opportunity learning center. In addition, there are four private schools. Jefferson County has a 90% high school graduation rate which is just over the national average of 89%, and higher than the rest of the state by 2% (County Health Rankings & Roadmaps, 2023). School locations can be seen in Figure 2-4 and summarized in Appendix F.

Jefferson County is home to two higher education institutions; the American Public University System that runs the online American Public University (APU) and the American Military University (AMU) programs is headquartered in Charles Town, and Shepherd University in Shepherdstown. There are several other colleges and universities that are within close proximity to the county including Blue Ridge Community and Technical College in Martinsburg, Shenadoah University in Winchester, and Hood College in Frederick.

Figure 2-4: Jefferson County Public and Private Schools



2.3. Population and Demographics

Table 2-3 shows current population estimates for Jefferson County. The total population is estimated to be 57,701. According to the American Community Survey 5-year estimates (2017-2021), the median age in Jefferson County is 41. The 65+ group was the fastest growing between 2017 and 2021 with its population increasing 13.3 percent. The percentage of Jefferson County's population that is age 65 and older has increased from 15.7 percent of the population in 2017 to 17.3 percent in 2021. The 0 to 4 age group declined the most dropping 8.7 percent between 2017 and 2021. With more than 17 percent of Jefferson County residents being 65 years or older, the impact of hazards on elderly populations must be carefully considered. The age of the population may also impact which outreach methods work best for hazard mitigation awareness or education actions. Actions involving the internet or cell phones may exclude certain population groups. (U.S. Census Bureau, 2023).

Table 2-3: Jefferson County Population Estimates	
Population (2020 Decennial Census)	Jefferson County
Total Population	57,701
Population Percent Change 2010 - 2020	7.70%
Population (2035 Estimate)	Jefferson County
Total Population	68,245
Age (ACS 2021 5-year estimates)	
Persons under 5 years	4.90%
Persons under 18 years	21.30%
Persons 18 years to 64 years	61.40%
Persons 65 years and over	17.30%

U.S. Census Bureau, 2020 and U.S. Census Bureau, 2021

Table 2-4 shows the municipalities located within Jefferson County and their corresponding population and population growth. The Charles Town and U.S. Route 340 corridor are some of the fastest growing areas in the county.

Table 2-4: Municipality Population Estimates			
Municipality	2021 Population Estimates	2016 Population Estimates	Population Change
Bolivar	1290	1225	5.30%
Charles Town	6373	5682	12.20%
Harpers Ferry	292	213	37.10%
Ranson	5404	4830	11.90%
Shepherdstown	1529	1578	-3.10%

U.S. Census Bureau, 2020

The median income of households (according to 2017-2021 estimates) in Jefferson County is $86, 711. County statistics report that 9.7 percent of the Jefferson County population live in poverty. According to 2021 estimates, approximately 24,708 total housing units are estimated in the county. The median

monthly housing costs for mortgaged homeowners is $1,709 in Jefferson County. The median rent is $978 per month in Jefferson County. Ethnic origins of the county can be seen in Table 2-5.

Table 2-5: Race and Ethnic Origin in Jefferson County as a percentage of the population, 2022

Race and Ethnic Origin (ACS 2022 5-Year Estimates)	Jefferson County
White Alone	88.1%
Black or African American Alone	6.5%
American Indian and Alaska Native Alone	0.4%
Asian Alone	1.7%
Native Hawaiian and Other Pacific Islander Alone	0.1%
Two or More Races	3.2%
Hispanic or Latino	6.8%
White Alone, not Hispanic or Latino	82.2%

U.S. Census Bureau, 2023

2.4. Land Use and Development

Most of Jefferson County falls under the hay and pasture land use category, followed by deciduous forest. There are also significant amounts of cultivated crop, and mixed forest scattered across the county. Developed land uses are found concentrated in areas of higher population density and near major travel routes. This can be seen in Figure 2-5.

The region as a whole continues to see significant development as a part of the Metropolitan Washington, DC. As such, the potential for development is likely to continue. While there has been a significant amount of commercial development in Jefferson County since the 2004 Comprehensive Plan, it has slowed considerably in recent years. During this same time period, residential growth occurred at a more rapid rate, particularly in the early 2000's. With Jefferson County's proximity to Washington, D.C. and Baltimore, MD and with the existing economic cluster of federal agencies, the County has the opportunity to attract additional federal facilities. Some of the industries that the JCDA has identified to target for growth is agriculture development, government, information technology, manufacturing, small business, and tourism.

With growing population and development comes a myriad of concerns for vulnerability to natural and man-made hazards. Some of the specific concerns cited by stakeholders include increase in drought vulnerability by spreading the source water thinner throughout more people, as well as an increase in invasive species by intermodal travel. Stakeholders were particularly concerned with the ongoing COVID-19 pandemic, and significant gaps in the community, state, and federal response in protecting the population.

The Jefferson County Planning and Zoning Department and the Jefferson County GIS Department work together regularly to keep development plans up to date. The map in Figure 2-6 illustrates the county's future land use guide. The map specifies preferred growth areas and village expansions in addition to the land use classification of all the areas in the county.

Figure 2-5: Jefferson County Land Cover

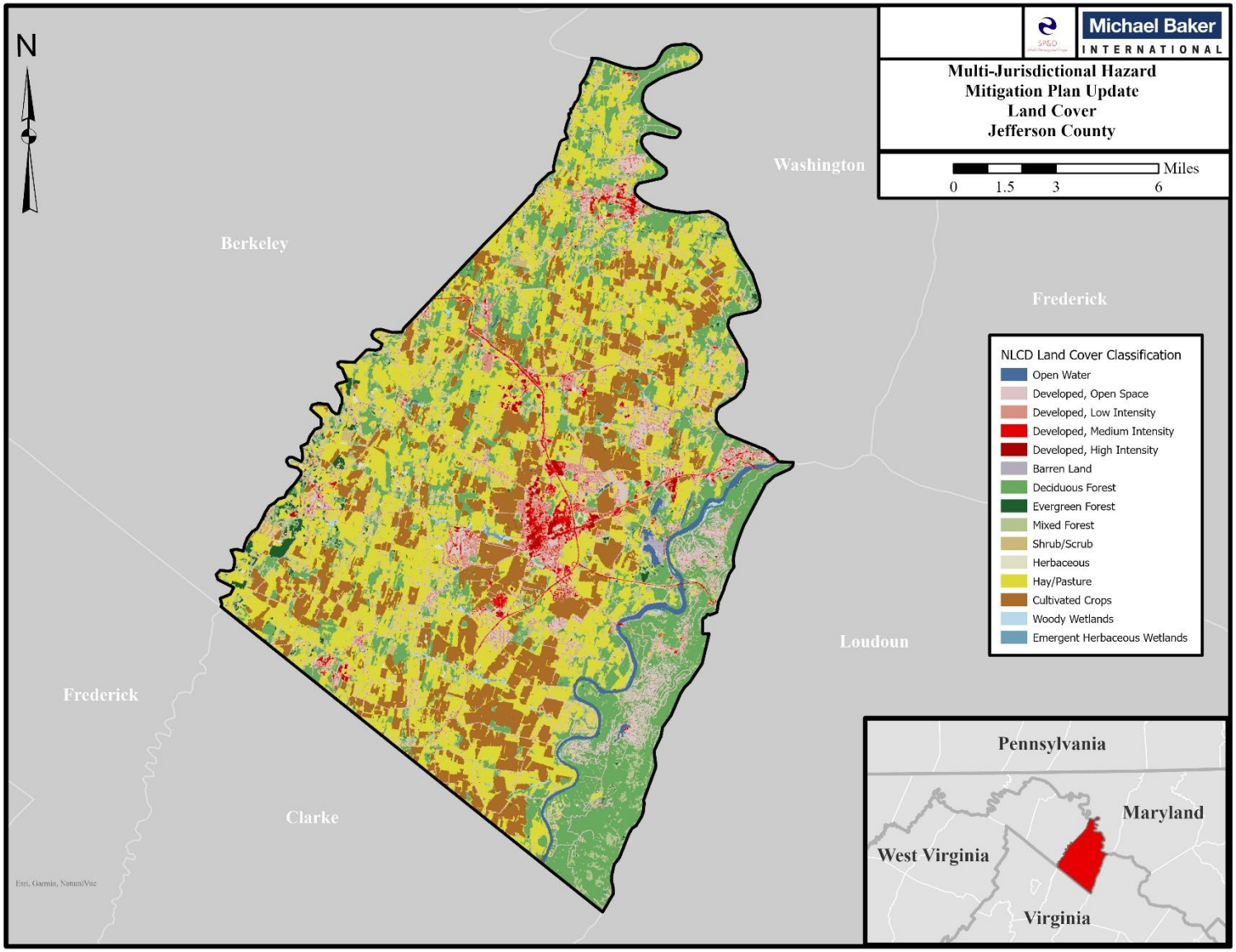
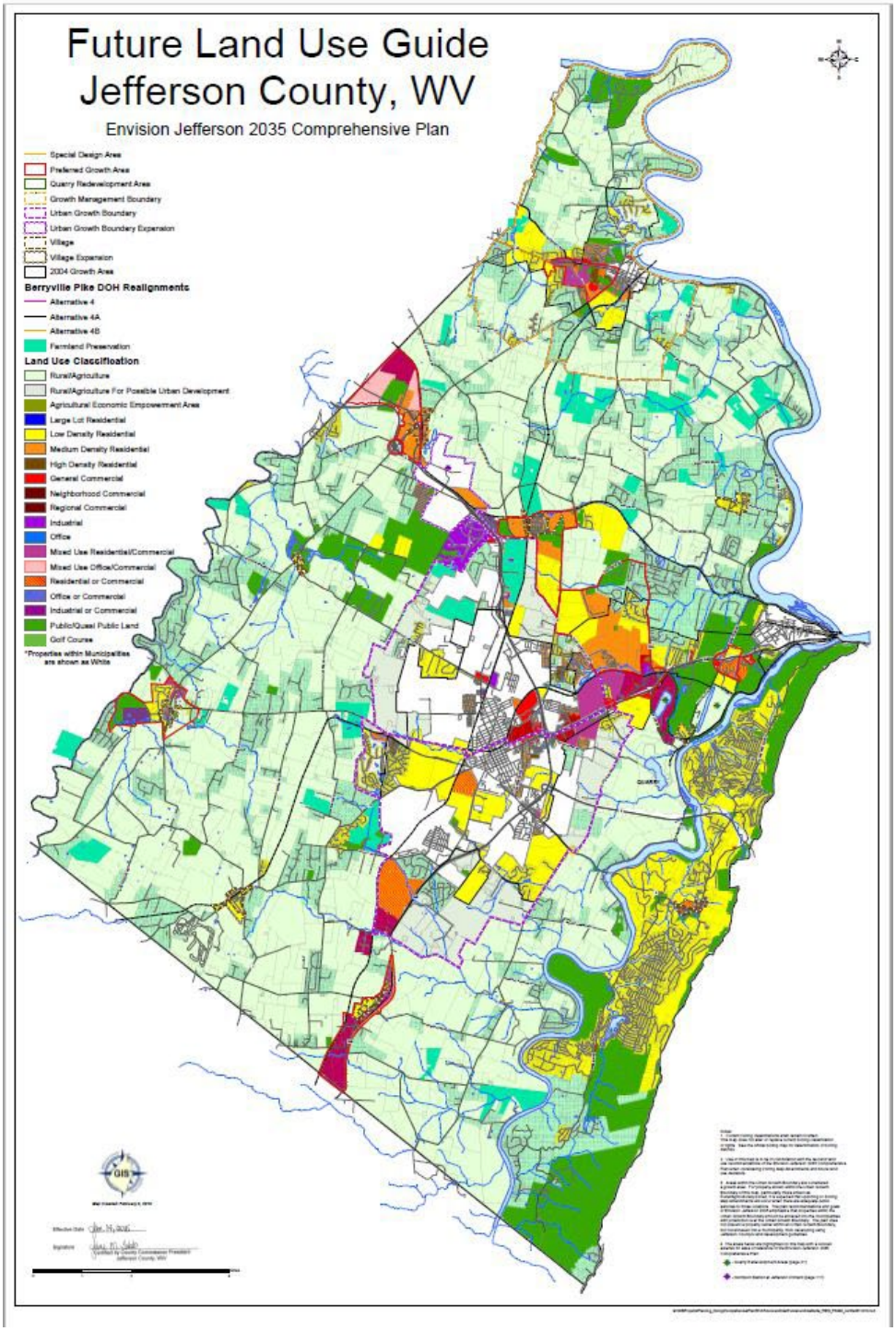


Figure 2-6: Jefferson County Future Land Use Guide



2.5. Data Sources and Limitations

Geographic Information System (GIS) data used in the mapping and analysis of hazards throughout the HMP were provided by a few different sources. Data including West Virginia watersheds, land use, school

locations, dam locations, karst features and climate data were retrieved from the online West Virginia State GIS Data Clearinghouse which is maintained by the West Virginia GIS Technical Center (WV GISTC) at West Virginia University (WVU). Jefferson County transportation features and flood zone areas were obtained from the Jefferson County GIS Coordinator.

Additional information used to complete the risk assessment for this plan was taken from various government agency and non-government agency sources. Those sources are cited where appropriate throughout the plan with full references listed in Appendix B – Bibliography. Online local news sources were also used extensively to identify the previous occurrence of a hazard, detail the hazard's extent and impact, and provide photographs. News media is important in hazard mitigation planning as both a source of data and to facilitate public interest and involvement.

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 Center for Environmental Information (NCEI) database was utilized. NCEI is a division of the US Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). Information on hazard events is compiled by NCEI from data gathered by the National Weather Service (NWS), another division of NOAA. NCEI then presents it on their website in various formats. The data used for this plan came from 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 NCEI Storm Events Database as of July 2023.

This HMP evaluates the vulnerability of the area's critical facilities. For the purposes of this plan, critical facilities are those entities that are essential to the health and welfare of the community. This includes, police departments, fire stations, emergency medical services (EMS), schools, and hospitals and medical centers. For a full list of critical facilities, please see Appendix F – Critical Facilities.

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 Jefferson County Hazard Mitigation Plan. This section describes the update process and how the Plan evolved since it was first approved by the Federal Emergency Management Agency (FEMA).

Hazard Mitigation Planning Committee (HMPC) members were identified and approached by the Jefferson County Office of Homeland Security and Emergency Management (JCOHSEM). All five municipalities: Bolivar, Charles Town, Harpers Ferry, Ranson, and Shepherdstown participated in the vulnerability assessment and the development of the Mitigation Strategy to address these vulnerabilities.

To begin this process, Jefferson County hosted an Internal Planning Team kick-off meeting on May 5, 2023. During this meeting, attendees reviewed the Hazard Mitigation Planning process, as well as changes to the planning process presented in FEMA's Local Mitigation Planning Policy Guide (FP 206-21-0002) released on April 19, 2022 and effective April 19, 2023. Additionally, the attendees discussed the scheduling of HMPC meetings and public outreach options to include electronic email invites, hardcopy mailers, bi-monthly newsletters and radio broadcasts.

During scheduled monthly meeting the HMPC used worksheets to gather information from county agency representatives and local municipal staff that participated in the planning process. These worksheets were designed to collect information about the hazards that affect the county, and how those hazards impacted each of the municipalities. Additional worksheets were used to gain information about the mitigation strategy, including a review of the 2018 goals and actions to determine their efficacy and identify edits or additional information to include in the 2023 update. Completed versions of these forms are included in Appendix D – Meeting and Other Participation Documentation.

The plan format is structured in accordance with the most current planning guidance from FEMA, Local Mitigation Planning Handbook (May 2023). The Plan Update was led by the HMPC and informed by the Planning Team. Community leaders and other agency and organizational stakeholders were invited by JCOHSEM to attend monthly meetings and participate in the plan update process.

3.2. The Hazard Mitigation Planning Committee (HMPC)

The HMPC assembled for the 2023 Hazard Mitigation Plan Update included county agency staff, county and local officials, and municipal representatives. Stakeholders including staff from local utilities, educators, healthcare professionals, regional employers, neighboring communities, and the public. The HMPC was assembled to guide the overall direction of the Hazard Mitigation Plan Update and make decisions pertaining to its completion in conjunction with Jefferson County and the consultant team. Table 3-1 details the members of the 2023 HMPC. The primary roles of the HMPC included providing risk assessment, determining capability updates, and providing technical expertise and mitigation action development. All participation documentation including meeting sign-in sheets are provided in Appendix D – Meeting and Other Participation Documentation.

Table 3-1: 2023 Hazard Mitigation Planning Committee Invited Stakeholders

Name	Organization	Meeting Participation
Allen, Steve	JCHSEM	1 / 2 / 3 / 4
Armentrout, Michael	Harpers Ferry Police Department	2 / 3
Ath, Clare	Jefferson Co. Commission	
Auxer, Jim	Shepherdstown	
Barre, Jennifer	Private Citizen	2 / 3
Beall, Andy	Shepherdstown Floodplain Manager	1
Benites-Im, Edwina	Jefferson Co. Development Authority	1 / 2 / 3
Boyd, Amy	Shepherdstown	
Brockman, Jennie	Jefferson Co. Planning and Zoning	
Brown, J.D.	Harpers Ferry Police Department	2
Burns, Becky	Jefferson Co. Engineering Department	
Butcher, Thomas	Potomac Edision	1
Butler, George	CBP/ATC	
Carter, Mason	Jefferson Co. Engineering Department	1
Caton, Brandon	Jefferson Co. BOE	3
Channel, Jackie	Jefferson County Clerk	2
Cogel, Earl	Blue Ridge Fire Company	
Dettmer, Helen	Bolivar	
Edwards, Sallie	Volunteer	1
Fernandes, Nuno	American Public University	
Freund, Jon	Kent Cartridge	1
Frye, Holly Morgan	Shepherd University	
Gatto, Laura	Hollywood Casino	
Goldman, Michele	Jefferson Co. COAD	
Goodwin, Roger	Jefferson Co. Engineering Dept.	
Gormont, Jessica	Jefferson Co. GIS	1 / 2 / 3 / 4

Table 3-1: 2023 Hazard Mitigation Planning Committee Invited Stakeholders		
Name	**Organization**	**Meeting Participation**
Green, Sanford	WVDHSEM	3
Grove, Stephanie	Shepherdstown	1
Grubb, Donnie	WVU Medicine	
Hansen, Tom	Jefferson Co. Sheriff's Dept.	
Herbst, Larry Jr.	Citizens Fire Company	
Horn, Craig	Jefferson Co. Emergency Services Agency	
Hott, Jesse	American Red Cross	2 / 3
Jackson, Tricia	Jefferson Co. Commission	
Jenkins, Andrew	CBP/ATC	1
Jimeno, Dan	Town of Bolivar	3
Krouse, Jennifer	Jefferson Co. Commission	2 / 3
Kuhn, Laura	Jefferson Co. Maintenance	
Kutcher, Chris	Charles Town Police Department	
Levins, Ryan	Harpers Ferry NHP	4
Low, Bruce	Citizen	3 / 4
Mantheiy, Keith	US Fish and Wildlife Service	2
Maraugha, Lori	Shepherd University	
Marchun, Alan	WV Public Health	
Marrone-Reese, Paula	Good Shepherd Inter-Faith	
Mood, Michael	Middleway Fire Company	
Morgan, Ross	Shepherdstown Fire Company	
Morrow, Emily	WVU Extension Service	
Morse, Pat	Harpers Ferry	
Murphy, Kerry	NCTC	2
Myers, Dick	Jefferson Co. OHSEM	1 / 2 / 3 / 4
Newman, James	Charles Town Floodplain Management	3
Pardis, Steve	Harpers Ferry Water Works	2 / 3
Parkin, Jonnie	Volunteer	
Parsons, Kelly	Nichols, Dehaven & Associates	1 / 2
Pennington, Matt	Downstream Strategies	
Pierson, Duke	Ranson	
Pippel, Jeff	Jefferson Co. Utilities	1 / 2 / 3 / 4
Polczynski, Jeff	Jefferson Co. Emergency Communications	
Reidy, Terrence	Jefferson Co. Health Department	1 / 2 / 3
Roberts, Robbie	Ranson Police Department	
Rosier, Stephanie	WVEMD	
Schwartz, Jeff	Jefferson Co. Solid Waste Authority	

Table 3-1: 2023 Hazard Mitigation Planning Committee Invited Stakeholders		
Name	**Organization**	**Meeting Participation**
Sell, Robert	Jefferson County Sheriff's Office	2 / 3 / 4
Shadle, Jacqueline	Jefferson County Clerk	2 / 3 / 4
Sherwood, John	Volunteer	
Shuler, Eric	Shepherd University	
Shultz, April	Charles Town Utilities	
Shutts, Ronnie	Friendship Fire Company	
Sine, Mike	Jefferson Co. Emergency Services Agency	3 / 4
Sisco, Gino	Jefferson Co. Health Department	
Smith, Josh	Bakerton Fire Company	
Smith, Ed	Independent Fire Company	
Smooth, Stephen	Rep. Alex Mooney's Office	
Snavely, Rachel	Region 9	3
Snyder, Lee	Snyder Environmental	
Stanley, Reiley	Ranson Floodplain Manager	2
Sotomayor, Ben	Harpers Ferry Job Corps	
Stolipher, Steve	Jefferson Co. Commission	
Strong, Chris	National Weather Service	
Tabb, Jane	Jefferson Co. Commission	
Taylor, Joe	CSX	
Thomas, Andrea	American Water	
Trainor, Bob	City of Charles Town	
Vaughn, Gregory	Harpers Ferry	
Vezzosi, Carolyn	Charles Town	
Vosika, Matt	Kent Cartridge	1
Ware, Nathan	WV Dept. of Highways	
Watson, Adam	Independent Fire Company	
Weikle, Mason	Jefferson. Co. Health Department	1 / 2 / 3 / 4
Welch, Frank	Shepherdstown Water	1 / 2 / 3 / 4
Wells, John	Summit Point Raceway	
White, Joyce	Jefferson Co. Board of Education	1
Whyte, Monica	WV Health Department	1 / 2 / 3
Willingham, Larry	Jefferson Co. Board of Education	
Wilt, Todd	Ranson	
Whittington, Laura	Bolivar	
Zonfrilli, Makayla	Jefferson Co. Administrator	2
Khanal, Suraj	CBP/ATC	
Mark James	Michael Baker International	1 / 2 / 3 / 4

Table 3-1: 2023 Hazard Mitigation Planning Committee Invited Stakeholders		
Name	**Organization**	**Meeting Participation**
Wes Stafford	Michael Baker International	1 / 2
Sheila Hicks	Michael Baker International	1 / 2
Jeff Cragle	Michael Baker International	1 / 2
Virginia Smith	Smith Planning and Design	1 / 2 / 3
Michele King	Smith Planning and Design	1 / 2 / 3

3.3. Meetings and Documentation

JCHSEM and the consultant scheduled four in-person meetings with the HMPC; each one covered a different topic. A brief description of each meeting is presented below. Invitations, agendas, sign-in sheets, completed exercises / worksheets and minutes for these meetings are included in Appendix D – Meeting and Other Participation Documentation.

3.3.1. Planning Team Kickoff Meeting May 5, 2023

The Planning Team consisting of director and deputy director of JCOHSEM and consulting staff was created at project inception and met on May 5, 2023 to initiate the 2023 Hazard Mitigation Plan update. During this meeting the consultants went over the scope of work, expectations and deliverables. A list of new stakeholders and committee members was provided pre meeting and new membership to include regional perspectives was discussed during the meeting. Jefferson County staff compiled a list of HMPC members and provided it to the consultant to send out upcoming plan invitation emails.

Given the short timeline the planning team agreed to meet on a by weekly basis to provide updates, discuss data challenges, public outreach efforts, and set action items. The planning team also agreed to establish a monthly HMPC meetings on the 4th Thursday of each month. Committee meetings were hybrid and started at 1PM at the Hospice of the Panhandle 330 Hospice Ln, Kearneysville, WV.

- First Meeting, Project Kickoff - 1.5 hours
- Second Meeting, Hazard Analysis / Risk Assessment - 2 hours
- Third Meeting, Mitigation Strategy Development - 4 hours
- Fourth Meeting, Draft Plan Review - 2 hours

Plan milestones and deliverables were scheduled in line with the HMPC meetings. The consultant developed a task tracker that kept the plan on schedule and was used to provide County Council updates.

The JCOHSEM website was used to post plan updates, and public surveys with linked notifications sent to HMPC members to disseminate to their networks. Plan format including colors, design and GIS map templates were also agreed on during this meeting.

3.3.2. Hazard Mitigation Planning Committee Kick-Off Meeting - May 24, 2023, 2:30PM – 4:00PM

Held in person with a virtual option the first meeting introduced the project to county agency staff and local officials, inform community representatives of the plan update process, schedule, and evaluate hazards and risk within the county. Invitations were sent to county agencies, municipal officials and stakeholders listed in Table 3-1. The agenda for the meeting is presented below in Table 3-2.

Table 3-2: 2023 Kick Off Meeting – Committee Agenda Items

Meeting	Attendance	Agenda
May 24, 2023 2:30 - 4:00PM	24 (3 Virtual)	1. Welcome and Introductions 2. Project Overview 3. 2023 Planning Process 4. Risk Assessment Overview and Hazard Review Exercise #1: Risk Evaluation and Identification 5. Capability Assessment and Mitigation Strategy Overview Exercise #2: Capability Assessment Survey 6. County NFIP Survey Results 7. Equity & Social Vulnerability 8. Five-Year Plan Review 9. Next Steps and Action Items

The Jefferson County Director of Homeland Security and Emergency Management welcomed everyone to the meeting, briefly introduced the project and turned the meeting over to the Consultant. A brief review of the definition of mitigation and the importance of mitigation planning was covered. The group went over the different parts that integrate the hazard mitigation plan. During this initial introduction, expectations and the importance of committee member participation throughout plan update process was stressed. A tentative schedule for the plan update with meeting dates, agenda items, and expected progress was presented to the HMPC.

Meeting attendees were asked to fill out hazard identification and risk assessment worksheets. The purpose of the exercise was to evaluate previously profiled hazards and to identify any new hazards that exist. Committee members agreed that there was an increase in magnitude or occurrence of impacts in all but 4 hazards. earthquake, infestation, and dam failure saw no change in the last 5 years and severe winter storm saw a decrease. Additional hazards that will be considered in the 2023 plan update include karst/sinkholes, utility interruption and cyber security. A community capability assessment worksheet was also circulated to municipalities as homework after the meeting. The purpose of this worksheet was to gain insight on available resources and document capabilities of county agencies and within each municipality. A third worksheet that addressed equity and social vulnerability was circulated to gain information on known areas of social vulnerability, shifts that committee members have seen in needs to address equity, and suggested ways to include equity and social vulnerability into planning and services. Photographs of the meeting can be seen in Figure 3-1.

Figure 3-1: Jefferson County Hazard Mitigation Plan Kick-Off Meeting

3.3.3. Hazard Analysis & Risk Assessment Meeting – June 27, 2023, 1:00PM – 3:00PM

The second HMPC Meeting was held in person with a virtual option on June 27. The focus of this meeting was to have the committee members prioritize Jefferson County's hazard vulnerability and discuss the progress of mitigation actions from the 2018 Plan. Invitations were sent to each municipality, county departments and stakeholders listed in Table 3-1. The agenda for the meeting is presented below in Table 3-3.

Table 3-3: Hazard Analysis and Risk Assessment Meeting – Committee Agenda Items

Date	Attendance	Agenda
June 27, 2023, 1:00 – 3:00PM	22 (3 Virtual)	1. Welcome and Introductions 2. Project Update & Recap of May 24 Meeting 3. Risk Assessment Overview & Hazard Identification Exercise #1: Risk Ranking Evaluation 4. Mitigation Strategy Discussion Exercise #2: Mitigation Action Progress (Take Home) 5. Next Steps and Action Items

The Jefferson County Director of Homeland Security and Emergency Management welcomed everyone to the meeting, briefly introduced the project and turned the meeting over to the Consultant. A recap of the May 24 meeting was provided, emphasis was placed on participating municipalities roles and responsibilities, expansion to a diverse cross section of participants and the importance of participating in the importance of applying for FEMA Hazard Mitigation Assistance funds.

An overview of what was included in the 2018 plan versus what is addressed in the 2023 plan was provided. There are three new hazards addressed in the 2023 plan:

- Karst / Sinkholes
- Utility Interruption
- Cyber Terrorism

The consultant explained that the profiles for each hazard provided in the risk assessment section use the same format so the reader can easily refer one to the other and recognize the content. Hazard profiles were distributed to the HMPC for review with summary sheets as they were completed. Two example hazards (floods and dams) were reviewed and details on what to expect in the plan was presented.

Meeting attendees were asked to complete a hazard risk ranking evaluation. This exercise allows the reviewer to prioritize new and previously profiled hazards. HMPC members were asked to evaluate each hazard using a risk assessment ranking of 1 to 5 for five categories: Probability, Impact, Spatial Extent, Warning Time, and Duration. A sample of the exercise is provided in Figure 3-2.

Figure 3-2: Risk Ranking Evaluation Exercise for Prioritizing Current and New Hazards

Prioritizing Hazards Using Risk Assessment

This worksheet summarizes **Jefferson County** risk ratings for hazards profiled in the 2018 Hazard Mitigation Plan. How has the frequency of occurrence, magnitude of impact, and/or geographic extent changed in your community? Please grade each **Risk Assessment Category** with Degree of Risk Index Number (1,2,3,or 4) defined on the attached **Risk Methodology Sheet**.

Community/Organization:	
Name and Title:	

HAZARD	RISK ASSESSMENT CATEGORY					RISK FACTOR	NC=No Change I=Increase D=Decrease (Results from May 24 Meeting)	Explanation for hazards marked I or D (Results from May 24 Meeting)
	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION			
Drought							I	Climate Change (Greater Chance) Decrease in Water Levels
Earthquake							NC	
Extreme Temperatures							I	Climate Change (More Frequent and Longer)
Flood							I	Climate Change (More Extreme)
Invasive Species							NC	
Land Subsidence							I	Increase in Sinkholes
Landslide							I	Rockslides in Harpers Ferry
Public Health Crisis							I	Covid Pandemic Threat of Homemade Viruses Increase Cases of Diabetes & Mental Health (see Community Needs Assessment)
Severe Thunderstorm and Hail							I	Climate Change (More Frequent)
Severe Wind and Tornado							I	Climate Change (More Frequent and Stronger)

A take-home exercise was provided to hazard mitigation committee members to review and provide an update on hazard mitigation actions that were presented in the 2018 Plan. Committee members were asked to review each action and determine if it was completed, canceled, deferred or is ongoing. In

preparation for the next meeting an introduction to mitigation techniques was provided. Five types of mitigation activities were covered: Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, Education and Awareness Programs, and Emergency Response/Recovery Opportunities. The public notice and invitation to participate in the 2023 Hazard Mitigation Plan survey on the Jefferson County website can be seen in Figure 3-3. A photograph of the hazard analysis & risk assessment meeting can be seen in Figure 3-4.

Figure 3-3: Invitation to Participate in the 2023 Jefferson County Hazard Mitigation Plan

Figure 3-4: Jefferson County Hazard Analysis and Risk Assessment Meeting

3.3.4. Mitigation Strategy Workshop – July 26, 2023, 11:00AM – 3:00PM

The third Hazard Mitigation Committee Meeting was held in person on July 26. The focus of this meeting was to have HMPC members review and update plan goals, review and add mitigation actions, and develop project sheets. Save the dates and Invitations were sent to each municipality, county departments and stakeholders listed in Table 3-1. The agenda for the meeting is presented below in Table 3-4.

Table 3-4: Mitigation Strategy Workshop – Committee Meeting Agenda

Date	Attendance	Agenda
July 26, 2023, 11:00AM – 3:00PM	28	1. Welcome and Introductions 2. Project Update & Recap of June 27 Meeting 3. Mitigation Workshop Goals – Review & Update Mitigation Actions – Review, Update, & Add New Mitigation Projects – Develop for 2023 Plan 4. Next Steps and Action Items

After a recap of the past two meetings committee members were asked to sit in assigned groups that consisted of 5 key groups:

- Municipal
- Emergency Services & Public Health
- Education and Public Awareness
- Local Planning and Regulations
- Natural Resources and Protection

Committee members were then asked to review the 2018 hazard mitigation plan goals. The groups were instructed to keep remove or modify existing goals, and add new goals. Committee members were provided goals form the 2023 West Virginia Plan and the goals from the 2018 Jefferson County plan for reference. The resulting goals and objectives are available in Chapter 5: Mitigation Strategies. Specific modifications made to goals and objectives are available in the workshop's meeting notes, Appendix D – Meeting and Other Participation Documentation.

Prior to the mitigation strategy workshop HMPC members were tasked with providing information on the current status of mitigation actions (e.g., Completed, Canceled, Delayed, or Ongoing). Each mitigation project included the following information for committee members to review:

- Project Number
- Project Description
- Hazards Addressed
- Assigned Group

A total of seventy three (73) mitigation actions from the 2018 plan were evaluated during this workshop. Committee members had the opportunity to review each action and determine if it should be carried over into the 2023 plan. All mitigation actions included in this plan were either proposed by committee members or were identified from risk and vulnerability assessments conducted within the hazard profiles.

Each group was provided with reference material to aid in completing a mitigation action worksheet. When finished, each group reported their findings to the larger group, including their top action items and whether or not they added any new mitigation projects. Fourteen (14) new action items were developed during the workshop. Action items identified as being most important were further developed into mitigation projects based on the information gathered during the workshop. Results of the Mitigation Workshop are included in Chapter 5: Mitigation Strategy.

Following the workshop, an online prioritization survey was distributed to HMPC members to determine "high", "medium", and "low" priority projects. Results of this survey indicated six "high" priority mitigation projects. High priority projects include the following:

Project 4: Snow Removal MOU and Debris Management Plan
Project 5: Dark Grid Training & Exercises
Project 13: Citizen Preparedness Training and Outreach
Project 14: Hazard Materials Response Plan and Training

Prioritization results and completed project sheets are available in Chapter 5: Mitigation Strategy.

As part of the Mitigation Workshop held on July 26, municipal representatives worked together as a group to identify municipal specific action items. The municipal group evaluated 49 actions and independently identified up to 5 priority mitigation projects per municipality.

3.3.5. Draft Plan Review & Public Open House August 29, 2023, HMPC 1:00PM-2:00PM / Public 2:00PM-5:00PM

The purpose of this final HMPC meeting was to provide general findings in the Jefferson County draft plan. The agenda for the meeting is presented below in Table 3-5. The meeting was an open house format where committee members were provided a briefing on the results of the mitigation strategy workshop for both County-wide projects and municipal specific priority projects. Results of the public survey were presented and compared to how committee members rated hazards and capabilities. Results of the public survey are included in Appendix D. During the meeting, committee members were able to reviewed an electronic copy of the draft plan and a question-and-answer period was used to gain feedback on plan details, process and next steps.

The meeting space was then opened to the public for a 3-hour period, during which a running slide show summarizing the elements of the plan, committee meetings and results of the plan played, and large hazard maps were displayed for the public to view. The public open house was promoted in the bi-monthly newsletter, on the County website and at the County Fair. Three members of the public attended the open house.

Table 3-5: Open House – Committee Agenda Items

Date	Attendance	Agenda
August 29, 2023 1:00PM – 5:00PM	11 (3 Public)	1. Risk Assessment Survey vs Committee Results 2. Results from Last Meeting 3. Next Steps and Action Items 4. Welcome in Public

The HMPC determined that a 2-week review period should be allowed for members to provide comment and feedback on the final draft plan. A draft version of the plan was circulated to committee members during the first week of September and comments collected and discussed during a September 18 virtual HMPC meeting.

3.4. Public and Stakeholder Participation

Each municipality was given multiple opportunities to participate in the plan update process through invitation to above outlined meetings, review of risk assessment results and mitigation actions, and an opportunity to comment on a final draft of the 2023 Hazard Mitigation Plan Update. The tools listed below were distributed with meeting invitations, at meetings, and on the JCHSEM website to solicit information, data, and comments from both local municipalities and other key stakeholders in Jefferson County. Responses to these worksheets and surveys are included in Appendix D: Meeting Participation Documentation.

1. **Evaluation of Identified Hazards and Risk Worksheet:** Collects information on hazards identified in the 2018 Plan regarding whether there have been changes to the frequency of

occurrence, magnitude of impact, or geographic extent of hazards over the past 5 years. In addition, the form asks members of the HMPC to select any additional hazards they believe should be considered for inclusion in the 2023 Plan.

2. **Capability Assessment Survey:** Collects information on local planning, regulatory, administrative, technical, fiscal, political, and resiliency capabilities that can be included in the plan's Capability Assessment section.
3. **National Flood Insurance Policy (NFIP) Survey:** Collects information on the County and municipality's floodplain management program and ordinance enforcement of NFIP standards and requirements.
4. **Social Equity Survey:** Collects information on shifts in the needs of underserved communities or gaps in social equity and if there has been any effort to include social equity and/or vulnerability into any planning or services.
5. **Prioritizing Hazards Using Risk Assessment Worksheet:** Calculates the risk factor associated with each hazard using a rating system to evaluate risks based on 5 factors: Probability, Impact, Spatial Extent, Warning Time, and Duration. The results of this workshop was factored into prioritizing hazards.
6. **Mitigation Action Review Form:** This exercise was used to review mitigation actions that were identified in the 2018 Hazard Mitigaiton Plan to provide the current status of each action and document any progress made.
7. **New Mitigation Action Worksheet**: This form was provided to include new actions in the HMP. The purpose was to collect details about the action, including priority, responsible parties, potential partners, potential funding sources, implementation and timeframe.

Community participation and comment were encouraged throughout the planning process. Press releases were issued before monthly HMPC meetings. During the Jefferson County Kick-off meeting, there was an active discussion amongst participants regarding planning ideas and stakeholder engagement. Participants discussed how current programs could be improved, as well as the shortcomings of communication during the COVID-19 pandemic. At the Draft Plan Review & Public Open House, participants discussed remaining ideas for new mitigation actions, particularly regarding transportation accidents and hazardous materials and the implementation of a more advanced reverse 911 system.

Public input was also solicited through an online hazard mitigation survey composed by Jefferson County and disseminated on Jefferson County agency and municipal websites. The survey collected demographic data of respondents, had respondents assess hazard risks, asked for mitigation action ideas, and gauged respondents' participation in public hazard mitigation efforts. About 56 residents participated, a large increase from the 2018 survey. Participants were most concerned about utility interruption, hazardous materials, and severe thunderstorms. Hazards that were rated as lowest concern included landslide, dam failure, and earthquake. Most participants felt that their county and municipality ability to handle a hazard event was average. Overall, residents agreed that cell phone alerts are the most effective way for the community to alert and advise them during a hazard event. Participants were most concerned with not having access to clean water, not having electrical power for extended time, not having police or fire

protection, not having access to medical services and required medicine, and not being able to get warning messages or other information regarding the hazard.

A posting made to JCOHSEM website notifying residents of the survey can be seen in Figure 3-5. Full Survey results can be found in Appendix D.

Figure 3-5: Hazard Mitigation Survey Link posted to Jefferson County OEM Facebook

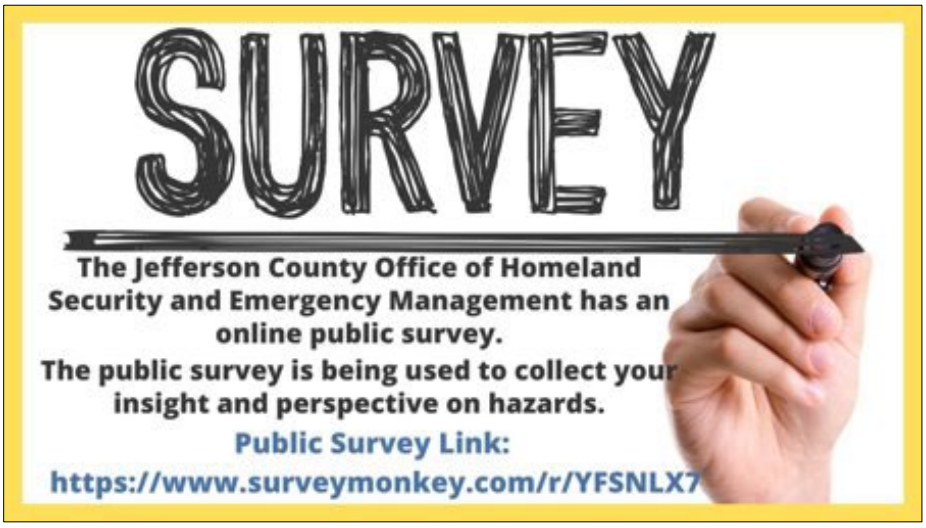


Figure 3-6: Eastern Panhandle Talk on WRNR Talk radio FM 106.5/AM 740

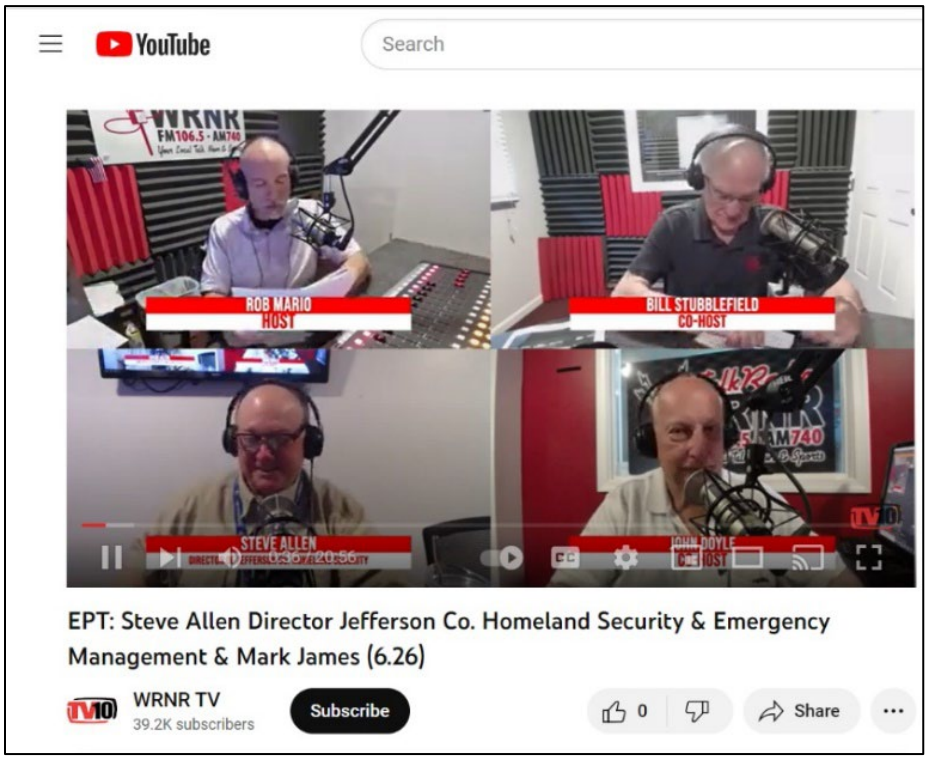
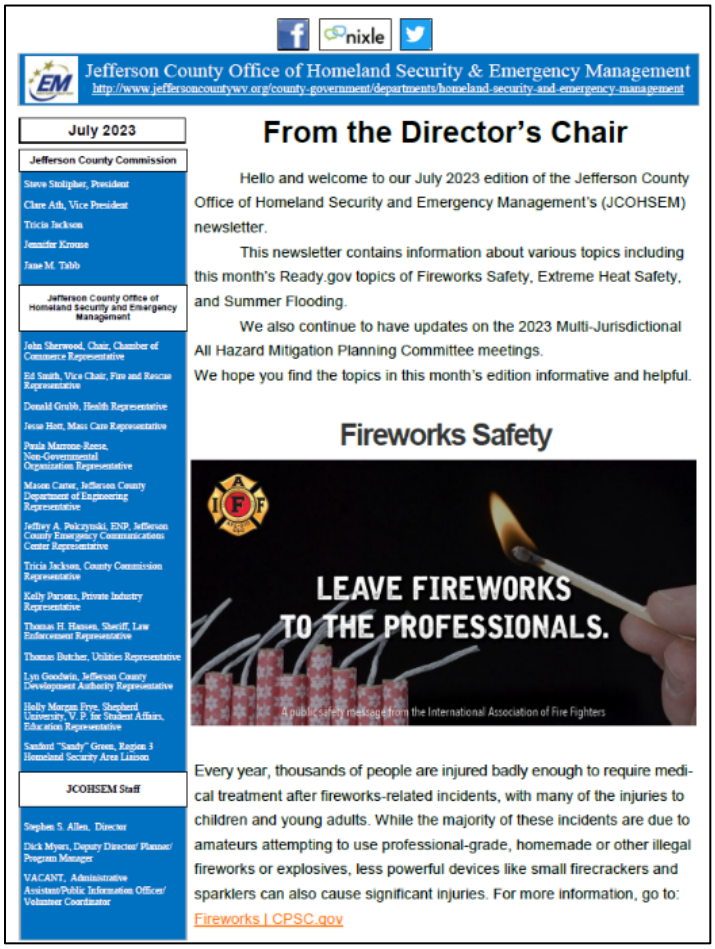


Figure 3-7: Facebook posting of June 29, 2021 HMP radio show and photo from live broadcasting.

JCHSEM and their consultant participated in two radio shows discussing the Plan update. The radio shows provided an opportunity to answer the public's questions and involve them in the planning process. The radio shows covered topics such as what is a Hazard Mitigation Plan, what the benefits of having an HMP in place are, and how the HMP update process works. A June 21, 2023 radio appearance on the show Panhandle Live on 93.7 & 1340 WEPM and 93.5 & 1010 WCST can be replayed at Panhandle News Network - WEPM/WCST. A June 26, 2023 radio appearance on the show Eastern Panhandle Talk on WRNR Talk radio FM 106.5/AM 740 can be replayed Radio Shows - Talk Radio WRNR. A posting in the Panhandle Live Facebook page about the show can be seen in Figure 3-7. Broadcast talking notes for both radio shows are presented in Appendix D.

A press release was issued by Jefferson County on May 19, 2023 and a newspaper notice was published in the Journal inviting the citizens of Jefferson County to participate in the 2023 Hazard Mitigation Plan update and plan to attend a series of meetings that will be scheduled throughout the summer of 2023. A copy of the May 19, 2023, Journal newspaper notice is presented in Figure 3-8 and the press release is included in Appendix D. A second press release was issued on August 21, 2023 that provided details on the importance of participating in the public survey.

Figure 3-8: Journal Newspaper News Release (JCHSEM July Newsletter Cover)



Jefferson County Office of Homeland Security & Emergency Management
http://www.jeffersoncountywv.org/county-government/departments/homeland-security-and-emergency-management

July 2023

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JCOHSEM Staff
Stephen S. Allen, Director
Dick Myers, Deputy Director/ Planner/ Program Manager
VACANT, Administrative Assistant/Public Information Officer/ Volunteer Coordinator

From the Director's Chair

Hello and welcome to our July 2023 edition of the Jefferson County Office of Homeland Security and Emergency Management's (JCOHSEM) newsletter.

This newsletter contains information about various topics including this month's Ready.gov topics of Fireworks Safety, Extreme Heat Safety, and Summer Flooding.

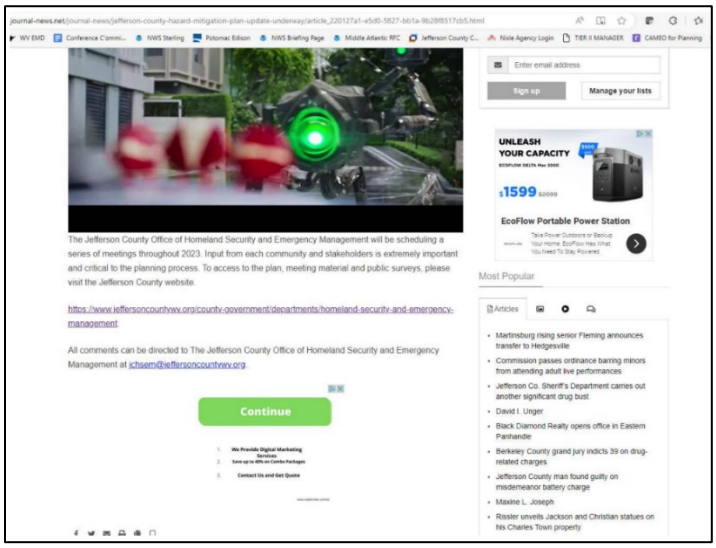
We also continue to have updates on the 2023 Multi-Jurisdictional All Hazard Mitigation Planning Committee meetings.

We hope you find the topics in this month's edition informative and helpful.

Fireworks Safety

Every year, thousands of people are injured badly enough to require medical treatment after fireworks-related incidents, with many of the injuries to children and young adults. While the majority of these incidents are due to amateurs attempting to use professional-grade, homemade or other illegal fireworks or explosives, less powerful devices like small firecrackers and sparklers can also cause significant injuries. For more information, go to: Fireworks | CPSC.gov

Figure 3-9: The Journal Posting of the Jefferson County 2023 & Jefferson County Homeland Security Emergency Management Monthly Newsletter – Hazard Mitigation Plan Update



The Jefferson County Office of Homeland Security and Emergency Management will be scheduling a series of meetings throughout 2023. Input from each community and stakeholders is extremely important and critical to the planning process. To access to the plan, meeting material and public surveys, please visit the Jefferson County website.

https://www.jeffersoncountywv.org/county-government/departments/homeland-security-and-emergency-management

All comments can be directed to The Jefferson County Office of Homeland Security and Emergency Management at jchsem@jeffersoncountywv.org.

Continue

JCOHSEM issues a monthly newsletter that is distributed to 325 readers. The July edition of the newsletter featured a 2 page article on the 2023 Hazard Mitigation Plan Update with a link and QR code to the public survey. A copy of the July newsletter cover is presented in Figure 3-8 and a full copy of the newsletter is included in Appendix D. JCOHSEM also had a stand at the Jefferson County Fair from August 20 through 26 which they were able to connect with over 150 people on topics of hazard mitigation.

Figure 3.10: Jefferson County Fair Add and JCOHSEM stand

All HMPC members and stakeholders could review plan updates and download plan material on the County's Office of Homeland Security and Emergency Management website:

https://www.jeffersoncountywv.org/county-government/departments/homeland-security-and-emergency-management.

This website included general resources pertaining to hazard mitigation planning, posts of upcoming events, and project announcements. In addition, meeting and workshop materials were posted including: the agenda, PowerPoint presentation, draft plan sections and worksheets.

The 2023 Draft Hazard Mitigation Plan was posted on County's website beginning September 4, 2023 and a public comment period was held for 14 days. The availability of the draft Hazard Mitigation Plan was made public by disseminating the information to the HMPC via email. Committee members were instructed to submit comments in writing via email to JCHSEM staff.

3.5. Multi Jurisdictional Planning

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

Table 3-6 documents local jurisdictional presence at the meetings and other involvement from each jurisdiction throughout the planning process. Each jurisdiction was emailed invitations to all meetings and, received reminders prior to each meeting. Surveys and forms were provided at meetings emailed to

jurisdictions along with letters requesting that local information be provided. All five municipalities in Jefferson County participated in the plan, thus achieving 100 percent participation.

Table 3-6: County and Municipal Participation in 2023 Hazard Mitigation Planning Process

	Participation Summary	Jefferson County	Bolivar	Charles Town	Harpers Ferry	Ranson	Shepherdstown
Meetings	**Hazard Mitigation Committee Kick-Off** May 24, 2023	✓					✓
	Hazard Analysis & Risk Assessment June 27, 2023	✓	✓		✓	✓	✓
	Mitigation Strategy July 26	✓	✓	✓	✓	✓	✓
	Draft Plan Review / Public Meeting August 29, 2023	✓			✓		✓
Worksheet	**Identified Hazards and Risk**	✓	✓	✓	✓	✓	✓
	Community Capability Assessment	✓	✓	✓	✓	✓	✓
	Mitigation Action Review	✓	✓	✓	✓	✓	✓
	New Mitigation Action and Priorities	✓	✓	✓	✓	✓	✓

4. Risk Assessment

4.1. Update Process Summary

To reduce the potential for damage due to hazards, it is necessary to identify hazards that may affect Jefferson County. Hazards that may affect the county are identified and defined in terms of location and geographic extent, magnitude of impact, previous events, and likelihood of future occurrence. All information from the previous plan has been included or updated in the 2023 Jefferson County Hazard Mitigation Plan Update, unless otherwise indicated. The HMPC reviewed the hazards profiled in the 2018 Jefferson County Hazard Mitigation Plan Update during the May 24 Kick-Off Meeting. The HMPC determined that all the existing hazards should be carried over into the 2023 plan update and decided that Cyber Terrorism, Utility Interruption and Karst / Sinkholes should be profiled as additional hazards in the 2023 plan update. The hazards selected by the HMPC were then reviewed at the June 27 Hazard Analysis & Risk Assessment Meeting. The municipalities completed an Evaluation of Hazards and Risk Form to indicate their jurisdictional risk to each hazard that would be profiled in the 2023 plan.

Hazard profiles were then developed to define the characteristics of each hazard as it applies to the county. This process was completed using published information and websites that address hazards globally, nationally, within West Virginia, or specifically within the county, as well as anecdotal information provided by members of the HMPC.

Following hazard identification and profiling, a vulnerability assessment was performed to identify the impact of natural hazard events on people, buildings, infrastructure, and the community. Each natural hazard is discussed in terms of its potential impact on individual communities in Jefferson County, including the types of parcels and critical facilities that may be at risk. This assessment allows the county and its municipalities to focus mitigation efforts on areas most likely to be damaged or most likely to require early response to a hazard event. A vulnerability analysis was performed which identifies structures, critical facilities, or people that may be impacted by hazard events and describes what those events can do to physical, social, and economic assets. Depending upon data availability, assessment results consist of an inventory of vulnerable structures or populations.

4.2. Disaster Declarations

Under the Stafford Act, there are two forms of presidential action that authorize federal disaster assistance dollars. Emergency declarations trigger aid that protects property, public health, and safety and lessens or averts the threat of an incident becoming a catastrophic event. Given their purpose, the emergency declarations may precede an event. A major disaster declaration is generally issued after catastrophes occur and constitutes broader authority for federal agencies to provide supplemental assistance to help state and local governments, families and individuals, and certain nonprofit organizations recover from the incident. 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 2021, these thresholds are $3.89 per capita for counties and $1.55 per capita for the state. State and county thresholds must be simultaneously attained for a Presidential Disaster Declaration to be issued. The table below identifies Presidential Disaster and Emergency Declarations that have affected Jefferson County from most to least recent. Additional declarations beyond 2003 can be found on the FEMA website at:

https://www.fema.gov/disasters/disaster-declarations.

Table 4-1: Presidential Disaster & Emergency Declarations affecting Jefferson County 1954-2021

Declaration #	Date	Event
3450*/4517*	March 13, 2020	West Virginia COVID-19
4378	May 28, 2018	Severe Storms, Flooding, Landslides, And Mudslides
3358*	October 29, 2012	Hurricane Sandy
4071	July 23, 2012	Severe Storms and Straight-Line Winds
3345*	June 30, 2012	Severe Storms
1903	April 23, 2010	Severe Winter Storms and Snowstorms
1881	December 18,2009	Severe Winter Storm
1769	June 3, 2008	Severe Storm, Tornadoes, Flooding, Mudslides, and Landslides
3221*	September 5, 2005	Hurricane Katrina Evacuation
1496	September 23, 2003	Hurricane Isabel
* Presidential Emergency Declaration		

(FEMA, 2021)

Since 1954, declarations have been issued for various hazard events including hurricanes or tropical storms, severe summer and winter storms, flooding, landslides, and blizzards. A unique Presidential Emergency Declaration was issued in September 2005. Through Emergency Declaration 3221, President George W. Bush declared that a state of emergency existed in the State of West Virginia and ordered federal aid to supplement state and local response efforts to help people evacuated from their homes due to Hurricane Katrina. All counties within the state, were indirectly affected by Hurricane Katrina as a result of evacuee assistance.

In coincidence with Presidential Emergency Declaration 3450, West Virginia Governor declared that a state of emergency existed in the State of West Virginia, in conjunction with the closure of public and governmental spaces, schools, nursing homes, recreation facilities, and retail and food service locations. All counties within the state, were subsequently affected by the COVID-19 pandemic because of these orders.

4.3. Summary of Hazards

The HMPC was provided a standard list of Hazards to consider for evaluation in the 2023 plan update. Following a review of the hazards evaluated in the 2018 HMP, the HMPC decided that the 2023 plan should identify, profile, and analyze 19 hazards. All hazards identified in 2018 plan were included in the 2023 HMP update. The hazards were reviewed by the HMPC at the May 24, Kick-Off Meeting. Each municipal attendee was provided with an Evaluation of Hazards and Risk Form. Following review of this hazards list and completion of the Evaluation of Hazards and Risk Form, the HMPC determined that Cyber Terrorism, Utility Interruption, and Karst/Sinkholes would be added as new hazards in the 2023 plan update.

4.4. Hazard Descriptions

4.4.1. 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 Jefferson County due to the presence of farms as well as water-dependent industries and recreation areas across the Eastern Panhandle. 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.

4.4.1.1. Location and Extent

Droughts are regional climatic events, so when these events occur in the Eastern Panhandle, impacts are often felt across the state or the region. The spatial extent for areas of impact can range from county level to the entire mid-Atlantic Region. Areas with extensive agricultural land use can experience particularly significant impacts.

Locations of droughts nationwide are monitored continuously by USGS, and the National Drought Mitigation Center at the University of Nebraska-Lincoln in concurrence with the NOAA monitors conditions throughout the state. Maps showing locations currently experiencing drought conditions are posted on various websites (including http://waterwatch.usgs.gov) and show locations where stream flow is below normal and where drought conditions exist or are emerging.

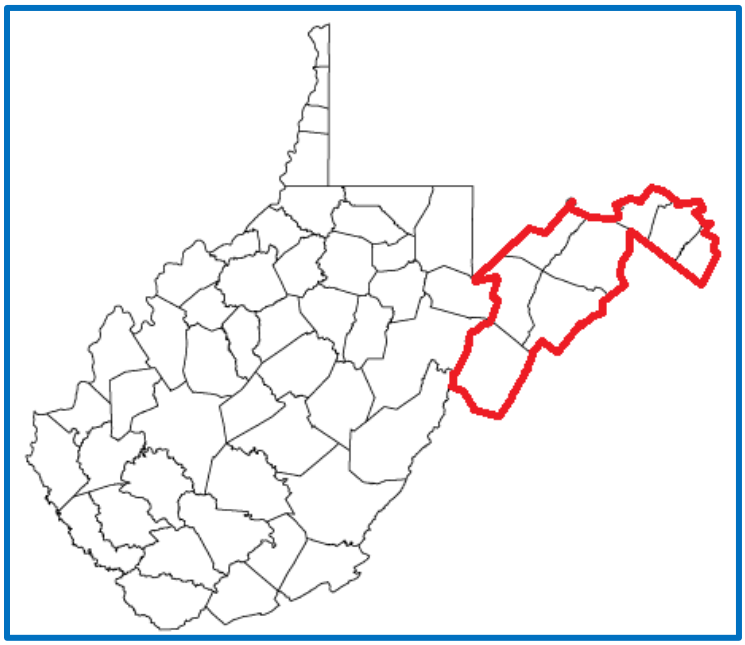
The State of West Virginia Emergency Operations plan defines four types of droughts: meteorological, agricultural, hydrological, and socio-economic drought (State of West Virginia, 2016).

- Meteorological drought is often defined by a period of substantially diminished precipitation for a duration and/or intensity that persists long enough to produce a significant hydrologic imbalance.
- Agricultural droughts occur when there is inadequate precipitation and/or soil moisture to sustain crop or forage production systems. The water deficit results in serious damage and economic loss to plant or animal agriculture, usually proceeded by a meteorological drought.
- Hydrologic drought is defined in terms of reduction of stream flows, reduction in lake or reservoir storage and lowering of groundwater levels. This results from a shift in normal weather patterns over an area causing the amount of precipitation to fall significantly below the long-term average.
- Socio-economic droughts occur when physical water shortages start to affect the health, well- being and quality of human life, or when the drought starts to affect the supply and demand of an economic product.

4.4.1.2. Past Occurrence

Minor droughts occur frequently in Jefferson County, but extended periods of severe drought that creates major disruption and economic loss are rare. The decades with the most severe droughts are 1916-1925, 1926-1935, 1966-1975, and 1996-2005. This is based on data from the National Oceanic and Atmospheric Administration (NOAA) WV Climate Division 6, which encompasses Jefferson County, as well as six other counties in Northeastern WV, as seen in Figure 4-1 (ESRL NOAA, 2021)

Figure 4-1: Northeastern WV as Defined by NOAA WV Climate Division 6 (ESRL NOAA, 2021)



The most recent severe drought in Jefferson County occurred in 1999. Every month in 1999 had a mean PDSI value of -3.00 or less. (ESRL NOAA, 2016). The drought of 1999 started in the late summer of 1998.

Below average rainfall continued for the fall and into the start of winter. In fact, in November of 1998 rainfall for most weather stations in the area was less than 1". There was little relief with some snow in January and February, but the drought expanded into the spring of 1999. An extreme drought continued into the summer of 1999 and with little moisture in the air, this means hotter temperatures. Crops were hit hard, livestock was affected, the water supply and the rivers ran nearly dry.

Average rainfall for a summer is about 12". Rainfall for the entire summer of 1999, that's June, June, and August was about what you would typically see in a month outside of a drought year. Rainfall was about 8 to 10" below average for that summer.

In the summer of 1999, the Clinton Administration declared all of West Virginia and 33 counties of Virginia an agricultural drought disaster area. Losses to farmers just in West Virginia totaled $80 million.

With the persistent and severity of the drought, rivers ran low as well as the tributaries. According to the National Weather Service report, "The Shenandoah River dropped to less than 22% of its normal flow and the water level near Strasburg was at the lowest recorded in July since records began 72 years ago."

The lack of precipitation was simply devastating for local and state agriculture. Crops just didn't have a chance to grow, or they died in the fields with the lack of rain. Even trees were shedding leaves early. This excerpt is from the National Weather Service report, " Corn that should have been 6 feet high was only waist-high at best and did not germinate." Some farmers had to reduce their herd sizes in order to stretch hay and water supplies.

Because of the drought the spring wildfire season basically extended into the summer. The Virginia Department of Forestry reported a record fire season January through July of 1999 with 1,320 fires burning 6,146 acres across the state.

This historic drought ended in the fall of 1999 for the Shenandoah Valley, but drought conditions persisted for West Virginia through the winter, and ending the following spring.

Between June 1998 and June 1999, the area received about 12 inches less rainfall than average. The local agricultural economy was impacted significantly, and Jefferson Utilities enacted emergency water restrictions. President Bill Clinton declared a disaster declaration for the entire state of West Virginia (Tuckwiller, 1999).

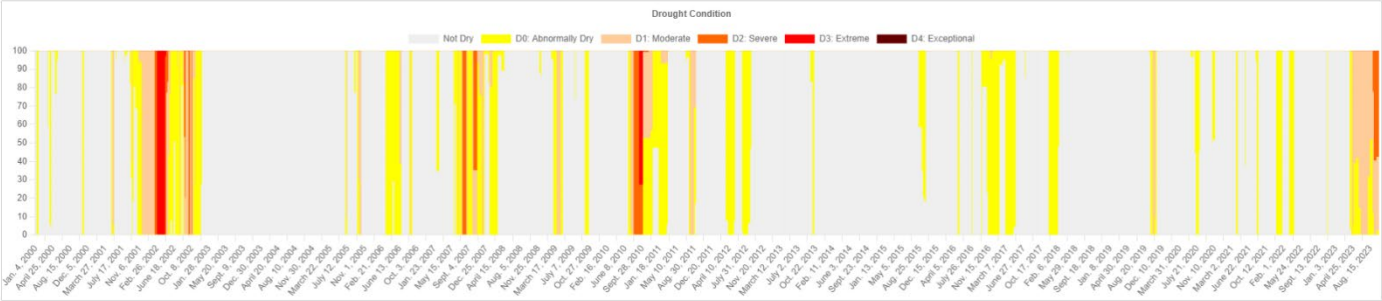
The U.S. Drought Monitor (USDM) identifies areas in drought and labels them by intensity. The map uses four categories of drought, from D1—the least intense—to D4, the most. It also highlights areas with no drought and uses the D0 category to indicate abnormally dry areas that could be entering or recovering from drought.

U.S. Drought Monitor reports three periods of extreme drought (D3) between 2000 and 2023, occurring in 2002, 2007 and 2010. The NCEI reports four droughts between 1997 and 2007, occurring in 1997, 1998, 1999, and 2007. This roughly gives a total of six significant droughts between 1997 and 2023. NCEI does not have records for the drought of 2002 in Jefferson County, the year the majority of the country

experienced droughts. In March of 2002, there was an extreme drought (D3) throughout the East Coast region. Other parts of the country experienced droughts at different times throughout the year.

Drought conditions are not spread out evenly throughout the year, or even over a period of years. As the graph above indicates, there can be several years with no drought conditions, and then more than one year with consistent drought conditions.

Figure 4-2: Jefferson County Drought Monitor Categories



On October 3, 2019, West Virginia Governor Jim Justice declared a State of Emergency for all 55 West Virginia counties due to a prolonged shortage of rainfall that caused moderate drought conditions across much of the state and severe drought conditions in southern West Virginia (State of West Virginia Executive Department, 2019). The emergency declaration proclaimed the drought reflected both meteorological and agricultural drought characteristics, and included some restrictions on water usage, as well as some voluntary measures.

As displayed in Figure 4-2, From the beginning of 2023 to the end of March, Jefferson County did not experience drought conditions. However, between the approximate 2-month period from the beginning of May to the beginning of October in 2023, nearly the entirety (96%-100%) of Jefferson County was exposed to D0: Abnormally Dry to D2: Severe Drought conditions, according to the U.S. Drought Monitor. In comparison, since the start of 2023, the Continental United States faced mixed conditions across the landscape. In January of 2023, 60-70% of the country experienced a range of D0: Abnormally Dry to D4: Exceptional Drought conditions. Between April and May 2023, the estimated percentage of “Not Dry” areas varied between 40 to 59.

The United States Department of Agriculture (USDA) Risk Management Agency (RMA) operates and manages the Federal Crop Insurance Corporation program. Since Jefferson County farms are eligible for crop insurance, it is possible to determine agricultural losses in Jefferson County. Table 4-2 displays the crop loss insurance payments by year in Jefferson County since 2010. The most losses occurred in 2010, with corn suffering the most substantial losses as defined by indemnity amount. In 2010, Jefferson County received $1,556,397 million in indemnity.

Table 4-2: Crop Loss Insurance Compensation Due to Drought (USDA RMA, 2023)	
Crop Year	**Indemnity Amount**
2010	$1,556,397
2011	$602,457
2012	$72,921
2013	$4,136
2014	$27,535
2015	$68,049
2016	$60,191
2017	$43,296
2018	$0
2019	$4,791
2020	$144,266
2021	$51,012
2022	$40,050
2023 (Year to Date)	$4,582

Crop Indemnity Maps | RMA (usda.gov)

4.4.1.3. Future Occurrence

It is difficult to forecast the severity or frequency of future drought events with any certainty. However, based on historical drought data between 1896 and 2021, northeastern WV had 93 months of moderate and severe drought (defined as a month with a mean PDSI of -3.00 or less), or spent 6.18 percent of that time in a moderate or severe drought (NOAA, 2021a). While some form of drought condition frequently exists in the region, the impact depends on the duration of the event, severity of conditions, and area affected.

Table 4-3: Severe Drought Events in Jefferson County 1997-2023 (NCEI, 2023)			
Date	**Crop Damage ($)**	**Type**	**Description and Source**
1997	$2,150,000	Severe	NCEI: A very dry month, containing one 7-day heat wave, exacerbated drought-like conditions across much of the fertile farmland of eastern West Virginia. The weather in July proved to be the death knell for much of the crop yields, including corn, hay, and pasture. The West Virginia Farm Service Agency reported the following damage statistics: Corn, hay, and pasture yields were 40 to 50 percent of normal. Estimated damage to the corn crop included 2500 to 3000 acres per county in the Potomac Highlands but as much as 10,000 acres in the eastern panhandle. Hay damage was estimated to be 40,000 acres per county; pasture lands an additional 80,000 acres per county. No significant damage to alfalfa was noted. Though some summer fruit was damaged by the drought, most of what survived was excellent.

Table 4-3: Severe Drought Events in Jefferson County 1997-2023 (NCEI, 2023)			
Date	**Crop Damage ($)**	**Type**	**Description and Source**
8/1/1998	0		NCEI: Drought conditions persisted for six months in a row across the Eastern Panhandle of West Virginia. Persistent high pressure over the Southeast U.S. forced most precipitation producing low-pressure systems to steer north of the region. In addition, record high temperatures baked the region during the first week of the month. Monthly precipitation totals from Jefferson County was 1.3 inches. Average precipitation for the month of December is around 3 inches. Most locations received less than half of their normal precipitation from July through December. A ban on open burning continued through mid-December in Jefferson County due to extreme fire danger.
10/1/1998	0		
11/1/1998	0		
12/1/1998	0		
5/1/1999	0		NCEI: Rainfall from two tropical storms and a handful of low-pressure systems made an impact in the drought that plagued the region since the summer of 1998. By the end of the month, conditions across the Eastern Panhandle were upgraded from an extreme to a moderate drought because rainfall was above average during September. Rainfall totals included 7.9 inches in Jefferson County. Effects of the drought still lingered in the agricultural community. Across the state by the end of the month, 81% of topsoil was reported short or very short of moisture. 32% of apples, 67% of corn, 69% of hay, 77% of pasture land, 30% of soybeans, and 33% of tobacco crops were in poor or very poor condition. By month's end, 28% of farmers were still hauling water for livestock, and 25% of wells were dry or had an extremely low water reserve.
6/1/1999	0		
7/1/1999	0		
8/1/1999	0		
9/1/1999	0		
2002	-	D3 Extreme Drought	U.S. Drought Monitor: Dryness and drought remained unchanged in the Northeast, and expanded or intensified in parts of the mid-Atlantic, Southeast, and the central and southern Appalachians. D3 conditions were extended to cover central North Carolina, the Virginia Blue Ridge and Northern Neck, eastern West Virginia, and the entire Delmarva Peninsula
7/24/2007	0	D2 Severe Drought	Severe drought conditions persisted through much of October in Jefferson County. Rainfall deficits reached a high of 10 inches below normal for the year, but a series of low-pressure systems moving across the Mid Atlantic helped to decrease those deficits by a few inches.
8/1/2007	0		
10/1/2007	0		
2010	-	D3 Extreme Drought	U.S. Drought Monitor: Across the panhandle of West Virginia, northwest Maryland and extreme southwest Pennsylvania, extreme drought (D3) conditions were

Table 4-3: Severe Drought Events in Jefferson County 1997-2023 (NCEI, 2023)			
Date	**Crop Damage ($)**	**Type**	**Description and Source**
			added. Precipitation for the most recent 30 and 90 days measure in at about 40% of normal, while the SPI, NLDAS soil moisture, and stream flows are all below the 5% threshold for indicating extreme drought. Across northern Virginia, abnormal dryness was expanded from the west toward the District of Columbia to reflect the field reports of deciduous trees dropping leaves and fruit earlier than normal due to lack of recent rainfall.

4.4.1.4. Range of Magnitude

Droughts can have varying effects, depending on the month in which they occur, as well as the severity, duration, and location of the event. Even short-term droughts can be devastating, especially in conjunction with extreme temperatures.

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 WVEMD Emergency Operations Plan (EOP) uses a combination of five indices to determine the magnitude of a drought (State of West Virginia, 2016). Descriptions of the indices from the EOP are as follows:

a. Palmer Drought Severity Index

The PDSI attempts to measure the duration and intensity of the long- term drought-inducing circulation patterns. Long-term drought is cumulative, so the intensity of drought during the current month is dependent on the current weather patterns plus the cumulative patterns of previous months.

b. Palmer Z Index

The Palmer Z index is a variation of the PDSI that measures short-term drought on a monthly scale.

c. Crop Moisture Index (CMI)

This index uses a meteorological approach to monitor week-to-week crop conditions by evaluating short-term moisture conditions across major crop-producing regions. It is based on the mean temperature and total precipitation for each week within a climate division, as well as the CMI value from the previous week. The CMI responds rapidly to changing conditions, and it is weighted by location and time so that maps can be used to compare moisture conditions at different locations.

d. Standardized Precipitation Index (SPI)

This is a probability index that considers the probability of recording a given amount of precipitation. The probabilities are standardized so that an index of zero indicates the median precipitation amount where half of the historical precipitation amounts are below the median, and half are above the median. The index is negative for drought, and positive for wet conditions. The SPI is computed by the National Centers for Environmental Information (NCEI) for several time scales, ranging from one (1) month to 24 months, to capture both short-term and long-term drought.

e. National Fire Danger Rating System

A broad scale system that incorporates science, technology, and local experience to analyze the various factors of fuels, weather, topography, and risk, in combination, to assess the daily fire potential of an area including the potential for a fire to ignite, spread and require suppression action. Fire danger is usually expressed in numeric or adjective terms.

Precipitation, ground water, stream flow, reservoir levels, PDSI, CMI, SPI, Fire Weather Forecast, and the Fire Danger drought criteria are assessed by the WVEMD each month, the WVEMD then assigns one of four stages of concern as shown in Table 4-4.

Table 4-4: WVEMD EOP Levels of Concern for Drought

Level of Concern	Indices		
	PDSI	CMI	SPI
Normal (Stage I)	Normal levels	Normal levels	Normal levels
Alert (Stage II)	-2.00 to -2.99 Moderate Drought	-1.0 to -1.9 Abnormally Dry	-1.00 to -1.49 Moderately Dry
Conservation (Stage III)	-3.00 to -3.99 Severe Drought	-2.0 to -2.9 Excessively Dry	-1.50 to -1.99 Severely Dry
Emergency (Stage IV)	-4.00 and below Extreme Drought	3.0 or less Severely Dry	-2.00 and less Extremely Dry

I. Alerts are rescinded and drought status returns to normal when the PDSI is above -1, indicating normal or near normal levels.

II. Stage II is reached when the PDSI reads -2.00 to -2.99 and stream, reservoir, and ground water levels are below normal over a several month period and/or the WVEMD Director determines Stage II activities are required. The governor is requested to make a Drought Alert Declaration.

III. Stage III is reached when the PDSI reads -3.00 to -3.99, stream, reservoir, and ground water

levels continue to decline, forecasts predict an extended period of below normal precipitation, and/or the WVEMD Director determines Stage III activities are required. A return to Stage II is allowed when precipitation increase, streams, reservoirs, and ground water levels stop declining, the PDSI reaches to -2.99 or higher, and/or the WVEMD Director determines Stage II activities are sufficient and Stage III is no longer required. and to

IV. Stage IV is reached when the PDSI reads -4.00 and/or the WVEMD Director determines Stage IV activities are required. The governor is requested to make a Drought Emergency Declaration when water supplies will be inadequate to meet projected demand and more extreme measures must be undertaken. This declaration allows state agencies to implement emergency programs and actions according to West Virginia Code and to review the allocation of water supplies in communities that are not adequately responding to their water shortage.

Environmental impacts of drought include:

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

4.4.1.5. Vulnerability Assessment

The entire County is exposed and vulnerable to drought. While drought events typically do not impact buildings, infrastructure that provides water may be impacted. This can include loss or severe reduction of water supply, loss of water pressure, or poor water quality. Even though droughts do not directly affect state buildings, there are secondary impacts related to drought that state buildings would be more susceptible to wildfires and tree mortality. Droughts can put more stress on trees, making them more susceptible to pest infestations and other diseases and dying trees. This leads to increased risk of tree limbs falling and damaging buildings and infrastructure and creating more fuel for wildfires.

In relation to wildfire, drought conditions can create more prolonged fires fueled by excessively dry vegetation, along with reduced water supply for firefighting (NOAA - NIDIS n.d.). Risk to life and property is greatest in areas where forested areas adjoin urbanized areas known as the wildland urban interface

(WUI). Therefore, all state buildings and critical facilities in and adjacent to the WUI zone and located in high wildfire risk areas are considered vulnerable to wildfire. Section 3.3.11 (Wildfire) describes the County's vulnerability to the wildfire hazard.

Some of the most significant losses resulting from drought events are typically found in the agricultural sector. Jefferson County is home to agricultural activity, and the local economy could be severely impaired by prolonged drought. The 1999 drought was estimated to have caused more than $200 million in damage to agriculture across the state, and yields were down as low as 50 or 60 percent (WV DEP, 2006; Borger, 1999). State agencies and the WVU Extension Service are valuable resources in reducing drought vulnerability through education and other services to area farmers.

4.4.1.6. People

The entire population of Jefferson County is either directly or indirectly impacted and vulnerable to drought events. For those that rely on surface water (e.g., reservoirs and lakes) for potable water, a decline in surface water flows can be detrimental to the water supply.

Between 1997 and March 2023, droughts in Jefferson County did not directly or indirectly harm anyone physically. Still, severe droughts can have dire consequences on the wellbeing of Jefferson County's residents. For example, Jefferson County's water for utilities is sourced from primarily sourced from groundwater supplies. According to the U.S. Drought Monitor, groundwater levels begin to deplete during D2 level droughts. Therefore, a prolonged drought could interfere with the utility company's ability to provide water to its residents.

4.4.1.7. Structures

While drought events typically do not impact buildings, infrastructure that provides water may be impacted. This can include loss or severe reduction of water supply, loss of water pressure, or poor water quality. Even though droughts do not directly affect state buildings, there are secondary impacts related to drought that state buildings would be more susceptible to wildfires and tree mortality. Both wildfires and tree mortality can damage or destroy state assets, and droughts can increase that risk.

Soil volume and firmness are highly susceptible to the amount of water soil holds. During periods of little to no rain, the soil will likely lose moisture and diminish in size. When soil volume varies greatly, infrastructure and buildings are prone to instability, which could damage structures, particularly if the foundation is not in good condition.

4.4.1.8. Systems

In the 2018 WV Statewide Mitigation Plan, Jefferson County is identified as the locality with the "highest amount of agricultural land per square mile (0.44)" in the state. Additionally, according to the USDA, Jefferson County accounts for 4% of West Virginia's state agriculture sales and is subsequently prone to experience interruptions the economy as the harvesting and production of crops declines as a result of droughts. In 2017, Jefferson County's Market Value of Crops Sold soared over $28.5 million. In addition to

crops, farms in the county also participate in producing livestock and poultry products, which was reported to have a total Market Value of Livestock Sold of $10.884 million.

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 Jefferson County are vulnerable to the effects of a drought. From 2012 to 2017, the number of farms increased by 21% in Jefferson County. In contrast, the average size of a farm decreased by 19%, while the total acreage of farmland decreased by 1%. Also in the same timeframe, total market value of sold products and total farm-related income decreased by 19% and 30% respectively. Similarly, the average farm market value of sold products decreased by 33% and average farm-related income by 36%.

Drought can cause municipalities to enforce water rationing and distribution. It also increases the region's vulnerability to other hazards such as severe weather, extreme heat, and public health emergencies. The special needs population of any county must also be considered during drought conditions.

As with many hazards, determining specific risk and vulnerability areas for drought is difficult. Drought is an "overall" hydrologic condition; that is, if one small area was without precipitation but a nearby area was not, it would be difficult to classify the entire area as "in a drought" due to the eventual seepage of said precipitation to the overall groundwater supply. Consequently, drought is said to affect the entire region evenly.

Table 4-5: Jefferson County Agriculture Market Values (USDA, 2017)

	Market Value of Crops Sold	Market Value of Livestock Sold	Total
Jefferson County	$28,654,000	$10,844,000	$39,498,000

While the economic effects of a drought damaging crops are noticeable immediately, droughts also pose long-term threats to a farm's agricultural capacity. As described by the NCEI drought database narrative, recurring drought events throughout 1998 and 1999 stripped moisture from 81% of West Virginia's topsoil. In the long-run, severe drought conditions could contribute to the already rapidly declining number of farms, as limited harvesting capacity reduces profits.

4.4.1.9. Natural, Historic and Cultural Resources

Environmental losses from drought are associated with damage to plants, animals, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term, and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent.

As most living beings are highly dependent on water, prolonged periods without it can have extremely detrimental effects on the health and condition of natural resources. Below, a table from the U.S. Drought

Monitor describes the accumulating effects low to severe drought categories. From the lower end, a D0 drought can stunt crop growth and cause wilting, while also depleting surface water levels. On the higher end, a D3 drought can cause extensive crop loss and prompt extended well digging.

Figure 4-3: Drought Severity (Cape Cod Times, 2023)

Category	Examples of historically observed impacts
D0	Crop growth is stunted; planting is delayed
	Fire danger is elevated; spring fire season starts early
	Lawns brown early; gardens begin to wilt
	Surface water levels decline
D1	Honey production declines
	Irrigation use increases; hay and grain yields are lower than normal
	Trees and landscaping are stressed; fish are stressed
	Voluntary water conservation is requested; reservoir and lake levels are below normal capacity
	Wildfires and ground fires increase
D2	Fish kills occur; wildlife move to farms for food
	Golf courses conserve water
	Producers begin feeding cattle; hay prices are high
	Specialty crops are impacted in both yield and fruit size
	Trees are brittle and susceptible to insects
	Warnings are issued on outdoor burns; air quality is poor
	Water quality is poor; groundwater is declining; irrigation ponds are dry; outdoor water restrictions are implemented
D3	Crop loss is widespread; Christmas tree farms are stressed; dairy farmers are struggling financially
	Extremely reduced flow to ceased flow of water is observed; river temperatures are warm; wells are running dry; people are digging more and deeper wells
	Water recreation and hunting are modified; wildlife disease outbreak is observed
	Well drillers and bulk water haulers see increased business

4.4.1.10. Community Activities

During D2 droughts and above, it is probable that the air and water quality of the region will considerably worsen. As a result, outdoor activities are at risk of cancellation. Businesses in Harpers Ferry, a town and hub for numerous outdoor and water recreation activities in Jefferson County, also face risk of temporarily pausing operations. Below are community activities that occur throughout the year or annually.

- Jefferson County Fair – July and August at Jefferson County Fairgrounds and weekly farm markets
- Historical Walking Tours of Harpers Ferry, WV – Available All Year (Note four (4) of the National Register Areas within Harpers Ferry are located in the 1-percent-annual chance floodplain.)
- Hollywood Casino Horse Races – Reoccurring – Located in Charles Town
- September 22 - 24 - Mountain Heritage Arts & Craft Festival at Jefferson County Fairgrounds
- October 7 - Freedoms Run (Note: held in in Harpers Ferry & Shepherdstown.)

4.4.2. 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. They can also result from human activity like mine blasts and nuclear experiments. Future earthquakes are most likely to occur in the same general regions that have had earthquakes previously. Earthquakes can cause damage to buildings and other rigid superstructures, depending on factors like magnitude, distance of local areas to the epicenter, and local geologic conditions. It remains incredibly difficult to predict when and where an earthquake will occur in the northeast U.S. and West Virginia.

Earthquakes move or shake the earth in three different directions depending on the plate movements: convergent, divergent, and transform generating primary and secondary waves. There are three common ways to measure an earthquake:

- Richter Scale: The Richter scale measures the scale and severity of an earthquake; the magnitude of an earthquake can range between 0 and 10. The effects of an earthquake can extend far beyond the site of its occurrence.
- Modified Mercalli Scale: The modified Mercalli scale measures earthquakes based on their intensity on the surface. This scale uses Roman numerals I through XII to denote detection and damage levels associated with an earthquake.
- Peak Ground Acceleration (PGA): PGA is "the maximum ground acceleration that occurred during earthquake shaking at a location. PGA is equal to the amplitude of the largest absolute acceleration recorded on an accelerogram at a site during a particular earthquake" (Douglas, 2003).

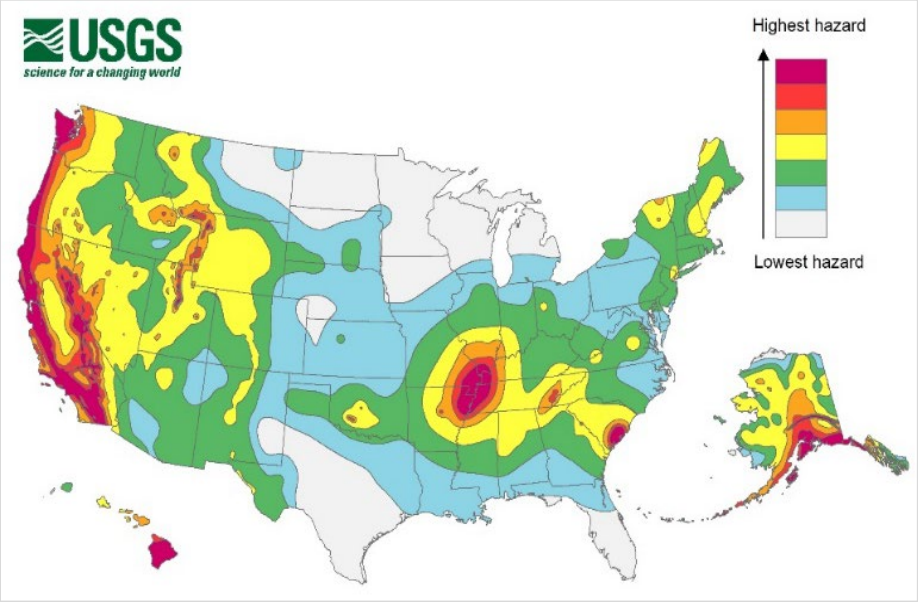
4.4.2.1. Location and Extent

The U.S. has areas that are prone to earthquakes; the coasts of California, Oregon and Washington are more vulnerable to seismic activity due to the presence of the Ballenas, Brothers, and the San Andreas Faults on the west coast. Also of note is the New Madrid Seismic Zone located in Arkansas, Missouri, and Tennessee. On the east coast, there is the Eastern Tennessee Seismic Zone that stretches from Alabama to Virginia.

The nearest area of seismic activity is the southeast and south-central United States region, which covers a large area of relatively diffuse, low- rate seismicity. Principle areas of activity include the New Madrid Seismic Zone of the central Mississippi Valley and the Southern Appalachian Seismic Zone, extending from Virginia to Alabama; Figure 4-4. This map shows the majority of the State of West Virginia as low risk; this includes Jefferson County. The southernmost part of the state has only a slightly higher risk of earthquake hazards.

Figure 4-4: Simplified 2018 USGS Hazard Map

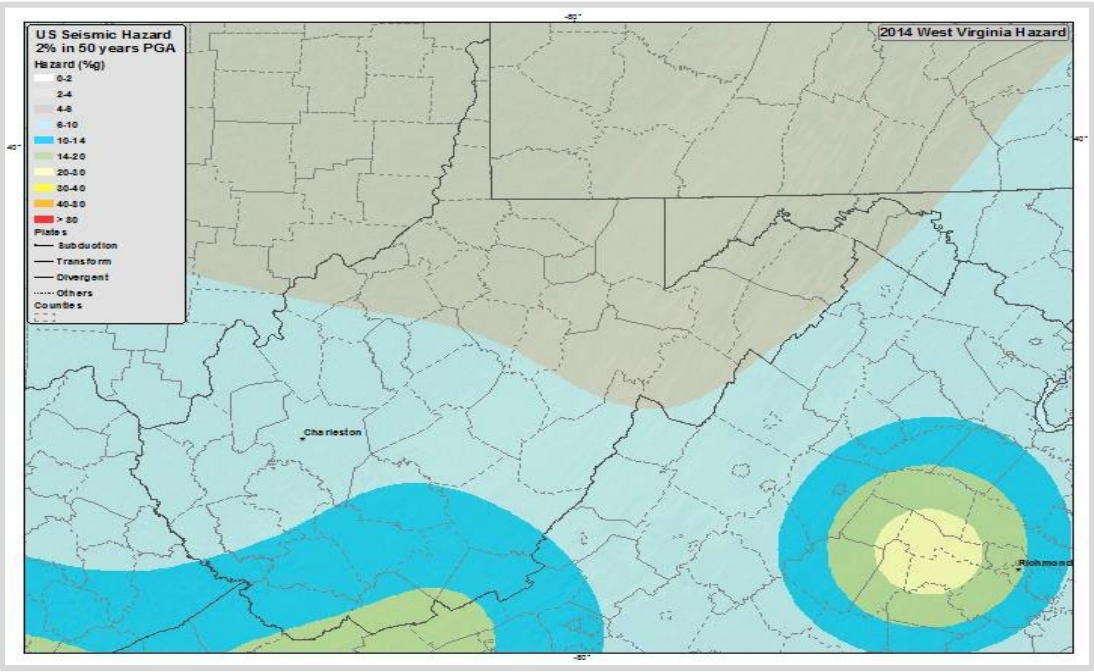
2% Chance of Exceedance in 50 Years Scaled in Peak Ground Acceleration (PGA) (USGS, 2018)



When events occur, they impact relatively small areas. According to a region-specific seismic hazard map, as seen in Figure 4-5, Jefferson County faces the possibility of marginally more severe earthquake with a 2 percent chance of exceeding a Peak Ground Acceleration (PGA) of 8-10 %g in 50 years (USGS, 2018).

Figure 4-5: WV 2014 USGS Hazard Map

2 percent Chance of Exceedance in 50 Years (most recent figure available) (USGS, 2018)

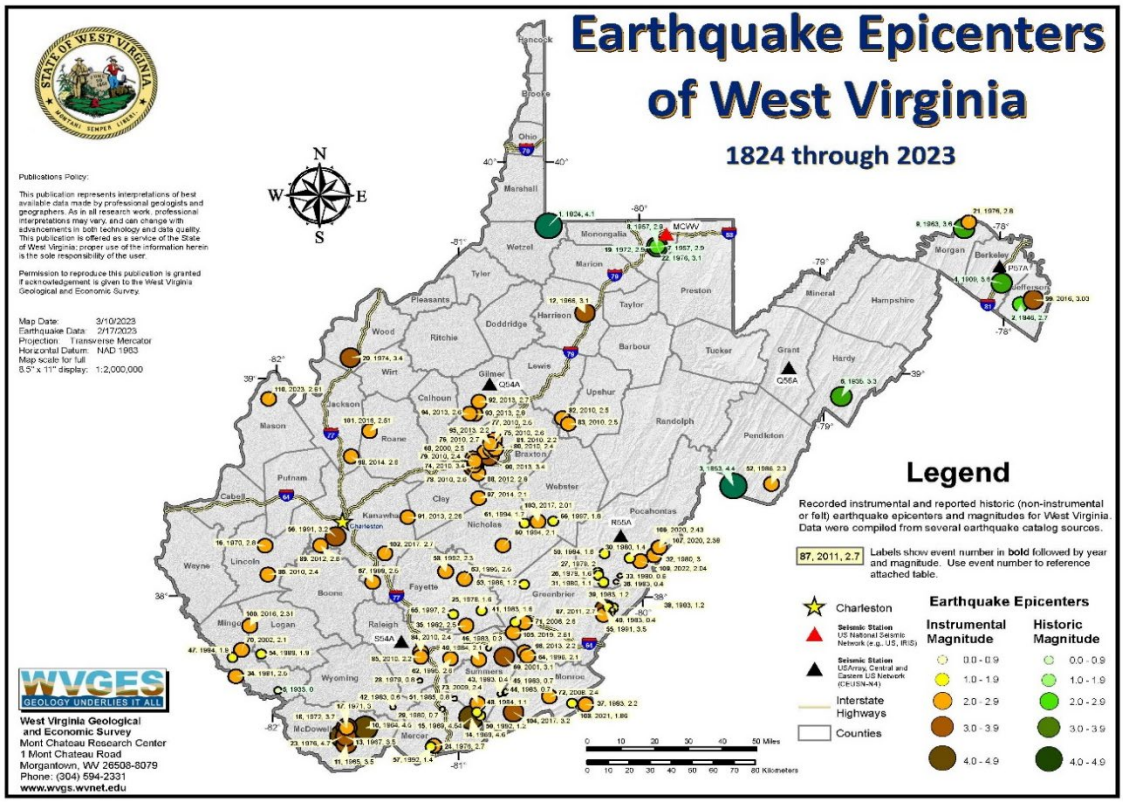


4.4.2.2. Past Occurrence

According to the U.S. Geological Society, based on historical trends, the frequency of an earthquake occurrence inversely relates to its magnitude. There are an estimated 1.3 million earthquakes every year with a magnitude between 2.0 and 2.9 while there is, on average, one magnitude 8.0 or higher earthquake annually.

In 2016, Jefferson County experienced an earthquake of 3.0 magnitude, but according to the State of West Virginia 2023 Hazard Mitigation Plan, the intensity measured a V, which is higher than the expected intensity for a 3.0 magnitude earthquake. The table below lists the epicenters of earthquakes within an 80-mile radius of Jefferson County. Since 2000, there have been five epicenters although the community has felt others originating from further away. The location of these earthquakes can be seen in Figure 4-6, as well as other historical earthquake locations throughout West Virginia.

Figure 4-6: WV Geological and Economic Survey Earthquake Epicenters (WVGES, 2023)



The USGS has an earthquake hazards program in which they ask, 'did you feel it?' and anyone can record their answers. The USGS then takes that data and creates a map for every year. Since 2000, the maps show that there have been seven earthquakes that people have felt in 2003, 2010, 2011, 2012, 2014, 2016, and 2017. As data shows, there have been more earthquakes felt in the last six years than since 2000, which indicates that they are becoming a more common occurrence.

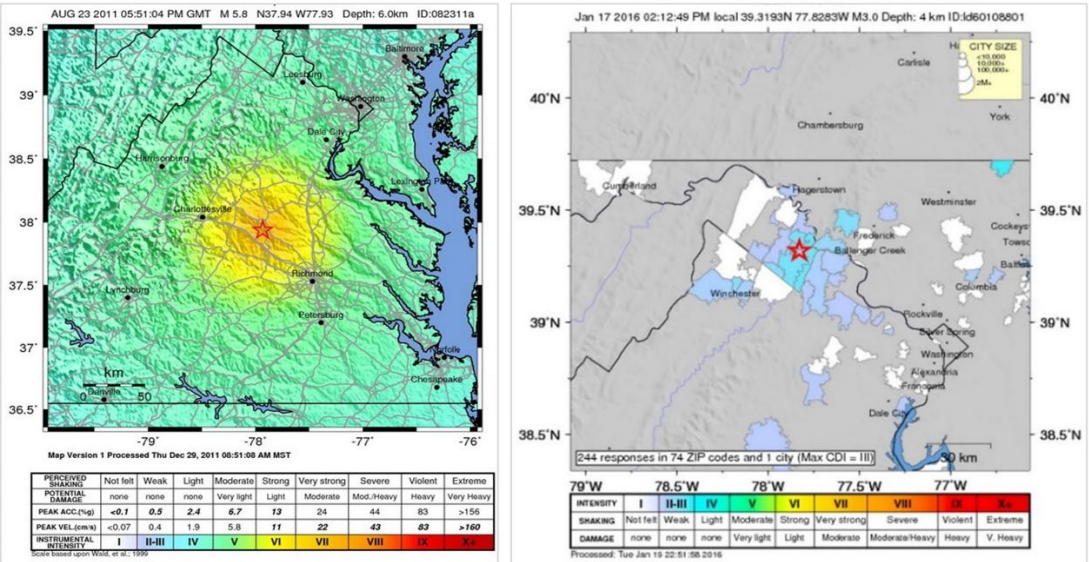
4.4.2.3. August 23, 2011

The most high-profile earthquake event to occur near the Potomac Highlands of West Virginia occurred in August 2011. A magnitude (Richter Scale) 5.7 earthquake centered in Louisa, Virginia (a little over 100 miles from Jefferson County) shook structures throughout West Virginia, Pennsylvania, Virginia, Maryland, and New York. Several aftershocks, ranging up to 4.5 in magnitude, occurred after the main tremor. Damage to historic structures like the National Cathedral and the Washington Monument were noted in Washington D.C. Evacuations occurred in D.C. as well as New York City because the general population was not accustomed to experiencing an earthquake of that magnitude. However, the intensity of the earthquake was quite low outside of central Virginia, as seen in Figure 4-7. No deaths and only minor injuries were reported, and minor damage to buildings was widespread. In Martinsburg, several government buildings were evacuated, and multiple citizens reported feeling their homes shaking violently enough to rattle picture frames off the walls. In Charleston, the Kanawha County Courthouse, the West Virginia State Capitol campus, and several other downtown buildings were evacuated. In Philippi, part of a chimney collapsed at the Barbour County courthouse. No damages were reported in Jefferson County.

4.4.2.4. January 17, 2016

More recently, in January 2016, an earthquake shook the West Virginia – Virginia state border. The earthquake happened at 2:12 p.m., and its epicenter was about two miles south-southeast of Bolivar, which is next to Harpers Ferry. The magnitude was 3.0 according to the Richter Scale and the intensity was minimal, but the earthquake was clearly felt up to 28 miles away in Martinsburg (USGS, 2016). There were no reports of damage or injuries. That day, 51 people in Charles Town reported feeling it, and 38 in the Bolivar and Harpers Ferry areas reported experiencing it. According to USGS records of earthquakes from 1900-Present, the 2016 earthquake is the most recent in the area of this scale (USGS, 2016).

Figure 4-7: USGS ShakeMaps for August 2011 and January 2016 Earthquakes (USGS, 2011 & 2016)

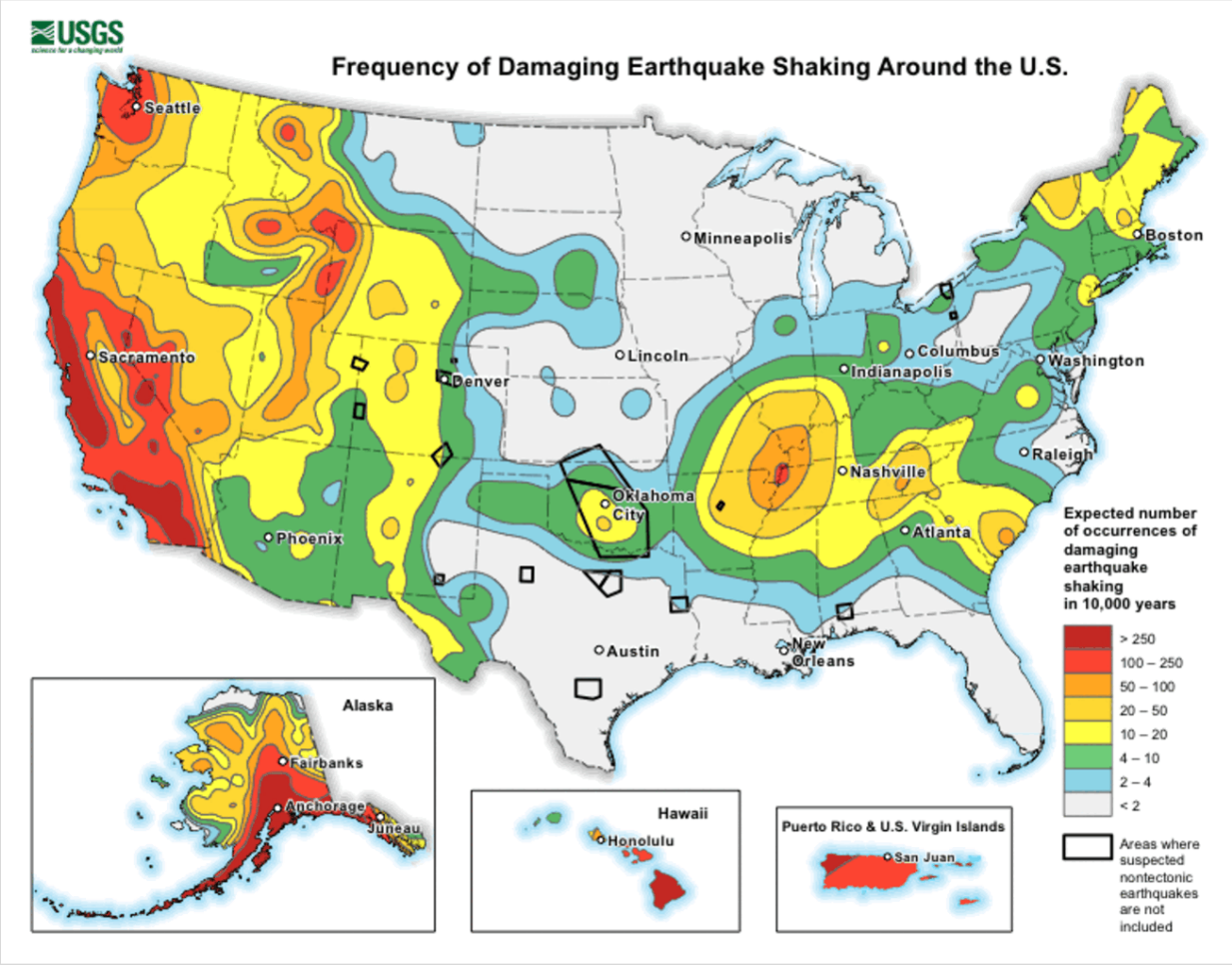


4.4.2.5. Future Occurrence

As aforementioned, Jefferson County has a 2 percent chance of exceeding a Peak Ground Acceleration (PGA) of 8-10 %g in 50 years according to Figure 4-5. The probability of an earthquake occurring in Jefferson County each year is very low, and the probability of a destructive earthquake is highly improbable. Historical records indicate that the future likelihood of an earthquake is unlikely as defined by the Risk Factor Methodology probability criteria (see Table 4-6).

Figure 4-8 depicts how many times earthquakes can cause damaging earthquakes (MMI VI or greater) in 10,000 years. The State of West Virginia 2023 Hazard Mitigation Plan states earthquakes of any magnitude can happen at any time in West Virginia. The figure shows that the northern portion of the state can expect between 2 and 4 damaging earthquakes in 10,000 years.

Figure 4-8: Frequency of Damaging Earthquake Shaking Around the United States, (USGS, 2023)



As of 2021, six seismic monitoring stations exist across West Virginia. These stations collect data about any future earthquake events and may help West Virginians further understand their earthquake risk.

4.4.2.6. Range of Magnitude

The map in Figure 4-4 is measured using Peak Ground Acceleration (PGA). This is defined as the maximum acceleration experienced by an area during the motion of an earthquake. This unit of measure is often used because building codes tend to regulate how much horizontal force a building should be able to endure during an earthquake, and force is directly proportional to acceleration. This is measured in %g, referring to the quotient of the PGA divided by the acceleration due to gravity (known as g, which is a constant of 9.80665 m/sec2) expressed as a percentage. A reference point for this unit of measure is 10%g, which the USGS believes approximates the maximum threshold of damage for pre-1965 or non-earthquake resistant buildings and roughly equates to VI to VII on the Modified Mercalli Intensity Scale, which is defined below (USGS, 2016).

The impact of an earthquake event is often measured in terms of earthquake intensity, which is measured using the Modified Mercalli Intensity (MMI) Scale, shown in Table 4-6. This scale has a measure of severity from I to XII, and relates to another commonly used scale, the Richter Scale (USGS, 2016).

Table 4-6: Modified Mercalli Intensity Scale with Associated Impacts

Scale	Intensity	Description	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 do not 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
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

Table 4-6: Modified Mercalli Intensity Scale with Associated Impacts			
Scale	**Intensity**	**Description**	**Corresponding Richter Scale Magnitude**
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

Source: USGS - The Modified Mercalli Intensity Scale

Earthquake magnitudes are often measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake. Table 4-7 summarizes Richter Scale magnitudes as they relate to the spatial extent of impacted areas. 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 Modified Mercalli Intensity Scale is used to measure earthquake intensity (USGS, 2016).

Table 4-7: 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.

Source: USGS Richter Scale

The worst earthquake recorded in West Virginia according to records maintained by The West Virginia Geological and Economic Survey was a magnitude 4.6 (or VI MMI) earthquake centered in Mercer County, WV, a county along the southern border of the state in 1969. Therefore, a worst-case scenario for this hazard would likely be if an earthquake of similar magnitude occurred in the Eastern Panhandle region or near the border of adjacent counties, which may cause mild damage in populated areas. Structural damage would not be expected in this scenario for most buildings, but blighted structures or those in a state of disrepair might experience further structural damage (West Virginia Geological and Economic Survey, 2016).

Environmental impacts of earthquakes can be numerous, widespread, and devastating, particularly if indirect impacts like economic impacts are considered. Earthquakes are known for causing induced tsunamis, flooding, landslides, and avalanches; poor water quality; damage to vegetation; and breakage in sewage or toxic material containments. However, because of their geographic location, these impacts are extremely unlikely to occur in Jefferson County (USGS, 2016).

4.4.2.7. Vulnerability Assessment

The somewhat random historical occurrences of earthquakes would indicate that all structures throughout Jefferson County to be equally at risk from earthquakes. The severity of those earthquakes, though, is expected to be very low. In a mild earthquake of the magnitude typically experienced in West Virginia, no structural damage is anticipated. In other cases, damages are expected to be limited, and examples of anticipated damages are broken dishes and windows and toppled file cabinets.

However, for earthquakes, the available history covers a period of less than 300 years, which is a relatively short period of time for an examination of earthquakes. Large earthquakes may only affect a location every several centuries or millennia. Environmental impacts of earthquakes can be numerous, widespread, and devastating, particularly if indirect impacts are considered. Some secondary hazards caused by earthquakes may include fire, hazardous material release, landslides, flash flooding, avalanches, tsunamis, and dam failure. These secondary events could also result in disruptions to natural ecosystems, poor water quality, damage to vegetation, and the release of toxic materials and sewage. Impacts to infrastructure could include train derailments, pipe failures, and utility interruptions. A very large earthquake affecting the counties might cause structural damage in dilapidated structures or structures that do not meet current building codes. Thus, the impact of an earthquake might range from negligible to catastrophic. Based on historical data for the counties, damage is likely to be minimal.

FEMA's National Risk Index indicates that Jefferson County's risk index is very low compared to other counties to the United States, in fact 45% of U.S. counties have a lower risk index than Jefferson County. The risk index rating for neighboring jurisdictions is relatively low for Berkeley County (West Virginia) and Loudoun County (Virginia), while Clarke County (Virginia) is very low.

The hazard type Risk Index score measures the relative risk of a community for a specific hazard type by comparing its hazard type Risk Index value with other communities at the same level. These scores are calculated using data for only a single hazard type and reflect a community's Expected Annual Loss (EAL)

value, community risk factors, and the adjustment factor used to calculate the risk value. The composite Hazard Type Risk Index score for earthquake in Jefferson County is detailed in Table 4-8.

Table 4-8: Jefferson County Earthquake Hazard Type Risk Index Score

Hazard Type	Expected Annual Loss Value	Social Vulnerability	Community Resilience	Community Risk Factor	Risk Value	Score
Earthquake	$121,715	Very Low	Relatively Moderate	1.04	$135,772	47.8

Source: National Risk Index – Jefferson County, West Virginia

Jefferson County as an expected annual loss value of $121,715 from an earthquake impact, is rated "very low" for social vulnerability, and is "relatively moderate" in terms of community resilience.

4.4.2.8. People

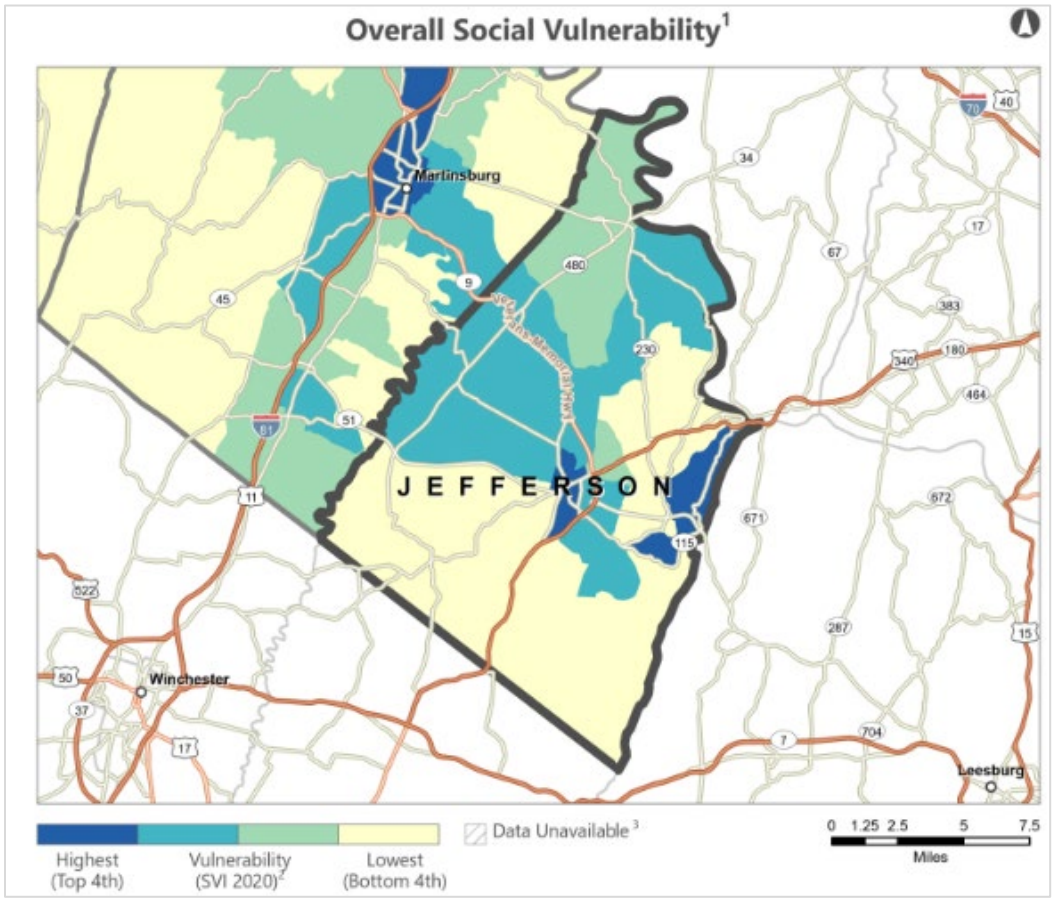
Earthquakes can affect people and structures alike, although older structures may be more susceptible to cracks and damage. "With most earthquakes, trauma caused by the collapse of buildings is the cause of most deaths and injuries. However, a surprisingly large number of patients require acute care for non-surgical problems such as acute myocardial infraction, exacerbation of chronic diseases such as diabetes or hypertension, anxiety and other mental health problems, respiratory disease from exposure to dust and asbestos fibers from rubble, and near drowning because of flooding from broken dams. As with most natural disasters, the risk of secondary epidemics is minimal, and only mas vaccination campaigns based on results of epidemiological surveillance are appropriate following earthquakes" (Noji, 1999).

The HAZUS-MH program from the Federal Emergency Management Agency analyzes the effects of a potential earthquake striking Jefferson County. The scenario depicts a 5.0 earthquake (the lowest possible magnitude to use in the program) located at the epicenter of the latest 2016 earthquake, just northeast of Ranson. According to the Hazus results, estimates for the county are as follows:

- 118 injuries that require medical attention, but not hospitalization,
- 28 injuries that require hospitalization, but are not life-threatening,
- 5 injuries that require hospitalization that can become life-threatening if not promptly treated, and
- 7 deaths.

In terms of social vulnerability, the National Risk Index (NRI) determines social group susceptibility to the adverse impacts of natural hazards when compared to the rest of the U.S. This is measured using the Social Vulnerability Index (SVI) published by the Centers for Disease Control and Prevention (CDC). The SVI considers well-established indicators of social vulnerability, including socioeconomic status, household characteristics, racial & ethnic minority status, and housing type & transportation.

Figure 4-9: Social Vulnerability Index (CDC, 2020)



According to the NRI, people, including underserved communities and socially vulnerable populations, in Jefferson County have a very low susceptibility to the adverse impacts of natural hazards in comparison to the rest of the U.S. Related to neighboring jurisdictions, Loudoun County (Virginia) social vulnerability is very low as well, while Berkley County is relatively low. The likelihood of an earthquake causing major damage or injuries in Jefferson County is low, however, the area in and around Charles Town and south of Harpers Ferry, which contains socially vulnerable populations, Figure 4-9 should be considered for preparedness and response activities.

4.4.2.9. Structures

Considering that there is no history of damage in the region due to earthquakes, damages are estimated to be limited to the more dilapidated structures and structures with unreinforced masonry. Therefore, structures identified as potentially at risk of damage due to an earthquake are older structures. In consideration of new structures, modern building codes and the low expected magnitude of earthquakes in the county, limited property damage is anticipated.

The Hazus analysis data in Table 4-9 and Table 4-10 have not been recently updated, however due to the low probability of an earthquake event and damages resulting from the magnitude of an earthquake likely

to be experienced by Jefferson County. Based on past earthquake hazard occurrences specific to Jefferson County, the previous Hazus analysis is sufficient for planning purposes. Keep in mind that the Hazus analysis used a probabilistic earthquake scenario, which was not a past occurrence.

Building damages by occupancy type and the building-related economic loss estimates results from FEMA's Hazus program for the earthquake scenario, a 5.0 earthquake with the epicenter just northeast of Ranson, are described in the following tables. Note, historical occurrences for Jefferson County indicates that two (2) earthquakes were felt by people in the area, however, no damages or deaths were reported.

Table 4-9: Jefferson County Expected Building Damage By Occupancy (Hazus)

	None		Slight		Moderate		Extensive		Complete	
	Count	%	Count	%	Count	%	Count	%	Count	%
Agriculture	25	0.30	22	0.41	25	0.62	10	0.71	3	0.79
Commercial	207	2.43	162	3.04	222	5.46	108	7.34	32	8.43
Education	9	0.10	6	0.12	9	0.22	4	0.28	1	0.32
Government	11	0.12	8	0.15	12	0.30	6	0.43	2	0.50
Industrial	68	0.80	51	0.95	79	1.95	42	2.84	13	3.27
Other Residential	1,655	19.46	1,173	21.92	1,269	31.29	602	41.00	138	35.93
Religion	31	0.37	20	0.37	19	0.47	9	0.58	2	0.61
Single Family	6,503	76.43	3,908	73.05	2,424	59.72	688	46.81	192	50.15
TOTAL	**8,509**		**5,350**		**4,060**		**1,469**		**383**	

Source: 2018 Jefferson County Hazard Mitigation Plan

Table 4-10: Jefferson County Hazus Building-Related Economic Loss Estimates (Millions Of Dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses	Wage	0.00	3.53	13.25	0.68	1.27	**18.74**
	Capital Related	0.00	1.49	11.89	0.40	0.21	**14.00**
	Rental	6.43	4.67	5.16	0.25	0.58	**17.10**
	Relocation	23.77	4.14	8.40	1.30	3.65	**41.26**
	Subtotal	30.20	13.83	38.71	2.64	5.71	**91.09**
Capital Stock Losses	Structural	36.88	7.08	9.14	3.16	3.72	**59.98**
	Non-Structural	126.40	26.92	27.66	10.10	9.61	**200.70**
	Content	46.66	6.78	14.58	6.86	5.42	**80.30**
	Inventory	0.00	0.00	0.36	1.57	0.13	**2.06**
	Subtotal	209.94	40.79	51.74	21.70	18.88	**343.04**
TOTAL		**240.14**	**54.61**	**90.45**	**24.33**	**24.59**	**434.13**

Source: 2018 Jefferson County Hazard Mitigation Plan

In addition to overall building losses, essential facilities may suffer some damage based on the probabilistic earthquake scenario, not past occurrences.

4.4.2.10. Systems

An earthquake may precipitate a major technologic disaster by damaging or destroying nuclear power stations, hospitals with dangerous biologic products, hydrocarbon storage areas, and hazardous chemical plants. Hazus generated the following results for utility systems in Jefferson County.

- Transportation and Utility Lifeline Damage: two bridges and one light rail facility will have at least moderate damage; economic loss estimate is $4.8 million.
- Utility System Facility Damage: one potable water, eleven wastewater, and three communications facilities will have at least moderate damage; economic loss estimate is $203.10 million.
- Utility System Pipeline Damage: there will be 211 potable water, 106 wastewater, and 36 natural gas pipeline leaks, and 53 potable water, 26 wastewater, and nine natural gas pipeline breaks.

4.4.2.11. Historic Resources & Community Activities

Historic buildings are especially vulnerable considering the structures were not designed and constructed to absorb the swaying ground motions caused by earthquakes. Therefore, major structural damage, or outright collapse, can result. However, given the extremely low risk factor and associated impacts for Jefferson County, the likelihood of damages resulting from an earthquake are very low. This is also true for impacts from an earthquake to community events. While a slight disruption to events may occur as a result of an earthquake in the region, long term disruptions or event cancelations are not anticipated from this hazard, based on past occurrences. Below are community activities that occur throughout the year or annually.

- Jefferson County Fair – July and August at Jefferson County Fairgrounds and weekly farm markets
- Historical Walking Tours of Harpers Ferry, WV – Available All Year (Note four (4) of the National Register Areas within Harpers Ferry are located in the 1-percent-annual chance floodplain.)
- Hollywood Casino Horse Races – Reoccurring – Located in Charles Town
- September 22 - 24 - Mountain Heritage Arts & Craft Festival at Jefferson County Fairgrounds
- October 7 - Freedoms Run (Note: held in in Harpers Ferry & Shepherdstown.)

4.4.3. Extreme Temperatures

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

The National Oceanic and Atmospheric Administration (NOAA) can generate reports of monthly "normals" at its different stations. The data chosen for the region is from the Eastern WV Regional Airport (the closest to Jefferson County in West Virginia).

4.4.3.1. Heat

Temperatures vary widely over the course of a year, but each season has average temperature ranges associated with them. Summer and winter have, generally, the highest and lowest range of temperatures, respectively. When the temperature is consistently greater than the normal in summer, meteorologists refer to it as a heat wave, which means, "temperatures of ten or more degrees above the average high temperature persist across the geographic region for several days or weeks" (Haddow, Bullock, & Coppola, 2014, p.51). These conditions can be a contributor to drought conditions when combined with a lack of rainfall. Excessive heat has a history of being deadly. In the United States, "more than 1,500 die from exposure to excessive heat" (Haddow, Bullock, & Coppola, 2014, p.52). These conditions can also have serious impacts on crops, causing below average harvests. Repeated years of extreme temperatures can easily cause significant economic impacts on agricultural industries. The National Centers for Environmental Information (NCEI) tracks two types of extreme heat temperatures.

- **Heat:** A period of heat resulting from the combination of high temperatures (above normal) and relative humidity. A heat event occurs whenever heat index values meet or exceed locally/regionally established advisory thresholds, or a directly related fatality occurs due to the heat event.
- **Excessive Heat:** Excessive heat results from a combination of high temperatures (well above normal) and high humidity. An excessive heat event occurs when heat index values meet or exceed locally/regionally established excessive heat warning thresholds, on a widespread or localized basis (National Weather Service Instruction 10-1605, 2007).

4.4.3.2. Cold

While there is no widely accepted definition of extremely cold temperatures, periods of colder than average conditions can cause an array of negative consequences depending on their duration (Haddow, Bullock, & Coppola, 2014, p.51). Extremely cold temperatures are immediately dangerous to both humans and livestock by causing frostbite and hypothermia, which can lead to permanent injury and death. The

chart on the next page shows how quickly frostbite can occur at different temperatures and wind speeds. In unprotected structures cold temperatures can freeze water pipes causing them to burst upon thawing, leading to significant damage. Cold snaps during typically warmer weather during the growing season can damage and destroy some crops, depending on their sensitivity to temperature. The Jefferson County Hazard Mitigation Plan Risk Assessment NCEI tracks two types of extreme cold temperatures.

- **Cold/Wind Chill:** Period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory (typical value is -18° F or colder) conditions, on a widespread or localized basis. There can be situations where advisory criteria are not met, but the combination of seasonably cold temperatures and low wind chill values (roughly 15° F below normal) may result in a fatality.
- **Extreme Cold/Wind Chill:** A period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria (typical value around -35° F or colder), on a widespread or localized basis. Normally these conditions should cause significant human and/or economic impact. The polar vortex is a large area of low pressure and cold air surrounding both of the Earth's poles. It ALWAYS exists near the poles, but weakens in summer and strengthens in winter. The term "vortex" refers to the counter-clockwise flow of air that helps keep the colder air near the Poles. Many times during winter in the northern hemisphere, the polar vortex will expand, sending cold air southward with the jet stream. This occurs fairly regularly during wintertime and is often associated with large outbreaks of Arctic air in the United States.

In addition to the extreme cold temperature events listed above, NCEI tracks "Frost/Freeze" conditions.

- **Frost/Freeze:** The threshold for these conditions can be met when the temperature falls below 36°F but impact is further exacerbated the more the temperature drops. When the temperature hits below 32°F, it is more likely that a larger portion of the environment will be affected (NWS, 2022). When the temperature falls below 28°F, the event can be classified as a "hard freeze" because of its severity (NWS, 2022). Jefferson County typically experiences its first range of Freeze events of the year sometime between October and mid-November. Because temperatures commonly drop below the thresholds for Frost/Freeze in the winter, weather warnings are only issued for these events from May 1 to October 20 (NWS, 2022).

4.4.3.3. Location and Extent

All of Jefferson County is subject to extreme temperatures in the summer and winter seasons. Urban environments are more susceptible to extreme heat as they tend to retain the heat well into the night, leaving little opportunity for dwellings to cool. Demographics also are a consideration, as large populations of elderly or poor represent those most vulnerable to temperature extremes.

Table 4-11 shows monthly mean maximum and minimum temperatures between 1981 and 2010 and the average number of days where temperatures exceed 90°F or drop below 32°F. Elevation, topography, and surrounding development may account for much of the difference between these two locations. The

Eastern Panhandle reaches its highest maximum mean daily temperature in July. Eastern WV Regional Airport climbs to a mean daily maximum of 85.8 °F in July. The region reaches its lowest temperatures in January, with Eastern WV Regional Airport (Martinsburg Regional Airport) dropping to a mean daily minimum of 22.3°F (NCEI NOAA, 2021).

Table 4-11: Summary of Monthly Extreme Temperatures (°F), 1981-2010
Martinsburg Eastern WV Regional Airport (NCEI NOAA, 2021)

	Mean		Mean Number of Days	
Month	**Daily Max**	**Daily Min**	**Max >= 90**	**Min <= 32**
Jan	39.5	22.3	0.0	25.7
Feb	43.2	24.4	0.0	22.7
March	52.6	31.4	0.0	16.5
April	64.0	40.8	0.1	4.5
May	72.7	49.6	0.8	0.2
June	81.7	58.9	3.6	0.0
July	85.8	63.7	7.5	0.0
Aug	83.9	61.8	5.6	0.0
Sept	76.7	53.9	1.5	0.0
Oct	65.4	42.3	0.0	3.7
Nov	54.3	34.1	0.0	12.1
Dec	42.8	25.5	0.0	23.9
Summary	63.6	42.4	19.1	109.3

Table 4-12: Summary of Monthly Extreme Temperatures (°F), 1980-2023
Martinsburg Eastern WV Regional Airport (NCEI NOAA, 2021)

Month	Daily Max	Daily Min
Jan	75 in 1997	-18 in 1994
Feb	83 in 2018	-5 in 1996
March	88 in 2018	-3 in 2014
April	93 in 2002	19 in 2013
May	96 in 1996	30 in 2005
June	102 in 2012	39 in 1993
July	107 in 1988	48 in 2010
Aug	103 in 1991	40 in 1986
Sept	100 in 1998	32 in 2020
Oct	92 in 2019	22 in 1992
Nov	81 in 1982	13 in 2014
Dec	78 in 2001	-12 in 1983

Given Martinsburg's proximity to Jefferson County, it is beneficial to use its data because the National Weather Service does not provide information for specific towns or cities in the county. From 1980 to 2023, Martinsburg experienced numerous abnormal weather events, as portrayed in Figure 4-11. One of the most notable discrepancies between the monthly daily maximums and minimums happened just four years apart. In March 2018, the highest recorded value was 88 degrees while in 2014 the lowest recorded value was -3.

4.4.3.4. Past Occurrence

The region has often encountered severe and dangerous temperatures in the past. A map of minimum temperatures in Jefferson County can be seen in Figure 4-10, and a map of maximum temperatures can be seen in Figure 4-11 for the years 1981 to 2010. This data was the most current geospatial temperature data available for analysis (NOAA, 2021). Previous temperature extremes impacting Jefferson County can be as seen in Table 4-12. Historically, the Eastern WV Regional Airport experienced a WV record of 112^{o}F on July 11, 1936. According to the NWS Heat Index, a temperature of that magnitude presents an extreme danger. On the other end of the spectrum, on January 21, 1994, Eastern WV Regional Airport reached 18^{o}F (The Weather Channel, 2016). With wind chill, these cold temperatures could quickly cause frostbite on exposed skin.

Figure 4-10: Jefferson County Average Minimum Temperatures 1991-2020

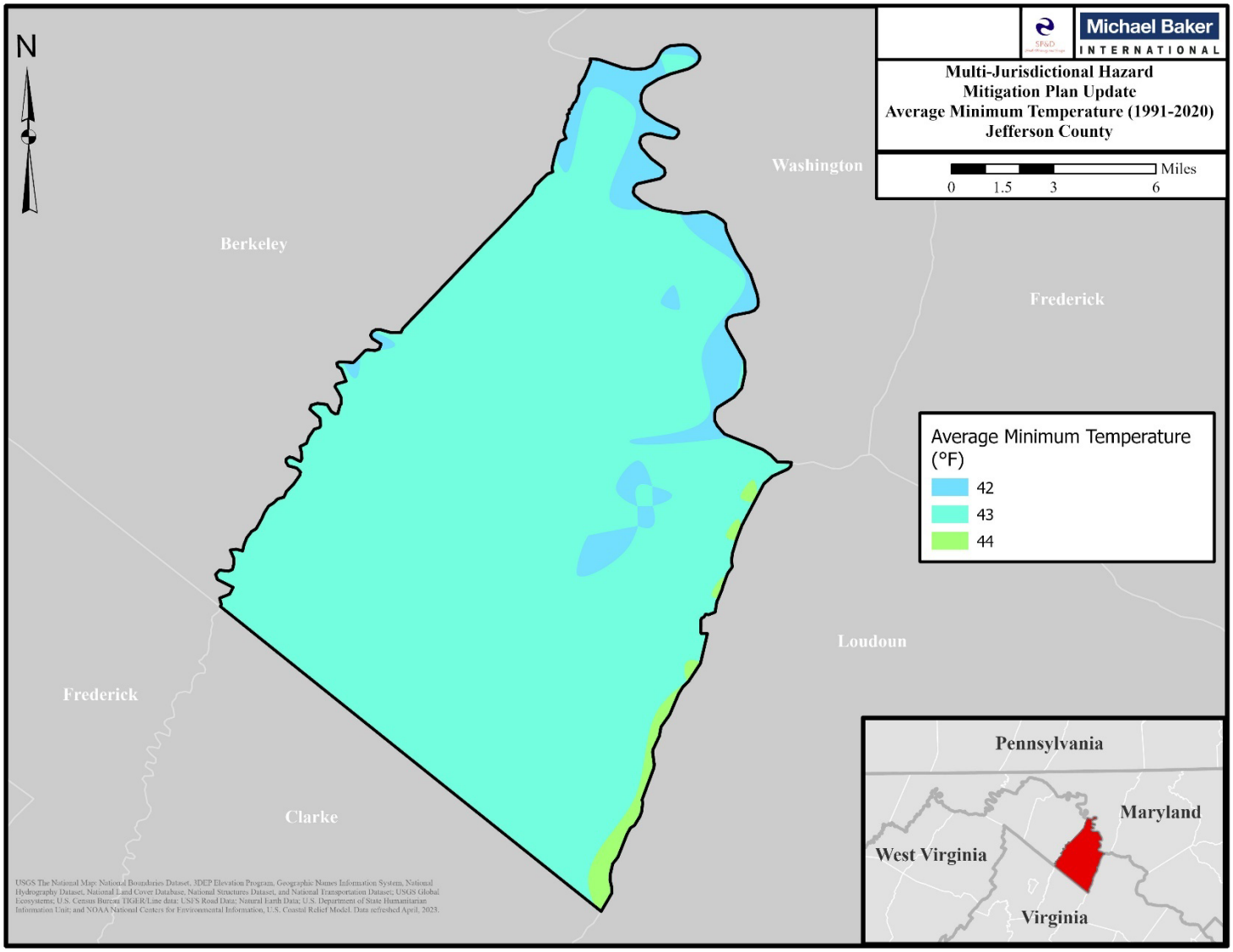
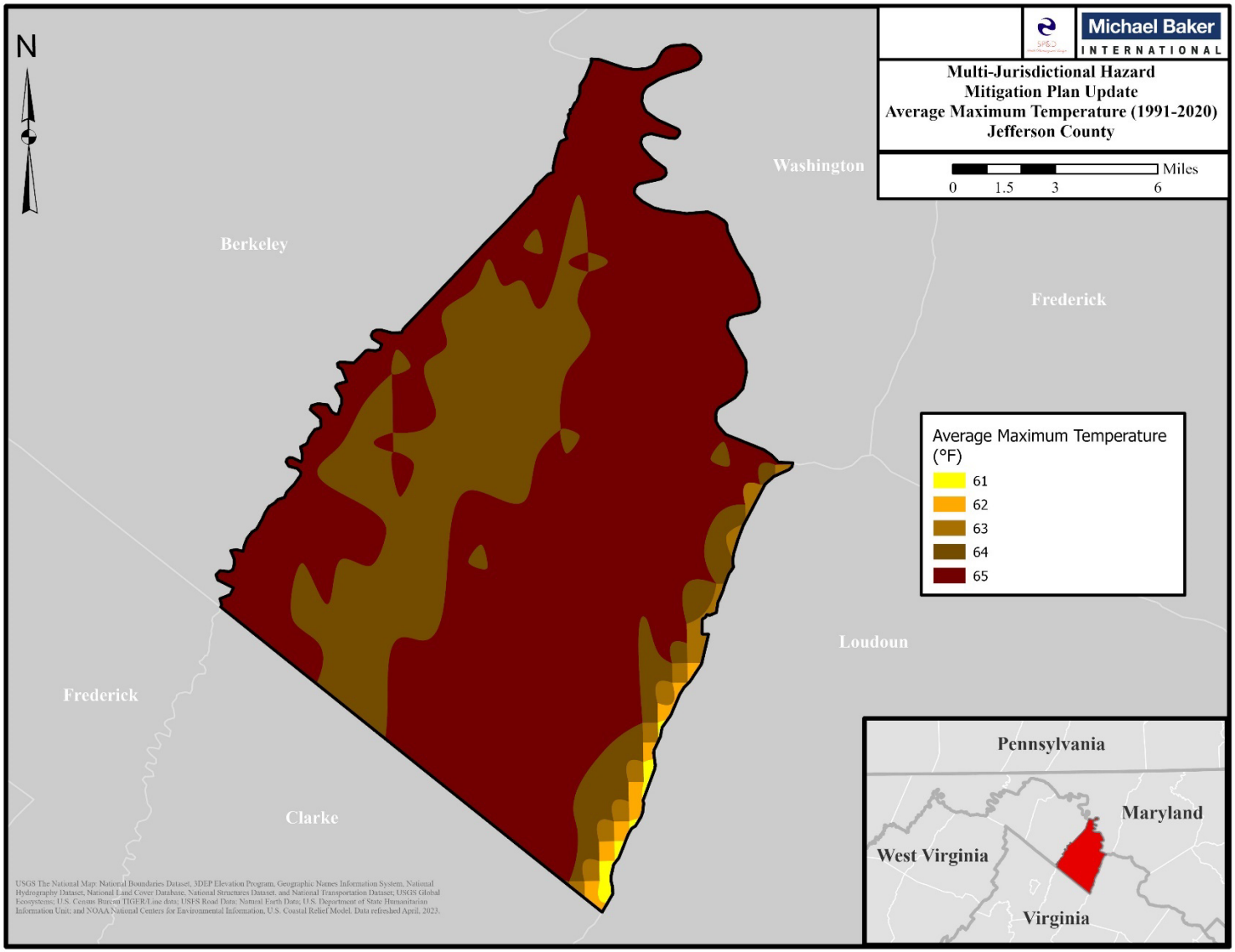


Figure 4-11: Jefferson County Average Maximum Temperatures 1991-2020



Since 1997, the NCEI reports a total of 33 heat events, four excessive heat events, nine cold/wind chill events, five extreme cold/wind chill events, and 37 Frost/Freeze events. All combined, there have been a total of 88 extreme temperature events that NCEI has recorded. The occurrences between 1997 and 2023 are outlined in Table 4-13 below, which includes event-specific injuries and crop damage. The NCEI has not reported any deaths or property damage as a result of extreme temperatures.

Table 4-13: Temperature Extremes Impacting Jefferson County (1997-2023) (NOAA NCEI, 2023)

Date	Event	Injuries	Crop Damage ($)	Date	Event	Injuries	Crop Damage ($)
4/10/1997	Frost/Freeze	0	1000000	10/29/2011	Frost/Freeze	0	0
8/16/1997	Heat	0	0	3/27/2012	Frost/Freeze	0	0
1/6/1998	Heat	0	0	7/7/2012	Heat	0	0
3/11/1998	Cold/Wind Chill	0	0	10/13/2012	Frost/Freeze	0	0
3/27/1998	Heat	0	0	5/14/2013	Frost/Freeze	0	0
7/21/1998	Heat	0	0	10/25/2013	Frost/Freeze	0	0
6/7/1999	Heat	3	0	10/18/2015	Frost/Freeze	0	0
7/4/1999	Heat	0	0	10/19/2015	Frost/Freeze	0	0
1/2/2000	Excessive Heat	0	0	4/3/2016	Frost/Freeze	0	0
1/21/2000	Extreme Cold/Wind Chill	0	0	4/5/2016	Frost/Freeze	0	0
1/22/2000	Extreme Cold/Wind Chill	0	0	4/5/2016	Frost/Freeze	0	0
1/27/2000	Extreme Cold/Wind Chill	0	0	4/9/2016	Frost/Freeze	0	0
3/8/2000	Heat	0	0	4/13/2016	Frost/Freeze	0	0
5/6/2000	Heat	0	0	4/14/2016	Frost/Freeze	0	0
6/10/2000	Heat	0	0	7/25/2016	Heat	0	0
6/25/2000	Heat	0	0	8/13/2016	Heat	0	0
12/22/2000	Extreme Cold/Wind Chill	0	0	10/26/2016	Frost/Freeze	0	0
4/19/2001	Extreme Cold/Wind Chill	0	0	5/9/2017	Frost/Freeze	0	0
6/12/2001	Heat	0	0	7/20/2017	Heat	0	0
6/27/2001	Heat	0	0	10/27/2017	Frost/Freeze	0	0
8/6/2001	Heat	0	0	1/5/2018	Cold/Wind Chill	0	0
5/20/2002	Frost/Freeze	0	0	4/21/2018	Frost/Freeze	0	0
7/2/2002	Heat	0	0	6/18/2018	Heat	0	0
7/28/2002	Heat	0	0	7/1/2018	Heat	0	0
8/1/2002	Heat	0	0	7/2/2018	Heat	0	0
8/12/2002	Heat	0	0	7/3/2018	Heat	0	0
8/22/2002	Heat	0	0	9/4/2018	Heat	0	0
12/7/2002	Cold/Wind Chill	0	0	10/19/2018	Frost/Freeze	0	0
1/10/2004	Cold/Wind Chill	0	0	1/21/2019	Cold/Wind Chill	0	0

Table 4-13: Temperature Extremes Impacting Jefferson County (1997-2023) (NOAA NCEI, 2023)							
Date	Event	Injuries	Crop Damage ($)	Date	Event	Injuries	Crop Damage ($)
1/15/2004	Cold/Wind Chill	0	0	1/30/2019	Cold/Wind Chill	0	0
1/31/2004	Cold/Wind Chill	0	0	7/19/2019	Excessive Heat	0	0
4/28/2004	Frost/Freeze	0	0	7/20/2019	Excessive Heat	0	0
10/27/2005	Frost/Freeze	0	0	7/21/2019	Excessive Heat	0	0
10/29/2005	Frost/Freeze	0	0	10/19/2019	Frost/Freeze	0	0
5/23/2006	Frost/Freeze	0	0	4/16/2020	Frost/Freeze	0	0
7/17/2006	Heat	0	0	4/18/2020	Frost/Freeze	0	0
8/1/2006	Heat	0	0	5/8/2020	Frost/Freeze	0	0
10/13/2006	Frost/Freeze	0	0	5/9/2020	Frost/Freeze	0	0
4/6/2007	Frost/Freeze	0	0	7/19/2020	Heat	0	0
4/7/2007	Frost/Freeze	0	0	7/20/2020	Heat	0	0
4/8/2007	Frost/Freeze	0	0	10/31/2020	Frost/Freeze	0	0
4/9/2007	Frost/Freeze	0	0	4/23/2021	Frost/Freeze	0	0
4/10/2007	Frost/Freeze	0	0	8/12/2021	Heat	0	0
10/29/2007	Frost/Freeze	0	0	12/23/2022	Cold/Wind Chill	0	0
7/22/2011	Excessive Heat	0	0				

4.4.3.5. Future Occurrence

Jefferson County is unlikely to face hazardous extreme temperatures in a given year, though temperatures are of some concern during winter and summer months. Jefferson County is more likely to encounter extreme cold weather than excessive heat. As seen in Table 4-13 the region is more likely to experience temperatures under 0^{o}F than over 100^{o}F in a given year. However, topography and vegetation can impact temperature differentials in the area. Therefore, the probability of an extreme temperature event in the region is considered possible as defined by the Risk Factor Methodology probability criteria.

Members of the Hazard Mitigation Committee rated temperature hazards a medium level of concern, but as seen in Table 4-14, Jefferson County should be aware of a general trend of warming as discussed in Section 2.1 Geography and Environment. According to the Fourth National Climate Assessment, which utilized the Intergovernmental Panel on Climate Change's Representative Concentration Pathways (RCP) 4.5 and 8.5 scenarios, the annual average temperature across the United States is projected to increase by 2.5°F (RCP 4.5) or 2.9°F (RCP 8.5) between 2021 and 2050, relative to 1976-2005. The RCP 4.5 scenario assumes moderate measures are taken to reduce emissions, while the 8.5 scenario assumes a lower effort and thus more severe impacts. For the Northeast region, the change in annual average temperature is 3.98°F (RCP 4.5) or 5.09°F (RCP 8.5) by 2036-2065 and 5.27°F (RCP 4.5) or 9.11°F (RCP 8.5) by 2071-2100. These changes translate to approximately 20 to 30 more days above 90°F and 20 to 30 fewer days below freezing in the northeastern parts of the United States by mid-century (RCP 8.5) (Vose et al. 2017).

4.4.3.6. Range of Magnitude

Temperature advisories, watches, and warnings are issued by the National Weather Service (NWS) relating the above impacts to the range of temperatures typically experienced in West Virginia. Table 4-14 summarizes thresholds for heat advisories given across the region.

Table 4-14: Thresholds for Heat Advisories (NWS, 2021)

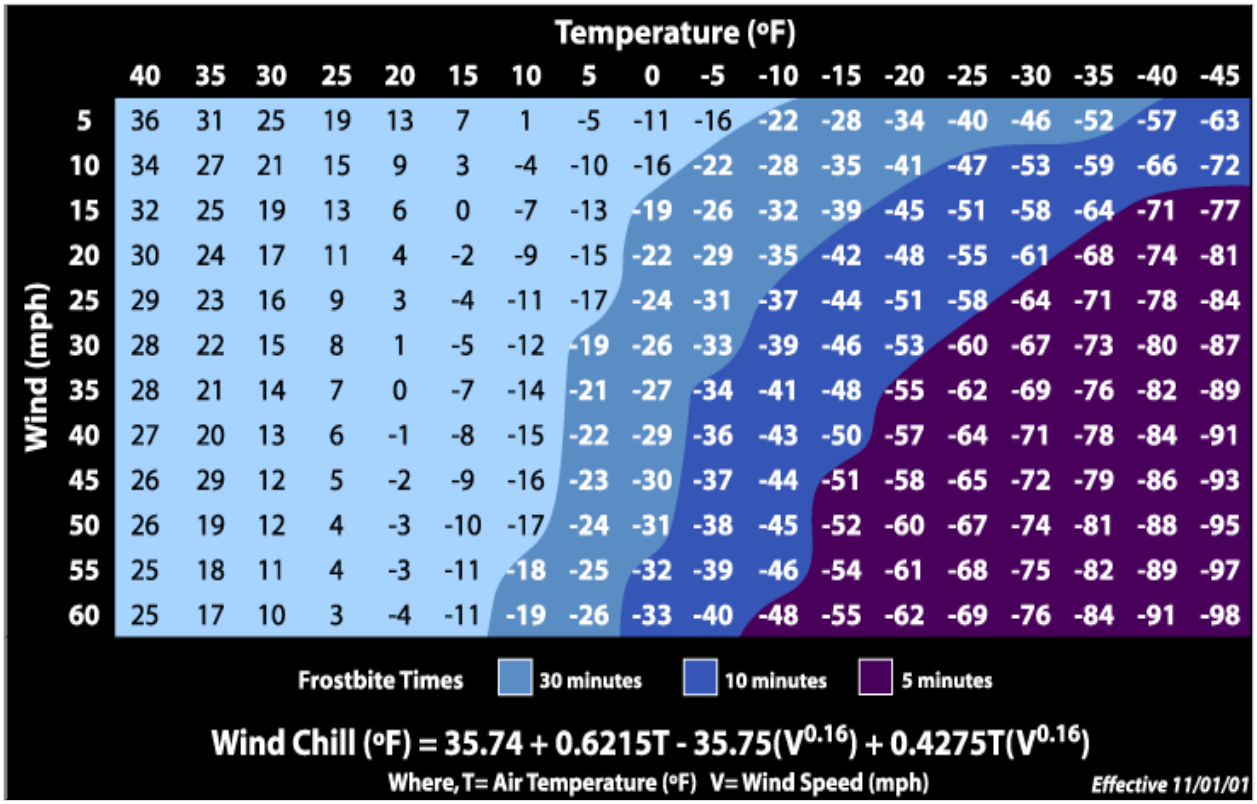
Advisory Level	Description
Heat Advisories	Criteria for a Heat Advisory is a heat index of 100-104°F. The heat index must remain at or above criteria for a minimum of 2 hours. Heat advisories are issued by county when any location within that county is expected to reach criteria
Excessive Heat Warnings	Criteria for an Excessive Heat Warning is a heat index of 105°F or greater that will last for 2 hours or more. Excessive Heat Warnings are issued by county when any location within that county is expected to reach criteria
Excessive Heat Watches	Issued when Heat Warning criteria is possible (50-79 percent) 1 to 2 days in advance

In terms of human health concerns, extremely high temperatures cause heat stress which can be divided into four categories. Each category is defined by apparent temperature which is associated with a heat index value that captures the combined effects of dry air temperature and relative humidity on humans and animals. Major human risks for these temperatures include heat cramps, heat syncope, heat exhaustion, heatstroke, and death. Note that while the temperatures in Table 4-13 serves as a guide for various danger categories, the impacts of high temperatures will vary from person to person based on individual age, health, and other factors. The elderly, the very young, and those with low or no income are most vulnerable to health-related impacts of extreme temperatures (Seltenrich, 2015).

Cold temperatures can be extremely dangerous to humans and animals exposed to the elements. Without heat and shelter, cold temperatures can cause hypothermia, frost bite, and death. Wind chill temperatures are often used in place of raw temperature values because wind can have in drawing heat from the body under cold temperatures (NOAA NWS, 2021). These values represent what temperatures actually feel like to humans and animals under cold, windy conditions. Similarly, to high temperatures, the effect of cold temperatures will vary by individual.

Figure 4-12 and Figure 4-13 show the effects of wind speed on extreme cold events and humidity on extreme heat events. These compounding factors can increase the risk experienced by vulnerable populations and the public.

Figure 4-12: Danger Posed by Low Temperatures and Wind (NOAA NWS, 2021)

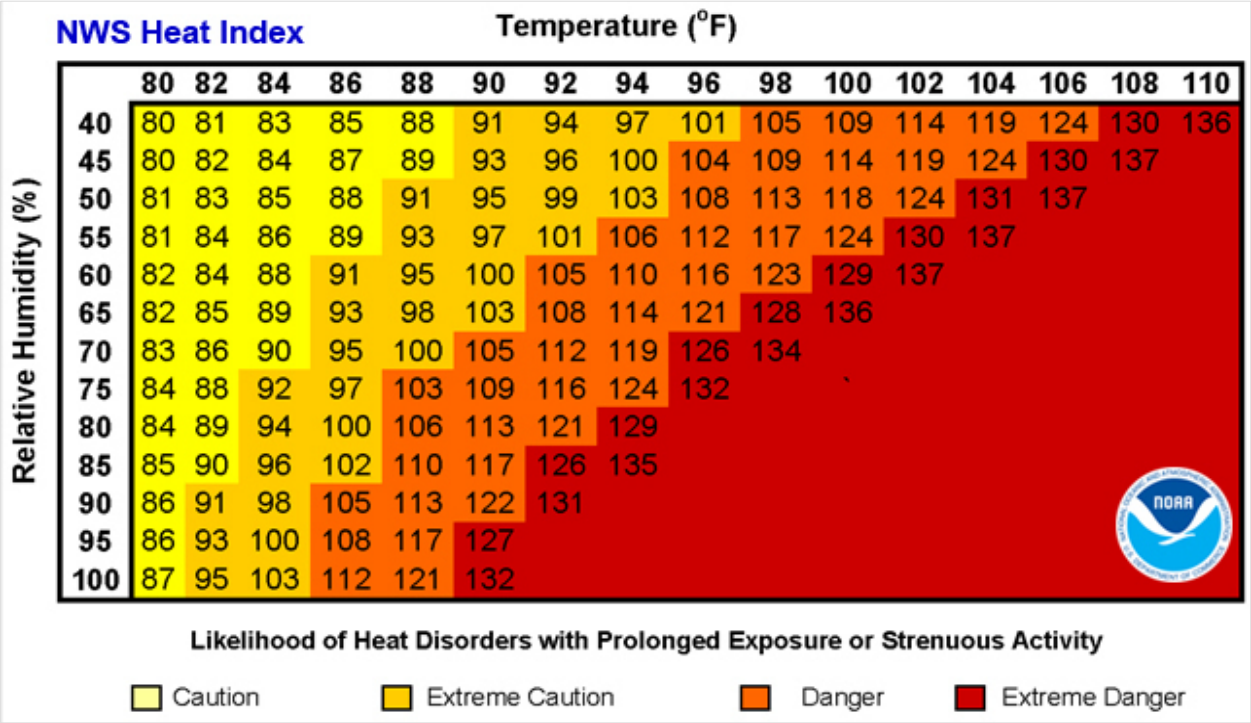


Wind (mph) \ Temperature (°F)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	29	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Cold weather has several effects, most dramatically on the general population mortality rate. The average mortality on a winter day is about 15 percent higher than on a summer day. Cold weather is directly responsible for deaths through hypothermia, influenza, and pneumonia. It is also an indirect factor in several ways such as death and injury from falls, accidents, carbon monoxide poisoning, and house fires all of which are partially attributable to cold.

Exposure to heat can also cause health problems indirectly, such as through increased workload on the heart. This can be especially dangerous to individuals with preexisting medical conditions, typically the elderly (Seltenrich,2015).

Figure 4-13: Danger Posed by Heat and Humidity (NOAA NWS, 2021)



The following impacts can be observed following extreme temperature events:

- **Health Impacts:** The health impacts of extreme cold are greater in terms of mortality in humans, but often after more prolonged exposure vs. a cold snap. Extreme heat waves, however, can prove more deadly over a shorter duration. At greatest risk of death in heat waves are the urban-dwelling elderly without access to an air-conditioned environment for at least part of the day.
- **Transportation:** Cold weather can impact automotive engines, possibly stranding motorists, and stress metal bridge structures. Highway and railroad tracks can become distorted in high heat. Disruptions to the transportation network and accidents due to extreme temperatures represent an additional risk.
- **Agriculture:** Absolute temperature and duration of extreme cold can have devastating effects on trees and winter crops. Livestock is especially vulnerable to heat and crop yields can be impacted by heat waves that occur during key development stages.
- **Energy:** Energy consumption rises significantly during extreme cold weather, and any fuel shortages or utility failures that prevent the heating of a dwelling place residents in extreme danger. Extreme heat also can result in utility interruptions, and sagging transmission lines due to the heat can lead to shorting out.

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

Jefferson County would include extreme cold temperatures, with injuries resulting from direct exposure (as a result of an interruption of energy supplies), and from being cut off from medical care due to associated snow or ice impacting travel. Medical afflictions could be a result of direct influence on the coronary circulation system and the respiratory system, and influenza and other infectious diseases would be secondary impacts. Extreme heat could also be disastrous, particularly if mixed with effect of a drought (Seltenrich, 2015).

4.4.3.7. Vulnerability Assessment

The potential for extreme heat and cold always exists in and around the summer and winter months. Meteorologists and weather forecasters can normally predict the temperature with excellent accuracy. Adhering to extreme temperature warnings can significantly reduce the risk of temperature related deaths. Those hardest hit by both heat and cold waves are adults 75 years of age or older, many who are already physically vulnerable. Excessive heat exposure also affects people with certain pre-existing medical conditions, including cardiovascular disease, respiratory illnesses, and obesity. As of July 2022, 17.3% of Jefferson County's population was over the age of 65, while 33% of the population was classified as obese in 2021. Additionally, Jefferson County's ageing population grew by 58.7% between 2010 and 2021, becoming the fastest-growing age group in the area (USA Facts, 2022). Efforts to mitigate the impacts should focus on those groups most vulnerable. These groups will more likely be located in areas where the population is aging; however, affects will be noticed in senior communities and neighborhoods throughout Jefferson County. Officials should also focus on mobile home parks, where populations also tend to be aging. Jefferson County is vulnerable to extreme temperatures, but vulnerabilities are extremely individualized among the general population and will continue to be extremely difficult to address from a county-wide or even local emergency response standpoint.

4.4.3.8. People

Extreme temperature events can pose a threat to the entire county's population. Still, certain populations are considerably more vulnerable to experiencing health issues due to underlying health conditions or age. People living without adequate access to air conditioning and heating are also particularly vulnerable.

From excessive heat to extreme cold, extreme temperatures have the capacity to cause a wide range of health problems varying in severity. In the United States, extreme heat is one of the biggest culprits in of weather-related deaths, while also causing heat strokes, heat exhaustion, rhabdomyolysis, heat syncope, heat cramps, and heat rashes. Prolonged exposure to extreme cold can cause hypothermia or frostbite, which can lead to permanent health damages, amputation, or death in worst-case scenarios.

4.4.3.9. Structures

Typically, heat or excessive heat events do not significantly damage structures, besides potentially "overheating of heating, ventilation, and air conditioning (HVAC) systems." On the other hand, extreme cold can freeze pipes or cause them to burst. Poor condition or aging facilities are especially susceptible to extreme temperature events and may not be able to tolerate them.

4.4.3.10. Systems

Extreme heat events can sometimes cause short periods of utility failures, commonly referred to as "brown-outs," created by increased usage from air conditioners, appliances, and similar equipment. Similarly, heavy snowfall and ice storms, associated with extreme cold temperature events, can interrupt power as well.

Between 2012 and 2022, West Virginia was included in nine extreme temperature-related agricultural disaster declarations.

4.4.3.11. Natural, Historic and Cultural Resources

Extreme heat events, especially when accompanied by drought conditions, can lead to environmental consequences. Increasing temperatures can lead to exacerbated risk of wildfire; drought and its effects on the health of watersheds; and increased stress, migration, and death in plants and animals. Freezing and warming weather patterns create changes in natural processes. An excess amount of snowfall followed by early warming periods may affect natural processes such as flow of water resources.

4.4.3.12. Community Activities

Outdoor activities are likely the most at risk to cancellation during extreme heat events, as mitigating risk to the community primarily revolves around taking shelter in adequately heated or cooled spaces, depending on the type of extreme temperature occurring. Below are community activities that occur throughout the year or annually.

- Jefferson County Fair – July and August at Jefferson County Fairgrounds and weekly farm markets
- Historical Walking Tours of Harpers Ferry, WV – Available All Year (Note four (4) of the National Register Areas within Harpers Ferry are located in the 1-percent-annual chance floodplain.)
- Hollywood Casino Horse Races – Reoccurring – Located in Charles Town
- September 22 - 24 - Mountain Heritage Arts & Craft Festival at Jefferson County Fairgrounds
- October 7 - Freedoms Run (Note: held in in Harpers Ferry & Shepherdstown.)

4.4.4. Flood

Flooding has impacted Jefferson County in the past and will continue to threaten the County in the future, particularly as storms are expected to become more severe due to the changing climate. Flooding is normally the result of a larger event such as a thunderstorm, rapid snowmelt, and/or ice jam. Flooding can be as frequent as the occurrence of a spring rain or summer thunderstorm. The amount of precipitation produced by storm events determines the type of flooding. Flash floods, which typically occur more frequently than general floods, occur along small streams and creeks of the type that are widely present throughout the Eastern Panhandle.

Flooding is one of the most frequent natural hazards faced by communities across the country as well as one of the costliest. West Virginia is no stranger to flooding; in fact, it is the number one natural hazard in the state. The topography of the region is mountainous with many valleys and gorges with rivers and streams, making the region prone to flooding activity. There are several types of floods, each with their own characteristics and related dangers.

- Riverine Floods typically develop over a period of days and occur when a river gradually rises and overspills its banks. These floods can be attributed to large amounts of rain or snowmelt both in the region impacted and upstream. Due to their nature of gradually building up, these types of floods will typically have a warning period of a few days.

- Flash Floods are the most common severe weather emergency in the United States according to the National Flood Insurance Program (NFIP) (2016). The NFIP also states that a flash flood is, “a rapid flooding of low-lying areas in less than six hours, which is caused by intense rainfall from a thunderstorm or several thunderstorms” (2016).
    - According to NOAA, some of the possible causes for flooding include the following:
    - Excessive Rainfall: This is the most common cause of flooding. Water accumulates quicker than the soil can absorb resulting in flooding.
    - Snowmelt: It occurs when the major source of water involved is caused by melting snow. Unlike rainfall that can reach the soil almost immediately, the snowpack can store the water for an extended amount of time until temperatures rise above freezing and the snow melts.
    - Ice or Debris Jams: Common during the winter and spring along rivers, streams, and creeks. As ice or debris moves downstream, it may get caught on any type of obstruction to the water flow. When this occurs, water can be held back, causing upstream flooding. When the jam finally breaks, flash flooding can occur downstream.
    - Dam Breaks: Dams can overtop, have excessive seepage, or have structural failure. Dam failure has been identified as a new threat and is included as a new chapter in this plan.

4.4.4.1. Location and Extent

Flood sources within Jefferson County include rivers and streams. For inland areas like the Eastern Panhandle, excess water from snowmelt or rainfall accumulates and overflows onto stream banks and adjacent floodplains. Jefferson County is located at the confluence of the Potomac and Shenandoah rivers and is separated by three (3) major drainage divides; Potomac River, Shenandoah River, and Opequon Creek. Communities located along the banks of the Potomac and Shenandoah Rivers are in particularly low-lying areas. Examples include the towns of Bolivar, Harpers Ferry, and Shepherdstown.

A network of 22 major streams feed into the Potomac River, Shenandoah River, and Opequon Creek. Most streams in the County flow northwest-southeast orientation toward Opequon Creek or Shenandoah River. Large tributaries in the region include Turkey Run, Evitts Run, and Flowing Springs Run. All waters flow into the lower Potomac River and the Chesapeake Bay.

From a municipal perspective:

- In Bolivar and Harpers Ferry, the 1-percent-annual chance flood hazard area reaches the outer edges of the towns along the Shenandoah and Potomac Rivers. It mainly covers the rail lines that pass through the town and a few streets along the rivers. See Figure 4-21 and Figure 4-23.
- In Charles Town, the main areas that flood include the areas around Evitts Run and its tributaries to the south and Cattail Run and extend to reach a few streets in the surrounding area. See Figure 4-22.
- Evitts Run similarly affects Ranson in that it can overflow and reach some surrounding streets; Flowing Springs Run could also affect rails and streets that are close to the stream. See Figure 4-24 .
- Shepherdstown is along the Potomac River but does not experience significant flooding along the river itself but along Town Run that cuts through the jurisdiction and can significantly flood the downtown area. See Figure 4-25.

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. However, in assessing the potential spatial extent of flooding it is important to know the difference between the 1-percent-annual chance floodplain and the 0.2-percent-annual chance floodplain. The 1-percent-annual chance flood event, also known as the base flood, represents a flood event having a 1-percent chance of being equaled or exceeded in any given year or 100-year flood. The National Flood Insurance Program (NFIP), for which Flood Insurance Rate Maps (FIRM) are published, identifies the risk associated with the 1-percent-annual chance flood. This 1-percent-annual chance flood event is used to delineate the Special Flood Hazard Area (SFHA) and to identify Base Flood Elevations (BFE). Figure 4-14 and Figure 4-15 illustrates these terms. The SFHA serves as the primary regulatory boundary used by FEMA, and the State of West Virginia, when determining risk associated with flooding.

Figure 4-14: Diagram Identifying Special Flood Hazard Area and 100-Year Floodplain

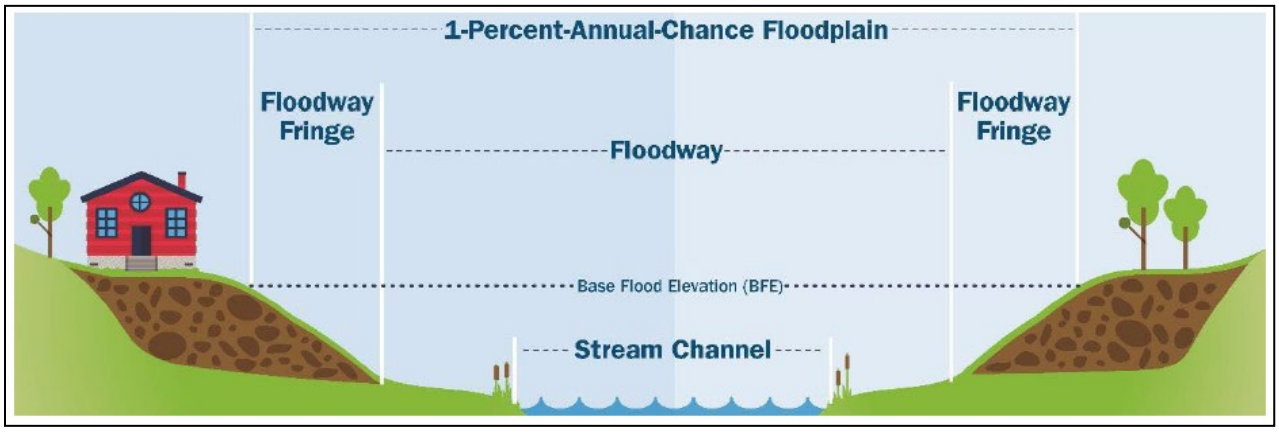
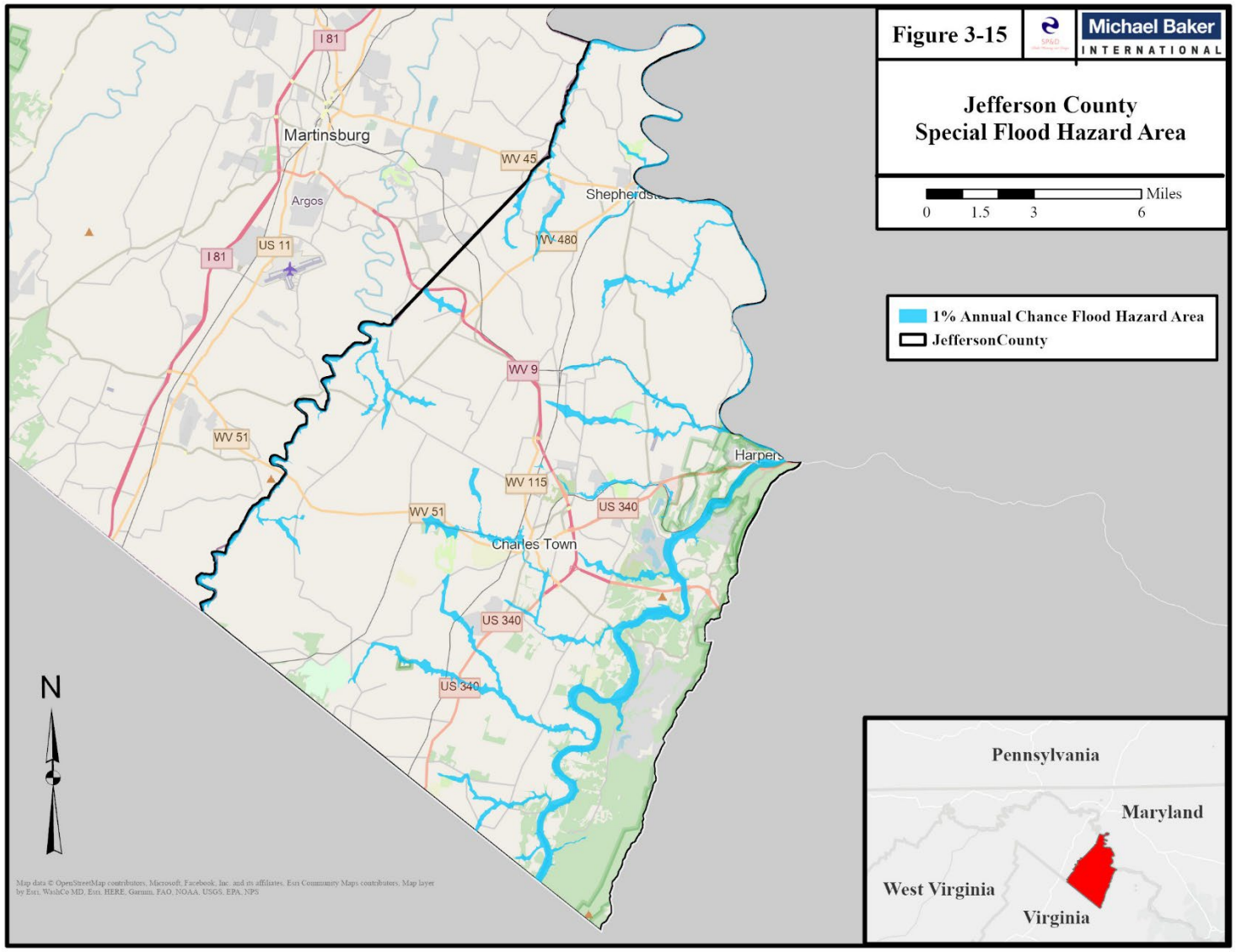
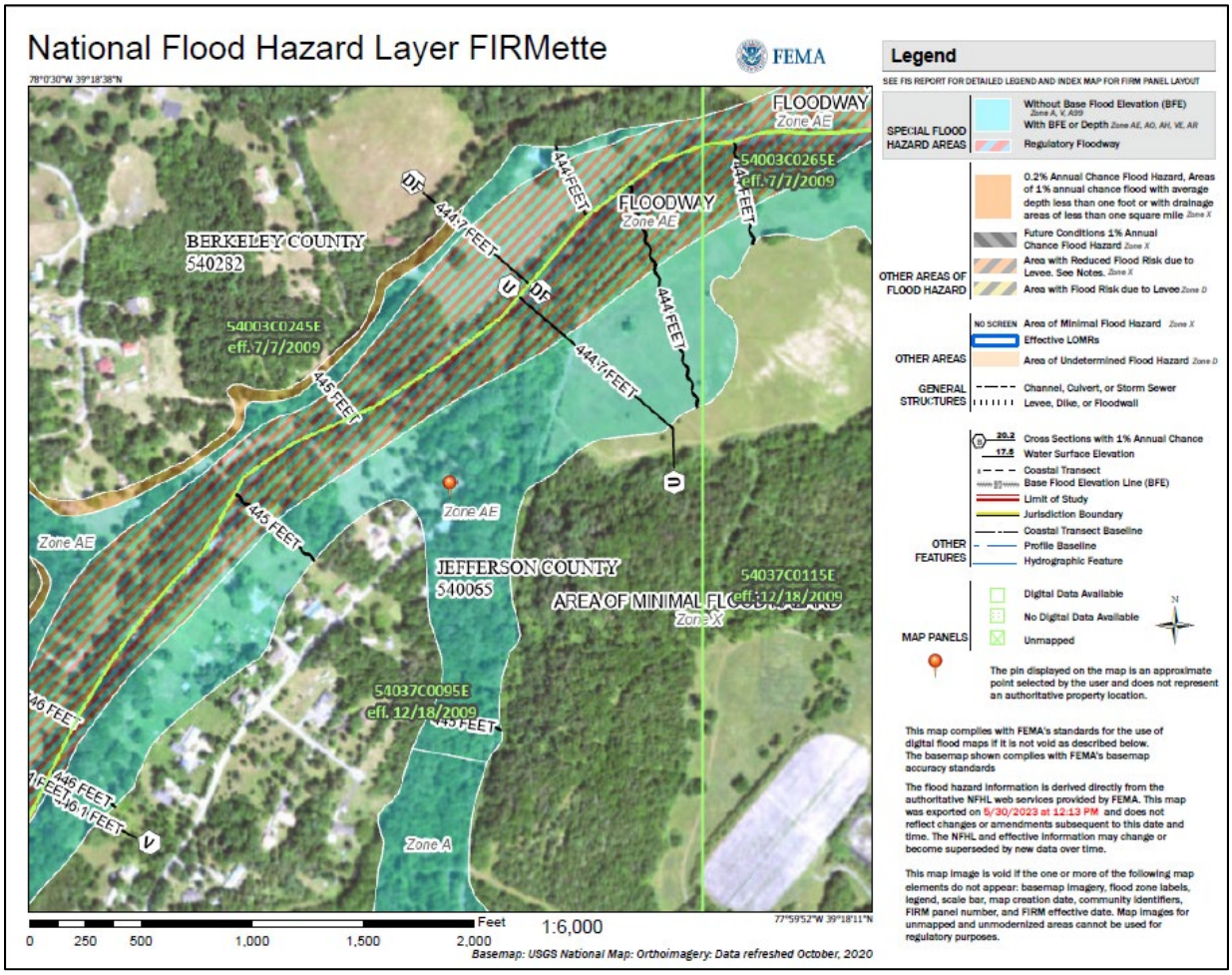


Figure 4-15: Jefferson County Special Flood Hazard Area



The current countywide FIRM and Flood Insurance Study (FIS) report was published for Jefferson County on December 18, 2009 (FEMA, 2023c). The best available flood hazard data, which was used to update this flood hazard profile, included current effective FIRM data and incorporated Letters of Map Revision (LOMRs). Figure 4-16 displays an example of a FIRM, found along Opequon Creek. The FIRM and FIS for Jefferson County can be obtained from the FEMA Map Service Center (http://www.msc.fema.gov) and can be used to identify the expected spatial extent and elevation of flooding from a 1-percent and 0.2-percent-annual chance event.

Figure 4-16: FIRM Panel 54037C0095E Showing Flood Hazard Areas along Opequon Creek Jefferson County (FEMA, 2023c)



According to Figure 4-15, Jefferson County faces flooding countywide. Jefferson County is most threatened by flooding resulting from Opequon Creek and its tributaries on the western boundary, while the Shenandoah River and its tributaries impacts the eastern to southeastern portion of the County. Jefferson County also faces some risk of flooding from the Potomac River. In these figures, Zone A represents areas with a 1 percent annual chance of flooding and a 26 percent chance of flooding over the

life of a 30-year mortgage. Zone AE represents the base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones. Zone X represents an area of moderate flood hazard (FEMA, 2023c).

In terms of future conditions, climate changes are expected to increase both the quantity and severity of storms. As a result, the locations and geographic extent of flooding are expected to increase. In addition to the 1-percent-annual chance floodplain, the 0.2-percent-annual chance flood represents a flood event having a 0.2-percent chance of being equaled one exceeded in any given year, sometimes referred to as the 500-year flood. This area is considered a moderate risk area, however, may become a high hazard risk area in the future.

As reported in a Washington Post article, American Underwater, extreme floods expose the flaws in FEMA's risk maps (Oakford et al, 2022). Excerpt from the article provided below:

Half a century ago, Congress directed FEMA to model for one-in-100-year floods, which is still what prompts property owners with federally backed mortgages to purchase flood insurance. But now, even more extreme precipitation events are growing increasingly common, as a warming climate allows storms to carry more moisture, producing greater rain or snow in a short period of time.

"Climate has changed so much that the maps aren't going to keep up for some time," said W. Craig Fugate, FEMA administrator under President Barack Obama. "They are not designed for extreme rainfall events."

4.4.4.2. Past Occurrence

Jefferson County has a long history of flooding events. Some small, localized flooding events occur annually with minimal property damage. However, occasionally larger floods can occur, seriously impacting communities and destroying property. Flood and flash flood events are listed in Table 4-15. These are the oldest floods for which data is available from the National Centers for Environmental Information (NCEI).

FEMA Flood Zones

In developing zone maps, FEMA focuses primarily on identifying the 1-percent annual chance floodplain (also known as the 100-year floodplain, Special Flood Hazard Area, or SFHA). As a result, FEMA maps the areas with a 1% annual chance of flooding. The SFHA designation is important because it is the basis for floodplain management regulations for communities across the country and because it decides whether a home is required to have flood insurance or not.

FEMA's high-risk flood zones – those that make up the SFHA – are those that begin with the letters "A" or "V." Note, Jefferson County does not have "V" zones as these are only found in coastal areas. Homeowners located in A or V zones are required to purchase flood insurance if they have a mortgage from a federally backed or federally regulated lender. FEMA's low and moderate-risk flood zones – those outside the SFHA – are those that begin with the letters "X," "B," or "C." Flood insurance is not required within these zones. These zones could still have flood risk as historically more than 20% of NFIP claims are made by policyholders in an X, B, or C zone.

Source: Understand The Differences Between FEMA Flood Zones

Property damages are estimates reported to the NCEI by trained storm spotters and displayed in the Storm Events database. Please note a zero-dollar entry may indicate minimal property damage, or that damage costs were not reported.

Table 4-15: Flood and Flash Flood Events Impacting Jefferson County 1996-April 2023 (NCEI NOAA, 2023b)

County	Starting Location	Date	Type	Property Damage ($)
Jefferson	Not Provided (NP)	1/19/1996	Flood	20,000,000
Jefferson	All	1/19/1996	Flash Flood	0
Jefferson	Countywide	9/6/1996	Flash Flood	100,000
Jefferson	North Portion	9/10/1997	Flash Flood	4,000
Jefferson	Countywide	11/7/1997	Flash Flood	0
Jefferson	Countywide	1/8/1998	Flash Flood	5,000
Jefferson	Countywide	2/4/1998	Flash Flood	0
Jefferson	Countywide	3/20/1998	Flash Flood	2,500
Jefferson	Countywide	6/15/2000	Flash Flood	0
Jefferson	NP	1/2/2003	Flood	0
Jefferson	NP	2/22/2003	Flood	0
Jefferson	NP	3/7/2003	Flood	0
Jefferson	NP	3/21/2003	Flood	0
Jefferson	NP	5/11/2003	Flood	0
Jefferson	NP	5/16/2003	Flood	0
Jefferson	Countywide	6/13/2003	Flash Flood	0
Jefferson	NP	9/19/2003	Flood	100,000
Jefferson	NP	11/19/2003	Flood	0
Jefferson	NP	2/6/2004	Flood	0
Jefferson	NP	4/13/2004	Flood	0
Jefferson	Charles Town	9/28/2004	Flash Flood	0
Jefferson	Countywide	11/29/2005	Flash Flood	150,000
Jefferson	Millville	6/27/2006	Flash Flood	25,000
Jefferson	Shepherdstown	3/2/2007	Flood	15,000
Jefferson	Shepherdstown	4/16/2007	Flood	0
Jefferson	Charles Town	3/13/2010	Flood	0
Jefferson	Shepherdstown	3/13/2010	Flood	0
Jefferson	Mountain Mission	4/16/2011	Flood	0
Jefferson	Bolivar	4/16/2011	Flood	0
Jefferson	Leetown	5/16/2014	Flood	0
Jefferson	Leetown	5/16/2014	Flood	0
Jefferson	Leetown	6/1/2015	Flash Flood	0
Jefferson	Millville	2/4/2016	Flood	0

Table 4-15: Flood and Flash Flood Events Impacting Jefferson County 1996-April 2023 (NCEI NOAA, 2023b)				
County	**Starting Location**	**Date**	**Type**	**Property Damage ($)**
Jefferson	Mountain Mission	5/6/2017	Flood	0
Jefferson	Bloomery	5/26/2017	Flood	0
2023 Plan Update				
Jefferson	Shepherdstown	4/17/2018	Flood	0
Jefferson	Engle	5/16/2018	Flood	0
Jefferson	Engle	5/16/2018	Flood	0
Jefferson	Shepherdstown	5/18/2018	Flood	0
Jefferson	Meyerstown	5/18/2018	Flood	0
Jefferson	Engle	6/2/2018	Flood	0
Jefferson	Uvilla	6/2/2018	Flood	0
Jefferson	Meyerstown	6/3/2018	Flood	0
Jefferson	Shepherdstown	6/3/2018	Flood	0
Jefferson	Harpers Ferry	6/4/2018	Flood	0
Jefferson	Millville	6/23/2018	Flood	0
Jefferson	Shepherdstown	9/9/2018	Flood	0
Jefferson	Aldridge	9/10/2018	Flood	0
Jefferson	Uvilla	9/10/2018	Flood	0
Jefferson	Meyerstown	9/18/2018	Flood	0
Jefferson	Shepherdstown	9/26/2018	Flood	0
Jefferson	Meyerstown	9/28/2018	Flood	0
Jefferson	Shepherdstown	9/28/2018	Flood	0
Jefferson	Harpers Ferry	9/29/2018	Flood	0
Jefferson	Millville	12/16/2018	Flood	0
Jefferson	Bolivar	12/16/2018	Flood	0
Jefferson	Millville	12/22/2018	Flood	0
Jefferson	Uvilla	5/5/2019	Flood	0
Jefferson	Leetown	5/5/2019	Flood	0
Jefferson	Aldridge	5/5/2019	Flood	0
Jefferson	Mt Pleasant	5/5/2019	Flood	0
Jefferson	Leetown	5/5/2019	Flood	0
Jefferson	Charles Town	7/8/2019	Flood	0
Jefferson	Charles Town	7/8/2019	Flood	0
Jefferson	Kearneysville	7/8/2019	Flood	0
Jefferson	Shepherdstown	5/1/2020	Flood	0
Jefferson	Leetown	12/25/2020	Flood	0
Jefferson	Bloomery	12/25/2020	Flood	0

Table 4-15: Flood and Flash Flood Events Impacting Jefferson County 1996-April 2023 (NCEI NOAA, 2023b)				
County	**Starting Location**	**Date**	**Type**	**Property Damage ($)**
Jefferson	Shepherdstown	3/1/2021	Flood	0
Jefferson	Bolivar	6/11/2021	Flood	0
Jefferson	Engle	6/11/2021	Flood	0
Jefferson	Mt Pleasant	6/11/2021	Flood	0
Jefferson	Bolivar	9/1/2021	Flood	0
Jefferson	Vanclevesville	5/7/2022	Flood	0

Source: National Centers for Environmental Information, June 2023.

Since 1996, which is the earliest year of record for flood events from NCEI, Jefferson County has experienced 13 flash floods and 61 floods; 2.7 events per year. The Spatial Hazard Events and Losses Database (SHELDUS) records flooding events before 1996; Table 4-16 includes these events.

Table 4-16: Flood Events Impacting Jefferson County Before 1996 (SHELDUS)		
Hazard	**Year**	**Month**
Flooding	1967	March
Flooding	1968	May
Flooding	1978	January
Flooding	1978	December
Flooding	1979	September
Flooding	1980	May
Flooding	1980	August
Flooding	1981	June
Flooding	1985	November
Flooding	1987	April
Flooding	1994	March
Flooding	1994	August

According to FEMA, there has been one disaster declaration for flooding in Jefferson County for events at the beginning of June of 2008. On June 19, 2008, President Bush declared that a major disaster exists in the State of West Virginia. This declaration made Individual Assistance requested by the Governor available to affected individuals and households in Barbour, Doddridge, Gilmer, Harrison, Jackson, Jefferson, Marion, Taylor, and Tyler Counties.

However, the NCEI storm event database does not present any records for flooding during this period. This declaration is for thunderstorm wind in Jefferson County.

The most severe flooding event Jefferson County encountered was the January 1996 flood event caused by heavy rain and snowmelt. The January 19, 1996 flooding resulted from an unprecedented combination of unseasonably warm air, rainfall totals between 3 to 5 inches, and an existing dense snowpack between 12 to 18 inches that melted within a 12-hour period. This influx of rain and snowmelt produced catastrophic flooding across the region, damaging homes, businesses, and causing several towns to evacuate. Property damage in Jefferson County was estimated at roughly $20,000,000 (NCEI, 2023). The National Park Service at historic Harpers Ferry (WVZ053) estimated damage to the park (and new construction within) at $3 million, comparable to the 1985 damage figures.

Another particularly intense year for flooding in the region was 2018. West Virginia Governor Jim Justice declared a State of Emergency in eight counties for flooding from heavy rain, including Jefferson County in June 2018. According to the NCEI event narrative, stream gauges on the Shenandoah River near Millville, the Potomac River at Shepherdstown, and the Potomac River at Harpers Ferry indicated each waterway exceeded the flood stages during this flood event (NCEI, 2023). On June 4, 2018 numerous locations in Jefferson County flooded according to National Weather Service (NWS) (NWS, 2023). This flood event was the third event in 2018 for Shepherdstown. Numerous roadways were closed, and several sections of road were damaged or washed out.

Figure 4-17: The Potomac River flows under the railroad bridge in Harpers Ferry.

(Journal photo by Victoria Dewey) Source: Flood waters rising; Jefferson County declares state of emergency

4.4.4.3. Repetitive Loss Properties

In addition to past flood events, the NFIP identifies properties that experience frequent flooding and can be used to determine areas of higher risk. These properties are identified through the NFIP when they receive more than one payment for flood damages. The NFIP defines a Repetitive Loss (RL) property as "any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling ten-year period, since 1978." The data provided in Figure 4-16 and throughout the plan represents the NFIP's definition of RL.

The FEMA NFIP defines a **repetitive loss property** as:

- Properties are those for which two or more losses of at least $1,000 each have been paid under the National Flood Insurance Program (NFIP) within any 10-year period since 1978."

The FEMA NFIP defines **severe repetitive loss properties** as:

- A property that has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or,
- A property for which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

The 2023 Hazard Mitigation Assistance Program and Policy Guide (page 304) defines repetitive loss and severe repetitive loss properties differently, and these definitions are as follows:

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 2 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.

A severe repetitive loss property is a structure that:

a. Is covered under a contract for flood insurance made available under the NFIP
b. Has incurred flood related damage –
    i. For which 4 or more separate claims payments (includes building and contents) 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 2 separate claims payments (includes only building) have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

Although Jefferson County has completed many flood mitigation projects in the past and continues participating in the community rating system, there still have been some repetitive and severe repetitive loss properties in the county. Using data provided by FEMA in August 2023, Table 4-17 displays repetitive loss properties by jurisdiction and type in Jefferson County. There is a total of 21 repetitive loss properties, and 1 severe repetitive loss property in the county (Table 4-18). Twenty of the repetitive loss structures are located in the unincorporated area of the county and are single family homes. In addition, the severe repetitive loss property is located in the unincorporated area of the county. Only one repetitive loss property is located in an incorporated area of the county, Ranson.

Table 4-17: Number and type of Repetitive Loss Properties by Municipality (FEMA, 2023)				
Jurisdiction	**Type**			**Sum of Repetitive Loss Properties**
	2-4 Family	**Other Non-Residential**	**Single Family**	
Jefferson County	0	0	21	21
Bolivar	0	0	0	0
Charles Town	0	0	0	0
Harpers Ferry	0	0	0	0
Ranson	0	1	0	1
Shepherdstown	0	0	0	0
Jefferson County Total	**0**	**1**	**21**	**22**

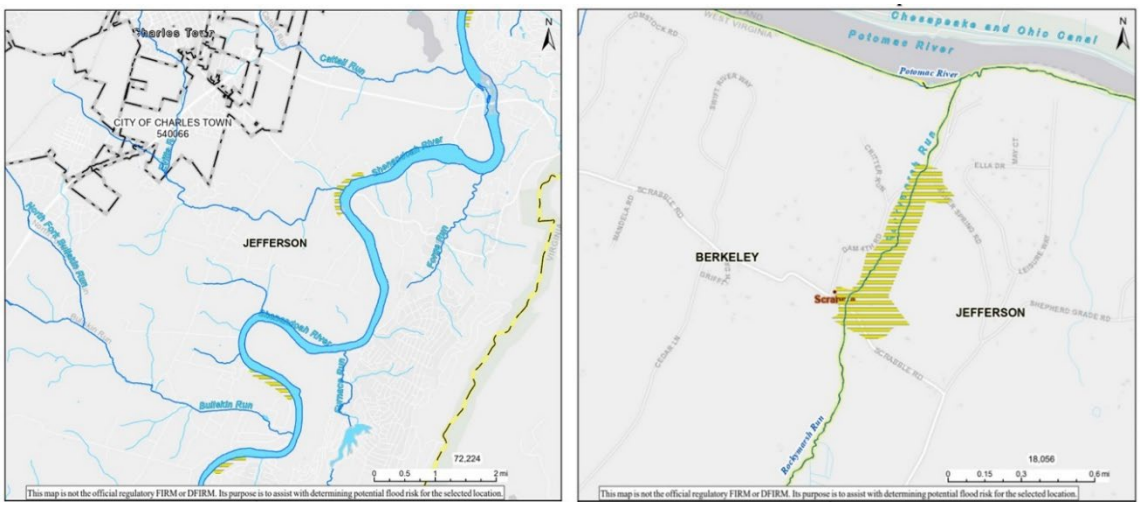
Table 4-18: Number and type of Severe Repetitive Loss Properties by Municipality (FEMA, 2023)				
Jurisdiction	**Type**			**Sum of Severe Repetitive Loss Properties**
	2-4 Family	**Other Non-Residential**	**Single Family**	
Jefferson County	0	0	1	1
Bolivar	0	0	0	0
Charles Town	0	0	0	0
Harpers Ferry	0	0	0	0
Ranson	0	0	0	0
Shepherdstown	0	0	0	0
Jefferson County Total	**0**	**0**	**1**	**1**

Repetitive loss areas are a portion (or portions) of a community that includes buildings on FEMA's list of repetitive losses and also any nearby properties that are subject to the same or similar flooding conditions. WV Flood Tool provides Repetitive Loss Areas, which are areas identified for flood risk assessment as part of HMGP project. Note, these areas are preliminary and not supposed to be definitive source for identification of repetitive loss areas. As depicted in below, four repetitive loss areas have been identified in the unincorporated areas of the County along the Shenandoah River. An additional area along Rockymarsh Run, which runs along the border of Berkeley and Jefferson County.

4.4.4.4. NFIP and CRS

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" (CRS, 2021).

Figure 4-17: Repetitive Loss Areas in Jefferson County



For citizens to protect their property against flood loss. Home and business owners can purchase flood insurance through private insurers or through the National Flood Insurance Program (NFIP).

Congress established the NFIP in 1968 to help control the growing cost of federal disaster relief (CRS, 2021). The NFIP, administrated through FEMA, offers federally backed flood insurance at discounted rates when communities adopt and enforce effective floodplain management ordinances to reduce future flood losses based on flood maps. NFIP is based on voluntary participation of communities but is required for communities to receive federal disaster relief funding.

Each jurisdiction participating in the NFIP has a designated NFIP coordinator, sometimes referred to as the floodplain manager. This individual maintains the jurisdiction's floodplain ordinance and ensures that development is compliant with that ordinance. Each local floodplain manager serves as the point of contact with FEMA regarding floodplain mapping. Table 4-19 lists the Jefferson County municipalities participating in the NFIP.

The minimum floodplain management requirements to be a community in good standing in the NFIP include:

- Review and permit all development in the Special Flood Hazard Area (SFHA);
- Elevate new and substantially improved residential structures 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 to minimize or eliminate flood damage; and
- Anchor foundation or structure to resist floatation, collapse, or lateral movement.

Table 4-19: Jefferson County NFIP Policies and Claim Information (FEMA, 2023)

Community	Policies in Force	Total Coverage	Prior Claims	Total Amount of Paid Claims
Jefferson County	26	$38,169	23	$207,392.56
Bolivar	0	$0	1	$7,409.13
Charles Town	43	$39,196	46	$648,055.71
Harpers Ferry	44	$59,710	42	$1,216,787.65
Ranson	19	$11,506	20	$54,045.10
Shepherdstown	36	$67,690	20	$238,575.50
Total	**168**	**$216,271.00**	**152**	**$2,372,265.65**

New information was added during the 2023 plan update which includes the FEMA Region 3 NFIP Questionnaire, see Appendix H. The questionnaire was reviewed by Jefferson County staff and includes the following topics:

- Floodplain Identification & Mapping,
- Floodplain Management,
- Flood Insurance, and
- Next Steps.

Next steps identified following the completion of the questionnaire have been integrated into the new mitigation strategies developed during this plan update.

The Community Rating System (CRS) is an additional, voluntary program run by the NFIP to encourage additional community activities that exceed minimum NFIP requirements, with the goal of reducing flood risk. By participating in the CRS, a community can receive discounted flood insurance premiums. Jefferson County is one of the five counties in West Virginia that participate in the CRS.

Jefferson County entered into CRS in October of 2006. In October of 2016, Jefferson County had a class 8 designation, which meant that flood insurance policyholders were eligible for a 10% discount on their rates. As of this plan update, Jefferson County is a class 7 CRS community which means that residents enjoy a 15% discount on their NFIP flood insurance.

4.4.4.5. Future Occurrence

The NFIP recognizes the 1 percent-annual-chance flood as the standard for identifying properties subject to federal flood insurance purchase requirements. The FIRMs published in 2009 can be used to identify areas subject to the 1 percent- and 0.2 percent-annual-chance flooding. Other storm frequencies such as the 2 percent- or 50-year flood and 10 percent-annual-chance flood are not shown on maps; however, water surface elevations associated with these events are included in the flood source profiles contained in the Flood Insurance Study Report. In this plan, the term "Special Flood Hazard Area" is used rather than floodplain to clarify that the area under consideration is identified on the FIRM as having at least a 1-percent chance of flooding in any given year. Historically, the area with a 1-percent chance of flooding in any given year has been called the "100-year floodplain" or the "base flood" and the area with a 0.2-percent chance of flooding in any given year has been called the "500-year floodplain." As these terms can be misleading by suggesting that there will be a flood only every 100 or 500 years respectively, are no longer used.

In Jefferson County, flooding occurs commonly and can take place during any season of the year. However, the possibility of flooding is greatly reduced during the winter months. Although most severe floods are attributable to rainfall alone, the spring floods can be compounded by snowmelt and moving ice. The major floods in the late summer and fall are often associated with tropical storms moving up the Atlantic coastline. Every two to three years, serious flooding occurs along one or more of the area's major rivers or streams and it is not unusual for such events to happen several years in succession. Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and related probability of occurrence. Historical records are used to determine the probability of occurrence (percent chance) for a flood of specific extent to occur. Annualized events for Jefferson County reported by the National Centers for Environmental Information using both flood and flash flood events, are 2.7 events per year.

4.4.4.6. Range of Magnitude

Floods are considered hazards when people and property are affected. Injuries and deaths can occur when people are swept away by flood currents or bacteria and disease are spread by moving or stagnant floodwaters. Most property damage results from inundation by sediment-filled water. A large amount of rainfall over a short 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. The topography of the county varies from steep mountains east of the Shenandoah River to more gently rolling terrain west of the river. Elevations in the county range from approximately 275 feet at Harpers Ferry to approximately 1,700 feet in the mountains east of the

Shenandoah River (FIS, 2009). Therefore, the significant amounts of sloping and mountainous terrain can contribute to more severe floods as runoff reaches receiving water bodies more rapidly over steep terrain. 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. According to the Jefferson County Stormwater Management Ordinance, in addition to quantity control criteria for newly developed impervious surface and/or changes to land cover, quality criteria requirements for site plans of 5,000 square feet or more of impervious surface and for major residential or commercial subdivisions are applicable.

In much of the northeastern United States, including Jefferson County, there are seasonal differences in how floods are caused. In the winter and early spring (February to April), major flooding has occurred as a result of heavy rainfall on dense snowpack throughout contributing watersheds, although the snowpack is generally moderate during most winters. 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.

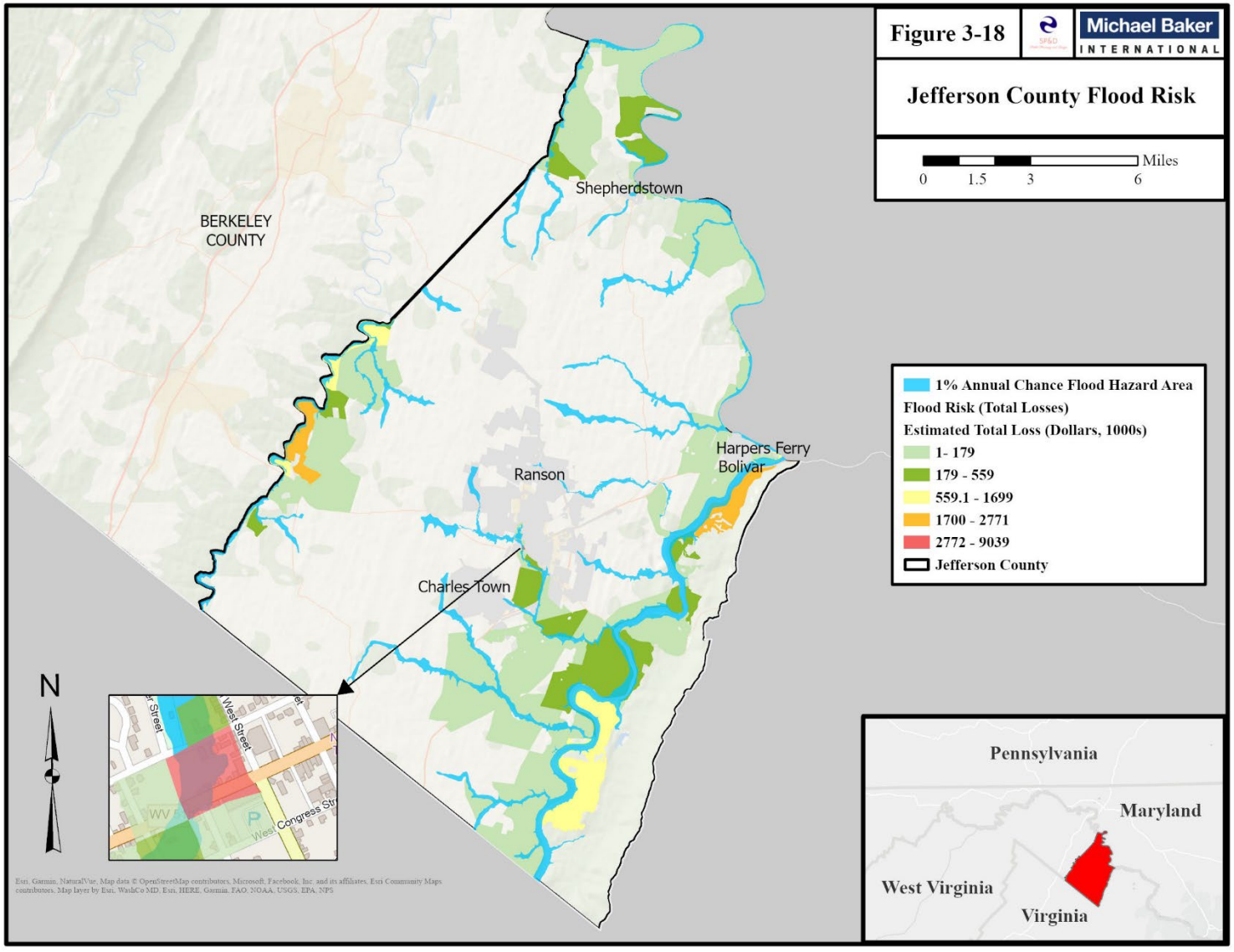
Flood effects can be volume or force related. Major floods along larger streams having wide floodplains tend to result in large-scale inundations. This causes widespread damage through soaking and silt deposits in homes, businesses, and industrial plants. In hilly regions where runoff paths are steep, 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 damage. 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.

According to Figure 4-18, one census block within Charles Town shows the highest risk in terms of total losses. Evitts Run's 1-percent-annual chance floodplain encompasses this area between West Liberty and West Washington streets. The next highest flood risk is near Harpers Ferry at the confluence of the Potomac River and Shenandoah River and continues on the east side of the Shenandoah River until the Blue Ridge Community. Another high-risk area is located on the western boarder of Jefferson and Berkeley county. This high-risk area is in the vicinity of Wide Horizon Boulevard to Hidden Hollow Road

and impacted by Opequon Creek. Flood mitigation measures in these high-risk areas along with other areas with projected loss should be considered.

Figure 4-18: Jefferson County Flood Risk



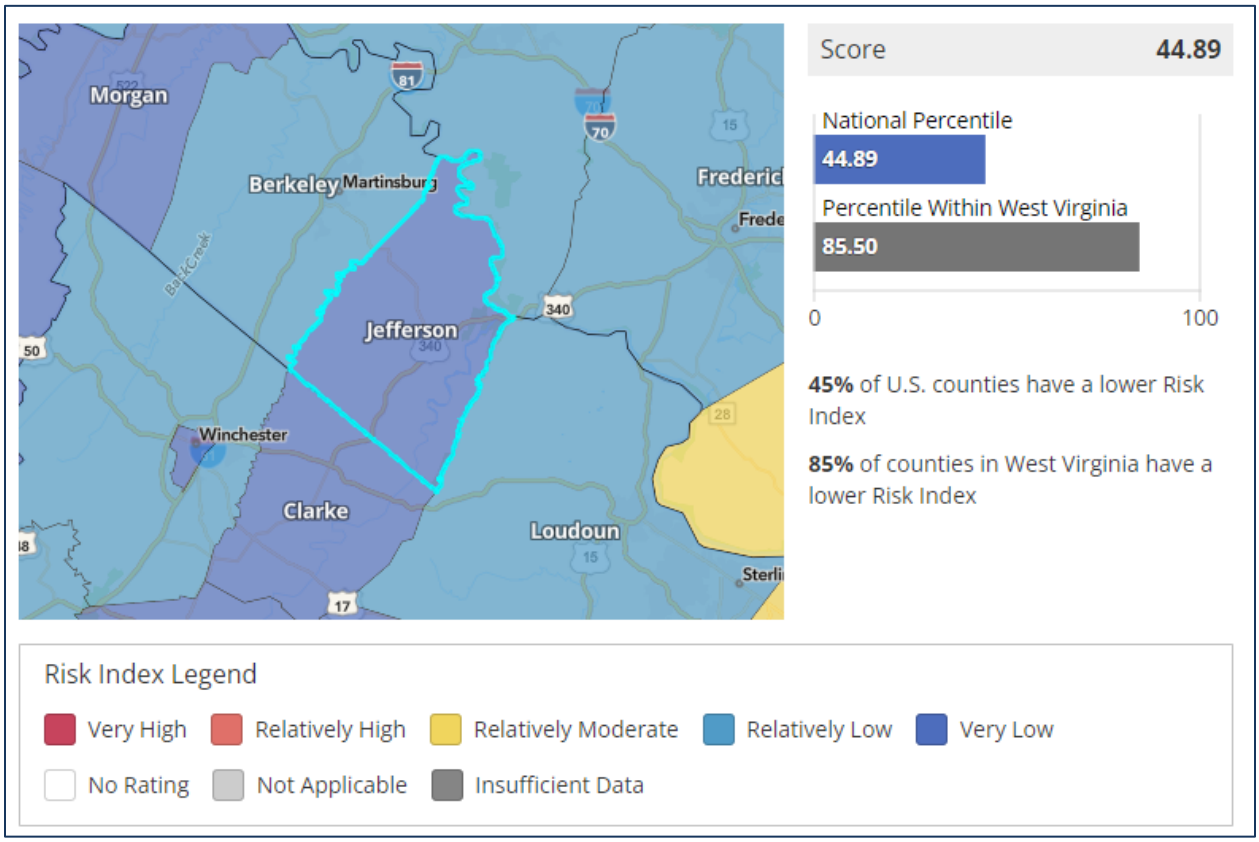
4.4.4.7. Vulnerability Assessment

Flooding can lead to property loss as well as to loss of life. Flooding damages structures, including homes and businesses, vehicles, and infrastructure, including roadways. People who are surrounded by flood waters may at some point require evacuation, placing their lives and the lives of rescuers in danger. Flooding can disrupt the operation of businesses and schools. Recovery from flood damage can be time consuming and costly.

According to FEMA, vulnerability is a description of which assets, including structures, systems, populations, and other assets as defined by the community, within locations identified to be hazard prone, are at risk from the effects of the identified hazard(s). As part of this plan update, the analysis of vulnerability to community assets was expanded. In addition, impacts from climate change, social vulnerability, and changes in land use have been included. Information has been integrated from FEMA's recently updated National Risk Index, which according to FEMA has changed the way risk is assessed.

Using data and analysis from FEMA's National Risk Index, Jefferson County's risk index is relatively low compared to other counties in the United States, in fact 45% of U.S. counties have a lower risk index than Jefferson County. The risk index rating for neighboring jurisdictions is relatively low for Berkeley County (West Virginia) and Loudoun County (Virginia), while Clarke County (Virginia) is very low.

Figure 4-19: Jefferson County Data and Analysis, FEMA's National Risk Index



The hazard type Risk Index score measures the relative risk of a community for a specific hazard type by comparing its hazard type Risk Index value with other communities at the same level. These scores are calculated using data for only a single hazard type and reflect a community's Expected Annual Loss (EAL) value, community risk factors, and the adjustment factor used to calculate the risk value. The composite Hazard Type Risk Index score for flood in Jefferson County is detailed in Table 4-20.

Table 4-20: Jefferson County Flood Hazard Type Risk Index Score

Hazard Type	Expected Annual Loss Value	Social Vulnerability	Community Resilience	CRF	Risk Value	Score
Flood	$378,074	Very Low	Relatively Moderate	1.04	$379,699	45.8

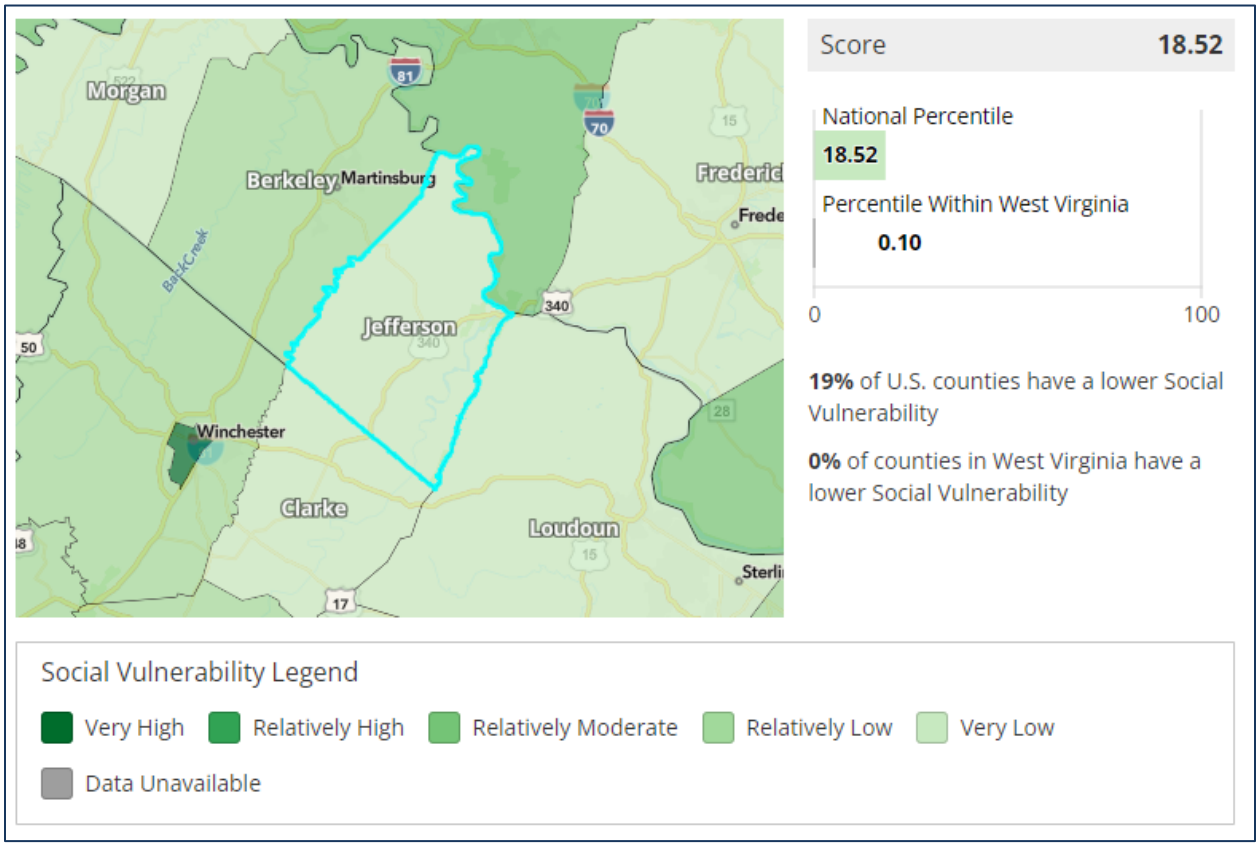
Jefferson County as an EAL value of $378,024 from flood impacts, is rated “very low” for social vulnerability, and is “relatively moderate” in terms of community resilience.

4.4.4.8. People

This section specifically focuses on how people are impacted by the flood hazard, including underserved communities and socially vulnerable populations. During a flood, people and first responders run the risk of sustaining injuries related to saving people and property as well as the possibility of drowning. In rare circumstances, floodwater can carry bacteria that can be harmful. One of the primary health-related flood concerns is power outages caused by flooding which impacts people who are reliant on power to run life-sustaining medical equipment; this is an example of a medically and socially vulnerable population.

Social Vulnerability for the Nation Risk Index (NRI) is measured using the Social Vulnerability Index (SVI) published by the Centers for Disease Control and Prevention (CDC). The SVI considers well-established indicators of social vulnerability, including socioeconomic status, household characteristics, racial & ethnic minority status, and housing type & transportation. According to the NRI, people, including underserved communities and socially vulnerable populations, in Jefferson County have a very low susceptibility to the adverse impacts of natural hazards when compared to the rest of the U.S. In comparison to neighboring jurisdictions, Loudoun County (Virginia) social vulnerability is very low as well, while Berkley County is relatively low.

Figure 4-20: Jefferson County Social Vulnerability



In addition, National Centers for Environmental Information (NCEI) provides death and injuries for flood and flash flood events in Jefferson County. The NCEI database reported no deaths or injuries due to flood and flash flood events in the County or its municipalities. However, according to NCEI reports for flood, drivers had to be rescued from their vehicles stalled in high water on Bloomery Road, which runs parallel to the Shenandoah River near the community Bloomery and Avon Bend Road, which also is parallel to the Shenandoah River, during the February 2003 flood event. A water rescue was required along the Berkeley/Jefferson County line when a man was stranded in a van on a water-covered bridge on Sulphur Springs Road. The Centers for Disease Control and Prevention report that over half of all flood-related drownings occur when a vehicle is driven into hazardous flood water (NWS, 2023). These drownings typically occur when people underestimate the force of flood waters.

4.4.4.9. Structures

The best way for communities to strengthen floodplain management is by reviewing current codes and ordinances and by strongly enforcing their floodplain codes on new developments to avoid worsening future 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 that went undetected by the National Weather Service created surface flooding, which forced evacuations in several floodplain communities.

Structures including facilities, lifelines and critical infrastructure were reviewed for vulnerability. In 2017, a Flood Risk Report (FRR) for the Conococheague – Opequon Watershed was developed. Unincorporated areas of Jefferson County, the Towns of Harpers Ferry and Shepherdstown, and the City of Ranson were included in this assessment. According to the FRR, The Conococheague-Opequon Watershed covers an area of 5,936 square miles and includes portions of Berkeley, Jefferson, and Morgan Counties in West Virginia. A community overview for Harpers Ferry, Shepherdstown, Ranson, and unincorporated areas of Jefferson County are provided in Table 4-21, below.

Table 4-21: Flood Risk Report (FRR) for the Conococheague Opequon Watershed Community Overview (FEMA FRR, 2017)

Community	Total Community Population	Percent of Population in TIEF	Total Community Land Area (sq mi)	Percent of Land Area in Watershed
Harpers Ferry	286	33	0.5	68
Ranson	4,440	<1	8.0	28
Shepherdstown	1,734	30	0.4	100
Jefferson County (unincorporated)	53,498	18	0.0	100
Berkeley County (unincorporated)	177,843	18	288.1	100
Morgan County (unincorporated)	28,159	35	219.2	68

Source: FEMA Flood Risk Report: Conococheague-Opequon Watershed, 02070004; Report Number 01; 1/31/2017

The FRR flood risk analysis incorporated results from the Total Exposure in Floodplain (TEIF) loss estimation tool and provides FEMA Average Annualized Loss (AAL) Study results for comparison; Table 4-21. The results indicate that the Town of Shepherdstown has the greatest loss ratio with 36%. The higher loss ration percentage for the Town is probable since 30% of the population is located within TEIF. Loss ratios for the unincorporated areas of Jefferson County is greater than Berkley or Morgan County even though the unincorporated areas Morgan County has a higher percentage of population in the TEIF.

Table 4-22: Conococheague-Opequon Watershed: Comparison of Estimated Potential Losses for Structures in the SFHA (FEMA FRR, 2017)				
Community	**Total Estimated Value**	**Total Exposure in Floodplain (TEIF)**		**Average Annualized Loss (AAL)***
		Dollar Losses[1,2]	**Loss Ratio[3]**	**Dollar Losses[1]**
Harpers Ferry	$19,400,000	$4,980,000	26%	$170,000
Ranson	$0	$18,260,000	0%	$180,000
Shepherdstown	$46,880,000	$16,860,000	36%	$20,000
Jefferson County (unincorporated)	$1,012,440,000	$226,850,000	22%	$2,040,000
Berkeley County (unincorporated)	$2,713,190,000	$256,440,000	9%	$5,660,000
Morgan County (unincorporated)	$908,280,000	$111,040,000	12%	$2,040,000

Source: FEMA Flood Risk Report: Conococheague-Opequon Watershed, 02070004; Report Number 01; 1/31/2017

Source: TEIF and AAL results stored as the Flood Risk Assessment Dataset in the Flood Risk Database.

1 Losses shown are rounded to nearest $10,000.

2 Estimated Value = Asset Replacement Value of all buildings for the community within the extent of the countywide floodplains. 3 Loss ratio = Dollar Losses / Estimated Value. Loss Ratios reflect community TEIF values and are rounded to the nearest integer percent.

*The AAL indicates the estimated economic loss value to property in any single year. It is generated by calculating losses for the 0.2%, 1%, 2%, 5% and 10% annual chance flood events and creating an average of those values. However, in many communities, the AAL inaccurately reports economic losses, and therefore should be used only to compare potential losses between states and counties. TEIF aims to address these inaccuracies by providing a total potential economic loss value to property, for all communities with development within the special flood hazard area. The total economic loss value can be used to understand the degree of risk in each community relative to others.

The 2022 West Virginia Statewide Risk Assessment estimates that approximately 734 buildings in Jefferson County are located within the 1% annual chance flood hazard area. The assessment estimates that the building dollar exposure to be approximately $118,388,409. The following tables summarize the HAZUS data.

Table 4-23: Building Dollar Exposure: Residential versus Non-Residential								
Community	Residential		Commercial Non-Residential		Other Non-Residential		Total Building Value	
	#	Value ($)	#	Value ($)	#	Value ($)	#	Value ($)
Unincorporated	505	$60,022K	14	$4,889K	7	$5,349K	526	$70,260K
Bolivar	3	$251K	0	$0K	1	$4,000K	4	$4,251K
Charles Town	23	$2,073K	4	$7,893K	0	$0K	27	$9,966K
Harpers Ferry	6	$722K	25	$6,243K	0	$0K	31	$6,965K
Ranson	3	$251K	0	$0K	1	$4,000K	4	$4,251K
Shepherdstown	23	$2,073K	4	$7,893K	0	$0K	27	$9,966K
Total	**654**	**$76,146K**	**67**	**$27,999K**	**13**	**$14,243K**	**734**	**$118,388K**

Source: Region 9 Tabular Community-Level Report Link: data.wvgis.wvu.edu - /pub/RA/State/CL/Community_Asset/

No essential facilities in Jefferson County were located within the 1-percent-annual or 0.2-pecent annual chance flood hazard areas. Essential facilities include police stations, fire stations, 911 center, schools, hospital, and nursing homes. Community assets for Jefferson County include government facilities (federal, state, local), emergency medical services (EMS), religious organizations, utilities, postsecondary educational facilities, or other buildings of significance that contribute to the built environment of community. A total of thirteen (13) community assets were located within the 1-percent-annual chance flood hazard area. Table 4-24 detail types of community assets at risk.

Table 4-24: Community Assets Flood Vulnerability for Jefferson County & Municipalities							
Community	Religious Org.	Govt. Bldg.	Utility	Education	EMS	Other	Total
Unincorporated	2	2	1	0	0	0	5
Bolivar	0	0	1	0	0	0	1
Charles Town	0	0	1	0	0	0	1
Harpers Ferry	0	1	0	0	0	0	1
Ranson	1	0	0	0	0	0	1
Shepherdstown	0	0	1	3	0	0	4
Jefferson County Total	3	3	4	3	0	0	13

Source: Region 9 Tabular Community-Level Report Link: data.wvgis.wvu.edu - /pub/RA/State/CL/Community_Asset/

Community assets most vulnerable to the 1-percent-annual-chance flood event are shown in Table 4-25. The flood depth grid and building damage estimates quantify the degree of risk at which facilities may be subject to the greatest flood damage.

Table 4-25: Community Assets Flood Vulnerability for Jefferson County & Municipalities					
Community	**Facility Name**	**Facility Type**	**Flood Tool Link**	**Flood Depth**	**Building Damage Percent**
Harpers Ferry	National Park Service Information Center	**Government**	FT	31.9	78%
Unincorporated Jefferson County	Millville Pentecostal Church	**Religious Institution**	FT	7.1	13%
Shepherdstown	Shepherd University White Hall	**Education**	FT	2.0	5%
Shepherdstown	Shepherd University McMurran and Reynolds Hall	**Education**	FT	2.0	5%

Source: Region 9 Tabular Community-Level Report Link: data.wvgis.wvu.edu - /pub/RA/State/CL/Community_Asset/

The WV GIS Technical Center has also performed in depth analysis of critical infrastructure, flood depth, building-level risk, and much more on the WV Flood Tool, located at: www.mapwv.gov/flood/map/. Hazus reports found in Appendix E provide links directly to different aspects of the flood tool.

4.4.4.10. Systems

Systems in this section refer to networks and capabilities. Floods often disrupt many systems including power, sewer, water, communications, and road access. Lacking these, it is difficult to continue critical services to the community. Damage to property, facilities, and infrastructure can range from minimal to total loss. The cost of recovery from floods can vary for everyone. Homeowners and businesses can claim insurance benefits if they have them but may not be able to continue working due to the flood-related damages within the community or of their own property.

According to the National Centers for Environmental Information narratives for flood and flash flood events impacted roadways and caused power outages. Below are examples of events that caused roadway closures and power outages.

- January 1996 - Across the entire region, numerous creeks and streams were out of their banks well into Friday morning, closing roads, damaging homes, and businesses, and causing mud and debris slides.
- September 1997 - A thin band of thunderstorms, laden with tropical moisture, dumped between 5 and 8 inches of rain in a small area of northern Jefferson County. Though no fatalities or injuries ((were reported, several local roads were closed.
- January 1998 - In Jefferson County, several secondary roads were closed due to high water, and many creeks were at or just above bankful. A portion of federal highway 340 was closed briefly just west of Harpers Ferry. Rainfall totals in the affected area ranged from 2 to 3 inches.
- February 1998 - Moderate rain, falling on top of 3 to 6 inches of snow, produced areas of flooding across the eastern panhandle late on the 4th and continuing through the afternoon of the 5th. In Jefferson County, 9 secondary roads closed.

- March 1998 - A combination of 22 primary and secondary roads were closed in Berkeley and Jefferson Cos, including state highways 51, 9, and 7 (all in Jefferson County).
- June 2000 - In Jefferson County, two trees were downed north of Charles Town where 2.85 inches of rain was recorded. Up to 4 feet of water covered roads in Ranson and several county roads were also flooded.
- June 2003 - In Jefferson County, water flowed over Leetown Road in Kearneysville.
- May 2003 - In Jefferson County, Route 230 was closed by high water. Roads were also flooded in the Ranson and Millville areas. In addition, flooding was reported along Route 340 near the confluence of the Shenandoah and Potomac rivers near Harpers Ferry.
- March 2007 - The South Branch of the Potomac River at Shepherdstown crested at 15 feet after midnight on March 2nd. A few nearby roads were flooded as a result of the heavy rain and river flooding.
- April 2007 - Heavy rain spread north across the region early April 15th, causing flooding by the afternoon and evening. Winds also increased in the wake of the low, downing trees and power lines across the eastern pan handle.

Utilities were assessed as part of the vulnerability analysis of systems. A total of four (4) utilities were located within the 1-percent-annual chance flood hazard area. The flood depth grid and building damage estimates quantify the degree of risk at which facilities may be subject to the greatest flood damage.

Table 4-26: Community Assets Flood Vulnerability for Jefferson County & Municipalities

Community	Facility Name	Facility Type	Flood Tool Link	Flood Depth	Building Damage Percent
Bolivar	Harpers Ferry Bolivar PSD Wastewater Treatment Plant	**Utilities**	FT	15.5	Not provided
Shepherdstown	Shepherd's Mill	**Utilities**	FT	12.3	55%
Shepherdstown	Shepherdstown Water Works Plant	**Utilities**	FT	2.9	16%
Charles Town	City of Charles Town Wastewater Treatment Plant	**Utilities**	FT	2.1	12%
Unincorporated Jefferson County	Harpers Ferry Water Works Treatment Facility	**Utilities**	FT	0.0	0%

4.4.4.11. Natural, Historic and Cultural Resources

The National Register of Historic Places was used to assess the vulnerability of natural, historic, and cultural resources. For more complete information about the historical designations, refer to the National Register WV Listings. Jefferson County is ranked fourth in the State as having the most historical buildings in the high-risk floodplain. Most of these historical buildings are in the towns of Shepherdstown and Harpers Ferry. The unincorporated area of Jefferson County is ranked first among all unincorporated areas in the State of West Virginia with 26 historical buildings.

Table 4-27: Historical Community Assets Flood Vulnerability for Jefferson County & Municipalities				
Community	**NR Bldg. Sites**	**Bldg. in Historic District (older than 1930)**	**Total Historic Bldgs.**	**# NR Areas /Districts in 1% Floodplain**
Unincorporated	3	23	26	21
Bolivar	0	3	3	3
Charles Town	0	14	14	2
Harpers Ferry	1	28	29	4
Ranson	0	0	0	1
Shepherdstown	1	50	51	2
Jefferson County Total	5	118	123	23

Source: Region 9 Tabular Community-Level Report Link: data.wvgis.wvu.edu - /pub/RA/State/CL/Community_Asset/

4.4.4.12. Community Activities

Activities that have value to the community could potentially be impacted by flood events. When these activities are delayed or cancelled due to flooding, the economy of the community is affected. Numerous activities are scheduled within Jefferson County and its municipalities. Below are community activities that occur throughout the year or annually.

- Jefferson County Fair – July and August at Jefferson County Fairgrounds & weekly farm markets
- Historical Walking Tours of Harpers Ferry, WV – Available All Year (Note four (4) of the National Register Areas within Harpers Ferry are located in the 1-percent-annual chance floodplain.)
- Hollywood Casino Horse Races – Reoccurring – Located in Charles Town
- September 22 - 24 - Mountain Heritage Arts & Craft Festival at Jefferson County Fairgrounds
- October 7 - Freedoms Run (Note: held in in Harpers Ferry & Shepherdstown.)

Impacts to community events would be dependent upon the event type and location.

Figure 4-21: Special Flood Hazard Area – Town of Bolivar Assets and 1% Annual Chance Flood Hazard Area

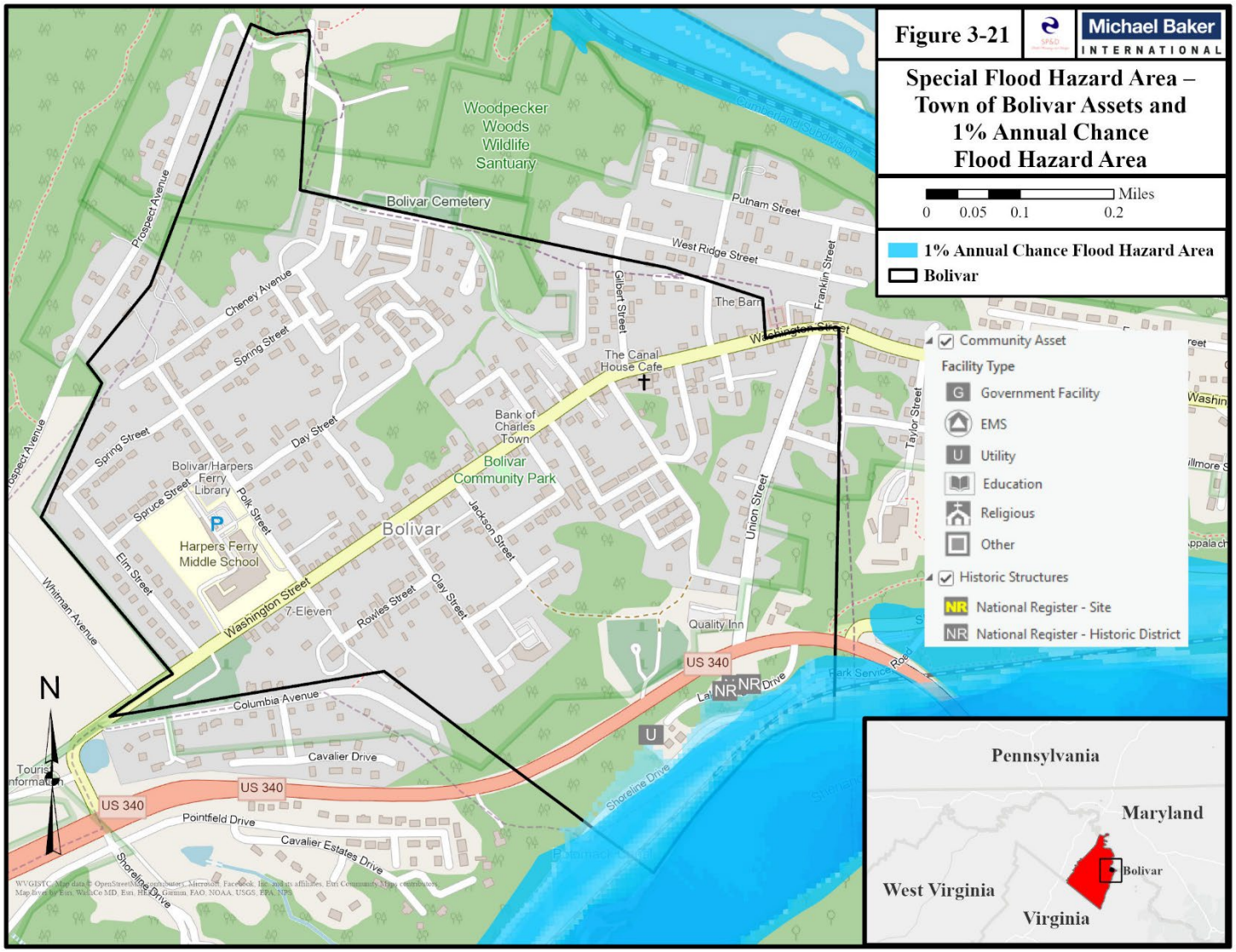


Figure 4-22: Special Food Hazard Area, City of Charles Town Assets and 1% Annual Chance Flood Hazard Area

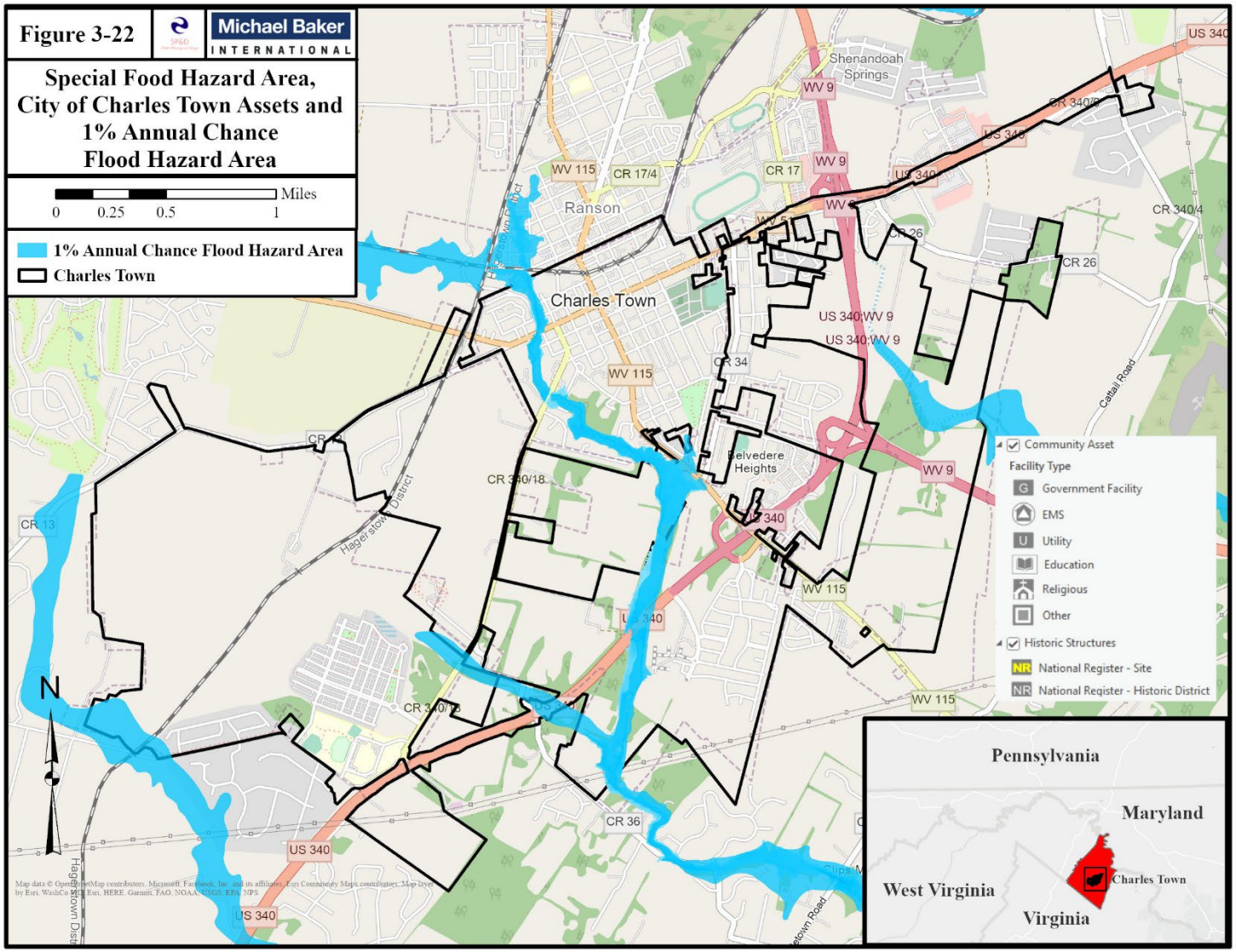


Figure +: Special Food Hazard Area, Town of Harpers Ferry Assets and 1% Annual Chance Flood Hazard Area

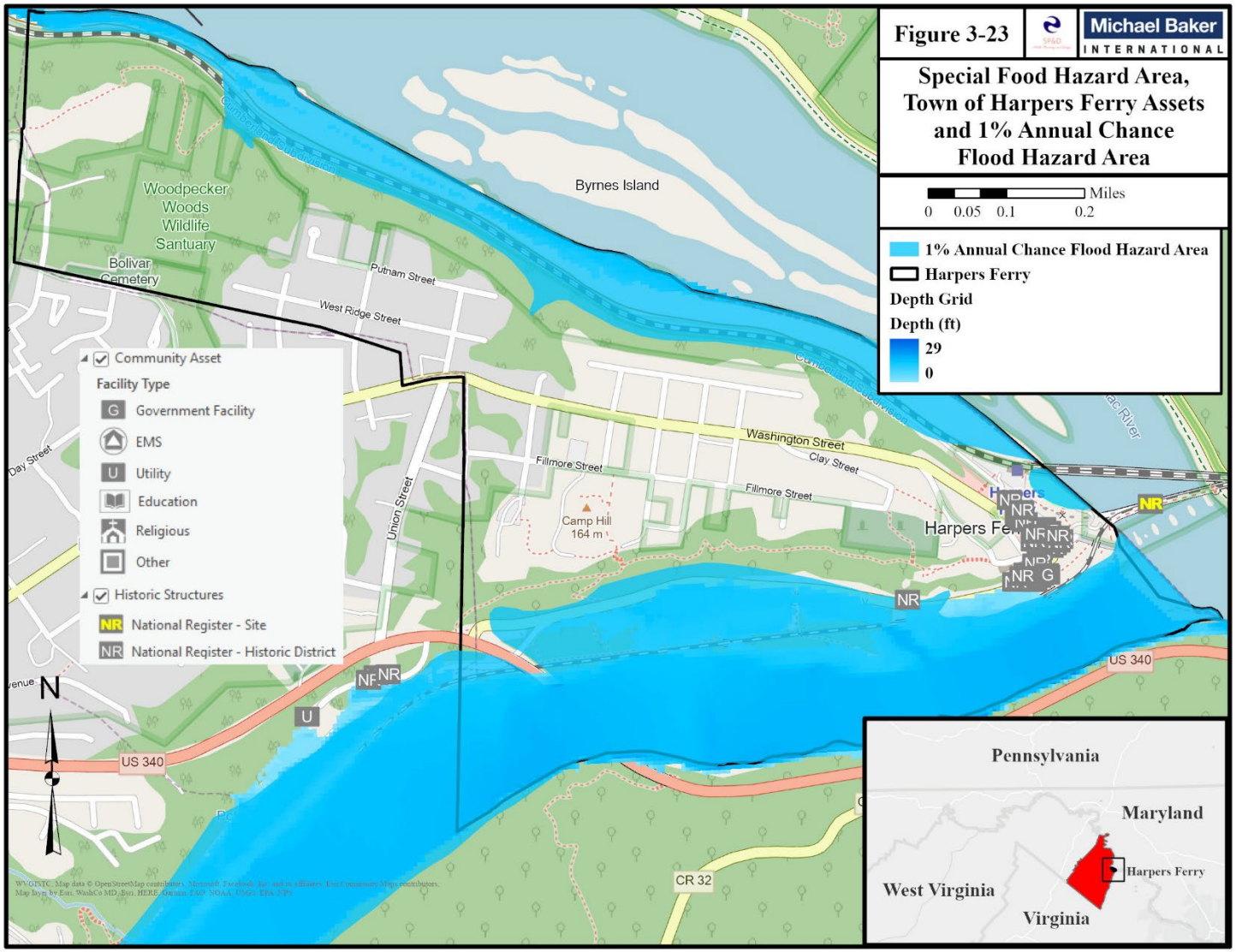


Figure 4-23: Special Food Hazard Area, Town of Ranson Assets and 1% Annual Chance Flood Hazard Area

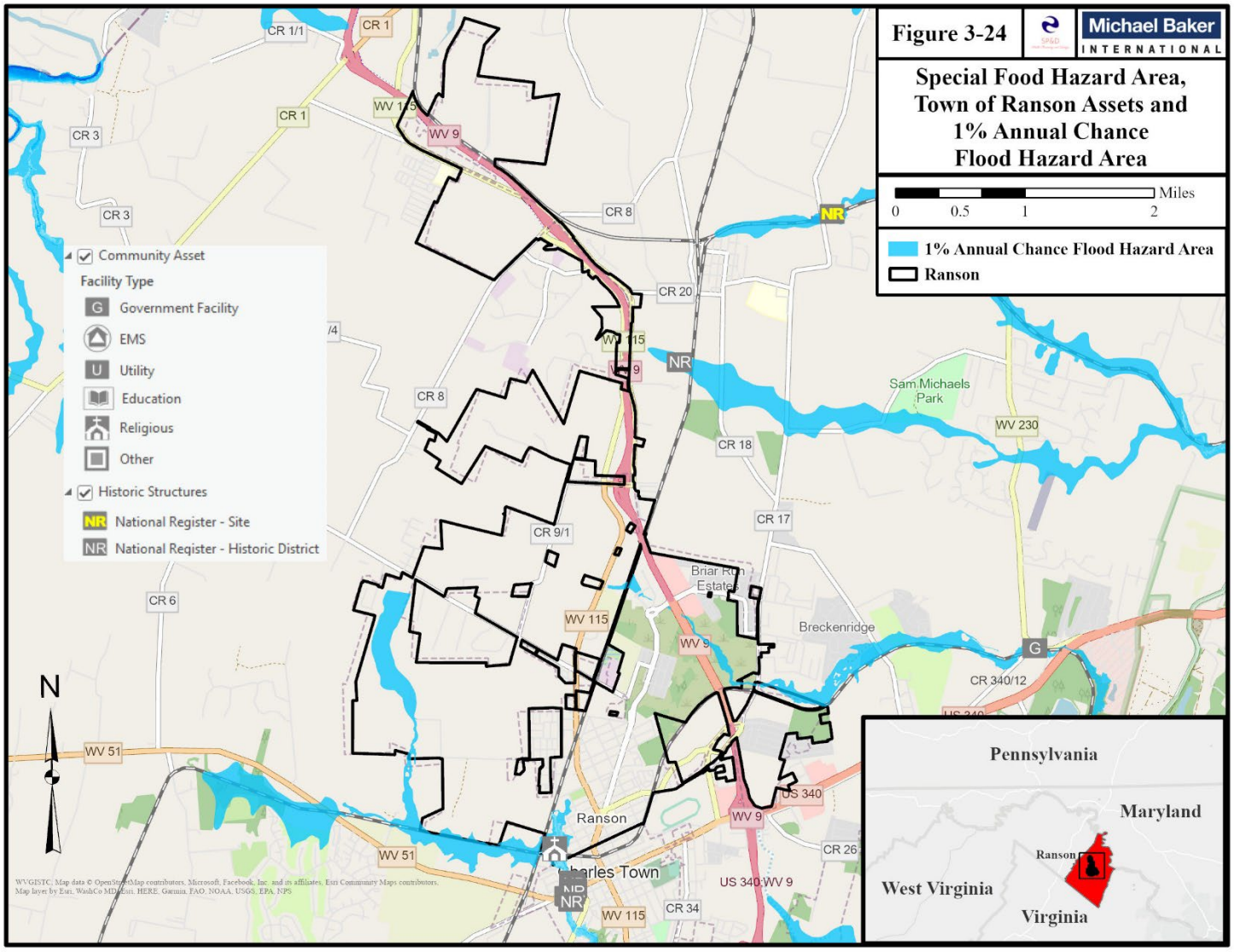
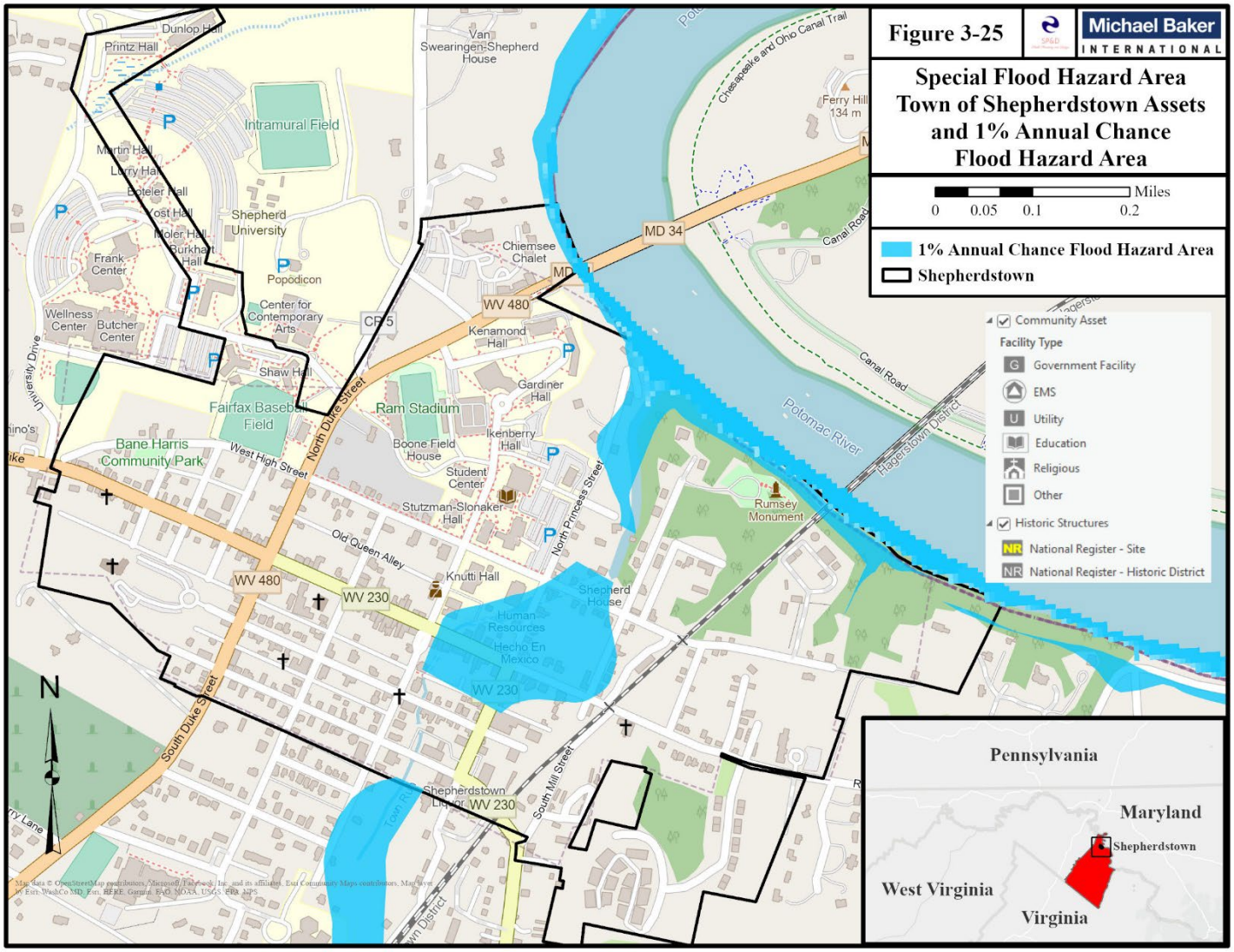


Figure 4-24: Special Flood Hazard Area Town of Shepherdstown Assets and 1% Annual Chance Flood Hazard Area



4.4.5. Landslides and Land Subsidence

Landslides are one of the most common natural hazards in West Virginia, having the potential to damage buildings and roads, disrupt utilities, and cause injuries and deaths (West Virginia Emergency Management Division, 2018).

A landslide consists of mass movements of soil and/or rock down a slope due to gravity and usually water. Slips, slumps, rock falls, slides, flows, and creep are terms used by geologists to identify specific mechanisms and velocities for mass movement. Most slopes in West Virginia are vulnerable, especially after heavy rain or snow melt; the telltale signs are hummocky surfaces, leaning and bent trees or utility poles, many seeps and sag ponds (water-filled depressions), and old or recent landslides where horizontal and vertical movement has occurred (WVGS, 2023). The West Virginia GIS Technical Center identifies five different types of landslides, all of which are capable of happening in the state:

- Slide – Translational or rotational movement of material downslope. Slides travel at a range of rates, displacing forests and infrastructure as they move. Quite common in West Virginia, large slides are readily identified using LiDAR data.
- Debris Flow – Failures saturated with water, where transported material moves downslope as a slurry of rock, soil, and debris. Flows may move quickly and cause loss of property and life far downslope from their source. Debris flows are common in mountainous areas of West Virginia but can be difficult to map using LiDAR data.
- Lateral Spread – Lateral movement of rock blocks across relatively shallow slopes. Spreads move slowly compared to most other landslides.
- Fall – Free-fall of material from a steep slope or cliff face. Falls often occur with little warning. Most falls are very difficult to map using LiDAR data because they are either promptly mitigated or consist of rock fragments too small to be identified.
- Undetermined Slope Failure – A contingency category consisting of slope failures in which available data is insufficient to assign failure material or mode (WV GIS Technical Center 2021). Land Subsidence.

Many factors cause landslides and rockfalls, but the following are prevalent in the State of West Virginia: water changes, seismic activity, mining, and human activity.

- Water – Intense rainfall, changes in groundwater level, and water level changes along coastlines, earthen dams, and the banks of lakes, reservoirs, and rivers are the primary triggers of landslides.
- Seismic Activity – Earthquakes in landslide-prone areas greatly increase the likelihood that landslides will occur, either due to ground shaking alone or shaking-caused dilation of soil materials.

- Mining – Huge amounts of vibrations, including blasting, reach yards under the soil surface, which poses a greater threat to areas that are already at risk for sliding.
- Human Activity – Landslides may result directly or indirectly from human activities. Construction activity that undercuts or overloads dangerous slopes or that redirects the flow of surface or34 groundwater can trigger slope failures (USGS 2023).

Land subsidence is a gradual settling or sudden sinking of the earth's surface due to removal and displacement of subsurface earth materials. Subsidence is one of the most diverse forms of ground failure, ranging from small or local collapses to broad regional lowering of the earth's surface. The principal causes are mostly due to human activities and include but are not limited to:

- Aquifer-system compaction associated with groundwater withdrawals
- Drainage of organic soils
- Fracking and underground mining
- Earthquakes and erosion
- Natural compaction or collapse
- Expansive soils
- Mining activities (USGS 2023)
- Reduces the ability to store water in an aquifer
- Partially or completely submerges land ♣ Collapses water well casings
- Disrupts collector drains and irrigation ditches
- Alters the flow of creeks and bayous, which may increase the frequency and severity of flooding
- Damages roadways, bridges, building foundations, and other infrastructure

Consequences of land subsidence include:

- Reduces the ability to store water in an aquifer
- Partially or completely submerges land
- Collapses water well casings
- Disrupts collector drains and irrigation ditches
- Alters the flow of creeks and bayous, which may increase the frequency and severity of flooding
- Damages roadways, bridges, building foundations, and other infrastructure

Land subsidence occurs on karst terrain, which is generally underlain by limestone or dolomite, in which the topography is formed chiefly by the dissolving of rock which may be characterized by sinkholes, sinking streams, closed depressions, subterranean drainage, and caves (USGS 2023).

4.4.5.1. Location and Extent

The Eastern Panhandle faces some risk of minor landslides, in large part due to its mountainous terrain, including North Mountain and Cacapon Mountain. Jefferson County encompass a variety of susceptibility, but at the local level only minor landslides in the form of falling rock and/or mud slides have occurred to date. No serious injury, death or property damage attributed to landslides has been identified in the region. Most of these landslides occur along road and highway cuts through the mountains. Figure 4-25 shows general landslide susceptibility and incidence rate throughout the region. According to the United States Geological Survey (USGS), most of West Virginia is listed as having high percentages of landslide incidents. Specifically, the southeastern corner of Jefferson County has the highest landslide risk. The remainder of the county is characterized as either a medium or low landslide risk. The communities of Harpers Ferry, Bolivar, Charles Town, and Ranson fall in the medium landslide risk category, whereas Shepherdstown is considered a low landslide risk area. (USGS, 2016). Figure 4-26 identifies landslide hazard areas throughout the region.

Figure 4-25: Landslide Incidence and Susceptibility near the Eastern Panhandle Region (USGS, 2016)

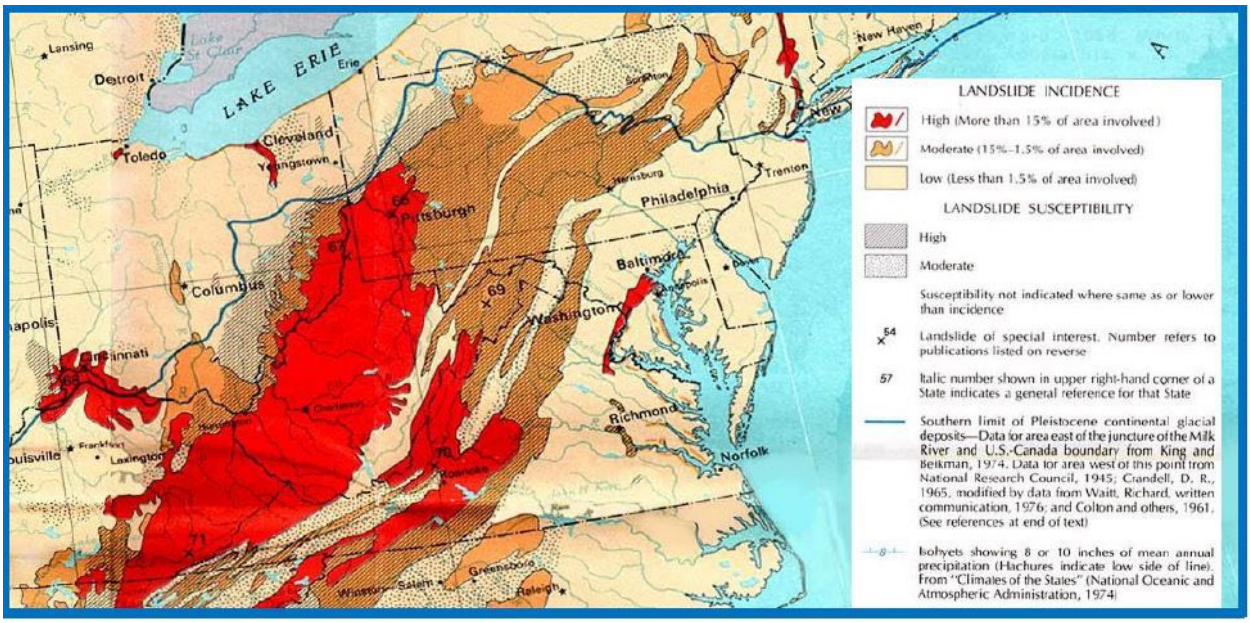
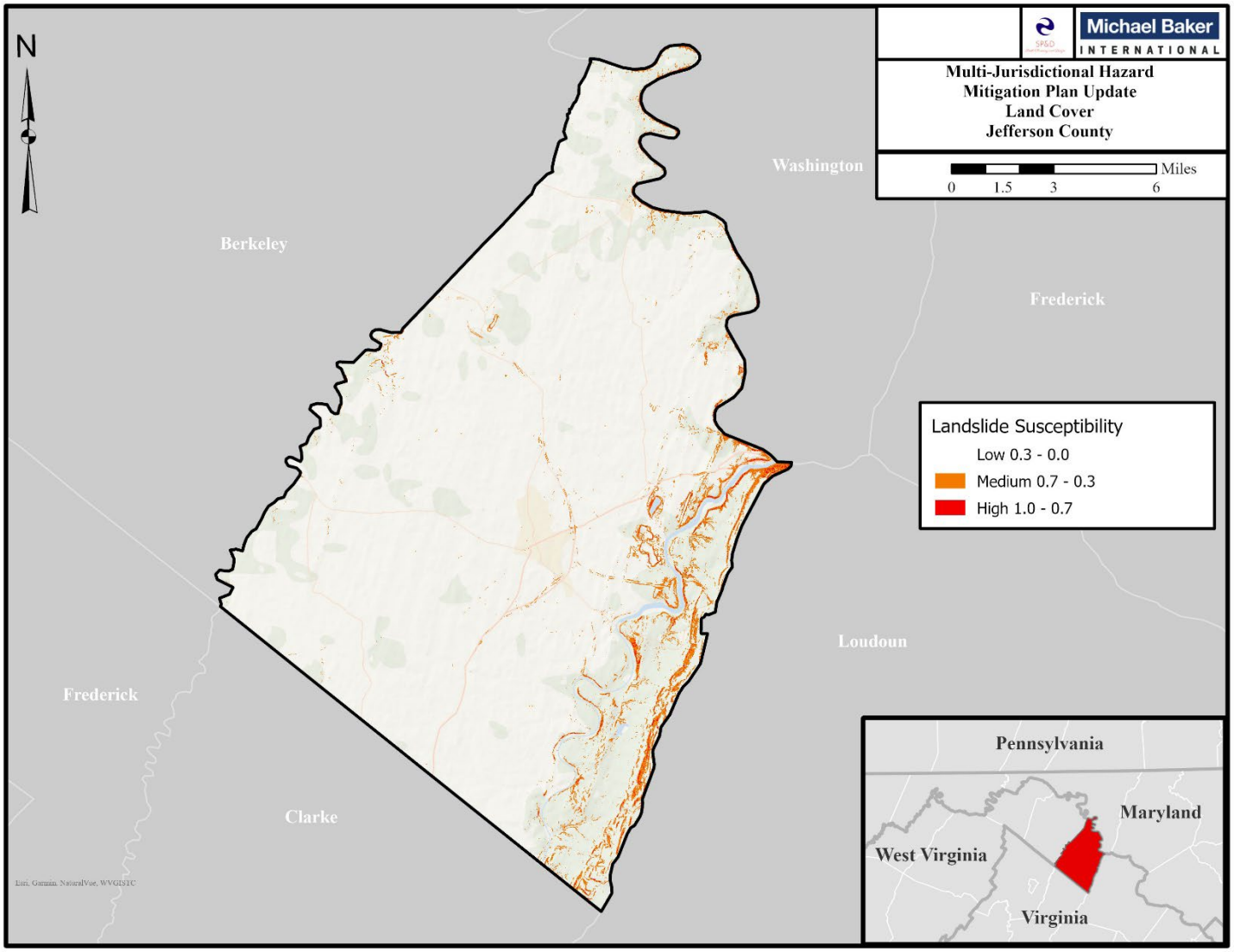


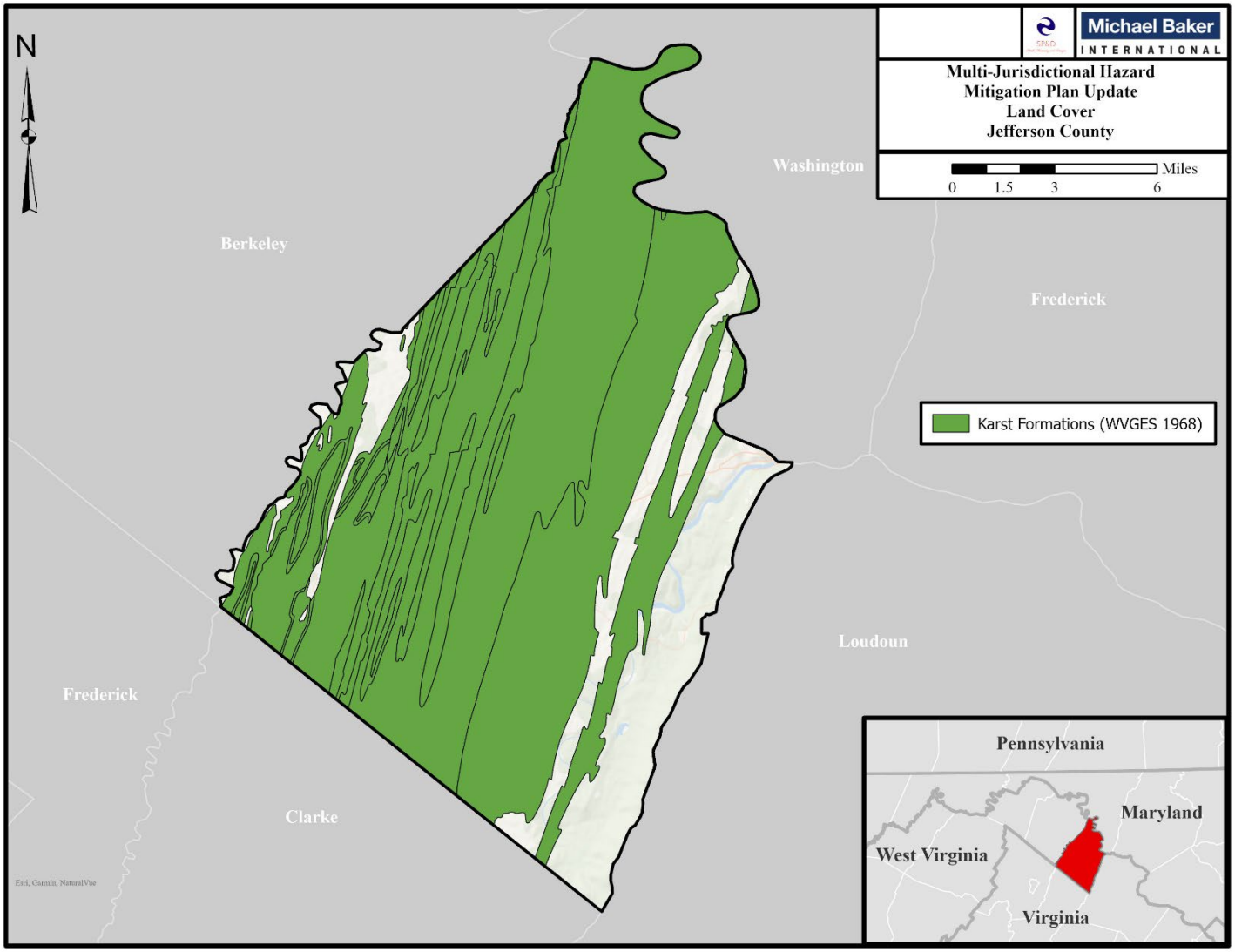
Figure 4-26: Landslide Hazard Susceptibility, Jefferson County



Land subsidence occurs in areas of abandoned mines and karst area underlain by carbonate rock. Karst is a terrain, generally underlain by limestone or dolomite, in which the topography is formed chiefly by the dissolving of rock and which may be characterized by sinkholes, sinking streams, closed depressions, subterranean drainage, and caves (WVGS, 2023). These formations often contain several underground caves that could collapse, causing subsidence on top of the ground. The County of Jefferson has the highest percentage (79.4 percent) of land in the karst subsidence area. Additionally, some portions of the region have also been undermined which could result in subsidence as well. As a result, the entire region appears susceptible to subsidence, but it should be noted that the type of subsidence could vary. Figure 4-27 depicts these areas, with the green representing carbonate rocks outcrops.

Human activity can often be the cause of a subsidence area. Leaking water pipes or structures that convey stormwater runoff may also result in areas of subsidence as the water dissolves substantial amounts of rock over time. In some cases, construction, land grading, or earth-moving activities that cause changes in stormwater flow can trigger subsidence events. Slow subsidence is typically caused by consolidation in areas in which the soil stresses increase materially. Slow developing regional subsidence is often the result of excessive removal of groundwater, or petroleum that increases the effective stresses in subsurface soils. Slow developing, site-specific subsidence is often the result of construction structures or facilities over uncontrolled fills, including soils dumped loosely at convenient dumping locations, leveled deposits of mine spoil, highway construction spoil, head-of-hollow fills, covered sanitary landfills, etc. (State of West Virginia, 2018).

Figure 4-27: Karst Formations, Jefferson County



4.4.5.2. Range of Magnitude

Landslide

Landslide velocity can vary from rapid to slow, and the amount of material moving in a landslide can range from a relatively small amount to a large amount. Landslides can include falling, sliding, or flowing of rocks and soil or a combination of these different types of motion.

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

Landslides can have potentially devastating consequences in localized areas. Landslides cause damage to transportation routes, utilities, and buildings and create travel delays and other side effects. Structures or infrastructure built on susceptible land will likely collapse as their footings slide downhill. Structures below the landslide can be crushed. Landslides next to roads and highways have the potential to fall on and damage vehicles or cause crashes. Most West Virginia landslides are moderate to slow moving and damage things rather than people.

Land Subsidence

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. Potential damage due to landslides or subsidence in the region is mostly limited to roadway closures and/or the possibility of highway accidents due to debris deposited on the roadway. The threat of landslides is greatest along high-volume traffic areas, especially where the road travels through a cut in the topography. Other problems related to subsidence include the disruption of utility services and damages to private and public property including buildings, 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. A worst-case scenario event for planning purposes would likely involve a U.S. Route traversing a higher risk area. Crushed vehicles, stranded motorists, economic impacts due to disruptions in freight movement, as well as the cost to clear debris would result from this scenario.

4.4.5.3. Past Occurrence

Landslides

Landslides have been known to occur in West Virginia and adjoining states since 1850, but the damage caused by landslides has become increasingly expensive as development encroaches more and more on the area's hillsides. A large portion of Jefferson County's topography is that of mountainous and steep.

According to the United States Geological Survey (USGS), most of West Virginia is listed as having high percentages of landslide incidents. Specifically, the southeastern corner of Jefferson County has the highest landslide risk. The remainder of the county is characterized as either a medium or low landslide risk. The communities of Harpers Ferry, Bolivar, Charles Town, and Ranson fall in the medium landslide risk category, whereas Shepherdstown is considered a low landslide risk area.

In recent years, there have been problems with several rockslides along the area of Route 340 across from Harpers Ferry, just before the Virginia State line.

Land Subsidence

There have been ambiguous and very limited historical reports of land subsidence activity in Jefferson County. Extensive research indicates that there have been unspecified limited land subsidence events in the county since the county adopted this plan originally in 2003.

During committee meetings members shared their experiences with recurrent and recent land subsidence events. The table below outlines the event date, if available, what happened, and how it could possibly be avoided going forward.

The Jefferson County Development Authority (JCDA) shows property with sinkholes. It's hard to find large properties without them. Although the JCDA does not keep a record of sinkholes, they do find them on most of the properties in the county.

Future Occurrence

Since the exact number of previous landslides over a definite time interval is not known, it is not possible to determine a quantitative probability of future occurrence for landslides in the region. Historical evidence indicates significant landslide and subsidence events are unlikely to occur in the region. However, mismanaged intense development in steeply sloped areas could increase their frequency of landslide occurrence. Building and road construction are contributing development factors to landslides as they can often undermine or steep otherwise stable soil. The West Virginia Statewide Standard Hazard Mitigation Plan (2018) recommends that the WV Department of Transportation (WVDOT) be involved in determining areas where roads experience sinkholes to improve on incidence reporting. Increased rainfall has also been shown to increase occurrences of landslide and land subsidence events.

Although subsidence events will continue to be a possibility in West Virginia, the probability of an occurrence is difficult to predict due to the low number of recorded previous events. Future development

and mining activities in the state can lead to a higher probability of subsidence occurring in the hazard area. Periods of drought and flooding are likely to increase in frequently in severity. Impacts from drought and flood events may exacerbate the likelihood of a subsidence event due to soil expansion and contraction. As drought levels increase, the need to pump water from aquifers also increases, which increase the likelihood of subsidence (Water Education Foundation, 2023).

Vulnerability Assessment

Earthen disturbances such as landslides and land subsidence can result in the disruption of roads, water, sewer, gas, electric and phone lines, as well as serious damage to public and private property. The loss of life likely to happen in such an occurrence would be a major concern, particularly for those areas where multi-family construction has taken place. While most of the development in the Eastern Panhandle is not particularly vulnerable to landslides, any landslide events that do occur in the region would take place in steeply sloped areas. In addition, conditions that may exacerbate or mitigate the severity and effects of landslides include erosion, unstable slopes, earthquakes, increase of weight of slopes, hydrologic factors, and human activity. Human activities are responsible for initiating or intensifying certain conditions where otherwise there would have been little or no risk. Activities that increase vulnerability by triggering landslides include:

- Excavations and developments in unstable slope materials
- Haphazard construction or improper use of pipelines
- Disruption of surface or subsurface drainage (streams and springs) e.g. by filling
- Overuse of fill materials on slopes, particularly at the heads of existing slide masses
- Removal of materials at the bases of slopes
- Vibrations from heavy traffic, blasting, and driving piles near unstable slopes

Additionally, increased deforestation and soil disturbances caused by development on sloped areas may further increase these risks. As timbering and development of sloped land continue, the risk of significant landslides increases.

The WVU GIS Technical Center released a landslide risk assessment in 2021 for Jefferson County profiling high and medium risk road segments and structure/parcels. The landslide risk assessment is designed to be updated as characteristics of the area, roads and structures change, and updates and further mapping can be found on the WV Landslide Tool.

Population

Generally, a landslide event would be an isolated incidence and impact the populations within the immediate area of the incident. Populations downslope of a landslide hazard area are particularly vulnerable to this hazard. Health threats from landslides include: 1) trauma caused by rapidly moving water and debris; 2) broken electrical, water, gas and sewage lines that can lead to injury or illness; and 3) disrupted roadways that can endanger motorists and disrupt transport and access to health care (CDC 2023). To understand the risk to populations residing in high landslide susceptibility areas, a spatial

analysis was conducted using the 2020 U.S. Census data. Table 4-28 exhibits the percent population located in the high susceptibility areas and percent population located in highly vulnerable areas.

Table 4-28: Population Located in Highly Susceptibility/Vulnerable Landslide Areas

Total County Population	Highly Susceptibility Population	% Total Population	High Vulnerable Population	% Highly Vulnerable Population
56,922	226	0.40%	0	0.01%

Land Subsidence also has the potential to impact human health and life of residents and responders, structures, infrastructure, and natural resources. Based on the analysis, an estimated 45,663 Jefferson County residents are located in the subsidence karst hazard area, and 5.2 percent are highly vulnerable. Table 4-29 exhibits the percent population located in the these high susceptibility areas.

Table 4-29: Population Located in High Susceptibility Land Subsidence Areas

Total Population Located in the Subsidence Karst Hazard Area	Highly Vulnerable Population Located in the Subsidence Karst Hazard Area	% Highly Vulnerable Population Located in the Subsidence Karst Hazard Area
45,663	2,389	5.20%

It is anticipated that any new development in the subsidence hazard areas would expose the population and structures to the subsidence hazard.

Structures and Systems

Table 4-30 summarizes the number and replacement cost value of state assets located in the subsidence/karst hazard area. The spatial analysis for the subsidence / karst hazard areas determined there are 13 state facilities located in the subsidence karst hazard area of Jefferson County. Jefferson County has the highest replacement cost value ($279 million) of state facilities in the state.

Jefferson County does not have any state facilities within highly susceptibility landslide hazard areas.

Table 4-30**: State Facilities Located Within the Subsidence Karst Hazard Area**

Number of Structures	Replacement Cost Value (Structure Only)	Replacement Cost Value (Contents Only)	Total Replacement Cost Value (Structure & Contents)
13	$250,331,187	$28,709,213	$279,040,400

Transportation routes are vulnerable to landslides and land subsidence and have the potential to be inaccessible, creating isolation issues. Those that are in poor condition are the most vulnerable; however,

roads and bridges in good condition could fault as well. Utility infrastructure is also vulnerable; the interruption of services may impact vulnerable populations and facilities that need to be in operation during a disaster. Full functionality of critical facilities such as police, fire, and medical services is essential for response during and after a subsidence event.

- Roads—Access to major roads is crucial to life-safety after a disaster event and to response and recovery operations. Landslides can block egress and ingress on roads, causing isolation for neighborhoods, traffic problems, and delays for public and private transportation.
- Bridges—Landslides can significantly impact road bridges. Mass movements can knock out bridge abutments or significantly weaken the soil supporting them, making them hazardous for use.
- Power Lines—Power lines are generally elevated above steep slopes; but the towers supporting them can be subject to landslides. A landslide could trigger failure of the soil underneath a tower, causing it to collapse and ripping down the lines.
- Rail Lines—Similar to roads, rail lines are important for response and recovery operations after a disaster. Landslides can block travel along the rail lines, which would become especially troublesome, because it would not be as easy to detour a rail line as it is on a local road or highway.

Critical facilities are crucial to continuity of operations statewide and are sorted into lifeline categories. Jefferson County does not have any critical facilities within highly susceptibility landslide hazard areas. However, there are two critical facilities in Jefferson County that are located in the subsidence/karst hazard area. Table 4-31 summarizes the critical facilities located in the subsidence/karst hazard area.

Table 4-31: Critical Facilities Located in the Subsidence Karst Area

Communications	Energy	Food, Water, Shelter	Hazardous Material	Health & Medical	Safety & Security	Transportation	Total
0	0	1	0	0	1	0	2

Understanding future changes that impact vulnerability in the state can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The State considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of future conditions

Historic Resources & Environment

Impacts from drought and flood events may exacerbate the likelihood of a subsidence event due to soil expansion and contraction. As drought levels increase, the need to pump water from aquifers also increases, which increases the likelihood of subsidence (Water Education Foundation, 2023).

Projections may alter the stability of land in the subsidence hazards areas. Karst soils are easily erodible by rains as the water seeps into the rock, which can alter the landscape (National Geographic 2022). Eroded landscapes can lead to unstable ground above, making the area at increased risk. The alteration of these landscapes should be factored into future land use regulations to avoid an increased risk to population and property.

Additionally, increased deforestation and soil disturbances caused by development on sloped areas may further increase these risks. As timbering and development of sloped land continue, the risk of significant landslides increases.

4.4.6. Invasive Species

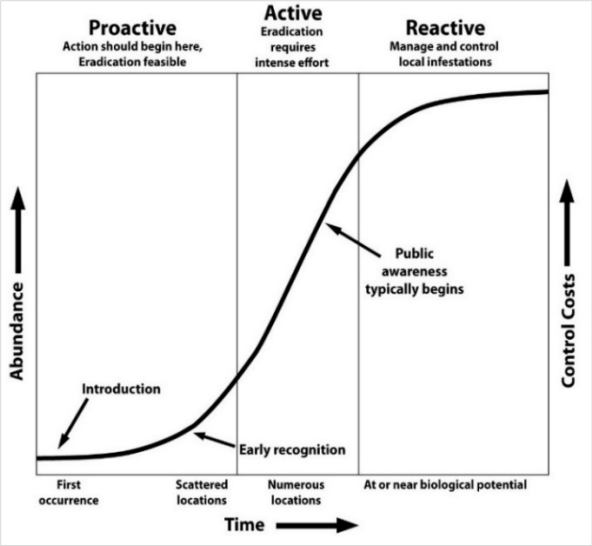
The spread of non-native plant, insect, and animal species, known as invasive species, has increased as international trade, travel and tourism have grown. Only a small percentage of these invasive species thrive and infest their new environment. Presidential Executive Order 13112 defines an invasive species as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." There are four main types of invasive species: aquatic species, plants, animals, and microbes (USDA, 2016). There are approximately 500 invasive plant species and over 50 invasive animals or insects in West Virginia (WVDNR, 2014), with 236 documented in Jefferson County, 229 plant species, and seven insect species (UGA, 2018).

Invasive species harm or kill native species, alter the ecosystem, introduce diseases, limit crop production, and harm humans and animals. Invasive species affect both aquatic and terrestrial habitats. The introduction of invasive species to a new environment may be either unintentional or deliberate. Vehicles, cargo, humans, and animals can all unintentionally transport these species, as "hitchhikers", into new environments. However, most invasive species "are deliberately introduced as pets, ornamental plants, crops, food, or for recreation, pest control or other purposes" (USDA, 2016).

4.4.6.1. Location and Extent

No area is immune to invasive species, and every area of the U.S. has an invasive species problem. Some regions have larger issues than others. Areas that are near large bodies of water are particularly vulnerable because of the number of transportation hubs those areas are known to have. Heavily wooded areas, fields, wetlands, streams, rivers, and bays are also identified as being invaded by invasive species because of the habitats and natural spread from pollution and water (U.S. Fish & Wildlife Service, 2018).

Figure 4-28: Phases of Species Infestation and Control



4.4.6.2. Range of Magnitude

The magnitude of an infestation varies as widely as the species that can cause them. Invasive species can have severe impacts to agriculture, wipe out tree species, and out compete native organisms. Infestations can be caused by plants, animals, insects, or pathogens, and there are over 1,000 invasive species in West Virginia. The complete scope of magnitude of these organisms is outside the scope of this document. However, as seen in Figure 4-28, infestations do not often occur overnight, and invasive populations grow along a logistic curve. The earlier along this curve control and eradication actions are taken against an infestation, the more effective they will be. Once populations reach their peak level, they are very difficult to eradicate, and communities are forced to rely on careful management and control of invasive populations (WV DNR, 2014). Education and public awareness become extremely important as invasive species spread.

4.4.6.3. Past Occurrence

Species that impact trees that have been of specific concern to Jefferson County in recent years include the emerald ash borer, the gypsy moth, hemlock woolly adelgid, and spotted lanternfly. The emerald ash borer eats the cambium (cellular plant tissue) of ash trees, killing the tree within 2 or 3 years of infestation. The emerald ash borer was first sighted in 2013 in Jefferson County, and ash trees are now extremely scarce in the Eastern Panhandle (WV DNR, 2014; USDA, 2016). The table below lists the invasive species that have been documented in Jefferson County; there have been insects, diseases, and plants that affect the region.

Table 4-32: Documented Invasive Species in Jefferson County

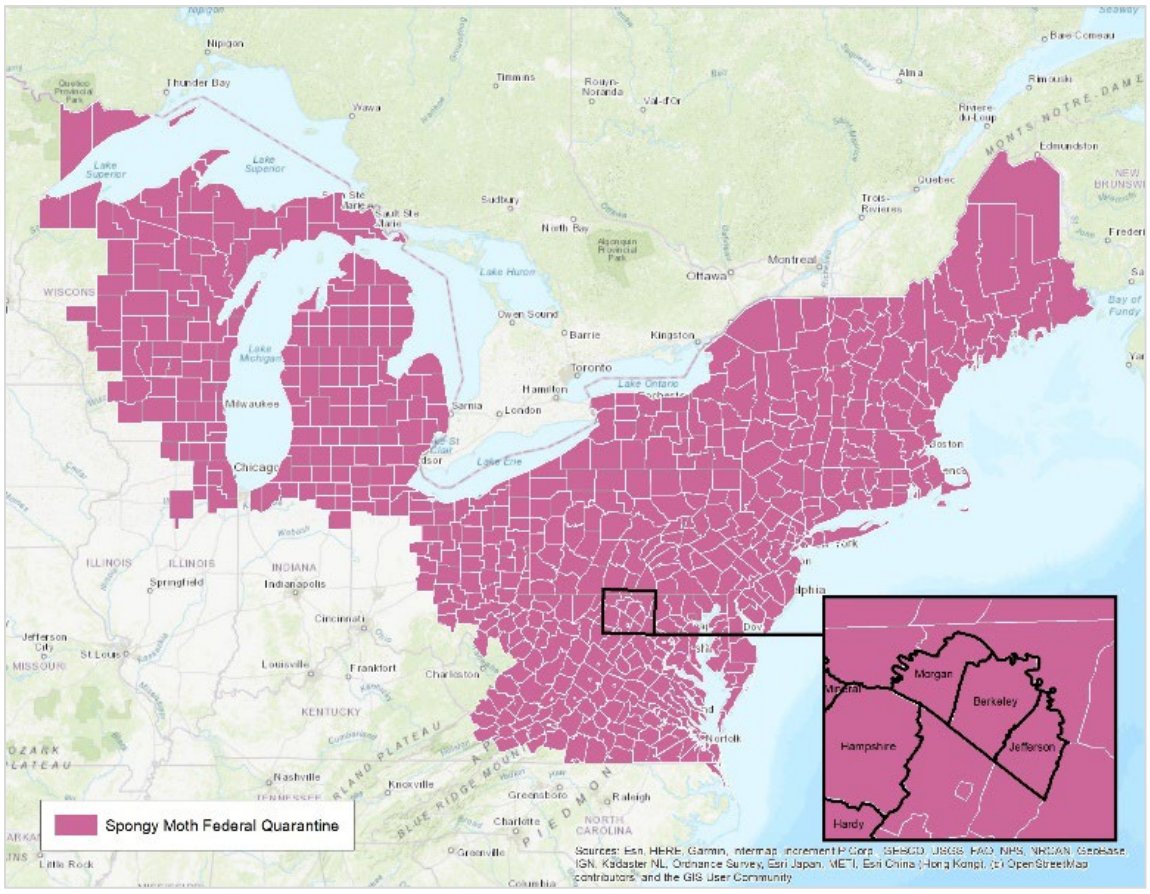
Insects			
Brown Marmorated Stink Bug	Mile-a-Minute Weevil	Emerald Ash Borer	Spotted Wing Drosophila
Gypsy Moth	Southern Pine Beetle	Hemlock Woolly Adelgid	
Diseases			
Butternut Cranker	Oak Wilt	White Pine Blister Rust	Dogwood Anthracnose
Plants			
Alfalfa	Common Cocklebur	Field Horsetail	Marsh Dayflower
Allegheny Blackberry	Common Cornsalad	Field Pennycress	Meadow Fescue
American Burnweed	Common Crupina	Field Pepperweed	Meadow Salsify
American Sycamore	Common Duckweed	Fiveangled Dodder	Mexicantea
Amur Honeysuckle	common Grape Hyacinth	Flixweed	Mile-a-Minute Vine
Annual Wormwood	Common Lilac	Giant Foxtail	Mimosa
Asiatic Dayflower	Common Mallow	Giant Ragweed	Morrow's Honeysuckle
Asparagus	Common Mullein	Goldenrain Tree	Motherwort
Bald Brome	Common Periwinkle	Ggoosegrass	Multiflora Rose
Bamboo	Common Pokeweed	Greater Celandine	Musk Mallow

Table 4-32: Documented Invasive Species in Jefferson County			
Birdsfoot Trefoil	Common Ragweed	Green Bristlegrass	Musk Thistle
Birdsrape Mustard	Common Salsify	Green Foxtail	Nettleleaf Goosefoot
Bittersweet Nightshade	Common Selfheal	Ground Ivy	Nodding Star-of-Bethlehem
Black Locust	Common St. Johnswort	Hairy Galinsoga	Northern Spicebush
Black Medic	Common Velvetgrass	Hedge Bindweed	Northern White Cedar
Black Mustard	Common Vetch	Hedge Mustard	Norway Maple
Black Walnut	Common Viper's Bugloss	Hemp Dogbane	Orchardgrass
Bluegrass	Corn Chamomile	Henbit	Oriental Bittersweet
Border Privet	Corn Cockle	Hollyhock	Oriental Lady's Thumb
Bouncingbet	Corn Gromwell	Horsenettle	Osage-Orange
Boxelder	Cornflower	Ivyleaf Morning-Glory	Oxeye Daisy
Bristlegrass	Creeping Bellflower	Ivyleaf Speedwell	Pale Smartweed
Bristly Foxtail	Creeping Buttercup	Japanese barberry	Paper-Mulberry
Bulbous Buttercup	Creeping Yellow Loosestrife	Japanese Honeysuckle	Paradise Apple
Bull Thistle	Curly Plumeless Thistle	Japanese Hop	Perennial Ryegrass
Bush Honeysuckles	Curly-Leaved Pondweed	Japanese Knotweed	Perilla Mint
Californis Privet	Cutleaf Teasel	Japanese Stiltgrass	Periwinkle
Callery Pear	Cypress Spurge	Jimsonweed	Pineapple-Weed
Canada Bluegrass	Dames Rocket	Johnsongrass	Plumeless Thistle
Canada Thistle	Dandelion	Kentucky Bluegrass	Porcelain-Berry
Canadian Horseweed	Deptford Pink	Kudzu	Poverty Brome
Catnip	Devil's-Claw	Lambsquarters	Purple Crown-Vetch
Cheatgrass	Dotted Smartweed	Large Aspen Tortrix	Purple Deadnettle
Chicory	Dyer's Woad	Large Crabgrass	Purple Loosestrife
Chinese Wisteria	Eastern Poison-Ivy	Large Hop Clover	Quackgrass
Chinese Yam	Eastern Redcedar	Lemon Balm	Queen Anne's Lace
Chocolate Vine	Eastern White Pine	Lily of the Valley	Rabbitfoot Clover
Coltsfoot	Eclipta	Longspine Sandbur	Rattail Fescue
Common Chickweed	English Ivy	Longstalk Cranesbill	Red Clover
Red Fescue	Spotted Knapweed	European Speedwell	Watercress
Red Mulberry	Spreading Hedgeparsley	European Stinging Nettle	Wavyleaf Basketgrass
Red Sorrel	Staghorn Sumac	False Strawberry	Western Salsify
Redstem Filaree	Standish's Honeysuckle	Field Brome	White Campion
Redstem Stork's Bill	Star-of-Bethlehem	Field Dodder	White Clover
Redtop	Stinging Nettle	Sweet Cherry	White Mulberry
Reed Canarygrass	Sweet Alyssum	Sweet Vernalgrass	White Poplar
Roughstalk Bluegrass	Tall Fescue	Toothed Spurge	White Willow

Table 4-32: Documented Invasive Species in Jefferson County			
Scarlet Pimpernel	Tall Morning-Glory	Trumpet Creeper	Wild Four-O'Clock
Seaside Rose	Tawny Daylily	Velvetleaf	Wild Garlic
Sericea Lespedeza	Teasel	Virginia Pepperweed	Willowleaf Lettuce
Shepherd's-Purse	Thoroughwort Pennycress	Wallflower Mustard	Wine Raspberry
Showy Baby's-Breath	Thymeleaf Sandwort	Water Knotweed	Winged Burning Bush
Siberian Elm	Timothy	Water Speedwell	Wisconsin Weeping Willow
Sickleweed	European Common Reed	Yellow Nutsedge	Yellow Alyssum
Silver Maple	European Privet	Yellow Rocket	Yellow Fieldcress
Small Carpetgrass	Yellow Sweet-Clover	Yellow Foxtail	Southern Catalpa
Small Hop Clover	Yello Toadflax	Yellow Groove Bamboo	Spiny Amaranth

Source: University of Georgia Center for Invasive Species and Ecosystem Health, 2017

Figure 4-29: APHIS Spongy Moth Federal Quarantine Counties



Gypsy moths have been a widespread issue in West Virginia after they first arrived in the state in the early 1970s. According to The West Virginia Division of Forestry, the gypsy moth is considered the most serious insect pest ever to invade West Virginia (WV Division of Forestry, 2020). The moths eat the leaves of many

hardwoods, which can kill trees and damage the health and appearance of forests. Exposure to the caterpillars of these moths can also cause minor health problems, such as irritation to the eyes or respiratory tract and rashes. Bans on the transport of certain trees and tree products, mobile homes, and outdoor household articles have been put in place in 44 West Virginia counties, including Jefferson County, to try to stop the spread of gypsy moths (WV DNR, 2014; USDA, 2016). Many counties are currently quarantined for Lymantria dispar by the USDA Animal and Plant Health Inspection Service (APHIS). Annually, new infestations are detected outside these counties and managed either by the STS program or eradicated by APHIS and state partners. Quarantined counties are shown in Figure 4-29 (USDA, 2023).

The hemlock woolly adelgid feeds off the sap of and is deadly to hemlock trees. It was reported in Jefferson County in 1997 and it has continued to spread across the state. The loss of hemlock trees contributes to dramatic changes in the composition of forests, habitat loss for birds, and the reduction of shade and increased sedimentation for cold water trout streams (WV DNR, 2014).

The spotted lanternfly has the potential to infest over 70 species of trees and vines. Its primarily known to infest the exotic and equally invasive tree-of-heaven (scientific name Ailanthus altissima) but has been detected on many of West Virginia's native tree hosts where it has the potential to cause severe economic and ecological damage. As of May 2021, a spotted lanternfly cluster was spotted in Jefferson County, just to the west of Kearneysville (West Virginia Department of Agriculture, July 2021).

Other infestations include a European fungus that causes white-nose syndrome and the death of bats, chestnut blight which eradicated chestnuts trees across their entire habitable entire range by 1940, and the brown marmorated stink bug which feeds on over 170 kinds of plants and crops (WV DNR, 2014). Feral cats are listed by the Global Invasive Species Database as one of the top 100 worst invasive species globally because of their impact on bird species and competition with other native species such as raccoons, foxes, and skunks. Over 270 invasive plants have been well documented in West Virginia, and more than a third of these are classified as posing moderate to high threats. These non-native species infest areas and out compete native plants and include Japanese knotweed, tree-of-heaven, and purple loosestrife (WV DNR, 2014).

The West Virginia Department of Agriculture (WVDA) confirmed that Jefferson County now hosts the invasive Spotted Lanternfly (*Lycorma delicatula*). Jefferson County was added to the list, which includes Berkeley and Mineral, after United States Department of Agriculture (USDA) collaborators spotted a small population on May 27 near Kearneysville, WV. The WVDA and USDA-APHIS confirmed the findings the following week. The WVDA will be conducting treatments with USDA-APHIS to contain the insects.

The Spotted Lanternfly is an invasive plant hopper that is native to China and arrived in North America hidden on goods imported from Asia. Juvenile spotted lanternflies, known as nymphs, and adults prefer to feed on the invasive tree known as Tree-of-Heaven (*Ailanthus altissima*), but also feed on a wide range

of crops and plants, including: grapes, apples, hops, walnuts and hardwood trees. For more information or to report potential Spotted Lanternfly sightings, contact bugbusters@wvda.us.

4.4.6.4. Future Occurrence

It is impossible to predict what infestations may emerge as a hazard, as new species can be introduced to the area without warning and existing pathogens can evolve to become a greater threat. However invasive species that already exist in West Virginia and may be of some concern for Jefferson County in the future include beech scale, yellow poplar weevil, and the Matsucoccus scale/Caliciopsis canker complex. Increases in temperature may also lead to greater risk of infestationby certain species of insect. These all threaten specific tree species and could fundamentally change the composition of forests in the Eastern Panhandle. Beech scale is a disease that exposes beech bark to attack by fungi, killing the tree, and is spreading north from the east central portion of West Virginia. It is has already reached Hardy and Mineral County. Yellow poplar weevils attack and eat the leaves of yellow poplar trees and has already begun to infest neighboring Berkeley County. It may spread to Jefferson County in the coming years. Matsucoccus scale is a bug that attacks cankers caused by Caliciopsis pinea, which is thought to be a fungus. The combination of these two conditions can kill white pines, but it has not spread to the Eastern Panhandle and so far is limited only to West Virginia counties that are further south (USDA, 2016).

As seen in Pennsylvania over the past several years, where the spotted lanternfly population exceeds that of West Virginia, spotted lanternflies can spread rapidly when introduced to new areas, especially if major highways, railways, or rivers are in proximity of the introduction site. The key to controlling the spread of this invasive pest throughout West Virginia will be early detection and prompt eradication efforts. Within the Eastern Panhandle, there is a profitable orchard industry which could be affected by an increased spotted lanternfly population. The West Virginia Department of Agriculture is diligently working to prevent the continued spread of spotted lanternfly with joint efforts including the USDA APHIS and other professional agricultural agencies (West Virginia Department of Agriculture, 2021). The probability of future invasive species impacting the region can be considered possible according to the Risk Factor Methodology (see Table 4-32).

4.4.6.5. Vulnerability Assessment

All of Jefferson County has been identified as the hazard area for invasive species; therefore, all assets within the county are vulnerable to the invasive species and infestation hazard. Invasive species are of significant concern to Jefferson County, mainly due to their effects on public health, natural resources, and agriculture. Estimated losses are difficult to quantify; however invasive species can impact Jefferson County's population and economy. Direct effects of infestation lead to cascading indirect impacts. As species compositions change due to infestation outbreaks, whole fire regimes can shift. Physical stresses on trees may also affect how trees respond to other natural hazards such as hurricanes, drought, and ice storms (Kurtz 2007). The following text details the analysis of potential impacts of the invasive species hazard on Onondaga County.

4.4.6.6. People

The entire population of Jefferson County is vulnerable to insect borne diseases that can be carried by invasive insects such as species of ticks and mosquitos. The elderly population and people with suppressed immune systems are most susceptible to effects of West Nile Virus, while these populations and children under 15 are most at risk for complications from EEE.

Species that cause eventual destabilization of soil, such as invasive insects that destroy plants or invasive plants that outcompete native vegetation but have less effective root systems, can increase runoff into waterbodies. This can lead to increased harmful algal blooms and negative impact on drinking water supplies. Soil destabilization can also increase the likelihood of mudslides in areas with steep slope. Species that kill trees such as EAB and Hemlock Woolly Adelgid, can increase the likelihood of trees or branches falling on people or knocking out utilities that people are dependent on.

4.4.6.7. Structures & Systems

No structures are anticipated to be affected directly by invasive species and infestations; however, as vegetation dies or becomes stressed and weakened by pests such as the Emerald Ash Borer, buildings, utilities, roads, and other infrastructure are vulnerable to damage by falling trees and debris. Additionally, available fuel and high intensity wildfires increase with the increase in deceased vegetation. Physical stresses on trees may also affect how trees respond to other natural hazards such as windstorms, drought, and ice storms (Kurtz 2007).

The Emerald Ash Borer and Hemlock Woolly Adelgid may cause a catastrophic loss of ash and hemlock trees throughout public parks and forests, which could result in stream bank instability, erosion, and increased sedimentation. Specifically, the hemlock tree is one of few species well suited for growth on steep slopes and helps to stabilize the soil (WVDNR, 2023). Unstable slopes in areas of infected hemlock tree may lead to a higher risk to impacts from ground failure for buildings, utilities and infrastructure downslope. In addition, a preponderance of dead tree limbs could increase the occurrence of downed trees on roadways and power lines in storms with heavy winds.

Some invasive plants have been shown to destabilize soil due to high densities and shallow root systems, negatively impacting nearby buildings and septic systems. This could also lead to degraded water quality in water bodies next to areas with steep slope and destabilized soils. Other invasive plant species such as phragmites and purple loosestrife have been known to clog culverts and streams, increasing flooding risk and compromising roads and pipes. In severe occurrences, utilities may also be interrupted by invasive plants, such as hydrilla, blocking the water intakes of treatment plants and power generation facilities (New York Invasive Species Information 2012).

4.4.6.8. Resources and Community Assets

Impacts of invasive species and infestations on the economy and estimated dollar losses are difficult to measure and quantify. Costs associated with activities and programs implemented to conduct surveillance and address invasive species and infestations have not been quantified in most available documentation.

Invasive species can harm wildlife in several different ways. When a species enters an ecosystem, it can breed or spread quickly and take over an area if it has no natural predators. Native species may not be able to defend their habitats from the invasive species. Native species may also become prey or have to compete for food. Invasive species can carry disease, prevent native species from reproducing or kill native species offspring (National Wildlife Federation, 2018).

There are also indirect results of an alien species moving into a new habitat. Invasive species can change the food web in an ecosystem by destroying or replacing native food sources. Though a new species may become an optional food source, it may not produce enough to supply the wildlife around it. Some species can completely reconstruct an ecosystem; aggressive plant species can take over ecosystems and replace every plant with a form of itself (National Wildlife Federation, 2018)

The effects of an infestation to this region could be quite damaging due to the thousands of acres of agriculture and forested land in the region. Infestations often spread regionally, as invasive species are often adept at gaining footholds and outcompeting native species in entire biomes. Typically, because of the make-up of the flora and fauna of an area, entire counties are impacted equally by the invasive species present there.

The emerald ash borer and gypsy moth can be transported through firewood or other tree products. Spotted lanternflies can be spread long distances by people who move infested materials or items containing eggs. Farmers or individuals involved in timber sales may be more vulnerable to the impacts of infestation due to the potential for pests to damage crops or trees; farmers in Jefferson County have millions of dollars in crops that could be affected.

Aquatic invasive species may compromise water bodies used for fishing, recreation, or industrial processes. Those involved in any of these activities may be directly or indirectly vulnerable, due to productivity or financial loss as well as the inability to enjoy outdoor aquatic habitats. These outcomes could indirectly affect human health due to financial strain or psychological impacts.

4.4.7. Public Health & Pandemic

In the 2023 Plan Update, the Public Health Crisis profile was changed to Public Health & Pandemic. Pandemic is defined as a disease affecting or attacking the population of an extensive region, including several countries, and/or continent(s). It is further described as an extensive epidemic. Generally, pandemic diseases cause sudden, pervasive illness in all age groups on a global scale. Infectious diseases are also highly virulent and can be spread person-to-person.

According to the Centers for Disease Control and Prevention (CDC), there are various levels that refer to the amount or extent of a disease occurrence.

- Pandemic refers to an epidemic that has spread over several countries or continents, usually affecting a large number of people.
- Endemic refers to the constant presence and/or usual prevalence of a disease or infectious agent in a population within a geographic area; it is the amount of a particular disease that is usually present in a community or baseline. Epidemics occur when an agent and susceptible hosts are present in adequate numbers, and the agent can be effectively conveyed from a source to the susceptible hosts. More specifically, an epidemic may result from:

- a recent increase in amount or virulence of the agent,
- the recent introduction of the agent into a setting where it has not been before,
- an enhanced mode of transmission so that more susceptible persons are exposed,
- a change in the susceptibility of the host response to the agent, and/or
- factors that increase host exposure or involve introduction through new portals of entry.

- Sporadic refers to a disease that occurs infrequently and irregularly.
- Hyperendemic refers to persistent, high levels of disease occurrence.
- Cluster refers to an aggregation of cases grouped in place and time that are suspected to be greater than the number expected, even though the expected number may not be known.
- Outbreak carries the same definition of epidemic but is often used for a more limited geographic area.

Some diseases are so rare in a given population that a single case warrants an epidemiologic investigation (e.g., rabies, plague, polio), other diseases occur more commonly so that only deviations from the norm warrant investigation.

For this plan, diseases considered are limited to West Virginia Reportable Diseases according to the WV Code 16-3-1: 64 CSR 7.

The statistics for disease and epidemics are gathered on a county basis; municipalities are included in the overall risk analysis performed by the state. An epidemic can affect all parts of Jefferson County but is more probable to occur in densely populated areas, such as the City of Charles Town and Ranson, particularly large, multi-unit residential developments, and facilities at which a large workforce is employed.

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

The region is primarily concerned with the possibility of a pandemic flu outbreak. Influenza, also known as “the flu,” is a contagious disease that is caused by the influenza virus and most commonly attacks the respiratory tract in humans. Influenza is considered to have pandemic potential if it is novel, meaning that people have no immunity to it, virulent, meaning that is causes deaths in normally healthy individuals, and easily transmittable from person-to-person.

Different strands of influenza mutate over time and replace older strands of the virus and thus have drastically different effects. The H1N1 virus, colloquially known as swine flu, is of particular concern. This virus was first detected in people in the United States in April 2009. On June 11, 2009, the World Health Organization signaled that a pandemic of 2009 H1N1 flu was underway (CDC, 2009). Avian influenza, also known as bird flu, infects birds. A recent strain, H5N1, has caused concern due to its ability to pass from wild birds to poultry then on to people. This virus has killed more than half of the people infected with it, although the avian flu is less likely to infect humans.

Prior to the beginning and during the 2023 Hazard Mitigation Plan Update process, a novel coronavirus spread into a worldwide pandemic. Named COVID-19, this type of coronavirus is a new virus that causes respiratory illness, is extremely contagious even prior to exhibiting symptoms or if the infected person is asymptomatic and can be fatal. Flu-like in nature, symptoms of the virus include fever, cough, shortness of breath, and diarrhea.

This virus became a great concern due to its high rates of transmission, and high incidence of mortality in addition to so little being known about it. Severe reactions that require immediate medical care include trouble breathing, persistent pain or pressure in the chest, new confusion, inability to wake or stay awake, and discolored skin, lips or nail beds (CDC, 2021a). In extreme COVID-19 cases that require hospitalization, patients require ventilators to support breathing and may pass away from COVID-19 or COVID-19 related reasons. Governor Jim Justice issued the first stay-at-home order on March 24, 2021 for all West

Virginians. Schools were moved to virtual settings, non-essential businesses were closed, and all essential state services were continued operation (WVDHHR, 2020). The region adopted all state-level restrictions and guidelines to slow the spread of the virus. People were advised to practice social distancing; only leaving the house for essentials like grocery shopping, and to avoid gathering even in small groups. Even when going on walks, people should remain six feet apart to slow the spread of transmission. At least three new variants of the virus have been detected globally, each reaching the United States by January 2021, with the possibility of more occurring (CDC, 2021a). On March 5, 2021, Governor Justice announced that, after continued discussions with members of the West Virginia pandemic response leadership team regarding the decreasing number of COVID-19 cases and the increasing number of vaccinated West Virginians, he was lifting capacity restrictions on several types of West Virginia businesses, increasing the social gathering limit, and permitting more youth travel sports to take place.

Starting January 2021, vaccines were distributed in phases based off of vulnerable populations as well as those who are frequently exposed.

The West Virginia Department of Health and Human Resources (DHHR) reports as of July 5, 2023, there have a total of 8,156 deaths attributed to COVID-19. Currently, West Virginians ages 6 months and older are recommended to stay up to date with COVID-19 vaccination. The free online tool, Calculator, helps individuals figure out when they may be due for a COVID-19 shot, making it easier to stay up-to-date on COVID-19 vaccination.

4.4.7.1. Past Occurrence

The United States Department of Health and Human Services estimates that influenza pandemics have occurred for at least 300 years at unpredictable intervals. There have been several pandemic influenza outbreaks over the past 100 years. A list of events and worldwide deaths are shown in Table 4-33 below.

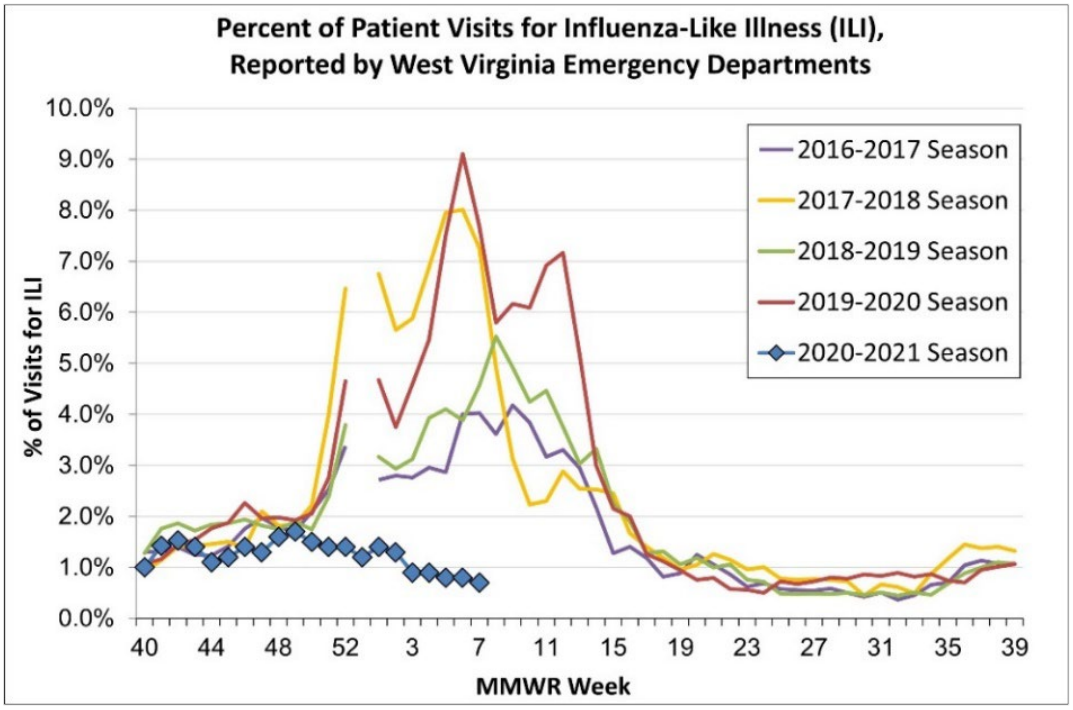
Table 4-33: Influenza Outbreaks over the Past Century (Global Security, 2009; WHO, 2009)

Date	Pandemic	Worldwide Deaths (approximate)
1918-1920	Spanish Flu / H1N1	50 million
1957-1958	Asian Flu / H2N2	1.5-2 million
1968-1969	Hong Kong Flu / H3N2	1 million
2009 - 2010	Swine Flu / A/H1N1	12,000
2020-Continuing	COVID-19	3.76 million +

The CDC marked the 2014-2015 flu season as severe, with approximately 590,000 hospitalizations. The 2017-2018 flu season was another severe season, with approximately 810,000 hospitalizations nationwide. Figure 4-30 below displays the percentage of emergency visits that were for influenza-like illness and that were reported during the current influenza season and the four preceding seasons (2015-2016, 2016-2017, 2017-2018, 2018-2019, and 2019-2020) in West Virginia. As demonstrated in that figure, influenza seasons vary in severity and duration. When peak influenza activity will occur and how severe it

will be cannot be predicted. “MMWR Week” refers to the number assigned to each week of the year by the CDC, with January 1st falling either in Week 1 or Week 52/53. MMWR Week 40 is usually the first week of October. Flu cases were remarkably down in the 2020-2021 season, likely due to masking, social distancing, and stay-at-home mandates due to the COVID-19 pandemic.

Figure 4-30: Percentage of Emergency Visits for influenza-like symptoms 2016-2021 (WVDHHR, 2021a)



The COVID-19 outbreak began in China in November 2019. According to a report published by the CDC on June 5, 2020, the first case of COVID-19 in the United States occurred on January 15, 2020 when a person traveled from Wuhan, China to Seattle and fell ill four days later. Small community spreading of the virus occurred during the second half of January and early February, prior to the more widespread outbreak of the virus in late February of 2020 (Jorden MA, Rudman SL, et al, 2020). The virus became more widespread in the US in late February 2020, and most counties in West Virginia were affected by March 2020. As of June 2021, there were more than 163,000 confirmed cases and more than 2,860 deaths in West Virginia, with 12,796 cases and 130 deaths reported in Berkeley County and 1,224 cases and 23 deaths in Morgan County (WVDHHR, 2021b). As of July 2023, a total of 18,335 confirmed cases and 151 deaths were reported for Jefferson County. In January 2021, a vaccine became available, and is readily available at the time of this writing. In spring 2021, many states, including West Virginia began to lift masking and stay at home mandates. The federal COVID-19 PHE declaration ended on May 11, 2023. Most tools, like vaccines, treatments, and testing, remain available. CDC's ability to collect and share certain data has changed.

The regional epidemiologist provided information for the following table that includes reportable disease

cases in Jefferson County from 2011 to 2021.

Table 4-34: Reportable Disease Cases in Jefferson County											
Disease	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Amebiasis	0	1	0	0	0	0	–	–	–	–	–
Animal Bites/Exposures	0	1225	174	170	201	180	149	154	235	0	222
Botulism, Infant	0	0	0	0	0	1	0	0	1	0	0
Campylobacteriosis	<5	13	8	1	10	17	21	16	22	6	23
Carbepenem-resistant Enterobacteriaceae	0	0	0	0	0	5	2	0	1	0	2
Cholera	0	0	0	0	0	1	0	0	–	0	0
Cryptosporidiosis	0	0	1	0	0	0	0	7	6	0	3
E. coli shiga-toxin producing (STEC)	0	1	2	1	2	1	3	–	–	1	4
Ehrlichiosis/Anaplasmosis	0	0	2	1	2	1	2	0	0	0	0
Giardiasis	<5	5	4	2	3	1	1	0	7	0	5
Haemophilus influenzae, invasive	<5	3	2	1	2	1	1	0	2	0	1
Hepatitis A, Acute	0	1	0	0	0	4	0	1	1	0	1
Hepatitis B, Acute	<5	3	1	1	0	0	7	8	1	1	0
Hepatitis B, Chronic	0	3	13	13	5	9	16	1	8	1	8
Hepatitis C, Acute	<5	3	1	1	0	0	2	0	0	0	2
Hepatitis C, Chronic	0	51	57	113	132	86	117	187	139	19	110
Hepatitis E	0	0	1	0	0	0	–	–	–	–	–
Influenza-related death, underage 18	0	0	0	1	0	0	–	–	–	0	0
Legionellosis	0	1	3	0	0	1	2	1	2	1	0
Listeriosis	0	0	1	0	1	0	0	0	0	0	1
Lyme Disease	40	39	27	22	44	34	42	30	38	8	35
Pertussis	<5	0	1	1	0	0	0	2	0	0	0
Q Fever	0	0	0	1	0	0	0	0	–	0	0
Rabies, animal	<5	5	3	7	5	1	5	7	5	0	1
Rocky Mt. Spotted Fever	0	0	0	0	1	2	4	4	1	–	–
Salmonella	6	16	10	7	10	8	12	11	15	6	15
Shigella	<5	1	0	0	0	1	2	3	2	0	1
Streptococcus, Group A invasive	<5	0	0	0	0	0	–	–	0	0	–

Disease	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Streptococcus, Group B invasive	0	0	1	0	1	4	–	–	8	2	–
Streptococcus pneumoniae, invasive	8	9	6	6	5	4	4	4	4	1	2
Tularemia	0	0	0	1	0	0	–	–	0	0	0
TOTAL	**73**	**283**	**321**	**352**	**426**	**363**	**392**	**436**	**498**	**46**	**436**

Source: WV Office of Epidemiology & Prevention Services Infectious Disease Surveillance Data - https://oeps.wv.gov/surveillance/pages/default.aspx

4.4.7.2. Future Occurrence

Future occurrences of pandemics and infectious diseases are unclear. The precise timing of pandemic influenza is uncertain, but occurrences are most likely when the Influenza Type A virus makes a dramatic change, or antigenic shift, that results in a new or "novel" virus to which the population has no immunity. This emergence of a novel virus is the first step toward a pandemic. Future pandemics may also emerge from other diseases, especially invasive pathogens that West Virginian's do not have natural immunity to. While it is unlikely that pandemics and infectious diseases will affect the region, this hazard occurred recently. It is impossible to predict this type of hazard. The best form of county response is to expect that these events can occur at any time and to constantly evaluate resources and update emergency response plans.

Looking at the number of historical incidences of pandemic-potential diseases, the probability of future pandemic events can be considered possible according to the Risk Factor Methodology, Section 3.

4.4.7.3. Range of Magnitude

The magnitude of a pandemic or infectious disease threat in Jefferson County will range significantly depending on the aggressiveness of the virus in question and the ease of transmission. Pandemic influenza is easily transmitted from person-to-person, but advances in medical technologies have greatly reduced the number of deaths caused by influenza over time. The magnitude of a pandemic may be exacerbated by the fact than an influenza pandemic will cause outbreaks across the United States, limiting the ability to transfer assistance from one jurisdiction to another. Additionally, effective preventive and therapeutic measures, including vaccines and other medications, will likely be in short supply or will not be available.

In terms of lives lost, the impact various pandemic influenza outbreaks have had globally over the last century has declined. The severity of illness from the 2009 H1N1 influenza flu virus varied, with the gravest cases occurring mainly among those considered to be high risk. High risk populations are considered to be more vulnerable and include children, the elderly, pregnant women, and chronic disease patients with reduced immune system capacity. Most people infected with swine flu in 2009 recovered without needing medical treatment. Unlike a regular flu season, according to the Centers for Disease Control and Prevention (CDC) the majority of people who died, as many as 77 percent, were 18-64 years old with up

to 11 percent of the deaths estimated in those 17 years old or younger (CDC, 2009).

The 1918 Spanish flu pandemic was the worst-case pandemic event in the 20th century for both West Virginia and worldwide. County data is unavailable, and mortality figures were probably under-reported. It is recorded that over 71,000 West Virginians died from the flu or its complications in this pandemic (Kercheval, 2020). Infection rates were much worse in denser cities, which should be a higher priority for response actions in future flu events.

In 2020 COVID-19, another worst-case pandemic began having worldwide impacts. As of June 2021, we are still facing impacts of the pandemic. Berkeley and Morgan County have faced varying impacts of the COVID-19 pandemic. It is believed that the virus originated in an open-air market in the Wuhan province of China in November 2019. Shortly afterwards, the virus began to spread to nearby countries including Japan and South Korea. By March 2020, the virus had reached almost every country worldwide, with the most cases in the United States. At first, concern was focused on people who might be infected due to recent travel. However, community infections soon began to crop up in many cities and towns. This led to a statewide shutdown of schools and businesses and the cancellation of large events for the remainder of 2020. Only life sustaining services were permitted to remain open, including medical facilities, pharmacies, and grocery stores. People were advised to remain home as much as possible in an attempt to slow the transmission of COVID-19. State health officials note that the virus has infected all age ranges at about the same rate, and that no age group can be considered more or less vulnerable to infection. However, people with underlying health conditions and the elderly population are more vulnerable to the virus having serious, or even deadly, symptoms. New variants of the virus reached the United States in January 2021. The CDC notes that these variants spread more easily and quickly than other variants, which may lead to a rapid increase in COVID cases (CDC, 2021a). It is currently unknown how new variants will interact with existing vaccines.

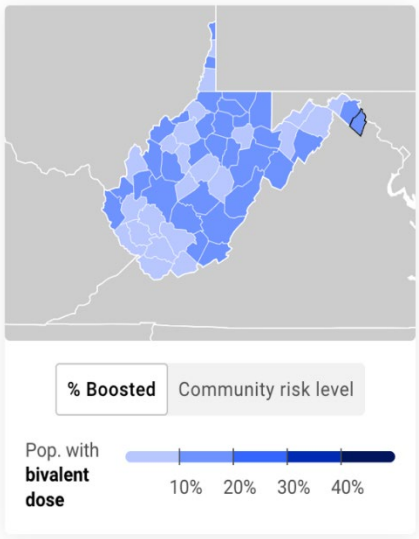
4.4.7.4. Vulnerability Assessment

Epidemics can develop with little or no warning and quickly erode the capacity of local medical care providers. A fast-developing epidemic can last several days and extend into several weeks. In some extreme cases, they can last for several months. An epidemic can occur at any time of the year, but the warm summer months, when bacteria and microorganism growth are at their highest, present the greatest risk.

Certain population groups are at higher risk of pandemic flu infection. This population group includes people 65 years and older, children younger than 5 years old, pregnant women, and people of any age with certain chronic medical conditions. Such conditions include but are not limited to diabetes, heart disease, asthma, and kidney disease (CDC, 2015). Schools, colleges, convalescent centers, and other institutions serving those younger than 5 years old and older than 65 years old, are locations conducive to faster transmission of pandemic influenza since population identified as being at high risk are concentrated at these facilities or because of a large number of people living in close quarters. In general,

jurisdictions that are more densely population are more vulnerable to disease threats when the disease is directly spread from human to human, but every jurisdiction in the state has some vulnerability to pandemic and infectious disease threats.

Local health departments have taken steps to ensure a base level of preparedness for pandemics and other infectious diseases. National and state efforts to encourage vaccinations have also been relatively successful. According to COVIDActNow.org, in Jefferson County, West Virginia, 46,206 people (80.9%) have received at least one dose, 38,418 (67.2%) have received at least two doses or a single Johnson & Johnson dose, 18,319 (32.1%) have received a booster dose, and 9,994 **(17.5%)** have received an updated bivalent booster dose. Vaccinations help protect even non-vaccinated individuals due to herd immunity, meaning that a pathogen has a more difficult time spreading due to higher immunity rates.



4.4.7.5. People

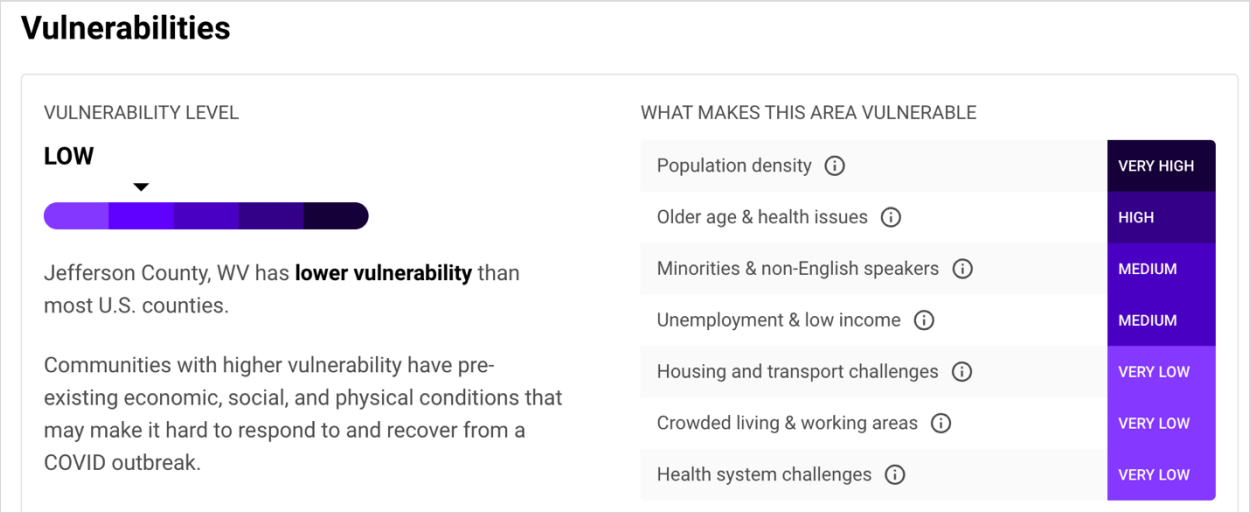
There are some occupation-specific risks that may make some employees more vulnerable. For example, those working in direct patient care situations are more likely to be exposed to a pandemic disease. Major concerns during an epidemic or outbreak include the ability of local health care providers to provide medical attention to everyone who becomes ill, and the ability to identify the source or what is causing the population to become ill. Cascading effects of epidemics can include the following.

- Illness or death
- Civil disturbance
- Distrust of government
- Poor water quality
- Temporary loss of income

In terms of social vulnerability, HHS emPower Map tool, users can select different geographies, as needed, to identify at-risk populations and download selected data results to inform their emergency preparedness, response, recovery, and mitigation public health activities. Users can also access near real-time natural hazard data layers to anticipate and address the needs of at-risk community members in emergencies. For more instructions and information, review the detailed job aids in the top right corner. Medicare data indicates that there are 12,235 beneficiaries within Jefferson County. Beneficiary means a person who is entitled to Medicare benefits and/or has been determined to be eligible for Medicaid. Medicare beneficiaries rely on electricity-dependent durable medical and assistive equipment (DME) and devices to live independently in their homes, and some of those individuals also have health care service dependencies.

Higher vulnerability areas are more likely to experience severe physical and economic suffering from COVID or other epidemics/pandemics, and to face a harder, longer recovery. According to COVIDActNow.org, Jefferson County has lower vulnerability than most counties in the U.S.

Figure 4-31: Jefferson County Vulnerability (COVIDActNow, 2023)



4.4.7.6. Structures, Systems, and Environmental Impacts

The West Virginia Electronic Disease Surveillance System (WVEDSS) utilizes the National Electronic Disease Surveillance System (NEDSS) framework to electronically manage and transmit communicable disease reports. The system serves healthcare providers, laboratories, hospitals, health departments and the Centers for Disease Control.

The environmental impacts of pandemics and infectious disease threats are still being determined. Many countries noted environmental benefits to everyone sheltering-in-place due to reduced commuting pollution and overall, an increase in air quality. Some areas have also identified "mask trash" from discarded face masks as a new form of litter that may have impacts on storm drains and otherwise still being determined. There will be significant economic and social costs beyond the possibility of disease-related deaths. Widespread illness may increase the likelihood of shortages of personnel to perform essential community services. In addition, high rates of illness and worker absenteeism occur within the business community, and these contribute to social and economic disruption. Social and economic disruptions could be temporary but may be amplified in today's closely interrelated and interdependent systems of trade and commerce. Social disruption may be greatest when rates of absenteeism impair essential services, such as power, transportation, and communications. Research of COVID-19 suggests that public transportation has greatly increased the transmission of this and other past viruses, bringing this vulnerability to light.

Jurisdictional losses in a pandemic or infectious disease outbreak stem from lost wages and productivity, not losses to buildings or land. Losses are difficult to estimate because the exact rates of absenteeism and cost of treating a widespread disease will depend on the virus or bacterium in question, the availability of vaccination or treatment, and the severity of symptoms. The World Bank estimates that a severe flu pandemic could kill as many as 71 million people worldwide and cause a $3 trillion recession (CIDRAP, 2008).

The COVID-19 pandemic has also spurred conversations around creating safe public spaces and work environments regarding pandemic and infectious disease. The International Code Council (ICC) published an overview of code compliance that helps facilitate response to pandemic instances. For example, properly designed, installed, and maintained ventilation systems can help in mitigating the spread of pathogens (ICC, 2020). Many buildings have chosen to inspect and upgrade these systems during shelter in place orders. This is essential towards stopping the spread of pathogens in high density residential buildings and ensures workers will return to a safe environment when it is safe to work in offices again.

Losses based on historical epidemic occurrences are difficult to estimate. According to a study by Molinari (2007), seasonal influenza results in a substantial economic impact, estimated, in part, at $16.3 billion in lost earnings. By population, Jefferson County represents 0.17% of the United States. Since seasonal influenza primarily impacts the human population, using Jefferson County's composition of the U.S. as a multiplier (i.e., 0.0017) and applying it to the potential economic impact, lost earnings in Jefferson County could reach a staggering $27,710,000 each year. Though that number appears high, it equates to approximately $491 per year for each person in the county. Epidemics rarely affect structures. Epidemics may affect people and, at times, the operations of critical facilities, businesses, and other community assets.

4.4.7.7. Resources & Community Activities

Community impacts may include the cancelation of various community activities, as seen during the Covid-19 Pandemic. In addition, an aversion to the workplace or other group gathering venues may occur both during and after a public health incident resulting in long-term issues. In addition, tourism activities due to travel avoidance, affects local restaurants and other public spaces that are supported by both the local population and tourism. Below are community activities that occur throughout the year or annually.

- Jefferson County Fair – July and August at Jefferson County Fairgrounds and weekly farm markets
- Historical Walking Tours of Harpers Ferry, WV – Available All Year (Note four (4) of the National Register Areas within Harpers Ferry are located in the 1-percent-annual chance floodplain.)
- Hollywood Casino Horse Races – Reoccurring – Located in Charles Town
- September 22 - 24 - Mountain Heritage Arts & Craft Festival at Jefferson County Fairgrounds
- October 7 - Freedoms Run (Note: held in in Harpers Ferry & Shepherdstown.)

4.4.8. Severe Thunderstorm & Hail Storm

The wind gusts associated with thunderstorms pose a threat to life and/or property. Severe thunderstorms also have the potential of producing a tornado with little or no advanced tornado warning. Thunderstorms can also produce hail or heavy downpours that can lead to localized flooding. Thunderstorms are often characterized by frequent cloud-to-ground lightning as well.

Table 4-35: Types of Thunderstorms

Type	Description	Duration	Wd Speeds	Associated Hazards
Single Cell	Uncommon	20 - 30 minutes	No Data Available	• Non-damaging hail • Microbursts • Weak tornadoes
Multi Cell	Common, organized cluster of two or more single cells.	Each cell lasts approximately 20 minutes	Downbursts of up to 80 mph	• Heavy rainfall • Downbursts • Hail • Weak tornadoes
Mesoscale Convective System (MCS)	Well organized system of thunderstorms	Up to 12 hours or more	55 mph or more	• Torrential rainfalls • Derechos • Tornadoes
Squall Lines	May extend over 250 to 500 miles and 10 to 20 miles wide	Individual cells last from 30 to 60 minutes	No Data Available	• Significant rain after the storm • Derechos
Super Cells	Most dangerous storms, visible with Doppler radars	1 - 6 hours	Updrafts and downdrafts of more than 100 mph	• Tornadoes • Hail

Lightning is a rapid discharge of electrical energy in the atmosphere. When the charge difference between the ground and the cloud becomes too large, a conductive channel of air develops between the cloud and the ground, and a small amount of charge (step leader) starts moving toward the ground. When it nears the ground, an upward leader of opposite charge connects with the step leader. At the instant this connection is made; a powerful discharge occurs between the cloud and the ground. This discharge is seen as a bright visible flash of lightning.

Hail is a form of precipitation that occurs when updrafts in thunderstorms move raindrops up into incredibly cold areas of the atmosphere, freezing them into balls of ice. Thunderstorms that have a very strong updraft repeatedly lift hailstones up into the top of the cloud where they encounter supercooled

water drops. These water drops will freeze on contact with the hail, increasing its size. The hail falls when the updraft can no longer sustain the weight of the hailstones (NSSL NOAA, 2021).

When the hailstone is heavy enough, it will fall to the ground (NSSL, n.d.). In 1986, Jonathan Webb, a member of the Tornado and Storm Research Organization (TORRO) in England, developed the TORRO Hailstorm Intensity Scale as a way to measure and categorize hailstorms (Voss Law Firm, n.d.).

Table 4-36: Torro Hailstorm Intensity Scale

Intensity		Typical Hail Diameter (mm)	Typical Hail Diameter (in)	Typical Damage	Example Size Description
H0	Hard Hail	5	Up to 0.33	No damage.	Pea
H1	Potentially Damaging	5 to 15	0.33-0.60	Slight general damage to plants, crops.	Mothball
H2	Significant	10 to 20	0.60-0.80	Significant damage to fruit, crops, vegetation.	Marble, Grape, Dime
H3	Severe	20 to 30	0.80-1.2	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored.	Walnut, Nickel to Quarter
H4	Severe	25 to 40	1.2-1.6	Widespread glass damage, vehicle bodywork damage.	Pigeon's egg > squash ball
H5	Destructive	30 to 50	1.6-2.0	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries.	Golf ball > Pullet's egg
H6	Destructive	40 to 60	2.0-2.4	Bodywork of grounded aircraft dented, brick walls pitted.	Hen's egg
H7	Destructive	50 to 75	2.4-3.0	Severe roof damage, risk of serious injuries.	Tennis ball > Cricket ball
H8	Destructive	60 to 90	3.0-3.5	(Severest recorded in the British Isles) Severe damage to aircraft bodywork.	Large orange > Soft ball
H9	Super Hailstorm	75 to 100	3.5-4.0	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open.	Grapefruit
H10	Super Hailstorm	>100	4.0+	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open.	Melon

4.4.8.1. Location and Extent

Thunderstorms are one of the most frequently occurring hazards throughout the County. NCEI records reflect the most severe thunderstorms. Storms, however, are common throughout the spring and summer months (although a thunderstorm can occur in any season) that cause downed trees and power lines. Residents and businesses are likely to incur more damage because of these "smaller" storms as individual houses and vehicles are damaged by fallen limbs and businesses are forced to close due to a lack of electricity.

More than 100,000 thunderstorms occur in the U.S. each year, with lightning striking more than 30 million points on the ground during that same period. This causes an average of between 55-60 fatalities and 300 injuries each year. Lightning can occur with all thunderstorms, of which the entire region is susceptible. Lightning fatalities are also most common during the summer and during the afternoon and evening.

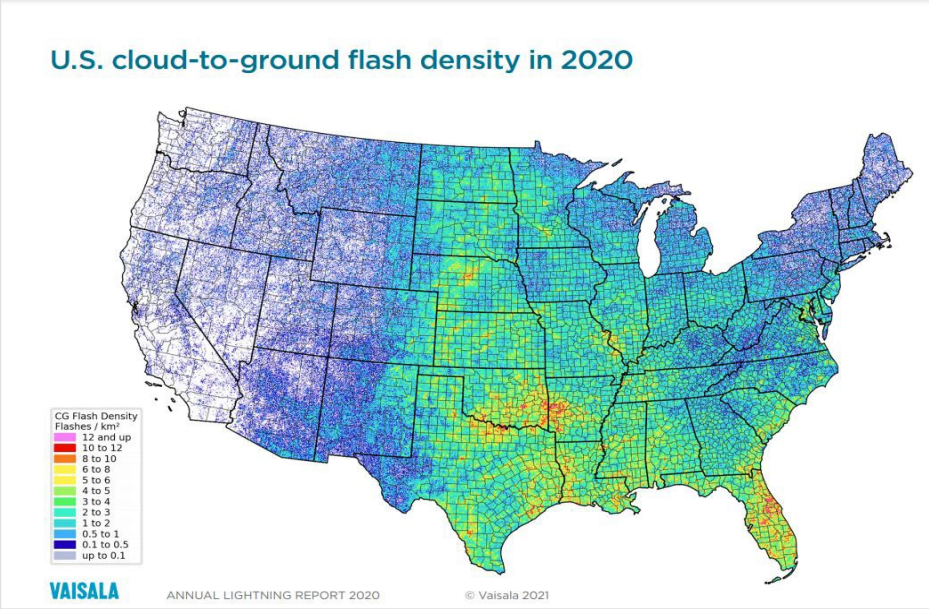
Hail is a relatively minor natural hazard in all parts of the region, but it occurs with some frequency. Even with these frequent occurrences, losses tend to be minor, especially to critical facilities and other infrastructure. Much like minor thunderstorms, hailstorms rarely slow down the daily lives of the residents in the region. If their vehicles or homes are damaged, they usually claim those damages on their insurance policies or repair the damage themselves.

When hail occurs, it can cause damage by battering crops, structures, automobiles, and transportation systems. When hailstorms are large, especially when combined with high winds, damage can be somewhat extensive. Hail is also much more common along mountain ranges because mountains force horizontal winds upwards thereby intensifying the updrafts within thunderstorms, where hail is formed, and making hail more likely. In mountainous areas, the falling hail has less time to melt before touching the ground (NSSL NOAA, 2021).

4.4.8.2. Past Occurrence

Even though lightning strike deaths and injuries are rare, they do happen. Between 1959 and 2017, 26 individuals have been killed by lightning in the State of West Virginia, an average of one person every other year (Vaisala, 2017). This puts West Virginia's risk in the bottom half of all states. Furthermore, West Virginia and the Eastern Panhandle have a moderate lightning flash density per year compared to other states. As seen in Figure 4-32, the density of lightning strikes the Eastern Panhandle experiences each year is 0.1 to 4 per square kilometer, compared to over 12 flashes per square kilometer in some parts of Florida (Vaisala, 2021).

Figure 4-32: U.S. Cloud-to-Ground Flash Density 2020 (Vaisala, 2021)



Records from the NCEI show that there were 89 lightning events in the 55 counties across West Virginia between 1950 and 2021 with 5 occuring in Jefferson County. A lightning "event" is defined as a lightning strike that results in fatality, injury, and/or property or crop damage (NOAA NWS, 2021).

There have been several hazardous hailstorms reported in the region. According to NCDC Event Records, 63 hail events of 0.5 inch or greater have been reported in Jefferson County since 1968. The largest reported hail in the area occurred during a hailstorm in Morgan County on May 6, 2002. It produced hail the size of a baseball, 2.75 inches in diameter (NCDC, 2021). Hail events from both 1968 to present for the county can be viewed in Table 4-37. Damages from these events totaled $10,000.00.

Table 4-37: Hail Events in Jefferson County 1968-2023

Location	Date	Magnitude	Property Damage ($)	Location	Date	Magnitude	Property Damage ($)
JEFFERSON CO	7/10/1975	1.75	0	HARPERS FERRY	8/14/2008	0.75	0
JEFFERSON CO	6/16/1982	0.75	0	HARPERS FERRY	8/14/2008	0.88	0
JEFFERSON CO	5/16/1988	1.75	0	BOLIVAR	8/14/2008	0.75	0
JEFFERSON CO	6/9/1990	1	0	KEARNEYSVILLE	4/25/2010	1	0
JEFFERSON CO	9/18/1991	1	0	HALLTOWN	4/25/2010	1	0
JEFFERSON CO	8/11/1992	0.75	0	MT PLEASANT	4/25/2010	1	0
JEFFERSON CO	8/11/1992	0.75	0	MECHANICSTOWN	4/25/2010	1	0
JEFFERSON CO	4/1/1993	0.88	0	MIDDLEWAY	4/25/2010	1	0
CHARLES TOWN	5/12/1993	1.75	0	KEARNEYSVILLE	05/26/2011	1	0
HARPERS FERRY	8/17/1993	1.25	5000	MIDDLEWAY	6/21/2011	1	0
JEFFERSON CO	5/29/1995	0.75	0	MIDDLEWAY	7/11/2011	1	0
JEFFERSON CO	7/10/1995	0.88	0	LEETOWN	9/14/2011	1	0
KABLETOWN	7/25/1999	1	0	SHEPHERDSTOWN	5/3/2012	1	0

Table 4-37: Hail Events in Jefferson County 1968-2023

Location	Date	Magnitude	Property Damage ($)	Location	Date	Magnitude	Property Damage ($)
SHEPHERDSTOWN	5/10/2000	1	0	SHEPHERDSTOWN	6/7/2012	1	0
SUMMIT PT	5/13/2000	1.25	0	BOLIVAR	7/8/2012	1	0
SHEPHERDSTOWN	7/14/2000	1	0	MT PLEASANT	6/23/2015	1	0
SHEPHERDSTOWN	7/16/2000	1.75	0	CHARLES TOWN	6/16/2016	1	0
KEARNEYSVILLE	5/26/2002	2.75	0	MT PLEASANT	5/18/2017	1	0
SHEPHERDSTOWN	5/26/2002	1.75	0	CHARLES TOWN ARPT	5/10/2018	1	0
HARPERS FERRY	6/14/2003	0.75	0	MT PLEASANT	5/14/2018	1.75	0
HARPERS FERRY	8/26/2003	0.75	0	MIDDLEWAY	5/14/2018	1.5	0
RANSON	5/23/2004	0.75	0	CHARLES TOWN ARPT	5/14/2018	1	0
HARPERS FERRY	5/25/2004	1.75	5000	CHARLES TOWN	5/14/2018	2.5	0
HARPERS FERRY	7/28/2007	0.88	0	MANNINGS	5/14/2018	1.75	0
SUMMIT PT	8/25/2007	1	0	CHARLES TOWN	5/14/2018	1	0
CHARLES TOWN	6/10/2008	0.75	0	SHEPHERDSTOWN	6/2/2019	1	0
BARDANE	6/23/2008	0.75	0	SHEPHERDSTOWN	6/2/2019	0.75	0
MECHANICSTOWN	6/28/2008	0.75	0	SHEPHERDSTOWN	6/2/2019	0.75	0
MECHANICSTOWN	7/26/2008	0.88	0	CHARLES TOWN ARPT	6/2/2019	0.88	0
BOLIVAR	7/26/2008	1	0	HARPERS FERRY	6/2/2019	0.75	0
MIDDLEWAY	8/10/2008	0.75	0	HARPERS FERRY	6/2/2019	1	0
MANNINGS	8/14/2008	0.75	0				

The most recent occurrence of sizeable hail was reported in Charles Town on May 14, 2018, with hail up to 2.5 inches in diameter. No damages were claimed. The most recent hail occurrence that caused property damage in the county is from Harpers Ferry in 2004, which resulted in $5,000 in losses.

4.4.8.3. Future Occurrence

Lightning strikes the earth about 100 times every second. Each year in the United States, approximately 400 people are struck (about one for every 86,000 lightning flashes in the U.S.), and 17,400 fires are caused by lightning. July is the peak month for lightning strikes in the United States. The probability of a lightning strike on a given building is a function of the object's lightning-attractive area (e.g., a tall metal pole is more likely to be struck by lightning than a shorter non-conductive objects).

The future occurrence of lightning and thunderstorm activity in Jefferson County is anticipated, and the susceptibility to damage from these severe storms will remain unchanged. The number of lightning events is influenced by the frequency of a severe thunderstorm occurrence. Therefore, potential future changes in climate and weather conditions may impact the future occurrences of lightning strike.

The future occurrence of hailstorm activity in Jefferson County is expected, and the susceptibility to damage from hail will remain unchanged. The past occurrences in the region indicate that this event is one that can happen several times in any given year, most likely during the late spring and summer months. However, the probability of hailstorm events resulting in multiple casualties and extensive structural damage can be considered unlikely, while the probability of nondamaging hail can be considered possible, according to the Risk Factor Methodology.

4.4.8.4. Range of Magnitude

Because lightning damage is largely unreported, statistics vary considerably. The insurance industry, however, estimates 6.5 percent of all property/casualty claims are related to lightning strikes (Credit Union National Association, 2015). While it is difficult to quantify lightning losses, it is estimated that $4-5 billion damage occurs each year. Likewise, the cost of lightning protection to safeguard critical equipment and facilities from lightning strikes during severe weather is enormous. In statistics kept from 1997-2012, West Virginia was reported as having an average of 210,169 cloud-to-ground flashes per year (NWS, 2016). The worst-case scenario for casualties from a lightning strike is envisioned to occur during a capacity sports game, crowded outdoor festival, or another outdoor event with a dense crowd. While to date there have been few casualties in the United States from direct lightning strikes to dense groups of people or from the mass movement of panicked individuals when lightning threatens, it is important to recognize this potential, albeit extremely low risk, event. Other worst-case scenarios could involve thunderstorms leading to car crashes, downed trees, and mass power outages.

Hail can vary significantly in its size and impact, but to be considered hail frozen precipitation must be greater than 0.2 inches in diameter. Table 4-37 demonstrates the range of reported hail sizes, with severe hail identified as being 1 inch or greater in diameter. The most severe hail experienced by Jefferson County is between 1.5-2.5 inches in diameter (NSSL NOAA, 2021).

Hailstorms can cause significant damage to crops, livestock, and property. Damage is dependent on the size, duration, and intensity of hail precipitation. Automobiles and aircraft are particularly susceptible to damage. Also, people are at risk for serious injury if they do not seek immediate shelter. Since hail precipitation usually occurs during thunderstorm events, the impacts of other hazards associated with thunderstorms (i.e. strong winds, intense precipitation, etc.) often occur simultaneously (NOAA NSSL, 2021).

A potential worst-case scenario of a hailstorm would be if a storm carrying hail of over two inches were to occur over a prolonged period in a predominantly agricultural area. Because hail can cause significant crop damage, a storm of this magnitude would potentially destroy agricultural yields and result in significant lost revenue, as well as property damage and injuries.

Table 4-38: Reference Object Used to Estimate Hail Size and Corresponding Scale of Hail Diameters

Hailstone Size	Measurement (Inches)	Updraft Speed (mph)
BB	< 0.25	< 24
Pea	0.25	24
Marble	0.50	35
Dime	0.70	38
Penny	0.75	40
Nickel	0.88	46
Quarter	1.00	49
Half Dollar	1.25	54
Walnut	1.50	60
Golf Ball	1.75	64
Hen Egg	2.00	69
Tennis Ball	2.50	77
Baseball	2.75	81
Teacup	3.00	84
Grapefruit	4.00	98
Softball	4.50	103

(NSSL NOAA, 2020)

4.4.8.5. Vulnerability Assessment

According to FEMA, vulnerability is a description of which assets, including structures, systems, populations, and other assets as defined by the community, within locations identified to be hazard prone, are at risk from the effects of the identified hazard(s). As part of this plan update, the analysis of vulnerability to community assets was expanded. In addition, impacts from climate change, social vulnerability, and changes in land use have been included. Information has been integrated from FEMA's recently updated National Risk Index, which according to FEMA has changed the way risk is assessed.

Using data and analysis from FEMA's National Risk Index, Jefferson County's risk index is very low compared to other counties to the United States, in fact 45% of U.S. counties have a lower risk index than Jefferson County. The risk index rating for neighboring jurisdictions is relatively low for Berkeley County (West Virginia) and Loudoun County (Virginia), while Clarke County (Virginia) is very low.

Thunderstorm is a hazard that can be said to affect the entire region equally (i.e., all structures in the region are at risk). In many ways, the cascading effects of thunderstorms are more damaging than the storm itself. For example, as mentioned above, lightning strikes may cause power surges that result in damage. Thunderstorm winds may down trees that fall onto personal property. Tracking these types of damages is difficult as many people may not turn such claims into their insurance. Outdoor activities and events are particularly vulnerable to thunderstorms, but when lightning threatens a large outdoor venue, the game or event itself is usually postponed. The environmental impacts most often associated with

lightning strikes include damage to or death of trees and ignition of wildfires. During the years of 2000 – 2020, the NOAA NCEI Storm Events Database reported 64 lightning events in West Virginia which caused two deaths, 17 injuries, property damage of $3,447,000 and $0 in crop damage (NOAA NCEI, 2021).

Losses due to lightning can be lessened by installing surge protection on critical electronic, lightning, or information technology systems. Lightning protection devices and methods, such as lightning rods and grounding, can be installed on a community's communications infrastructure and other critical facilities to reduce losses.

All of Jefferson County, including all critical infrastructure, is vulnerable to the effects of hail, as the storm cells that produce this hazard are spread over a large area. The area of damage due to these storms is relatively small, in that a single storm does not cause widespread devastation but may cause damage in a focused area of the storm. However, stakeholders have reported that hail damage can be especially damaging to tree orchards and other crops. According to the USDA Risk Management Agency (RMA) Federal Crop Insurance Corporation, which provides crop insurance to American farmers, over $2.5 million has been issued to farmers in Jefferson County from 2010 to 2023. Even though not all crops are insured through RMA, these records provide some insight into how damaging hail can be. The National Weather Service and other meteorological forecasters can predict severe hail and warn residents and farmers. Vulnerability will vary by community, and people who are outdoors and property that is not protected by a strong roof will be most vulnerable.

4.4.8.6. People

This section specifically focuses on how people are impacted by the thunderstorm and hail hazard, including underserved communities and socially vulnerable populations. During storm event, people and first responders run the risk of sustaining injuries related to saving people and property. One of the primary health-related concerns is power outages caused by downed trees which impacts people who are reliant on power to run life-sustaining medical equipment; this is an example of a medically and socially vulnerable population.

Socially vulnerable populations are most susceptible due to their physical and financial ability to react and respond during storm events. This population includes the elderly, young, and individuals with disabilities or access or functional needs who may be unable to evacuate in the event of an emergency. The elderly is considered most vulnerable because they require extra time or outside assistance during evacuations and are more likely to seek or need medical attention that might not be readily available due to isolation during a storm event. The vulnerable population also includes those who would not have adequate warning from an emergency warning system (e.g., television or radio); this would include residents and visitors. The population adversely affected by storm events may also include those beyond the disaster area that rely on affected roads for transportation.

Economically disadvantaged people are at high risk for bracing for storm events because of the potential inability to afford up-to-code homes and buildings that are deemed safe from storms passing through.

They also may pose health issues, such as exposure to mold and other health issues that water seepage may cause. These populations may also lack access to vehicles for any necessary evacuations.

4.4.8.7. Structures

Utility infrastructure could suffer damage from high winds associated with falling tree limbs or other debris, resulting in the loss of power. Loss of service can impact residents and business operations alike. Interruptions in heating or cooling utilities can affect populations such as the young and elderly, who are particularly vulnerable to temperature-related health impacts. Loss of power can impact other public utilities, including potable water, wastewater treatment, and communications. In addition to public water services, property owners with private wells might not have access to potable water due to pump failure until power is restored.

4.4.8.8. Systems

Systems in this section refer to networks and capabilities. Storm events often disrupt many systems including power, sewer, water, communications, and road access. Lacking these, it is difficult to continue critical services to the community. Damage to property, facilities, and infrastructure can range from minimal to total loss. The cost of recovery from thunderstorms and hail can vary for everyone. Homeowners and businesses can claim insurance benefits if they have them but may not be able to continue working due to storm-related damages within the community or of their own property.

Overall, all critical facilities are exposed to severe storm events. Transportation routes are vulnerable to severe storms and have the potential to be wiped out or blocked, creating isolation issues from responders. This includes all roads and bridges in the path of a severe storm event. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand high wind speeds and excessive precipitation. Utility infrastructure is also vulnerable; interruption of services may not only impact vulnerable populations but may also impact critical facilities that need to be in operation during a disaster. Because power interruption can occur, backup power is recommended for critical facilities and infrastructure. Full functionality of critical facilities such as police, fire, and medical services is essential for response during and after a severe storm event.

Environmental resources, including critical habitat (or habitats that are known to be essential for an endangered or threatened species), wetlands, parks, and reserves are particularly vulnerable to severe storms. Destroyed habitats could displace and kill organisms reliant on these habitats. The impacts of intense windstorms and precipitation on the environment typically take place over a larger area. Where these events occur, widespread, severe damage to plant species is likely. This includes uprooting or destruction of trees and an increased threat of wildfire in areas where dead trees are not removed.

4.4.8.9. Natural, Historic, and Cultural Resources

Environmental resources, including critical habitat (or habitats that are known to be essential for an endangered or threatened species), wetlands, parks, and reserves are particularly vulnerable to storm events. Destroyed habitats could displace and kill organisms reliant on these habitats. The impacts of high wind, hail and precipitation on the environment typically take place over a larger area. Where these events occur, widespread, severe damage to plant species is likely. This includes uprooting or destruction of trees and an increased threat of wildfire in areas where dead trees are not removed.

Jefferson County is ranked fourth in the State as having the most historical buildings in the high-risk to thunderstorms and hail. Most of these historical buildings are in the towns of Shepherdstown and Harpers Ferry. The unincorporated area of Jefferson County is ranked first among all unincorporated areas in the State of West Virginia with 26 historical buildings.

4.4.8.10. Community Activities

Potential economic impacts include loss of agriculture, business, and tourism. In addition, losses of buildings and infrastructure also take a toll on the economic condition of West Virginia. Similarly, damages to buildings can displace people from their homes, threaten life safety and impact a community's economy and tax base. Severe storms can also damage utilities and communication towers, which are costly because they need to be repaired almost immediately after damages occur, and these repairs can cost millions of dollars to fix for a single event.

Activities that have value to the community could potentially be impacted by thunderstorm events and hail. When these activities are delayed or cancelled due to thunderstorm events and hail, the economy of the community is affected. Numerous activities are scheduled within Jefferson County and its municipalities. Below are community activities that occur throughout the year or annually.

- Jefferson County Fair – July and August at Jefferson County Fairgrounds and weekly farm markets
- Historical Walking Tours of Harpers Ferry, WV – Available All Year (Note four (4) of the National Register Areas within Harpers Ferry are located in the 1-percent-annual chance floodplain.)
- Hollywood Casino Horse Races – Reoccurring – Located in Charles Town
- September 22 - 24 - Mountain Heritage Arts & Craft Festival at Jefferson County Fairgrounds
- October 7 - Freedoms Run (Note: held in in Harpers Ferry & Shepherdstown.)

4.4.9. Severe Wind & Tornado

This profile discusses two types of wind that stem from severe thunderstorms (see Section 3.4.7 Severe Thunderstorms & Hail), severe wind and tornadoes.

Severe Wind: Non-tornadic, damaging winds from thunderstorms include four common types (NWS & FEMA, 2001).

- Straight-Line Winds or Derechos: Winds having little or no curvature or rotation, capable of affecting a larger geographic area than a tornado.
- Downbursts: Localized downward gusts of air from a thunderstorm. These winds can be very damaging on and near the ground and tend to cover areas of just a few miles.
- Microbursts: Minimized downbursts affecting areas less than 2.5 miles in diameter. Microbursts induce a strong wind shear and can produce winds over 150 mph.
- Gust Fronts: Cool, gusty air that flows out of the base of a thunderstorm and spreads along the ground ahead of the thunderstorm cell.

One of the first scales to estimate wind speeds and the effects was created by Britain's Admiral Sir Francis Beaufort (1774-1857). He developed the scale in 1805 to help sailors estimate the winds via visual observations. The scale starts with 0 and goes to a force of 12. The Beaufort scale illustrated in Table 4-39 is still used today to estimate wind strengths (NOAA, n.d.; NOAA, n.d.).

Table 4-39: Beaufort Wind Scale

Force	Wind Speed			Appearance of Wind Effects	
	(mph)	(knots)	Description	On the Water	On Land
0	0-1	0-1	Calm	Sea surface smooth and mirror-like	Calm, smoke rises vertically
1	1-3	1-3	Light Air	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes
2	4-7	4-6	Light Breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move
3	8-12	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	13-18	11-16	Moderate Breeze	Small waves 1-4 ft. becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move
5	19-24	17-21	Fresh Breeze	Moderate waves 4-8 ft taking longer form, many whitecaps, some spray	Small trees in leaf begin to sway
6	25-31	22-27	Strong Breeze	Larger waves 8-13 ft, whitecaps common, more spray	Larger tree branches moving, whistling in wires
7	32-38	38-33	Near Gale	Sea heaps up, waves 13-19 ft, white foam streaks off breakers	Whole trees moving, resistance felt walking against wind
8	39-46	34-40	Gale	Moderately high (18-25 ft) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks	Twigs breaking off trees, generally impedes progress

Table 4-39: Beaufort Wind Scale

Force	Wind Speed			Appearance of Wind Effects	
	(mph)	(knots)	Description	On the Water	On Land
9	47-54	41-47	Strong Gale	High waves (23-32 ft), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, slate blows off roofs
10	55-63	48-55	Storm	Very high waves (29-41 ft) with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	64-72	56-63	Violent Storm	Exceptionally high (37-52 ft) waves, foam patches cover sea, visibility more reduced	
12	72-83	64-71	Hurricane	Air filled with foam, waves over 45 ft, sea completely white with driving spray, visibility greatly reduced	

Tornado: A tornado is a violently rotating column of air extending from a thunderstorm to the ground. Normally thunderstorms and associated tornadoes develop in warm, moist air in advance of strong eastward-moving cold fronts in late winter and early spring. Tornadoes can also occur along a “dryline” which separates very warm, moist air to the east from hot, dry air to the west. Both of these scenarios are common in the Central Plains. Another way that tornadoes can be created occurs when warm moist air flows upslope. Under the right temperature and moisture conditions, intense thunderstorms can produce tornadoes in higher terrain. Tornadoes can occur in every state, although the mid-west states have by far the greatest potential for this type of event. Tornadoes are ranked by intensity using the Enhanced Fujita (EF) Scale, replacing the original Fujita Scale devised by Dr. Theodore Fujita at the University of Chicago in 1971. The EF scale is broken into six categories from F-0 to F-5. F-0 relates to a tornado having a wind speed up to 72 miles per hour, while an F-5 tornado would have winds up to 318 mph.

4.4.9.1. Location and Extent

Both tornado and windstorm events can occur throughout Jefferson County. Tornado events are usually localized. However, severe thunderstorms may result in conditions favorable to the formation of numerous or long-lived tornadoes. 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, and most likely to occur during the spring and early summer months of March through August. Tornado movement is characterized in two ways: direction and speed of spinning winds and forward movement of the tornado, also known as the 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.

Severe winds are experienced on a region-wide scale and often accompany tornados and are caused by the 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.

Figure 4-33: Wind Zones of the US (FEMA, 2014)

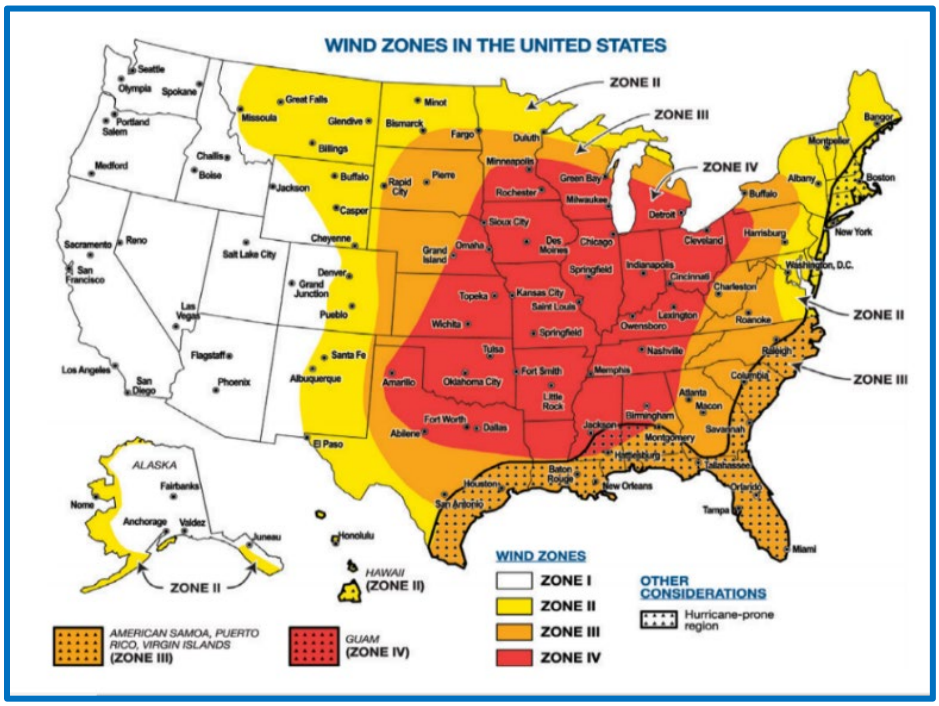


Figure 4-33 shows the wind speed zones developed by the American Society of Civil Engineers based on tornado and hurricane historical events. These wind speed zones are intended to guide the design and evaluation of the structural integrity of shelters and critical facilities. The whole of the Eastern Panhandle falls within Zone III, meaning the region is susceptible to winds up to 200 miles per hour. The whole Eastern Panhandle falls within Zone III, meaning that shelters and critical facilities should be able to withstand a 3-second gust of up to 200 mph, regardless of whether the gust is the result of a tornado, coastal storm, or windstorm event. Therefore, these structures should be able to withstand the wind speeds experienced in an F3 tornado event.

4.4.9.2. Past Occurrence

There have been five tornado events in Jefferson County since 1990, as seen in Table 4-40. They have all occurred between the months of May and September, and two tornados have inflicted injuries on the Jefferson County population since 1990. The first one occurred on July 2, 1997 and injured four people. The second one spawned by the Hurricane Ivan weather system on September 17, 2004, injured one person. The most severe documented tornado occurrence in the area had an F1 magnitude. The damage it caused was described in the 2013 WV Statewide HMP, stating that the tornado caused extensive damage to house and businesses and overturned vehicles on I-81. The path of this tornado can be seen in Figure 4-34 alongside other tornadoes in the region.

Hurricane Ivan resulted in the most recent severe tornadoes identified in the region. However, a recent severe windstorm did occur on May 3, 2021. Severe winds swept through the Eastern Panhandle, displacing several families. The National Weather Service confirmed a tornado hit Ranson, WV with peak winds at 90 mph. Emergency Officials reported severe damage in the Ranson area as well as the areas of Bunker Hill and Inwood in neighboring Berkeley County. A list of other hazardous windstorms from 1991 to March 2023 can be seen in Table 4-40.

Figure 4-34: Tornado Tracks of Hurricane Ivan (Prociv, 2004)

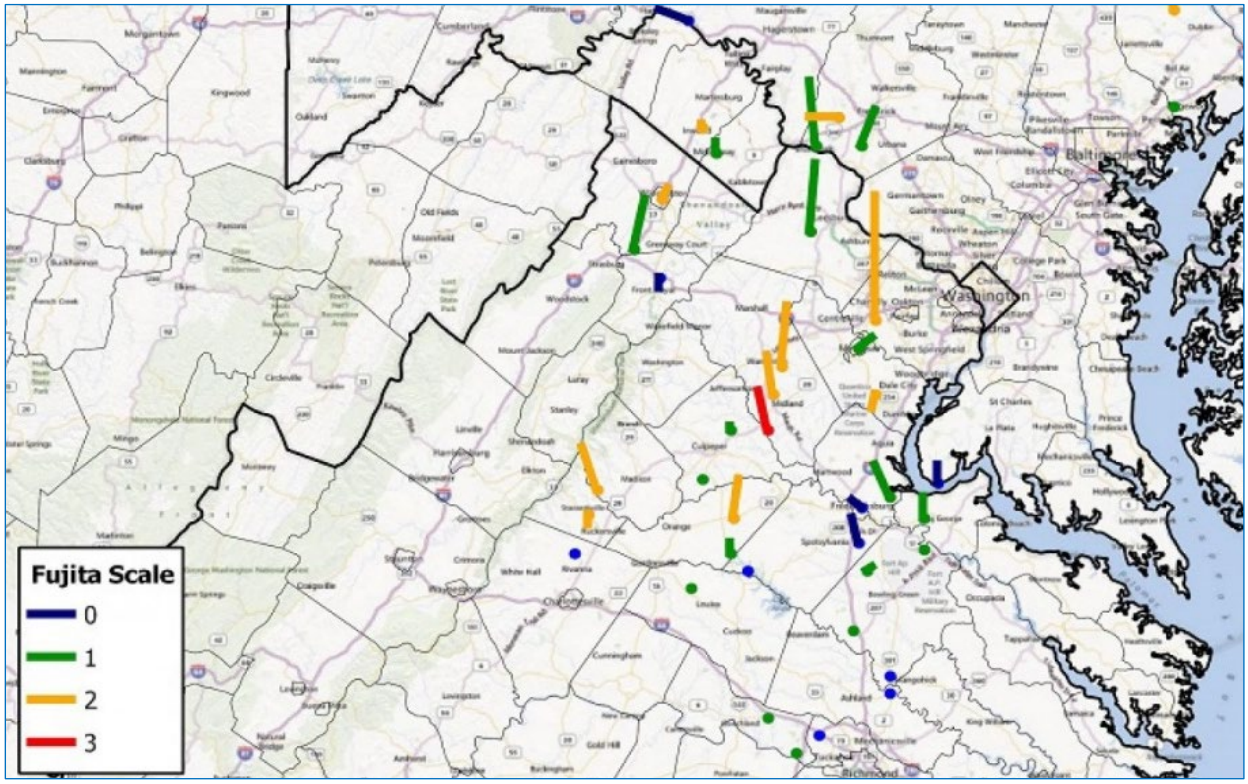
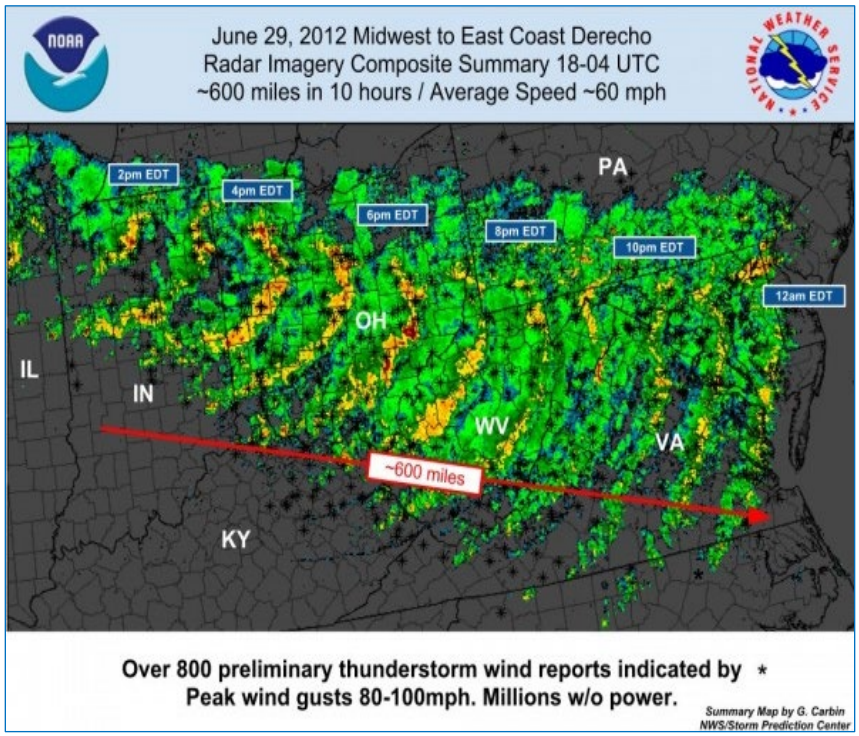


Figure 4-35: 6/29/12 Derecho Windstorm



On June 29, 2012, a type of violent windstorm system, called a derecho, moved eastward impacting Indiana, Ohio, West Virginia, Virginia, Washington DC, Maryland, and part of New Jersey, as seen in Figure 4-35. The storm carried thunder and wind gusts ranging between 60 and 100 mph. Thirteen people were killed as a result of this windstorm, three in West Virginia, with widespread power outages across the impacted area leaving 1.6 million people without power. Damages from the storm were reported in the Eastern Panhandle. Meteorologists theorize that the derecho event occurred in part thanks to the above average temperatures being experienced across the impacted region, which helped to fuel the storm (Daniel, 2012).

Table 4-40: Tornado Events Jefferson County, 1990 – March 2023, (NCEI NOAA, 2023)

Location	Date	Magnitude	Property Damage ($)	Crop Damage ($)	Injuries
Unknown (State Plan)	7/2/1997	F0	250,000	0	4
Summit Point (NCEI)	7/9/2003	F0	0	0	0
Middleway (NCEI)	9/17/2004	F1	250,000	0	0
Charles Town (NCEI)	7/5/2017	EF0	0	0	0
Charles Town (NCEI)	5/3/2021	EF1	100,000	0	1

In addition to tornadoes, Jefferson County has also endured considerable damage from countless hazardous wind events, shown in Table 4-41.

Table 4-41: Hazardous Wind Events in Jefferson County, 1990 – March 2023

Date	Type	Wind Speed (Knots)	Injuries	Property Damage ($)	Crop Damage ($)	Date	Type	Wind Speed (Knots)	Injuries	Property Damage ($)	Crop Damage ($)
4/9/91	T-Storm Wind	50	0	0	0	6/12/11	T-Storm Wind	56	0	3000	0
1/14/92	T-Storm Wind	53	0	0	0	7/11/11	T-Storm Wind	56	0	500	0
3/10/92	T-Storm Wind	0	0	0	0	7/11/11	T-Storm Wind	61	0	100000	0
7/17/92	T-Storm Wind	0	0	0	0	7/11/11	T-Storm Wind	61	0	5000	0
7/23/92	T-Storm Wind	0	0	0	0	7/11/11	T-Storm Wind	56	0	5000	0
4/16/93	T-Storm Wind	0	0	5000	0	7/19/11	T-Storm Wind	52	0	1000	0
8/17/93	T-Storm Wind	0	0	5000	0	7/19/11	T-Storm Wind	56	0	2000	0
8/13/94	T-Storm Wind	0	0	500	0	9/14/11	T-Storm Wind	52	0	0	0
9/13/94	T-Storm Wind	0	0	500	0	5/27/12	T-Storm Wind	52	0	0	0
11/1/94	T-Storm Wind	0	0	5000	0	6/29/12	T-Storm Wind	60	0	0	0
4/9/95	T-Storm Wind	0	0	0	0	6/29/12	T-Storm Wind	61	0	10000	0
6/3/95	T-Storm Wind	0	0	3000	0	6/29/12	T-Storm Wind	57	0	5000	0
6/11/95	T-Storm Wind	0	0	0	0	6/29/12	T-Storm Wind	57	0	1000	0
7/6/95	T-Storm Wind	0	0	25000	0	10/29/12	High Wind	52	0	0	10000
7/10/95	T-Storm Wind	0	0	10000	0	5/22/13	T-Storm Wind	52	0	1000	500
7/16/95	T-Storm Wind	0	0	15000	0	6/10/13	T-Storm Wind	52	0	0	250
7/30/96	T-Storm Wind	-	0	10000	0	6/24/13	T-Storm Wind	52	0	5000	500
9/6/96	High Wind	-	0	50000	25000	6/25/13	T-Storm Wind	52	0	500	500
3/6/97	Strong Wind	-	0	0	0	6/25/13	T-Storm Wind	52	0	0	500
3/31/97	Strong Wind	-	0	15000	0	6/25/13	T-Storm Wind	52	0	0	500
6/26/97	T-Storm Wind	-	0	25000	0	6/25/13	T-Storm Wind	52	0	0	500
7/28/97	T-Storm Wind	-	0	3000	0	7/7/13	T-Storm Wind	52	0	0	250

Table 4-41: Hazardous Wind Events in Jefferson County, 1990 – March 2023											
Date	Type	Wind Speed (Knots)	Injuries	Property Damage ($)	Crop Damage ($)	Date	Type	Wind Speed (Knots)	Injuries	Property Damage ($)	Crop Damage ($)
2/24/98	Strong Wind	-	0	0	0	7/2/14	T-Storm Wind	52	0	1000	1000
6/13/98	T-Storm Wind	56	0	20000	0	7/2/14	T-Storm Wind	52	0	3000	500
6/16/98	T-Storm Wind	-	0	5000	0	7/2/14	T-Storm Wind	52	0	0	1000
7/21/98	T-Storm Wind	71	0	35000	15000	7/2/14	T-Storm Wind	52	0	0	250
3/3/99	T-Storm Wind	-	0	3000	0	7/2/14	T-Storm Wind	52	0	2000	2000
5/12/99	T-Storm Wind	-	0	500	0	7/2/14	T-Storm Wind	52	0	1000	250
7/24/99	T-Storm Wind	-	0	5000	0	7/8/14	T-Storm Wind	52	0	0	250
7/28/99	T-Storm Wind	-	0	3000	0	7/13/14	T-Storm Wind	52	0	0	250
8/26/99	T-Storm Wind	-	0	4000	0	7/13/14	T-Storm Wind	52	0	0	500
9/29/99	T-Storm Wind	-	1	40000	0	7/13/14	T-Storm Wind	52	0	0	250
5/10/00	T-Storm Wind	-	0	2000	0	7/13/14	T-Storm Wind	52	0	0	250
5/13/00	T-Storm Wind	-	0	500	0	7/13/14	T-Storm Wind	52	0	0	250
5/13/00	T-Storm Wind	-	0	5000	0	7/13/14	T-Storm Wind	52	0	0	500
5/13/00	T-Storm Wind	-	1	2000	0	7/23/14	T-Storm Wind	52	0	0	500
5/13/00	T-Storm Wind	-	0	2000	0	7/23/14	T-Storm Wind	52	0	0	1000
6/15/00	T-Storm Wind	-	0	1000	0	9/6/14	T-Storm Wind	52	0	0	250
7/14/00	T-Storm Wind	-	0	500	0	5/16/15	T-Storm Wind	50	0	1000	0
8/9/00	T-Storm Wind	-	0	2000	0	5/16/15	T-Storm Wind	50	0	1000	0
12/12/00	Strong Wind	-	0	0	0	6/30/15	T-Storm Wind	52	0	2000	0
12/17/00	Strong Wind	-	0	0	0	8/4/15	T-Storm Wind	52	0	1000	0
1/27/01	Strong Wind	-	0	0	0	4/2/16	High Wind	50	0	0	0
2/9/01	Strong Wind	-	0	0	0	6/16/16	T-Storm Wind	50	0	0	0
3/6/01	Strong Wind	-	0	0	0	8/15/16	T-Storm Wind	50	0	0	0
3/13/01	T-Storm Wind	-	0	10000	0	8/15/16	T-Storm Wind	50	0	0	0

Table 4-41: Hazardous Wind Events in Jefferson County, 1990 – March 2023											
Date	Type	Wind Speed (Knots)	Injuries	Property Damage ($)	Crop Damage ($)	Date	Type	Wind Speed (Knots)	Injuries	Property Damage ($)	Crop Damage ($)
3/13/01	T-Storm Wind	-	0	2000	0	9/7/16	T-Storm Wind	50	0	0	0
3/13/01	T-Storm Wind	-	0	30000	0	2/12/17	High Wind	52	0	0	0
6/12/01	T-Storm Wind	-	0	500	0	3/1/17	T-Storm Wind	52	0	0	0
6/30/01	T-Storm Wind	-	0	500	0	3/1/17	T-Storm Wind	52	0	0	0
2/1/02	Strong Wind	-	0	0	0	7/22/17	T-Storm Wind	50	0	0	0
3/21/02	Strong Wind	-	0	0	0	7/22/17	T-Storm Wind	50	0	0	0
4/28/02	T-Storm Wind	-	0	5000	0	7/22/17	T-Storm Wind	50	0	0	0
4/28/02	T-Storm Wind	-	0	20000	0	8/3/17	T-Storm Wind	50	0	0	0
5/14/02	T-Storm Wind	-	0	10000	0	8/12/17	T-Storm Wind	50	0	0	0
5/14/02	T-Storm Wind	-	0	5000	0	3/2/18	High Wind	50	0	0	0
5/26/02	T-Storm Wind	-	0	10000	0	5/14/18	T-Storm Wind	50	0	0	0
6/6/02	T-Storm Wind	-	0	5000	0	5/14/18	T-Storm Wind	50	0	0	0
6/6/02	T-Storm Wind	-	0	2000	0	7/27/18	T-Storm Wind	50	0	0	0
7/9/02	T-Storm Wind	-	0	5000	0	8/17/18	T-Storm Wind	50	0	0	0
9/27/02	T-Storm Wind	50	0	2000	0	8/21/18	T-Storm Wind	50	0	0	0
1/8/03	Strong Wind	40	0	100	0	**2023 Plan Update**					
2/23/03	Strong Wind	30	0	100	0	6/27/19	High Wind	50	0	0	0
6/1/03	Strong Wind	40	0	1000	0	6/27/19	T-Storm Wind	50	0	0	0
6/12/03	T-Storm Wind	50	0	2000	0	6/29/19	T-Storm Wind	61	0	0	0
7/4/03	T-Storm Wind	50	0	500	0	6/29/19	T-Storm Wind	50	0	0	0
7/6/03	T-Storm Wind	50	0	2000	0	6/29/19	T-Storm Wind	50	0	0	0
8/22/03	T-Storm Wind	50	0	2000	0	6/29/19	T-Storm Wind	50	0	0	0
8/26/03	T-Storm Wind	55	0	5000	0	7/22/19	T-Storm Wind	61	0	0	0
9/18/03	High Wind	50	1	300000	50000	7/22/19	T-Storm Wind	50	0	0	0

Table 4-41: Hazardous Wind Events in Jefferson County, 1990 – March 2023											
Date	Type	Wind Speed (Knots)	Injuries	Property Damage ($)	Crop Damage ($)	Date	Type	Wind Speed (Knots)	Injuries	Property Damage ($)	Crop Damage ($)
10/15/03	Strong Wind	44	0	3000	0	8/6/19	T-Storm Wind	50	0	0	0
11/13/03	Strong Wind	45	0	3000	0	8/22/19	T-Storm Wind	50	0	0	0
5/21/04	T-Storm Wind	55	0	0	0	9/2/19	T-Storm Wind	50	0	0	0
5/21/04	T-Storm Wind	53	0	3000	0	3/3/20	T-Storm Wind	50	0	0	0
5/21/04	T-Storm Wind	55	0	2000	0	3/3/20	T-Storm Wind	56	0	3000	0
5/21/04	T-Storm Wind	53	0	2000	0	3/3/20	T-Storm Wind	56	0	20000	0
6/1/04	T-Storm Wind	55	0	5000	0	4/7/20	T-Storm Wind	56	0	3000	0
11/24/05	Strong Wind	40	0	100000	0	4/7/20	T-Storm Wind	60	0	30000	0
11/29/05	T-Storm Wind	50	0	100000	0	4/13/20	T-Storm Wind	60	0	30000	0
1/14/06	T-Storm Wind	60	0	100000	0	4/13/20	T-Storm Wind	50	0	0	0
1/14/06	High Wind	50	0	100000	0	5/29/20	T-Storm Wind	50	0	0	0
6/22/06	T-Storm Wind	50	0	10000	0	6/5/20	T-Storm Wind	55	0	10000	0
7/12/06	T-Storm Wind	50	0	13000	0	6/25/20	T-Storm Wind	50	0	5000	0
8/26/06	T-Storm Wind	50	0	27000	0	7/6/20	T-Storm Wind	50	0	1000	0
12/1/06	Strong Wind	45	0	10000	0	7/6/20	T-Storm Wind	65	0	50000	0
5/27/07	T-Storm Wind	50	0	1000	0	7/22/20	T-Storm Wind	50	0	5000	0
6/13/07	T-Storm Wind	50	0	3000	0	9/3/20	T-Storm Wind	50	0	2000	0
6/21/07	T-Storm Wind	50	0	1000	0	11/15/20	T-Storm Wind	50	0	2000	0
7/28/07	T-Storm Wind	50	0	2000	0	5/3/21	T-Storm Wind	55	0	20000	0
7/29/07	T-Storm Wind	50	0	0	0	5/3/21	T-Storm Wind	50	0	3000	0
12/16/07	High Wind	50	0	0	0	5/3/21	T-Storm Wind	50	0	1000	0
2/10/08	High Wind	50	0	25000	0	5/3/21	T-Storm Wind	50	0	1000	0
5/31/08	T-Storm Wind	50	0	1000	0	5/26/21	T-Storm Wind	55	0	10000	0
6/4/08	T-Storm Wind	70	0	20000	0	5/26/21	T-Storm Wind	65	0	25000	0

Table 4-41: Hazardous Wind Events in Jefferson County, 1990 – March 2023											
Date	Type	Wind Speed (Knots)	Injuries	Property Damage ($)	Crop Damage ($)	Date	Type	Wind Speed (Knots)	Injuries	Property Damage ($)	Crop Damage ($)
6/4/08	T-Storm Wind	70	0	20000	0	6/3/21	T-Storm Wind	55	0	3000	0
6/4/08	T-Storm Wind	74	0	0	0	6/21/21	T-Storm Wind	50	0	2000	0
6/4/08	T-Storm Wind	70	0	75000	0	6/21/21	T-Storm Wind	50	0	4000	0
6/4/08	T-Storm Wind	50	0	1000	0	6/21/21	T-Storm Wind	50	0	3000	0
6/4/08	T-Storm Wind	50	0	5000	0	6/30/21	T-Storm Wind	50	0	2000	0
6/4/08	T-Storm Wind	50	0	8000	0	7/12/21	T-Storm Wind	45	0	1000	0
6/16/08	T-Storm Wind	50	0	4000	0	7/12/21	T-Storm Wind	50	0	1500	0
6/28/08	T-Storm Wind	50	0	8000	0	7/17/21	T-Storm Wind	50	0	5000	0
6/28/08	T-Storm Wind	50	0	8000	0	8/10/21	T-Storm Wind	55	0	3000	0
7/23/08	T-Storm Wind	50	0	1000	0	8/10/21	T-Storm Wind	50	0	1000	0
2/11/09	T-Storm Wind	52	0	0	0	8/10/21	T-Storm Wind	50	0	1000	0
2/11/09	T-Storm Wind	50	0	0	0	8/11/21	T-Storm Wind	50	0	1000	0
2/12/09	High Wind	50	0	0	0	8/13/21	T-Storm Wind	50	0	1000	0
8/21/09	T-Storm Wind	52	0	0	0	8/13/21	T-Storm Wind	50	0	20000	0
2/26/10	High Wind	50	0	0	0	8/13/21	T-Storm Wind	55	0	12000	0
7/25/10	T-Storm Wind	70	0	10000	0	8/25/21	T-Storm Wind	50	0	1000	0
7/25/10	T-Storm Wind	62	0	10000	0	8/28/21	T-Storm Wind	50	0	6000	0
11/16/10	T-Storm Wind	61	0	0	0	6/16/22	T-Storm Wind	50	0	2000	0
11/16/10	T-Storm Wind	61	0	0	0	6/22/22	T-Storm Wind	50	0	1000	0
11/16/10	T-Storm Wind	61	0	0	0	6/22/22	T-Storm Wind	55	0	10000	0
11/17/10	T-Storm Wind	56	0	10000	0	7/1/22	T-Storm Wind	55	0	10000	0
2/25/11	High Wind	50	0	0	0	8/4/22	T-Storm Wind	50	0	1000	0
3/10/11	T-Storm Wind	50	0	500	0	9/25/22	T-Storm Wind	43	0	1000	0
6/12/11	T-Storm Wind	52	0	1000	0	3/23/23	T-Storm Wind	52	0	2000	0

Table 4-41: Hazardous Wind Events in Jefferson County, 1990 – March 2023											
Date	Type	Wind Speed (Knots)	Injuries	Property Damage ($)	Crop Damage ($)	Date	Type	Wind Speed (Knots)	Injuries	Property Damage ($)	Crop Damage ($)
6/12/11	T-Storm Wind	56	0	1000	0		T-Storm Wind	52	0	3000	0

(NOAA, 2023)

4.4.9.3. Future Occurrence

For the period between 1990 and March 2023, four tornadoes were reported in Jefferson County by NCEI. Therefore, the annual probability of being in the path of a tornado in the region is relatively minor. While the chance of being hit by a tornado is small, the damage that results when the tornado arrives can be potentially devastating. An F4 tornado, with a 0.01-percent-annual probability of occurring, can carry wind velocities of 200 mph, resulting in a force of more than 100 pounds per square foot of surface area. This is a "wind load" that exceeds the design limits of most buildings. While most of the recent windstorms and tornadoes have occurred outside of the county, their proximity contributes to future risk. Because more windstorms have been seen in the region, it is possible that an increasing number of tornadoes will be seen in Jefferson County.

According to these NCEI records, there have been 237 hazardous wind events in Jefferson County. The region experiences severe windstorm events more commonly than tornadoes, which causes power failures, loss of communication networks, and residents requiring temporary shelters and provision of supplies.

4.4.9.4. Range of Magnitude

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 impact of tornado hazards is ultimately dependent on the population or amount of property present in the area in which the tornado occurs. Tornado events are often so severe that property loss or human fatality is typically inevitable if evacuation or proper construction standards are not implemented.

Table 4-42: Enhanced Fujita Scale Categories with Associated Wind Speeds and Expected Damage

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.

Since 2007, enhanced Fujita Tornado Scale (or the -EF-Scale) has been used in the United States to describe the magnitude of tornadoes. Prior to 2007, the Fujita Scale (F-Scale) was commonly used to describe magnitude. This scale is based on new information about the relationship between wind speed given in miles per hour (mph) and corresponding damage. The EF Scale categorized tornadoes from EF0 to EF5 with EF0 being the most commonly occurring type of tornado. Table 4-42 shows the enhanced Fujita Tornado Scale and associated damages.

Since tornado and severe wind events are typically localized, environmental impacts are rarely widespread. However, where these events occur, severe damage to buildings and plant species is likely. This includes loss of trees and an increased threat of wildfire in areas where dead trees are not removed. Hazardous material facilities should meet design requirements to withstand a 3-second gust of up to 160 mph in order to prevent release of hazardous materials into the environment.

The worst-case scenario for windstorm and tornado events in Jefferson County would be an EF5 tornado that strikes the Charles Town area. This is the most densely developed and populated area in the county and a severe tornado here could cause maximum property damage and casualties. Most tornadoes only remain on the ground for around 5 minutes and travel a few miles, but some have tornadoes have remained grounded for over an hour and traveled 70 miles. An EF5 tornado can level houses, throw cars,

and deform reinforced or high-rise buildings. An event of this severity is exceptionally unlikely to occur and represents an extreme scenario only, but the possibility should be considered. More typical wind hazard events in Jefferson County involve tree and limb damage, with fallen trees and limbs possibly resulting in damage to nearby vehicles or structures.

4.4.9.5. Vulnerability Assessment

For tornadoes or high winds, aged and dilapidated structures or structures not built to applicable building codes are more susceptible to damage. Mobile homes and campgrounds are especially susceptible to damage due to tornadoes or high wind. Strong winds can rip roofs off any dilapidated structures and overturn mobile homes. Past experiences with tornadoes in the region show that, while rare, death and injury are indeed possibilities. Vulnerability to the effects of a tornado or high wind is somewhat dependent upon the age of a structure because as building codes become more stringent, buildings are capable of enduring greater wind forces.

In Jefferson County, high winds occur almost annually. The most common detrimental effects are interruptions in power supply and communications services due to downed wires and blocked roadways due to downed trees. Most severe power failures or outages are regional events. With the loss of power, electrical-powered equipment and systems will not be operational. Examples include lighting, HVAC and ancillary support equipment, communication systems, ventilation system, refrigerators, sterilizers, and medical equipment. This can cause food spoilage, loss of heat or air conditions, basement flooding (sump pump failure), lack of light, loss of water (well pump failure), lack of phone service, or lack of internet. While it is most often a short-term nuisance rather than a catastrophic hazard, utility interruptions can cause challenges for communications and response, particularly in more rural areas of the county. A worst-case scenario for utility interruption in the region would involve a power outage during winter snow or ice storms, which have the potential to cause power outages for prolonged periods of time.

High winds often occur during hurricanes and tropical storms. Information about potential annualized losses due to hurricane winds can be found in Section 3.5.3.

All structures and infrastructure might be exposed to the effects of a tornado or other high winds. Depending upon the severity of a tornado or high wind, any existing structures might be damaged to some extent. Any future structures might be exposed to tornados or high winds as this hazard does not occur in specific locations. However, future buildings will be somewhat protected from the effects of tornado or high wind as they will meet the most current State building code requirements for bracing and roof design.

Manufactured housing (i.e. mobiles homes or trailers) is particularly vulnerable to high winds and tornadoes. The U.S. Census Bureau defines manufactured homes as “movable dwellings, eight feet or wider and 40 feet or longer, design to be towed on its own chassis, with transportation gear integral to the unit when it leaves the factory, and without need of a permanent foundation (U.S. Census Bureau, 2021).” They can include multi-wide and expandable manufactured homes but exclude travel trailers,

motor homes, and modular housing. Due to their lightweight and often unanchored design, manufactured housing is extremely vulnerable to high winds and will generally sustain the most damage.

Table 4-43 below displays the number of manufactured housing units in Jefferson County, which account for a little more than 6% of the area's housing stock.

Table 4-43: Manufactured Homes in Jefferson County (U.S. Census Bureau, 2021b)

Total Housing Units	Number Mobile Homes	Percent Mobile Homes
23,607	1,448	6.1%

According to the NOAA Storm Events Database, Jefferson County has reported $2,235,000 in property damages due to tornados and extreme wind events, and $112,000 in crop damage from wind events (NOAA NCEI, 2023).

4.4.9.6. People

For the purpose of this plan, the entire population of Jefferson County is exposed to the severe windstorm and tornado hazards. Residents may be displaced or require temporary and long-term housing and sheltering. In addition, damages caused by a severe windstorm or tornado can lead to severe injuries and loss of life.

Socially vulnerable populations are most susceptible due to their physical and financial ability to react and respond during severe wind events and tornadoes. This population includes the elderly, young, and individuals with disabilities or access or functional needs who may be unable to evacuate in the event of an emergency. The elderly is considered most vulnerable because they require extra time and are more likely to seek or need medical attention that might not be readily available due to isolation during a storm event.

Vulnerable population also includes those who would not have adequate warning from an emergency warning system (e.g., television or radio); this would include residents and visitors. The population adversely affected by severe storms may also include those beyond the disaster area that rely on affected roads for transportation.

Economically disadvantaged people are at high risk for bracing severe wind events and tornadoes because of the potential inability to afford up-to-code homes and buildings that are deemed safe. They also may pose health issues, such as exposure to mold and other health issues that water seepage may cause.

In 2021, nearly 1,500 manufactured homes resided in Jefferson County. As mentioned previously, manufactured housing is more susceptible to physical deterioration from tornadoes and severe wind events than more secure structures. Still, severe wind events have caused considerable damage to

structures considered "well-constructed," meaning that every person within proximity of the hazard faces varying levels of harm.

Severe wind events and tornadoes can also cause respiratory illnesses or exacerbate their negative impacts on human health. In addition, tornadoes can knock down trees or structures, which can cause severe injury or death.

In 2018, Jefferson County residents identified severe wind events and tornadoes are one of their top hazard concerns. Often, tornado events require people to take shelter in sturdy structure or to evacuate the area, so not having the access to one can further endanger the population. Unfortunately, lacking the adequate resources to seek safety can cause anxiety in vulnerable populations on top of the dangers severe wind events and tornadoes already pose.

4.4.9.7. Structures

To understand risk, a community must evaluate what assets are exposed and vulnerable in the identified hazard area. For severe wind events and tornadoes, the entirety of Jefferson County has been identified as the hazard area. Therefore, all assets in the County (population, structures, critical facilities, and lifelines), are vulnerable.

The most vulnerable structures during severe wind events or tornadoes include manufactured housing, historic buildings, and general structure finishings.

4.4.9.8. Systems

Overall, all critical facilities are exposed to severe storm events. Transportation routes are vulnerable to severe wind and tornadoes and have the potential to be wiped out or blocked, creating isolation issues from responders. This includes all roads and bridges in the path of a storm event or tornado. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand high wind speeds and excessive precipitation.

Utility infrastructure is also vulnerable; interruption of services may not only impact vulnerable populations but may also impact critical facilities that need to be in operation during a disaster. Because power interruption can occur, backup power is recommended for critical facilities and infrastructure. Full functionality of critical facilities such as police, fire, and medical services is essential for response during and after a severe storm event.

Loss of service can impact residents and business operations alike. Interruptions in heating or cooling utilities can affect populations such as the young and elderly, who are particularly vulnerable to temperature-related health impacts. Loss of power can impact other public utilities, including potable water, wastewater treatment, and communications. In addition to public water services, property owners with private wells might not have access to potable water due to pump failure until power is restored.

One of the dangers of severe wind events or tornadoes lies in their high capacity to cause secondary or cascading consequences, as intense winds can topple over trees, scatter debris, or damage home finishings. Moreover, these consequences can interrupt necessary utility connections, block roads or train tracks, and damage crops.

4.4.9.9. Natural, Historic and Cultural Resources

Environmental resources, including critical habitat (or habitats that are known to be essential for an endangered or threatened species), wetlands, parks, and reserves are particularly vulnerable to severe storms. Destroyed habitats could displace and kill organisms reliant on these habitats. The impacts of intense windstorms and precipitation on the environment typically take place over a larger area. Where these events occur, widespread, severe damage to plant species is likely. This includes uprooting or destruction of trees and an increased threat of wildfire in areas where dead trees are not removed.

According to Jefferson County's Historic Landmarks Commission, 71 nationally registered landmarks can be found within the boundaries of the county. These sites are particularly vulnerable to destruction, as they already require specialized care to stay in good condition for preservation.

Animals and vegetation are also prone to harm, injury, or death in the event of severe wind or tornado.

4.4.9.10. Community Activities

Potential economic impacts include loss of agriculture, business, and tourism. In addition, losses of buildings and infrastructure also take a toll on the economic condition of Jefferson County. Similarly, damages to buildings can displace people from their homes, threaten life safety and impact a community's economy and tax base. Severe windstorms and tornadoes can also damage utilities and communication towers, which are costly because they need to be repaired almost immediately after damages occur, and these repairs can cost millions of dollars to fix for a singular event.

Activities that have value to the community could potentially be impacted by severe windstorms or tornados. When these activities are delayed or cancelled due to severe windstorms or tornadoes, the economy of the community is affected. Numerous activities are scheduled within Jefferson County and its municipalities. Below are community activities that occur throughout the year or annually.

- Jefferson County Fair – July and August at Jefferson County Fairgrounds and weekly farm markets
- Historical Walking Tours of Harpers Ferry, WV – Available All Year (Note four (4) of the National Register Areas within Harpers Ferry are located in the 1-percent-annual chance floodplain.)
- Hollywood Casino Horse Races – Reoccurring – Located in Charles Town
- September 22 - 24 - Mountain Heritage Arts & Craft Festival at Jefferson County Fairgrounds
- October 7 - Freedoms Run (Note: held in in Harpers Ferry & Shepherdstown.)

4.4.10. Severe Winter Storm

Winter storms are often erratic, affecting different areas unevenly; they often develop, dissipate, and reform with two to three centers, often delivering snow in only one quadrant, while places not too far away from a blizzard may experience rain or fog, or nothing at all. There are three elements that must be present to generate a winter storm (NSSL, n.d.).

- **Cold Air:** Below freezing temperatures in the clouds and near the ground are necessary to make snow and/or ice.
- **Lift:** Something to raise the moist air to form the clouds and cause precipitation. An example of lift is warm air colliding with cold air and being forced to rise over the cold dome. The boundary between the warm and cold air masses is called a front. Another example of lift is air flowing up a mountainside.
- **Moisture:** To form clouds and precipitation. Air blowing across a body of water, such as a large lake or the ocean, is an excellent source of moisture.

4.4.10.1. Location and Extent

Winter storms tend to encompass the entire county whereas flooding generally occurs within predictable boundaries along the regulatory SFHA and its main branches and tributaries. Nor'easters typically develop as extra-tropical storms which can produce winds equivalent to hurricane or tropical storm force as well as heavy precipitation, sometimes in the form of snow. These storms are regional events that can impact very large areas hundreds to thousands of miles across over the life of the storm. Risks associated and identified with severe winter storms include but are not limited to the following:

- Emergency medical evacuation of the sick, elderly, and infirmed to shelters.
- Power outages to those on life support systems.
- Communications interruptions and/or outages.
- Loss of the ability to heat homes.
- Interruption of the delivery of home supplies and food.

These above-described events fall within 2 general categories 1) road closures due to snow drifts and 2) utility failures (such as damaged supply lines). Additionally, data indicates that structural damage has occurred in several instances in the past as a result of extremely heavy snowfall. Structures damaged were usually buildings such as barns, garages, carports, etc. Additionally, because of the county's mountainous terrain, severe winter storms frequently result in dangerous driving conditions.

According to the 2018 WV Statewide HMP, Jefferson County averaged 1.1 to 2.4 days per year with snowfall equal or greater than 10.0 inches. Ten inches of snowfall in a day represents a winter storm of significant magnitude.

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

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

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

Any of the above events can result in the closing of secondary roads, particularly in rural locations, loss of utility services and depletion of oil heating supplies. 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 groundwater recharge. However, abrupt high temperatures following a heavy snowfall can cause rapid surface water runoff and severe flooding.

4.4.10.2. Past Occurrence

Winter storms are one of the most frequently occurring hazards in the Eastern Panhandle. Table 4-43 illustrate impacts resulting from winter storm (i.e., snow, ice, and blizzard) events in Jefferson County between 1997 and May 2023. As shown in the table, winter storm events have had minimal impact on property or crops and no injuries have been reported. Table 4-44 illustrate the number of Winter Storm

Events per year in Jefferson County. Some of these instances may have also been categorized as nor'easters; however, this was not differentiated within the database. According to the 2018 WV Statewide HMP, there are 6.5 annualized events in Jefferson County, totaling $2,000 from 2000-2016.

Over the last three decades, Jefferson County has faced numerous severe winter storm events with varying consequences. Some of the most notable are described below.

January 18, 1998

Warm moist air overrunning a shallow polar surface air mass produced winter weather; precipitation began as a mix of sleet and snow but quickly changed to rain and freezing rain across much of the area. Freestanding structures such as trees, power poles/wires, and exposed bridges received between ¼ and ½ inch of ice accretion. A strip of higher elevation areas (roughly between 500 and 1000 feet above sea level) in Jefferson County received the most icing. In this area, spotty power outages, and a few large limbs and small trees snapped under the weight of the ice.

January 14, 1999

A strong arctic cold front moved slowly southeast across the Mid-Atlantic region bringing a thin layer of sub-freezing air to the lowest levels of the atmosphere, but just off the surface, warmer air moved in. A low-pressure system developed over the Tennessee Valley. The low moved into the Mid-Atlantic region over the next few days, spreading precipitation region-wide. The precipitation started as snow but melted into rain as it fell through the warm layer of air in the mid-levels of the atmosphere. Unfortunately, the ground was below freezing during the period, so the rain froze on every surface it came in contact with. This created ice accumulations of ¼ to ½ inch. In terms of Jefferson County and surrounding areas, the storm caused several car accidents, slip and fall injuries, downed trees, and power outages. Winds gusted over 40 mph after the precipitation ended and some trees weighed down by ice fell onto roads and power lines.

February 1, 2008

An area of low pressure over the Lower Mississippi River Valley moved up the Appalachians; warmer temperatures aloft combined with subfreezing temperatures at the surface to produce widespread freezing rain across the Mid Atlantic. A quarter of an inch of ice was reported across the eastern panhandle of West Virginia. Numerous traffic accidents and power outages were reported across the region. Rain continued as warmer temperatures slowly filtered across the region.

December 18, 2009

Two systems combined to develop a strong area of low pressure that slowly tracked up the Mid-Atlantic Coast. The low-pressure system was able to tap into moisture from the Gulf of Mexico and the Atlantic Ocean causing copious amounts of precipitation to develop. High pressure to the north kept plenty of cold

air in place causing the precipitation to fall in the form of snow. According to the National Centers for Environmental Information, snowfall totaled up to 20.0 inches at Shenandoah Junction.

February 5, 2010

A potent area of low pressure strengthened over the central portion of the nation and slowly moved through the Mid-Atlantic before redeveloping off the Mid-Atlantic coast. Strong high pressure continued to pump in plenty of cold air across the region for the entire event. Due to the slow movement of the storm, there was a prolonged period of precipitation. The storm system ushered in copious amounts of moisture from the Gulf of Mexico and the Atlantic Ocean. The deep moisture combined with the forcing from the storm system to bring a period of heavy precipitation to the. Most of the precipitation fell in the form of snow due to the cold air that was already in place. West Virginia experienced major snow accumulations. Snowfall totals reported across Jefferson County were between 25 and 27 inches. Local newspapers also reported power outages across the county.

January, 2016

The January 2016 snowstorm caused closures and cancellations throughout Jefferson County and stretched resources. According to NOAA, the snowstorm was the fourth most impactful storm in the Northeastern U.S. since 1950. Jefferson County was ground zero for much of the heaviest snow patterns, receiving as much as 40.5 inches in some sections of the county. This storm was a category 4 (crippling) on the NESIS (Miller, 2018).

December, 2020

The January 2016 snowstorm was the most severe snowstorm in recent memory, but a December 16, 2020 snowstorm also impaired Jefferson County, which was also labeled as a nor'easter. WV Metro News meteorologists claimed there was as much as 12 to 18 inches of snow in Jefferson County.

The 2020 storm resulted in about 16 inches of snowfall across the Eastern Panhandle. The Jefferson County Council President declared a state of emergency and State Senator John Unger requested that Governor Earl Tomblin issue a state of emergency for Jefferson County to deploy additional assistance in snow removal and bring in other emergency services. Many businesses and schools were forced to close, and the governor told non-essential state employees not to report to work (Francis, 2020).

Table 4-43: Winter Storm Events Impacting Jefferson County from 1997 to May 2023 (NCEI NOAA, 2023)									
Date	**Type**	**Injuries**	**Property Damage ($)**	**Crop Damage ($)**	**Date**	**Type**	**Injuries**	**Property Damage ($)**	**Crop Damage ($)**
1/9/1997	Winter Storm	0	0	0	12/26/2012	Winter Weather	0	0	0
2/8/1997	Heavy Snow	0	0	0	1/15/2013	Winter Weather	0	0	0
2/13/1997	Winter Weather	0	0	0	1/25/2013	Winter Weather	0	0	0
12/27/1997	Winter Weather	0	0	0	1/28/2013	Winter Weather	0	0	0
12/29/1997	Winter Storm	0	0	0	2/22/2013	Winter Weather	0	0	0
1/15/1998	Ice Storm	0	8000	0	3/6/2013	Winter Storm	0	0	0
1/24/1998	Winter Weather	0	0	0	3/18/2013	Winter Weather	0	0	0
1/27/1998	Winter Weather	0	0	0	3/24/2013	Winter Storm	0	0	0
2/4/1998	Winter Storm	0	0	0	11/26/2013	Winter Weather	0	0	0
1/2/1999	Winter Storm	0	0	0	12/8/2013	Winter Storm	0	0	0
1/8/1999	Winter Storm	0	0	0	12/10/2013	Winter Storm	0	0	0
1/14/1999	Ice Storm	0	10000	0	12/14/2013	Winter Weather	0	0	0
3/3/1999	Winter Weather	0	0	0	1/2/2014	Winter Weather	0	0	0
3/9/1999	Winter Storm	0	0	0	1/5/2014	Ice Storm	0	0	0
3/14/1999	Winter Storm	0	0	0	1/10/2014	Winter Weather	0	0	0
1/20/2000	Winter Weather	0	0	0	1/21/2014	Winter Storm	0	0	0
1/25/2000	Winter Storm	0	0	0	2/3/2014	Winter Weather	0	0	0
1/30/2000	Winter Storm	0	0	0	2/4/2014	Winter Storm	0	0	0
2/18/2000	Winter Storm	0	0	0	2/12/2014	Winter Storm	0	0	0
12/13/2000	Ice Storm	0	0	0	2/19/2014	Winter Weather	0	0	0
12/19/2000	Winter Storm	0	0	0	3/2/2014	Winter Storm	0	0	0
1/5/2001	Winter Weather	0	0	0	3/16/2014	Winter Storm	0	0	0
1/20/2001	Winter Storm	0	0	0	3/19/2014	Winter Weather	0	0	0
2/5/2001	Winter Weather	0	0	0	3/25/2014	Winter Weather	0	0	0
2/22/2001	Winter Storm	0	0	0	3/30/2014	Winter Weather	0	0	0
3/5/2001	Winter Weather	0	0	0	11/26/2014	Winter Weather	0	0	0
1/6/2002	Winter Weather	0	0	0	12/2/2014	Winter Weather	0	0	0
1/19/2002	Winter Weather	0	0	0	12/8/2014	Winter Weather	0	0	0

Table 4-43: Winter Storm Events Impacting Jefferson County from 1997 to May 2023 (NCEI NOAA, 2023)									
Date	**Type**	**Injuries**	**Property Damage ($)**	**Crop Damage ($)**	**Date**	**Type**	**Injuries**	**Property Damage ($)**	**Crop Damage ($)**
12/5/2002	Winter Storm	0	0	0	12/22/2014	Winter Weather	0	0	0
12/11/2002	Ice Storm	0	0	0	1/3/2015	Winter Weather	0	0	0
12/24/2002	Winter Weather	0	0	0	1/6/2015	Winter Weather	0	0	0
1/5/2003	Winter Weather	0	0	0	1/11/2015	Winter Weather	0	0	0
2/6/2003	Winter Weather	0	0	0	1/26/2015	Winter Weather	0	0	0
2/14/2003	Winter Storm	0	0	0	2/16/2015	Winter Weather	0	0	0
2/26/2003	Winter Weather	0	0	0	2/21/2015	Winter Storm	0	0	0
3/30/2003	Winter Weather	0	0	0	3/1/2015	Winter Weather	0	0	0
12/4/2003	Winter Storm	0	0	0	3/3/2015	Winter Weather	0	0	0
1/17/2004	Winter Weather	0	0	0	3/5/2015	Winter Storm	0	0	0
1/23/2004	Winter Storm	0	0	0	3/20/2015	Winter Weather	0	0	0
1/25/2004	Winter Storm	0	0	0	1/22/2016	Winter Storm	0	0	0
2/3/2004	Winter Storm	0	0	0	2/9/2016	Winter Weather	0	0	0
2/5/2004	Winter Storm	0	0	0	2/14/2016	Ice Storm	0	0	0
2/24/2005	Winter Storm	0	0	0	12/12/2016	Winter Weather	0	0	0
2/28/2005	Winter Storm	0	0	0	1/5/2017	Winter Weather	0	0	0
12/5/2005	Winter Weather	0	0	0	1/10/2017	Winter Weather	0	0	0
12/9/2005	Winter Weather	0	0	0	1/14/2017	Winter Weather	0	0	0
12/15/2005	Ice Storm	0	0	0	3/13/2017	Winter Storm	0	0	0
2/11/2006	Heavy Snow	0	0	0	1/8/2018	Winter Weather	0	0	0
1/21/2007	Winter Weather	0	0	0	2/3/2018	Winter Weather	0	0	0
2/6/2007	Winter Weather	0	0	0	2/4/2018	Winter Weather	0	0	0
2/12/2007	Winter Storm	0	0	0	2/17/2018	Winter Weather	0	0	0
2/24/2007	Winter Storm	0	0	0	11/15/2018	Winter Storm	0	0	0
3/7/2007	Winter Weather	0	0	0	11/24/2018	Winter Weather	0	0	0
3/16/2007	Winter Storm	0	0	0	2023 Plan Update				
12/5/2007	Winter Weather	0	0	0	1/12/2019	Winter Storm	0	0	0

Table 4-43: Winter Storm Events Impacting Jefferson County from 1997 to May 2023 (NCEI NOAA, 2023)									
Date	**Type**	**Injuries**	**Property Damage ($)**	**Crop Damage ($)**	**Date**	**Type**	**Injuries**	**Property Damage ($)**	**Crop Damage ($)**
12/15/2007	Winter Storm	0	0	0	1/29/2019	Winter Weather	0	0	0
1/17/2008	Winter Weather	0	0	0	2/1/2019	Winter Weather	0	0	0
2/1/2008	Ice Storm	0	5000	0	2/10/2019	Winter Weather	0	0	0
2/12/2008	Winter Storm	0	0	0	2/17/2019	Winter Weather	0	0	0
2/20/2008	Winter Weather	0	0	0	2/20/2019	Winter Storm	0	0	0
12/16/2008	Winter Weather	0	0	0	3/1/2019	Winter Weather	0	0	0
1/6/2009	Winter Weather	0	0	0	3/1/2019	Winter Weather	0	0	0
1/19/2009	Winter Weather	0	0	0	3/3/2019	Winter Weather	0	0	0
1/27/2009	Winter Storm	0	0	0	12/13/2019	Winter Weather	0	0	0
12/5/2009	Winter Weather	0	0	0	12/16/2019	Winter Weather	0	0	0
12/8/2009	Winter Weather	0	0	0	12/16/2019	Winter Weather	0	0	0
12/13/2009	Winter Weather	0	0	0	1/7/2020	Winter Weather	0	0	0
12/18/2009	Winter Storm	0	0	0	1/18/2020	Winter Weather	0	0	0
12/25/2009	Winter Weather	0	0	0	12/16/2020	Winter Storm	0	0	0
1/30/2010	Winter Storm	0	0	0	1/25/2021	Winter Weather	0	0	0
2/2/2010	Winter Storm	0	0	0	1/31/2021	Winter Storm	0	0	0
2/5/2010	Winter Storm	0	2000	0	2/7/2021	Winter Weather	0	0	0
2/9/2010	Winter Storm	0	0	0	2/10/2021	Winter Weather	0	0	0
12/16/2010	Winter Weather	0	0	0	2/13/2021	Winter Weather	0	0	0
1/11/2011	Winter Weather	0	0	0	2/18/2021	Winter Storm	0	0	0
1/17/2011	Winter Weather	0	0	0	2/18/2021	Winter Weather	0	0	0
1/26/2011	Winter Storm	0	0	0	2/22/2021	Winter Weather	0	0	0
2/1/2011	Winter Weather	0	0	0	1/3/2022	Winter Weather	0	0	0
2/5/2011	Winter Weather	0	0	0	1/6/2022	Winter Storm	0	0	0
2/21/2011	Winter Weather	0	0	0	1/9/2022	Winter Weather	0	0	0

Table 4-43: Winter Storm Events Impacting Jefferson County from 1997 to May 2023 (NCEI NOAA, 2023)									
Date	**Type**	**Injuries**	**Property Damage ($)**	**Crop Damage ($)**	**Date**	**Type**	**Injuries**	**Property Damage ($)**	**Crop Damage ($)**
3/6/2011	Winter Weather	0	0	0	1/16/2022	Winter Storm	0	0	0
10/28/2011	Winter Storm	0	0	0	2/24/2022	Winter Weather	0	0	0
1/20/2012	Winter Weather	0	0	0	3/12/2022	Winter Storm	0	0	0
1/22/2012	Winter Weather	0	0	0	4/18/2022	Winter Weather	0	0	0
12/24/2012	Winter Weather	0	0	0	12/14/2022	Winter Weather	0	0	0
					12/22/2022	Winter Weather	0	0	0

Table 4-44: Number of Winter Storm Events per year in Jefferson County			
Year	**Number of Storms**	**Year**	**Number of Storms**
1996	4	2010	5
1997	6	2011	9
1998	4	2012	6
1999	6	2013	13
2000	6	2014	17
2001	5	2015	12
2002	6	2016	11
2003	6	2017	6
2004	6	2018	8
2005	7	**2023 Plan Update**	
2006	3	2019	13
2007	14	2020	8
2008	5	2021	9
2009	8	2022	9

(NOAA NCEI, 2023)

4.4.10.3. Future Occurrence

Data from NOAA shows that winter storms are a regular occurrence in Jefferson County. So, the probability of the occurrence of a damaging heavy snow or ice storm in the region in any given year is 100 percent. The severity and frequency of major winter storms and nor'easters 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 been affected by 3 to 17 winter storm events each year from 1996 to 2022. Given this

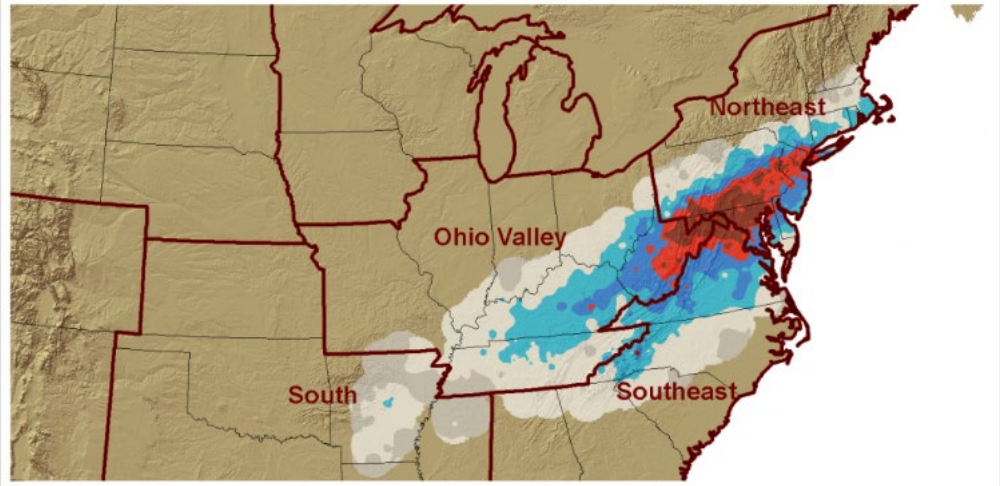
record of reported events, it is safe for planning purposes to assume that in an average year the county can expect to experience on average eight winter storm events.

Temperatures in West Virginia have risen 1°F since the beginning of the 20th century and are projected to continue rising in all seasons of the year (NCICS 2022). This overall increase in temperature leads to more water vapor being stored in the atmosphere. During winter months, despite a warmer temperature, this increase in water vapor can spur more frequent, intense winter weather. The frequency of large snowfall years has increased in the northern United States. Analysis of storm tracks indicates that there has been an increase in winter storm frequency and intensity since 1950, with a slight shift in tracks toward the poles (CSSR, n.d.). If current projections remain, the State of West Virginia can expect more frequent and intense winter weather events.

4.4.10.4. Range of Magnitude

Severe winter weather will affect several counties in a region at one time with varying intensities depending on temperature and moisture in the area. The heavily populated region between Washington D.C., Philadelphia, New York and Boston, the "I-95 Corridor," is especially impacted by Nor'easters (NWS, n.d.).

Figure 4-36: Regional Snowfall Index January 22-24, 2016



Region	RSI	Category
Northeast	17.758	4
Southeast	12.616	4
Ohio Valley	9.958	3
South	0.415	0

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A snowstorm on January 22, 2016, represents the largest impact Jefferson County has encountered Watertown, New York 13601 from a winter storm hazard. During this event, 25 to 40 inches of heavy snow fell across the Eastern Panhandle in less than two days. More specifically, Jefferson County recorded 27

½ inches of snow in just 24 hours, making it the County's "biggest snowfall" to date (Stacker, 2023). An image of the regional snowfall index can be seen in Figure 4-36. The governor issued a state of emergency, and it took until the evening of January 23 to reopen one lane on both Interstate 81N and 81S, temporarily paralyzing travel. The amount of snow put a strain on critical operations as well, and local emergency management officials were tasked with transporting local medical professionals safely to the medical centers they were employed at. The National Guard was activated to transport emergency responders using Humvees (West Virginia Press Association, 2016). A storm of this magnitude could be considered a worst-case scenario winter storm for Jefferson County. This is the most recent winter storm of this magnitude. Several other large winter storms have occurred since 2016, but none of this magnitude.

4.4.10.5. Vulnerability Assessment

While the Fujita and Saffir-Simpson Scales characterize tornadoes and hurricanes respectively, there is no widely used scale to classify snowstorms. Paul Kocin and Louis Uccellini of the National Weather Service developed the Northeast Snowfall Impact Scale (NESIS) that characterizes and ranks high-impact Northeast snowstorms. These storms have large areas of 10-inch snowfall accumulations and greater. The index differs from other meteorological indices in that it uses population information in addition to meteorological measurements. Thus, NESIS indicates a storm's societal impacts. This scale was developed because of the impact Northeast snowstorms can have on the rest of the country in terms of transportation and economic impact.

NESIS scores are a function of the area affected by the snowstorm, the amount of snow, and the number of people living in the path of the storm. The aerial distribution of snowfall and population information are combined in an equation that calculates a NESIS score which varies from around one for smaller storms to over ten for extreme storms. The raw score is then converted into one of the five NESIS categories (NOAA, n.d.).

Since winter storms are a regular occurrence in Jefferson County, as well as other counties throughout West Virginia, strategies have been developed to respond to these events. Snow removal and utility repair equipment is present to respond to typical events. The use of auxiliary heat and electricity supplies such as wood burning stoves, kerosene heaters, and gasoline power generators reduces the vulnerability of specific structures. Locations lacking adequate equipment to protect against cold temperatures or significant snow and ice are more vulnerable to winter storm events. Even for communities that are prepared to respond to winter storms, severe events involving snow accumulations that exceed six or more inches in a twelve-hour period can cause a large number of traffic accidents, interrupt power supply and communications, and cause the failure of inadequately designed and/or maintained roof systems. Some rural areas of the region 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 the region are vulnerable to winter storms.

According to the NSSL (n.d.), most deaths from winter storms are not directly related to the storm itself; people die in traffic accidents on icy roads, of heart attacks while shoveling snow, or of hypothermia from prolonged exposure to cold. During severe winter storms, everyone is potentially at risk; the actual threat depends on specific situations.

Another reason these blizzards are dangerous is the cold temperatures that follow behind the Arctic front. Anyone stranded in their vehicle or forced to walk outside is at risk of frostbite or hypothermia (NWS, n.d.).

Heavy accumulations of ice can bring down trees and topple utility poles and communication towers. Ice can disrupt communications and power for days while utility companies repair extensive damage. Even small accumulations of ice can be extremely dangerous to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces (NWS, n.d.).

Ice storms also tend to occur several times per year. These storms usually cause temporary icy conditions that result in increased numbers of traffic accidents and falls, but little other impact. Severe ice storms bring a significant accumulation of ice, which can pull down branches, trees, and power lines. These can cause widespread power outages and it can take hours to days to restore service to all customers.

Areas of vulnerability include low-income and elderly populations, mobile homes, and infrastructure such as roadways and utilities that can be damaged by such storms and the low-lying areas that can be impacted by flooding related to rapid snow melt.

4.4.10.6. People

For the purpose of this plan, the entire population of Jefferson County is exposed to the winter weather hazard. Residents may be displaced or require temporary and long-term housing and shelter. In addition, damage caused by severe winter weather can lead to severe injuries and loss of life. Socially vulnerable populations are most susceptible due to their physical and financial ability to react and respond during extreme winter weather

Socially vulnerable populations are susceptible based on many factors, including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Economically disadvantaged populations are likely to evaluate their risk and make decisions based on the major economic impact to their family and may not have funds to prepare for or respond to a winter weather event.

In relation to the hazard of winter weather, socially vulnerable populations will experience a disproportionate disadvantage. For example, the elderly are considered susceptible to this hazard due to their increased risk of injuries and death from falls and overexertion and/or hypothermia from attempts to clear snow and ice. In addition, harsh winter weather can reduce the ability of these populations to access emergency services. Residents with low incomes may not have access to housing, or their housing

may be less able to withstand cold temperatures. Populations with physical disabilities may not be able to leave their houses or maneuver outdoors due to covered walkways and ramps.

The aftermath of winter weather events present numerous threats to public health and safety, including weighted powerlines and tree branches, power outages, snow- and ice-covered walkways and roadways, and cold temperatures.

4.4.10.7. Structures

All facilities in Jefferson County are exposed and vulnerable to the winter storm hazard. High snow accumulation may cause structural failure and possible collapse. In general, structural impact damage may include damage to roofs and building frames, as well as damage to building contents. Structural failure from increased snow accumulation on roofs can be linked to several different causes, including but not limited to:

- Actual snow load significantly exceeds design snow load
- Drifting and sliding snow conditions
- Deficient workmanship
- Insufficient operation and maintenance
- Improper design
- Inadequate drainage design
- Insufficient design: in older buildings, insufficient design is often related to inadequate snow load design criteria in the building code in effect when the building was designed (FEMA, 2013).

Vulnerability to the effects of winter storms on buildings is somewhat dependent on the age of a building. As building codes become more stringent, buildings can support heavier loads and as buildings age, various factors may deteriorate their structural integrity. Jefferson County's current building codes are the 2018 International Residential Code (IRC) and 2018 International Building Code (IBC) adopted by the State of West Virginia. Vulnerability also depends upon the type of construction and the degree to which a 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.

The most vulnerable structures are those that were poorly built or are dilapidated. The weight of heavy snow or ice may lead to structural collapse or to minor damage. Some shed roofs that protect township and borough road maintenance or firefighting equipment have large span roofs that may collapse under the weight of especially heavy snow or ice although none have collapsed due to recent heavy snow or ice storms.

4.4.10.8. Systems

Critical facilities would be impacted by a storm event, but these structures are largely constructed of concrete and masonry; therefore, they should only suffer minimal structural damage. Because power interruption can occur, backup power is recommended for critical facilities and infrastructure. Motorists may occasionally become stranded on WV Route 9, during these storms. People must then be rescued and provided with shelter until conditions improve. Stranded motorists are also likely on US Route 340 and in remote and mountain locations.

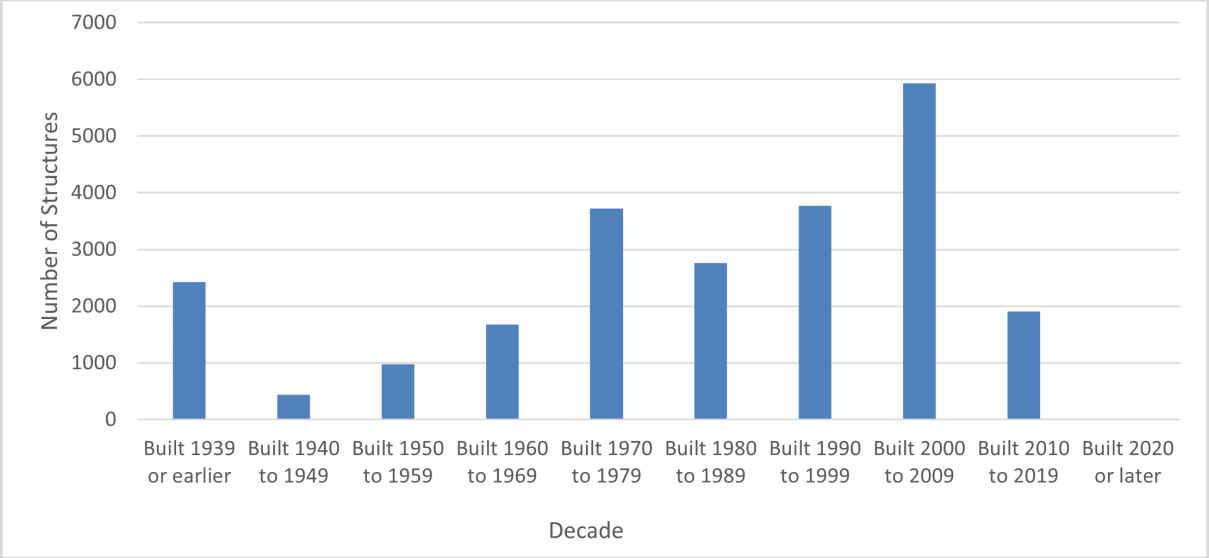
4.4.10.9. Natural, Historic and Cultural Resources

Environmental impacts from winter weather often includes damage to trees and shrubs caused by heavy snow loading, ice buildup, and/or high winds, which can break limbs and down large trees. Environmental resources, including critical habitat (or habitats that are known to be essential for an endangered or threatened species), wetlands, parks, and reserves are particularly vulnerable to severe winter weather. Destroyed habitats could displace and kill organisms reliant on these habitats to survive and reproduce. An indirect effect of winter storms is impairment of surface and groundwater adjacent to roadway surfaces treated with salt, chemicals, and other de-icing materials. These added pollutants can runoff into bodies of water and cause eutrophication, creating issues for ecosystems present in those water bodies

Winter storms can also have a positive environmental impact: gradual melting of snow and ice provides groundwater recharge. However, abrupt high temperatures following a heavy snowfall can cause accelerated snowmelt, rapid surface water runoff, and severe flooding (USGS 2019).

All structures and infrastructure in Jefferson County are exposed to heavy snow and ice. For this analysis, structures built prior to 1940 are identified as being potentially at risk of being somewhat weakened and more susceptible to damage due to heavy snow or ice. Figure 4-37 shows the distribution of building ages in Jefferson County; a little more than 10 percent (more than 2000) of all housing structures buildings were constructed prior to 1940 in Jefferson County.

Figure 4-37: Housing Structures Built by Decade, Jefferson County (U.S. Census, 2021a)



4.4.10.10. Community Activities

Potential economic impacts include loss of agriculture, business, and tourism. In addition, losses of buildings and infrastructure also take a toll on the economic condition of Jefferson County. Similarly, damages to buildings can displace people from their homes, threaten life safety, and impact a community's economy and tax base. Severe winter weather can also damage utilities and communication towers, which are costly because they need to be repaired almost immediately after damages occur and these repairs can cost millions of dollars to fix for a singular event.

Infrastructure at risk from the winter weather hazard also includes roadways that could be damaged by application of salt and intermittent freezing and warming conditions that can damage roads over time and cause potholes. Costs of snow and ice removals, as well as repairs of roads undergoing freeze/thaw cycles, can drain local financial resources quickly. A quick thaw or rain event after a heavy snow can cause substantial flooding, especially along small streams and in urban areas, which can become expensive to mitigate.

Activities that have value to the community could potentially be impacted by severe snow events. When these activities are delayed or cancelled due to snow, the economy of the community is affected. Numerous activities are scheduled within Jefferson County and its municipalities. Below are community activities that occur throughout the year or annually.

- Historical Walking Tours of Harpers Ferry, WV – Available All Year
- Handmade Christmas in Shepherdstown - November
- New Year's Eve Celebration

Impacts to community events would be dependent upon the event type and location.

4.4.11. Wild and Urban Fires

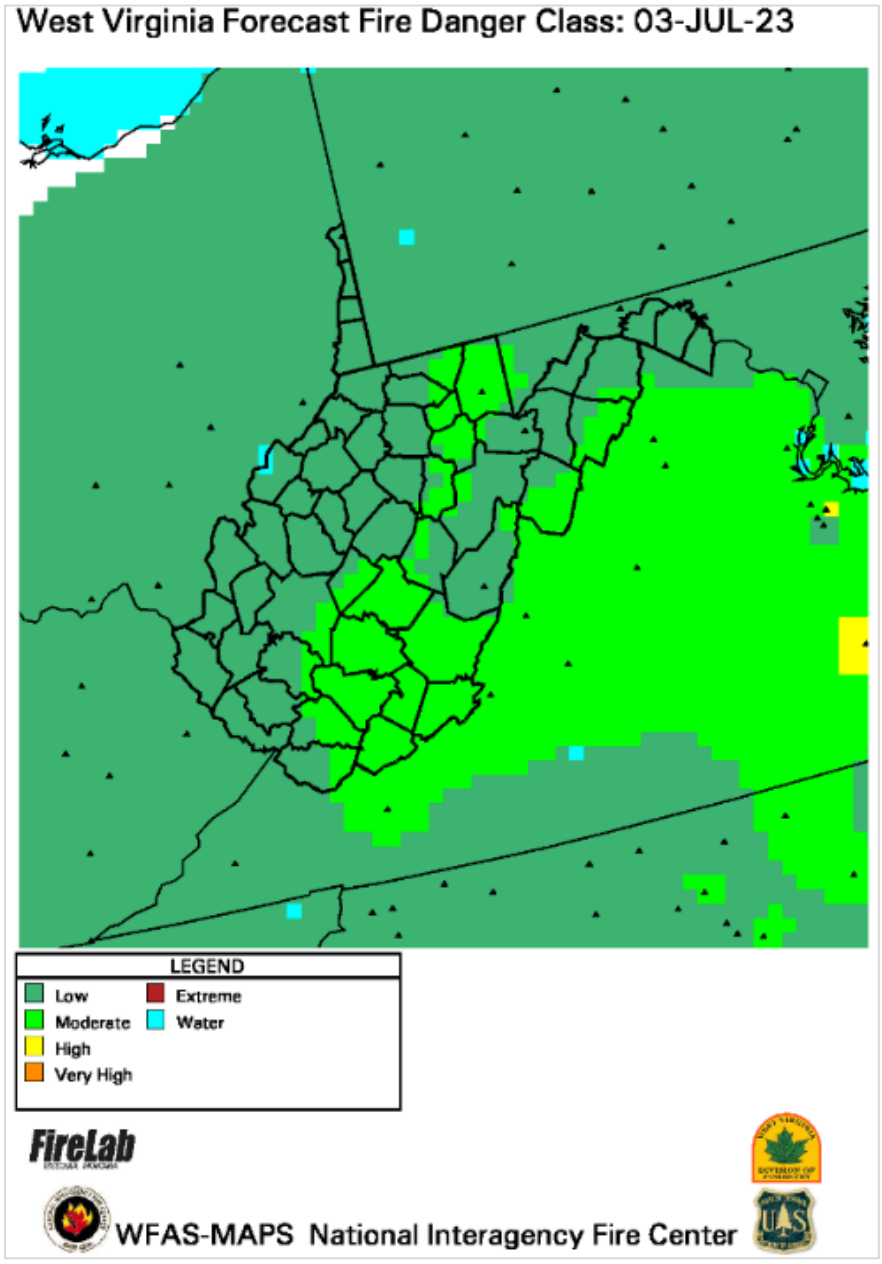
Wildfire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. Wildfires often begin unnoticed and can spread quickly, creating dense smoke clouds. A wildland fire is a wildfire in an area in which development is essentially nonexistent, except for roads, railroads, power lines, and similar facilities. An urban-wildland interface fire is a wildfire in a geographical area where structures and other human development meet or intermingle with wildland or vegetative fuels.

4.4.11.1. Location and Extent

Wildland fires are most common in the spring (March to May) and fall (October to November) months. During spring months, the lack of leaves on the trees allows the sunlight to heat the existing leaves on the ground from the previous fall. The same theory applies for the fall; however, the dryer conditions are a more crucial factor.

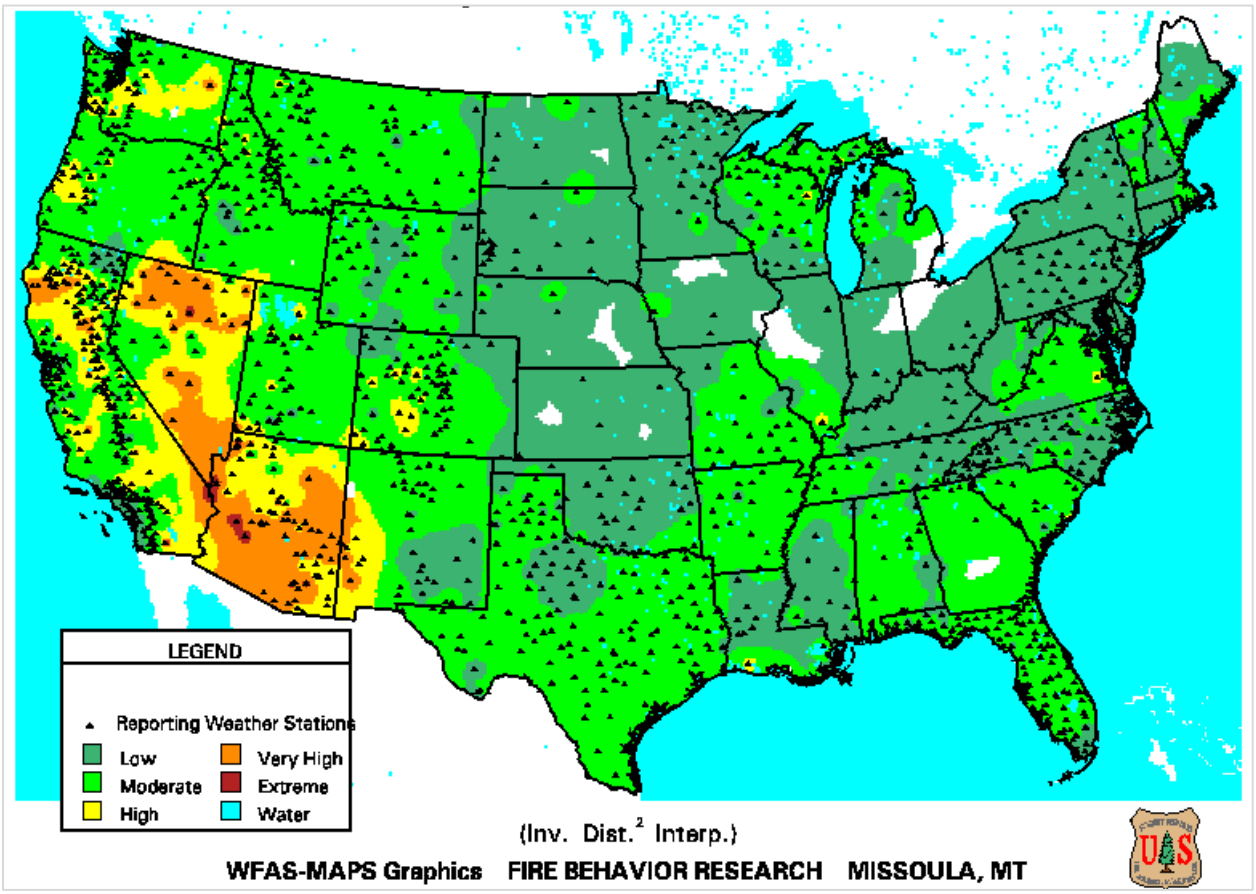
Wildfire events can occur at any time of the year but are most likely to occur in the region during a drought. Wildland fires in West Virginia can occur in fields, grass, and brush as well as in the forest itself. Under dry conditions or drought, wildfires have the potential to burn forests as well as croplands. Any small fire in a wooded area, if not quickly detected and suppressed, can get out of control. Most wildland fires are caused by human carelessness, negligence, and ignorance. They are usually signaled by dense smoke that fills the area for miles around. The size of a wildfire is contingent on the amount of fuel available, weather conditions, and wind speed and direction. The West Virginia Division of Forestry tracks and maps fire hazard daily with their Wildland Fire Assessment System, as seen for a day in July 2023 in Figure 4-38.

Figure 4-38: WV Forecasted Fire Danger (WV Div of Forestry, July 2023)



The size of a wildfire is contingent on the amount of fuel available, weather conditions, and wind speed and direction. The Wildland Fire Assessment System (WFAS)-Maps, Fire Behavior Research produces maps that show the fire danger in the United States; these fluctuate as the weather changes. Figure 4-39 shows that Jefferson County is at a low risk of fire danger in July. Generally, the entire State of West Virginia has a low or moderate risk of fire danger, as evidenced by the number of fires recorded (see historical occurrences section for detailed information on the number of fires in Jefferson County.

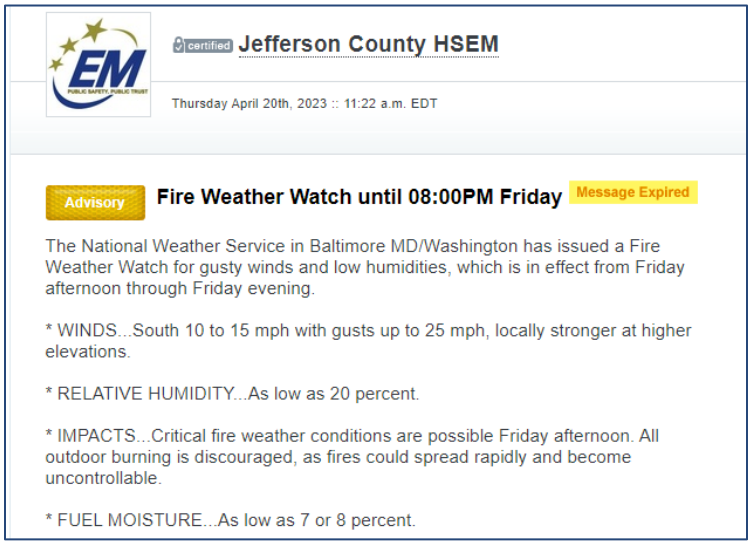
Figure 4-39: US Forecasted Fire Class (WFAS, July 2023)



Just because a single wildfire has been reported, one should not assume that vegetation fires do not occur frequently. Representatives from local fire departments throughout the region confirm that brush fires, ranging in size from a single acre to hundreds of acres occur each year. Many of these fires are extinguished before becoming a major problem. Additionally, most of these events occur in rural areas rather than in areas of urban-wildland interface.

According to the U.S. Fire Administration (USFA), overall trends for residential building fires and losses for the 10-year period of 2012 to 2021 have a 5% decrease in fires, an 8% increase in deaths, a 7% decrease in injuries, and an 11% increase in dollar loss (USFA, 2022). Fire loss reported through the National Fire Incident Reporting System (NFIRS) in 2021 for West Virginia, there were 5.2 deaths and 9.1 injuries per 1,000 all fire casualties. In 2021, the national average was 2.3 deaths and 7.2 injuries per 1,000 fires. Residential structure fire casualties reported in 2021 were 13.2 deaths and 18.8 injuries per 1,000 fires. In 2021, the national average was 6.5 deaths and 20.9 injuries per 1,000 fires.

Figure 4-40: Jefferson County HSEM Nixle Message (JSHSEM, July 2023)



The National Weather Service issues red flag warnings to inform area firefighters and the public about conditions that are favorable for wildland fires. These include the amount of water held by small vegetation such as grass, leaves, and mulch, the relative humidity, and the winds. Jefferson County Sheriff's Office and JCHSEM issue these warnings for their residents on social media; an example of this is shown to the right.

Areas that are most vulnerable to wildfires include agricultural and forest lands in the county. As for urban fires, as the name suggests, areas that are more densely populated or have houses that are older and do not have up-to-code fire protection are more vulnerable.

4.4.11.2. Past Occurrence

No major wildfires have been identified in the Eastern Panhandle, but this does not mean that vegetation fires do not occur frequently. Representatives from local fire departments throughout the region confirm that brush fires, ranging in size from a single acre to hundreds of acres occur each year. Many of these fires are extinguished before becoming a major problem. Additionally, most of these events occur in rural areas rather than in areas of urban-wildland interface.

One of the largest wildfires in West Virginia during the last 40 years occurred in the fall of 1987. A 19,560-acre wildfire blazed through Raleigh County, while another forest fire burned 15,192 acres in Boone County. The 1987 fire season proved to be the state's second worst year on record for forest fires, with more than 416,687 acres damaged (Steelhammer, 2013).

The following table presents data reported to the National Fire Incident Reporting System (NFIRS). It shows the number of fires in Jefferson County and the acres burned.

Table 4-45: Wildfires In Jefferson County					
Year	**Number of Fires**	**Brush Fire**	**Outside Fire**	**Structure Fire**	**Total Acres Burned**
2010	509	97	59	286	278
2011	427	63	26	299	28
2012	419	71	46	247	32
2013	354	58	23	221	15
2014	364	56	12	251	52
2015	393	58	31	262	117
2016	432	68	28	279	162
2017	310	44	37	195	160
2018	377	68	19	221	128
2019	389	74	36	224	131
2020	330	58	17	214	133
2021	341	82	28	195	782
2022	347	46	31	213	311
June 2023	193	55	12	100	119
Totals	**5,185**	**898**	**405**	**3,207**	**2,448**

Source: National Fire Incident Reporting System (NFIRS)

It is more difficult to determine the exact number of urban fires that have occurred in the county. However, there is one event that stands out and occurred within the last three years. On July 23, 2018, a fire destroyed several businesses in Harpers Ferry's historic area. The fire broke out around 3 a.m. and three alarms brought in resources from Maryland and Virginia to help get the fire under control. The fire reached three buildings that contained two apartments and eight businesses. No tenants or responders were injured.

During the months of May and June, 2023 portions of West Virginia was covered with hazy skies resulting from smoke from out-of-control forest fires in northeastern Canada. The conditions prompted advisories from the state Department of Environmental Protection and the Department of Health and Human Resources. Wildfire smoke contains fine particulate matter, known as PM2.5, which are microscopic solid or liquid droplets that can be inhaled and cause serious health problems, according to the U.S. Environmental Protection Agency (EPA).

The two agencies issued a joint Air Quality Advisory for fine particulate matter from wildfire smoke. The quality scores come from AirNow.gov. Air monitors in the Northern Panhandle counties of West Virginia indicated the air quality index was in the range of 201-300. The rating for that index is "very unhealthy" according to the advisory. According to the U.S EPA, AQI scores in the 201-300 range indicate an increased risk of health effects for everyone.

4.4.11.3. Future Occurrence

The WV State 2023 Hazard Mitigation Plan states Future conditions, including warming temperatures, have the potential to significantly increase vulnerability to wildfire in the state. The state has experienced longer droughts, an increase in consecutive dry days, and a decrease in the days of intense rainfall. Warm temperatures and drought create perfect conditions for wildfire outbreak throughout the state.

Previous events indicate that annual wildfire occurrences in the region are expected. In some cases, an increase in wildfires or acreage burned follows significant drought. Droughts in 1987, 1991 and 1999 had that effect. There were effects of drought visible during the 2001 fire season when 94,233 acres burned, the largest number of acres consumed since 2000.

Any fire, without the quick response or attention of fire-fighters, forestry personnel, and/or the public, has the potential to become a wildfire. The eastern border of the county will likely face more wildfires as a result of its rural nature. Therefore, the probability of a wildfire occurring in Jefferson County is considered possible as defined by the Risk Factor Methodology probability criteria (see Section 3.4.1).

4.4.11.4. Range of Magnitude

Wildfire events can range from small fires that can be managed by local firefighters to large fires impacting many acres of land. Large events may require evacuation from one or more communities and necessitate regional or national firefighting support. The impact of a severe wildfire can be devastating. While some fires are not human-caused and are part of natural succession processes, a wildfire can kill people, livestock, fish, and wildlife. They often destroy property, valuable timber, forage, and recreational and scenic values.

Vegetation loss is often an environmental concern with wildfires, but it typically is not a serious impact since natural re-growth occurs with time. The most significant environmental impact is the potential for severe erosion, silting of stream beds and reservoirs, and flooding due to ground-cover loss following a fire event.

Wildfires also have a positive environmental impact in that they burn dead trees, leaves, and grasses to allow more open spaces for new and different types of vegetation to grow and receive sunlight. Another positive effect of a wildfire is that it stimulates the growth of new shoots on trees and shrubs, and a fire's heat can open pinecones and other seed pods.

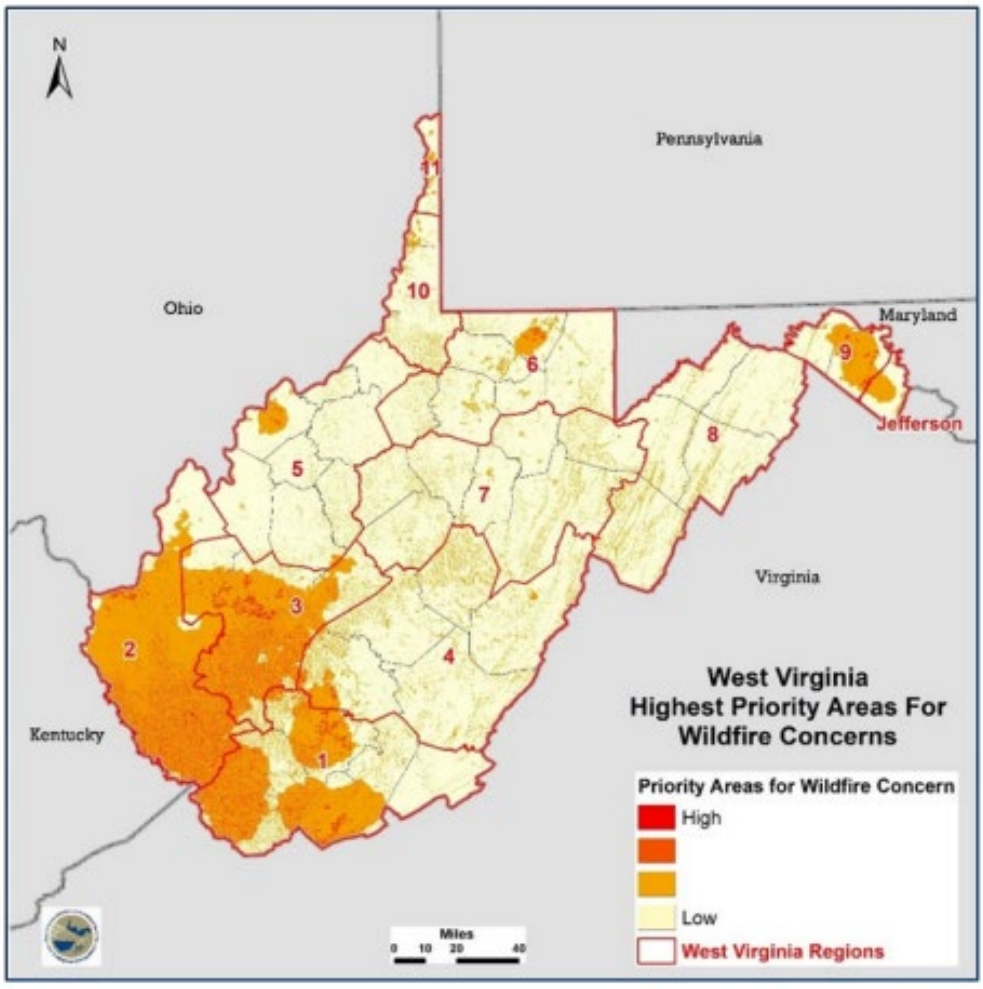
In addition to the risk wildfires post to the public and property owners, the safety of firefighters is also a concern. Although loss of life among firefighters does not occur often in West Virginia, it is always a risk. More common firefighting injuries include falls, sprains, abrasions, or heat-related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

4.4.11.5. Vulnerability Assessment

Nationally, the National Park Service lists several possible causes of wildfires including human-caused and nature-caused. Human-caused fires "result from campfires left unattended, the burning of debris, negligently discarded cigarettes and intentional acts of arson", which account for up to 90% of fires. Lightning or lava causes the remaining 10% of fires (NPS). This is also true in West Virginia where "in the spring of 2015, 43% of all forest fires were the result of escaped debris fires. Equipment use was the second highest cause of forest fires in W.Va., causing 29% of all wildfires.

The State of West Virginia 2023 Hazard Mitigation Plan provided a map of the state's highest priority areas for wildfire concerns, Figure 4-41. As shown in this figure, Jefferson County has a low to medium low priority area for wildfire concern.

Figure 4-41: Highest Priority Areas for Wildfire Concern (WVHMP, 2023)



However, based on the wildfire history of the area, Jefferson County appears to have a low vulnerability to severe wildfire. The wildfire hazard was defined based on conditions that affect wildfire ignition and/or

behavior such as fuel, topography, and local weather. These conditions are constantly changing, so the region's vulnerability will fluctuate over time.

In addition, the State of West Virginia 2023 Hazard Mitigation Plan conducted an analysis based on Wildland-Urban Interface (WUI) and WUI Intermix Wildfire Hazard Area for state facilities, critical facilities, population, and state roadways. The plan defines a wildland-urban interface (WUI) fire as a wildfire occurring in the WUI. The WUI is described as the area where structures and other human improvements meet and intermingle with undeveloped wildland or vegetative fuels. Due to the rural nature of the state, with over 80 percent of the state composed of forest land, most communities in the state are in the WUI. A total of 576,466 acres in the state are located in the interface wildfire hazard area, and a total of 3,758,488 acres are located in the intermix wildfire hazard area. Jefferson County specifically has a total of 13,178 acres in the interface wildfire area and a total of 14, 008 acres in the intermix wildfire area.

Table 4-46: Total Acres of Land Area Located in the Wildfire Hazard Areas by County

County	Total Acres of Land Area	Total Acres of Land Area (Excluding Waterbodies) Located in the Wildfire Hazard Areas			
		Total Acres Located in the WUI Interface Wildfire Hazard Area	Percent of Total	Total Acres Located in the WUI Intermix Wildfire Hazard Area	Percent of Total
Jefferson	134,920	13,178	9.8%	14,008	10.4%

(WV HMP, 2023)

4.4.11.6. People

Aside from the obvious effects on humans such as burns and injuries, the smoke from fires is of great concern. "The smoke produced by wildfires can produce effects ranging from airway and eye irritation to death, especially among individuals with conditions that make them more susceptible to inhalational exposures" (Clements, 2009, p.283).

The U.S. Fire Administration Topical Fire Report Series released October 2021 provided highlights on important findings from data collected in the U.S. Fire Administration's National Fire Incident Reporting System. Findings for this topical report are as follows:

- Risk by age:

- Adults ages 55 or older had a greater relative risk of fire death than the general population.
- Adults ages 85 or older had the highest relative risk of fire death.
- Children ages 4 and younger had a relative risk of fire death that was 50% less than that of the general population, the lowest relative risk for this age group since the mid-1970s; however, these children had an elevated risk of both fire death and injury when compared to older children (ages 5 to 14).

- Adults ages 25 to 64 and 80 or older had a greater relative risk of fire injury than the general population.
    - Risk by region: People living in the Midwest and South had the greatest relative risk of dying in a fire when compared to populations living in other regions of the United States.
    - Risk by gender: Males were 1.7 times more likely to die in fires than females.
    - Risk by race: African Americans and American Indians/Alaska Natives were at a greater relative risk of dying in a fire than the general population.

According to Section 1.3 Population and Demographics of the plan, adults ages 65 and older were the fastest growing between 2017 and 2021 with a population increase of 13.3%. The percentage of Jefferson County's population that is age 65 and older increased from 15.7 percent of the population in 2017 to 17.3 percent in 2021. The Topical Fire Report indicated that this age group has a greater relative risk of fire than the general population. This age group should be targeted for outreach on fire safety. The Federal Emergency Management Agency along with the U.S. Fire Administration release Fire Safety for Older Adults October 2018, which could be distributed via the JCOHSEM monthly newsletter and social media.

The WV State 2023 Hazard Mitigation Plan estimated population living in the high wildfire risk hazard areas (both Interface and Intermix) that could be impacted should a wildfire occur. Based on the overall analysis for the state, an estimated 422,175 residents are located in the wildland urban interface (WUI) hazard area and 23.34 percent are highly vulnerable. In addition, an estimated 1,807,426 residents are located in the WUI hazard area, with 6.18 percent being highly vulnerable. Results also indicate that Jefferson County does not have a highly vulnerable population within the WUI interface area and only 206 people in the WUI intermix area.

4.4.11.7. Structures

The WV State 2023 Hazard Mitigation Plan analyzed critical facilities located in wildfire hazard areas. Facilities at risk from being impacted by wildfire incidents include locations that provide services for vulnerable populations (i.e., schools and senior facilities) and emergency response agencies (i.e., fire and police). Medical facilities, fire/EMS, schools, and shelters could all sustain damages from wildfire events depending on the intensity of wind and pathway of the burn. Statewide, there are 51 facilities in the WUI Interface Wildfire Hazard area and 28 facilities in the WUI intermix wildfire hazard area. However, Jefferson County does not have any critical facilities in either WUI interface or intermix wildfire hazard areas.

The National Fire Protection Association studied the causes and circumstances of home structure fires reported to local fire departments in the United States from 2016 through 2020 (NFPA, 2023). The study found that most home fires and fire casualties result from five causes: cooking, heating, electrical distribution and lighting equipment, intentional fire setting, and smoking materials. Cooking equipment was the leading cause and accounted for 44% of home structure fires.

Loss estimations for urban fires are difficult to ascertain due to the unseen costs that go beyond fire suppression alone such as loss of life, injury, loss of property and livelihood. For this reason, loss and damage are calculated for wildfires only in Jefferson County.

4.4.11.8. Systems

According to the WV State 2023 Hazard Mitigation Plan, when post-fire flooding overwhelms the transportation, infrastructure failures inevitably occur, and communities have varying levels of risk depending on the nature of the infrastructure that exists, its vulnerability to post-fire flooding, and the level of redundancy in the transportation infrastructure for that community. Roads provide a vital transportation link between populated areas. Road closures, as a result of a wildfire event, will have significant impacts on the county and its communities. The State Plan indicated that Jefferson County has a total of 1.84 miles of state roads located within the WUI Interface Wildfire Hazard Area, while a total of 19.18 miles in the Intermix Wildfire Hazard Area.

4.4.11.9. Natural, Historic and Cultural Resources

Wildfires cause more than just the direct damage to structures, vegetation, or air quality; when a fire removes much or all of the vegetation in a watershed, subsequent rains will have much greater erosive potential, which in turn produces large quantities of sediment and plant debris that affect the water quality of streams and lakes (Keller, Devecchio, 2015, p.459).

However, wildfires can also have benefits to the soil; they “tend to leave an accumulation of carbon on the surface in the form of ash and increase the nutrient content of a soil. Under the right conditions when erosion does not remove the ash from the environment, a nutrient reservoir may form that is beneficial to local plants” (Keller & Devecchio, 2015, p 159).

In terms of historic structures, most structures at-risk to wildfires are those within the WUI. These structures are also more likely to be constructed from wood. The July 2018 structural fire that destroyed several businesses in Harpers Ferry’s historic area is an example of how fires can spread quickly through an area, specifically with older structures.

4.4.11.10. Community Activities

Activities that have value to the community could potentially be impacted by wildfires, however this location of the activity. In addition, poor air quality due to smoke generated by the wildfire can impact outdoor activities. Wildfires also release significant amounts of mercury into the air, which can impact both people and the environment. Below are community activities that occur throughout the year or annually.

- Jefferson County Fair – July and August at Jefferson County Fairgrounds and weekly farm markets

- Historical Walking Tours of Harpers Ferry, WV – Available All Year (Note four (4) of the National Register Areas within Harpers Ferry are located in the 1-percent-annual chance floodplain.)
- Hollywood Casino Horse Races – Reoccurring – Located in Charles Town
- September 22 - 24 - Mountain Heritage Arts & Craft Festival at Jefferson County Fairgrounds
- October 7 - Freedoms Run (Note: held in in Harpers Ferry & Shepherdstown.)

4.4.12. Dam Failure

The West Virginia Department of Environmental Protection (WVDEP) defines a dam as "an artificial barrier or obstruction that impounds, or will impound, water." In West Virginia, for a dam to be regulated by the state, it must be equal to or greater than 25 feet in height and contain 15 or more acre-feet of water volume or be greater or equal to 6 feet in height and contain 50 or more acre-feet of water volume. Some federally owned dams, dams that do not normally impound water (such as some culverts), and dams built for agricultural purposes that have been demonstrated not to cause loss of life if the dam were to fail, may be exempted from state regulation (WVDEP, 2009). The full regulation can be found in the Dam Control and Safety Act – W. Va. Code 22-14-3(f), and in the Dam Safety Rule (47CSR34-2.12).

Failure of these structures results in an uncontrolled release of impounded water. Dam failures most often occur during or after a massive rainfall, flooding, or spring thaws, sometimes with little to no warning. Depending on the size of the water body where the dam is constructed, water contributions may come from distant upstream locations.

4.4.12.1. Location and Extent

Dam failures can pose a serious threat to communities located downstream from major dams. The impact of a dam failure is dependent on dam and reservoir characteristics and the amount and distance of population or assets located downstream. Catastrophic failures are characterized by the sudden, rapid, and uncontrolled release of impounded water or any other fluid or semi-fluid.

Dams that meet the definition of a 'High Hazard Potential Dam' (HHPD) are a subset of the dams managed by the West Virginia DEP's Dam Safety Program. Following FEMA's definition, a HHPD meets the following guidelines:

- Dam is located in a state with a state dam safety program
- Dam is classified as "high hazard potential" by the state dam safety program
- Dam has an Emergency Action Plan (EAP) approved by the state dam safety program
- Dam fails to meet minimum state dam safety standards and poses an unacceptable risk to the public (as determined by the state)
- Dam is <u>not</u>:

- Federally owned,
- A hydroelectric dam licensed by the FERC, or
- Built under the authority of the Secretary of Agriculture.

Dams are used for a variety of purposes (recreation, flood control, water storage, irrigation, mine tailings, electrical generation, debris control or navigation); described by FEMA.

- **Flood Control**: Prevent loss of life and property caused by flooding. They impound floodwater and either release it under control to the river below or sore or divert the water for other uses.
- **Recreation**: Facilities designed for boating, skiing, camping, picnic areas, and boat launches can all be supported by dams.
- **Navigation**: Provide a stable system of inland river transportation.
- **Mine Tailings**: Allow the mining and processing of coal and other minerals while protecting the environment.

The primary hazard surrounding dam failure is the swift, unpredictable flooding of those areas immediately downstream. While general inundation areas can be determined, it is often impossible to know exactly how and where water held back by a dam will flow during a rapid failure of the dam. Generally, there are three (3) types of dam failures: hydraulic, seepage, and structural.

- **Hydraulic Failure:** Hydraulic failures result from the uncontrolled flow of water over the dam, around and adjacent to the dam, and the erosive action of water on the dam and its foundation. Earthen dams are particularly vulnerable to hydraulic failure since earth erodes at relatively small velocities.
- **Seepage Failure:** All dams exhibit some seepage that must be controlled in velocity and amount. Seepage occurs both through the dam and the foundation. If uncontrolled, seepage can erode material from the foundation of an earthen dam to form a conduit through which water can pass. This passing of water often leads to a complete failure of the structure, known as piping.
- **Structural Failure:** Structural failures involve the rupture of the dam and/or its foundation. This is particularly a hazard for large dams and for dams built of low strength materials.

Dam failures generally result from a complex interrelationship of several failure modes. Uncontrolled seepage may weaken the soil and lead to a structural failure. Structural failure may shorten the seepage path and lead to a piping failure. Surface erosion may lead to structural or piping failures.

Dam Safety requires that each dam be evaluated for its hazard potential downstream. Hazard potential is not related to the structural integrity of a dam, but strictly to the potential for downstream flooding. The hazard potential evaluation places the dam in one of four classifications that are defined in the West Virginia DEP's Dam Safety Regulations (47CSR34-3.5.b.). These classifications can be found in Table 4-47.

Table 4-47: Dam Hazard Potential Classifications (WV DEP)

CLASS	DESCRIPTION
1 (High Hazard)	Dams located where failure may cause loss of human life or major damage to dwellings, commercial or industrial buildings, main railroads, important public utilities, or where a high-risk highway may be affected or damaged.

Table 4-47: Dam Hazard Potential Classifications (WV DEP)	
CLASS	DESCRIPTION
	This classification must be used if failure may result in the loss of human life.
2 (Significant Hazard)	Dams located where failure may cause minor damage to dwellings, commercial or industrial buildings, important public utilities, main railroads, or cause major damage to unoccupied buildings, or where a low-risk highway may be affected or damaged. The potential for loss of human life resulting from failure of a Class 2 dam must be unlikely.
3 (Low Hazard)	Dams located in rural or agricultural areas where failure may cause minor damage to nonresidential and normally unoccupied buildings, or rural or agricultural land. Failure of a Class 3 dam would cause only a loss of the dam itself and a loss of property use, such as use of related roads, with little additional damage to adjacent property. The potential for loss of human life resulting from failure of a Class 3 dam must be unlikely. An impoundment exceeding forty (40) feet in height, or four hundred (400) acre-feet storage volume shall not be classified as a Class 3 dam. A waste disposal dam, the failure of which may cause significant harm to the environment, shall not be classified as a Class 3 dam.
4 (Negligible Hazard)	Dams where failure is expected to have no potential for loss of human life, no potential for property damage and no potential for significant harm to the environment. Examples of Class 4 dams include: dams across rivers, failure of which under any conditions will not flood areas above normal streambank elevations; dams located in the reservoir of another dam which, under any conditions, can contain water released by failure of the Class 4 dam; and dams in series where the toe of the Class 4 dam(s) is in close proximity to the reservoir of a dam which can contain failure of the Class 4 dam(s) under any condition. In considering a request for a Class 4 designation, the director may require written concurrence from the owner(s) of downstream dams that may be affected by failure of the Class 4 dam. Approval for use of this classification is vested in the director and will be based on engineering evaluation of the dam(s) and downstream areas in question.

Information about the hazard level and specific threats posed by a dam failure are often not shared with the general public. Owners of HHPDs are required to develop an Emergency Action Plan (EAP) as well, which is not shared publicly. Local emergency management personnel will be able to obtain this information from the WV DEP (WV DEP, 2021). Table 4-48 indicates whether a dam has developed an EAP or not.

There are four (4) dams profiled for Jefferson County in the United States Army Corp of Engineers (USACE) National Inventory of Dams (NID) (USACE, 2023). Table 4-48 lists all the dams in Jefferson County that the USACE maintains information. The location of all known existing dams and an evaluation of their hazard level can be seen in Figure 4-42.

Table 4-48: Jefferson County Dam Inventory (USACE, 2023)

Dam Name	Owner	River	EAP?	Hazard Potential Classification	Year Built	Longitude	Latitude
Keyes Ferry Acres Lake No.1	H.W. Speaks	UT Shenandoah	No	High (See Note 1 below)	1960	-77.776666	39.291669
Shannondale Club Ltd. Dam	Shannondale Club, Limited	Furnace Run	Yes	Significant	1965	-77.813611	39.212219
Lake Forest Dam	American Acreage, LLC	Furnace Run	Not Required	Low		-77.825555	39.180279
Millville	PE Hydro Generation, LLC	Shenandoah River	Not Required	Low	1905	-77.7823	39.2688

Source: USACE National Dam Inventory

In addition to these four (4) dams, the WV GIS Technical Center (WVGISTC) data for dams include two (2) other dams: Keyes Ferry Acres Lake No. 2 and Keyes Ferry Acres Lake No. 3. Detailed information on these two (2) dams was not available.

Aaron Tonkery, WVDEP-Dam Safety Program Manager, verified that the USACE information has not been updated for the majority of West Virginia for several years and that includes Jefferson County. Mr. Tonkery provided the following information on dams located in Jefferson County.

- Note 1 - Jefferson County has all of the Keyes Ferry Acres Lake Dams (including No. 1 listed above) recorded as non-jurisdictional. Therefore, WVDEP-Dam Safety has no regulatory authority over those dams. The Keyes Ferry Acres Lake No.1 Dam is below dimensions (height/volume) to be considered a "jurisdictional" dam and none of the Keyes Ferry Acres Lake Dams have an EAP given that any of them are of jurisdictional size. The hazard

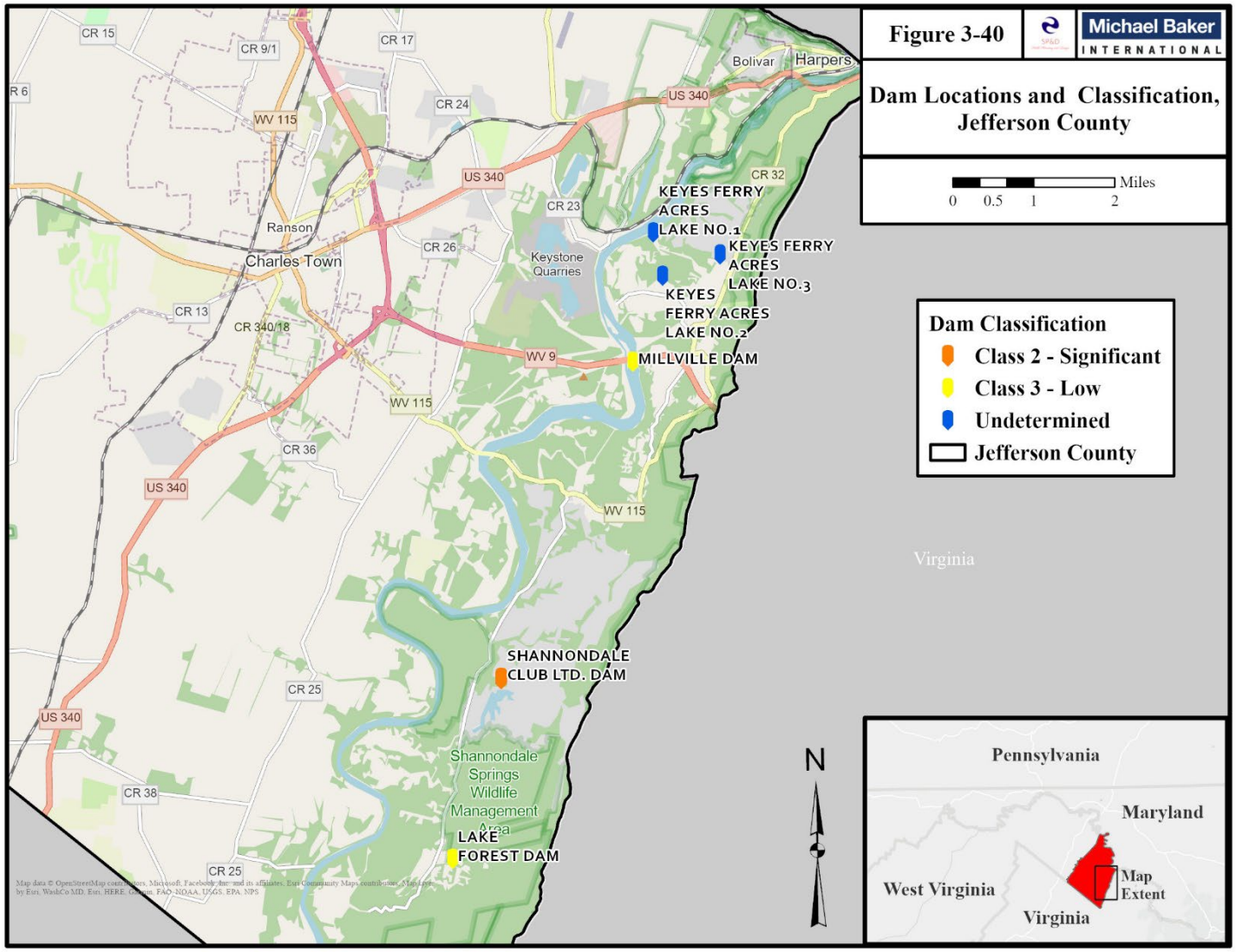
classification for Keyes Ferry Acres Lake Dam #1 should be reviewed given that it is below jurisdictional size.

- Information regarding Shannondale Lake and Lake Forest Dam are correct.
- The Millville Dam is hydro power, so WVDEP-Dam Safety does not regulate that structure.
- There are two high hazard dams not included in the NID that were discovered in 2018. The owner has decided to remove the dams and are in the final application stage at this point. They plan to have them removed before the end of the calendar year, 2023. The dams are listed as follows:

- Izaak Walton League Dam No. 1
    - Owner: Izaak Walton League of America - Jefferson County Chapter
    - Located on Dry Run
    - EAP is required
    - High Hazard
    - Lat: 39.3436 - Long: -77.9456
- Izaak Walton League Dam No. 2
    - Owner: Izaak Walton League of America - Jefferson County Chapter
    - Located on Dry Run
    - EAP is required
    - High Hazard
    - Lat: 39.3416 - Long: -77.9461

- Shannondale Lake Dam (03701) is the only one that requires Monitoring and Emergency Action Plans (MEAP) even though it is a Class 2. This is because there is a road downstream (low traffic) that would be affected if the dam was to fail. The MEAP has an inundation map for that dam.
- Lake Forest (03708), which is a Class 3 and does not require a MEAP. There is no inundation map for this dam.
- Other dams in the County, like the Keyes Ferry Acres Lake Dams, are below jurisdiction (too small to be "dams").

Figure 4-42: Dam Locations and Classification, Jefferson County



4.4.12.2. Past Occurrence

Several research methods to identify any past occurrences of dam failures in Jefferson County yielded no evidence of any historic or recent dam failures in the county. However, a catastrophic dam failure has occurred in West Virginia. On February 25th, 1972, a dam in Buffalo Creek Hollow, Logan County, that was used to contain waste from a coal mining operation failed. The failure was a result of heavy precipitation, a lack of safety features, and poor maintenance. The dam was also not permitted by the state. The disaster killed 123 people, injured 1,000 more, and left 4,000 people homeless (Choi, 1999).

4.4.12.3. Future Occurrence

The WV DEP, Division of Water and Waste Management (DWWM), Dam Safety Program maintains an inventory of dams in West Virginia within the jurisdiction of the Dam Control and Safety Act. DWWM regulates dams:

- 25 feet or more in height and capable of impounding 15 or more acre-feet of water;
- Or 6 feet or more in height and capable of impounding 50 or more acre-feet of water

The construction, operation, maintenance, modification, and abandonment of dams regulated by the DEP is reviewed and monitored by the Department's Program of Dam Safety. Dams are evaluated based on categories such as slope stability, undermining seepage, and spillway adequacy. The presence of structural integrity and inspection programs significantly reduces the potential for major dam failure events to occur. Minor dam failures are more common since low hazard structures are minimally regulated, but the impact of these events is minimal.

Emergency Action Plans (EAPs) drafted in accordance with the Federal Guidelines for Dam Safety identify the risk related information including the inundation area and the time lapse between dam failure and flooding reaching specific destinations downstream. These plans are also reviewed and approved by the West Virginia Division of Water and Waste Management Environmental Enforcement (DWWM EE).

Dams which are federally owned and regulated are subject to the dam safety offices of the regulating agency. The FERC Office of Energy Projects' Dam Safety and Inspections division conducts construction, operation, exemption, special, pre-license, and environmental and public use inspections of energy production dams to minimize risk associated with FERC dams. USACE dams are inspected and maintained by the district in which the dam is located.

According to the Army Corps of Engineers – Baltimore District, a catastrophic failure of the Jennings Randolph Lake Dam on the border of Garrett County, Maryland and Mineral County, West Virginia which impounds a 952-acre lake, could create a hazard to life and property and could cause significant downstream river flooding along the Potomac River in small portions Shepherdstown and Harpers Ferry. The dam was completed in 1981 and has a height of 296 feet and a maximum storage capacity of 130,900 acre-feet. The U.S. Army Corps of Engineers, Baltimore District, has installed a year-round early warning system at Jennings Randolph Lake intended to notify downstream public users of impending rapid

increases in water levels, and to evacuate the river immediately to higher ground for their safety. Accordioning to the USACE NID, the worst-case scenario of failure for this dam "could involve situations such as: a rare, extreme rainfall event resulting in water flowing over the earthen dam, eroding the dam, and leading to a breach of the dam, or; unexpected behavior of seepage through the dam eroding soil from within the embankment leading to a breach. If a breach were to occur, an uncontrolled surge of water would flow out of the reservoir, flooding downstream communities. Bloomington, Luke, Westernport, Piedmont, Keyser, Cumberland, and adjacent communities are in the most immediate danger in the event of a flood. Other communities along the North Branch Potomac River would also be impacted" (USACE 2021a). The NID does not include inundation mapping or vulnerable population estimates as of June 2023.

4.4.12.4. Range of Magnitude

Dam failures can pose a serious threat to communities located downstream from major dams. The impact of a dam failure is dependent on the volume of water impounded by the dam and the amount and distance of population or assets located downstream. Catastrophic failures are characterized by the sudden, rapid, and uncontrolled release of impounded water or any other fluid or semi-fluid from a dammed impoundment or water body. Dams are inspected yearly or sooner as necessary.

Dam failures may or may not leave enough time for evacuation of people and property, depending on their abruptness. Seepages in earth dams usually develop gradually, and, if the embankment damage is detected early, downstream residents have at least a few hours or days to evacuate. Failures of concrete or masonry dams tend to occur suddenly, sending a wall of water and debris down the valley at more than 100 miles per hour. Survival would be a matter of having the good fortune not to be in the flood path at the time of the break. Dam failures due to overtopping of a dam normally give sufficient lead time for evacuation. Dam failures may also be intentional, as their potential to cause serious destruction may make them a potential terrorism target.

The environmental impacts of dam failures can be devastating. Depending on the size of the event and number or type of structures located in the inundation area, water contamination from hazardous material facilities could occur. Water velocities could result in total destruction of trees and other vegetation. Severe erosion both during and after the failure event are probable. Additionally, if the dam's purpose is water supply, downstream communities will lose access to potable water.

4.4.12.5. Vulnerability Assessment

Vulnerability is defined by identifying the location of dams having high hazard potential. Specifically, those dams in Class 1 in which loss of life is possible should a failure occur and/or where economic loss would be excessive to extensive for residential, commercial, or agricultural resources and would cause substantial public inconvenience.

DEP completes an annual inspection of high hazard dams and notes safety concerns. Safety concerns include stability, flood flow issues, and poor maintenance. When a dam has safety concerns, DEP places

them on an unsafe dam list and contacts the owners to work on resolving the issues. The list is not publicly released in order to provide the dam owner with an opportunity for due process to resolve the concerns. DEP has also reviewed the dams deemed unsafe to confirm that they meet the other requirements for HHPD based on updated EAPs and ownership.

Dam permittees are responsible for conducting a dam breach analysis and inundation mapping. This data is not typically publicly available nor is it provided in a geospatial data format making further analysis challenging. The extent of downstream inundation areas varies based on dam and reservoir characteristics. Structures and critical facilities are vulnerable to the volume and velocity of water, and the population in these structures at the time of inundation is vulnerable to these impacts. In addition, while dams of any size may fail and cause damage, smaller dams do not have inundation areas delineated and reported to the DEP. Depending on the time of day of a dam failure, the population in residential structures could be especially vulnerable to a dam failure; if the failure took place at night those in an inundation area would be unaware of the failure before the inundation waters impacted their residences. Jurisdictional losses associated with exposed building value could not be estimated with the available information.

Should dam owners need dam inundation data moving forward, they will need approval from the local sponsors (e.g., the municipality, the Eastern Panhandle Conservation District, and the State Conservation Committee) and can then obtain the data from the Natural Resources Conservation Service (NRCS) via Andy Deichert (andy.deichert@wv.usda.gov).

According to the West Virginia Statewide Assessment, there are three "major" high-hazard dams located outside of Region 9 counties (Morgan, Berkeley, and Jefferson) that have the potential to impact Region 9 communities.

- **Jennings Randolph Dam** (Border of Mineral County, WV and Garett County, MD): The Jennings Randolph dam, located on the North Branch Potomac River in Garrett County, Maryland and Mineral County, West Virginia, is one of the largest dams in the region. Completed in 1981, the Jennings Randolph flood-control dam has a height of 296 feet and a maximum storage of 130,900 acre-feet. A dam failure of Jennings Randolph dam would affect downstream five counties (Mineral, Hampshire, Morgan, Berkeley, and **Jefferson**) and 12 jurisdictions, or from the unincorporated town of Barnum on the North Branch Potomac River downstream to **Harpers Ferry** at the confluence of the Potomac and Shenandoah Rivers. The U.S. Army Corps of Engineers, Baltimore District, has installed a year-round early warning system at Jennings Randolph Lake intended to notify downstream public users of impending rapid increases in water levels, and to evacuate the river immediately to higher ground for their safety.
- **Savage River Dam** (Garrett County, MD): Completed by the U.S. Army Corps of Engineers (USACE) in 1952, the dam is 184 feet high with a maximum storage of 31,800 acre-feet of water. Five miles downstream of the dam, the Savage River flows into the Potomac River

near the town of Piedmont, Mineral County, WV. The Savage River Dam, maintained by the U.S. Army Corps of Engineers, is classified as a "large", "high" hazard structure.

- **Lake Holiday Dam** (Frederick County, VA): The privately owned Lake Holiday Dam in Frederick County, Virginia, is located approximately 13 miles upstream from the Berkeley County border. In Virginia, the lake flows into Isaacs Creek, an east-flowing tributary of Back Creek, which flows north through Berkeley County to the Potomac River. This high hazard dam is 102 feet high and stores 10,166 acre-feet of water.

4.4.12.6. People

Dam failures themselves do not pose a threat to public health; the cascading effects that occur after a failure are more concerning. When a dam fails, it causes flooding downstream that can cause death, injury, and illnesses relating to water-borne diseases and standing water. As a result of flooding, people might have to evacuate and be displaced from their homes.

Inundation areas and vulnerable populations are being developed by the WV GIS Technical Center with concurrence with USACE. Future updates should more fully incorporate this data once completed. USACE is also updating its database and associated website to include dam-specific risk information and inundation maps for USACE dams.

Table 4-49 lists dams that would affect Jefferson County if a failure would occur. Areas that could be potentially impacted are provided. Both the towns of Shepherdstown and Harpers Ferry are downstream of the Jennings Randolph Lake Dam, while Harpers Ferry also is downstream of the Millville Hydroelectric Dam. Using the 2020 census data, Shepherdstown's population is 1,494 people, while Harpers Ferry has a population 269 people. A dam failure at either dam could potentially impact on these populations.

Table 4-49: Dams Affecting Jefferson County

Name of Dam	Class	Type	Stream / Downstream Area
Jennings Randolph Lake Dam	II	Rolled Earth & Rock Fill	North Branch Potomac River and Potomac River / Shepherdstown and Harpers Ferry.
Millville Hydroelectric-Dam	IV	Concrete	Shenandoah River / Areas along the river in the Millville area and potentially the lower town of Harpers Ferry.
Lake Shannondale Dam	II	Rolled Earth & Rock Fill	Furnace Run / Properties located along Mission Road and Riverside Drive

4.4.12.7. Structures

There have been no losses of life or property in Jefferson County due to a dam failure. However, this does not mean that there will never be any losses due to this type of event.

> *"Dam safety risk assessment is like a stool that stands on three legs. These legs quantify the likelihood that various initiating events (hydrologic, seismic, structural/internal, mechanical, or human error) will occur; the likelihood that the dam would fail given these initiating events; and the likelihood that, given a failure, the resulting flood wave would result in various levels of damage. The meaningful quantification of risk depends on credible estimates of the damage that would result from each significant failure scenario. Loss of human life is generally accepted as the most important consequence, so it often dominates dam-safety decisions. Unfortunately, the confidence with which life loss can currently be estimated is low. This high level of uncertainty applies to both statistical confidence limits and to expert opinion. As such, this single limitation is a critical hindrance to the credibility and value of dam-safety risk assessment results. Indeed, some would like to push the stool over on its weak leg and abandon probabilistic risk assessment altogether" (USACE, 2002).*

Jefferson County has one dam that could present the possibility of significant flood damage to the residents and businesses located near or downstream from the dam. Lakeside Properties, LLC privately owns the Lake Shannondale Dam which impounds a 50.5-acre lake, with a maximum depth of 86 feet. The dam was constructed in 1965. There are approximately 12 residential properties that could incur significant flooding if the dam were to fail catastrophically, all of which are located along Mission Road and Riverside Drive.

The owner of the Lake Shannondale Dam indicated that the dam is inspected annually by the West Virginia Department of Environmental Protection – Dam Safety Division, and a Monitoring and Emergency Action Plan (MEAP) was developed for the dam, that was updated in October 2021.

The current Jefferson County Emergency Operations Plan contains a dam failure incident specific annex.

4.4.12.8. Systems

Systems in this section refer to networks and capabilities. Dam failures could disrupt many systems including power, sewer, water, communications, and road access. The Millville Hydroelectric Dam is connected to the Millville Hydro Station, which is an energy plant that converts energy into bulk electrical power. The Power Plant distributes electrical power to the Jefferson County area electrical grid, which delivers it to electricity consumers. A failure at this dam is rated as a low hazard dam, however a dam failure incident would cause significant disruption to the systems in Jefferson County.

4.4.12.9. Natural, Historic and Cultural Resources

The National Register of Historic Places was used to assess the vulnerability of natural, historic, and cultural resources. For more complete information about the historical designations, refer to the National Register WV Listings. Historic structure locations were overlayed with dam locations. This assessment concluded no historic or culture structures are located in or around dams located in Jefferson County.

4.4.12.10. Community Activities

Activities that have value to the community could potentially be impacted by dam failures, however the identified dams are located in rural areas. Therefore, community activities would be unlikely to occur in these areas. Below are community activities that occur throughout the year or annually.

- Jefferson County Fair – July and August at Jefferson County Fairgrounds and weekly farm markets
- Historical Walking Tours of Harpers Ferry, WV – Available All Year (Note four (4) of the National Register Areas within Harpers Ferry are located in the 1-percent-annual chance floodplain.)
- Hollywood Casino Horse Races – Reoccurring – Located in Charles Town
- September 22 - 24 - Mountain Heritage Arts & Craft Festival at Jefferson County Fairgrounds
- October 7 - Freedoms Run (Note: held in in Harpers Ferry & Shepherdstown.)

4.4.13. Civil Disturbance

4.4.13.1. Location and Extent

Civil disturbance is a broad term that is typically used by law enforcement to describe one or more forms of disturbance caused by a group of people. Civil disturbances are typically a symptom of, and a form of protest against, major socio-political problems. Civil disturbance hazards include the following:

- **Famine:** Involving a widespread scarcity of food leading to malnutrition, increased mortality, and a period of psychosocial instability associated with the scarcity of food, such as riots, theft of food, and the falls of governments caused by political instability borne of an inability to deal with the crisis caused by famine
- **Economic Collapse, Recession:** Very slow or negative growth
- **Misinformation:** Erroneous information spread unintentionally
- Civil Disturbance, Public Unrest, Mass Hysteria, Riot: Group acts of violence against property and individuals, for example
- **Strike, Labor Dispute:** Controversies related to the terms and conditions of employment, for example:

Typically, the severity of the action coincides with the level of public outrage. In addition to a form of protest major socio-political problems, civil disturbances can also arise out of union protest, institutional population uprising, or from large celebrations that become disorderly. The scale and scope of civil disturbance events varies widely and the distinction between a violent civil disturbance and a peaceful protest must also be made. However, government facilities, landmarks, prisons, and universities are common sites where crowds and mobs may gather.

4.4.13.2. Past Occurrences

According to the Berkeley and Morgan County 2022 Hazard Mitigation Plan Update, an uprising against racism and police brutality swept the nation, in May of 2020. Triggered by the murder of George Floyd by Minneapolis Police in Minnesota, groups in cities and towns across the country hosted protests for several weeks, including Berkeley and Morgan County. Protests occurred throughout the region during the summer months of 2020, in Berkeley Springs, Martinsburg, and other communities. In one instance at a Berkeley Springs protest in August 2020, thirty to fifty people gathered to show support for the Black Lives Matter protest but were met with hundreds of counter protesters carrying Confederate flags and overpowering the speakers of the rally with chants of “U.S.A” and “all lives matter.” Police intervened and created a barricade with riot shields when counter protesters advanced towards the gazebo holding the speakers.

Jefferson County monitored this aforementioned “peaceful protest” event in Berkeley County and other communities throughout the panhandle according to Stephen Allen, Director, Office of Homeland Security and Emergency Management. In 2018, Ranson community members began to hold protests against the

construction of the Rockwool facility; a Danish stone wool insulation manufacturing facility. As of September 2022, the construction of this facility was under investigation for political improprieties, air quality and water quality. The West Virginia Fusion Center monitors and disseminates information to Jefferson County Fusion Liaison Officers. Finally, the Jefferson County Counter Terrorism Committee meets monthly to discuss and monitor civil disturbances.

4.4.13.3. Future Occurrences

Civil disturbance is always a possibility as long as there is discrimination or other perceived social economic injustices or development related. However, it may be possible to recognize the potential for an event to occur in the near-term. For example, an upcoming significant sporting event or other large public gathering in the State may result in gathering of large crowds or immediately after significant national news involving political or social debates. Local law enforcement should anticipate these types of events and be prepared to handle a crowd so that peaceful gatherings are prevented from turning into unruly public disturbances. Therefore, the probability of civil disturbance occurring in the region is considered possible as defined by the Risk Factor Methodology probability criteria.

The 2024 election cycle involving local, state, and national contests may be contentious and are very likely to result in local confrontations. Access to detailed plans by local law enforcement, political and community leaders, in response to varying degrees of unrest should be developed and made available. General guidelines should be publicized to assure the local population that good order and the rule of law will be maintained. The area around Shepherd University in Shepherdstown and Charles Town, county seat, may become a site for political activists to hold public demonstrations.

4.4.13.4. Range of Magnitude

Civil disturbances can take the form of small gatherings or large groups blocking or impeding access to a building or disrupting normal activities by generating noise and intimidating people. They can range from a peaceful sit-in to a full-scale riot, in which a mob burns or otherwise destroys property and terrorizes individuals. Even in its more passive forms, a group that blocks roadways, sidewalks, or buildings interferes with public order. There are two types of large gatherings typically associated with civil disturbances: a crowd and a mob. A crowd may be defined as a casual, temporary collection of people without a strong, cohesive relationship. Crowds can be classified into four categories (Juniata County, PA MJHMP, 2008):

1. Casual Crowd: A casual crowd is a group of people who happen to be in the same place at the same time. Violent conduct does not occur.
2. Cohesive Crowd: A cohesive crowd consists of members who are involved in some type of unified behavior. Members of this group are involved in some type of common activity, such as worshipping, dancing, or watching a sporting event. They require substantial provocation to arouse to action.
3. Expressive Crowd: An expressive crowd is one held together by a common commitment or purpose. Although they may not be formally organized, they are assembled as an expression of

common sentiment or frustration. Members wish to be seen as a formidable influence. One of the best examples of this type is a group assembled to protest for a cause.

4. Aggressive Crowd: An aggressive crowd is comprised of individuals who have assembled and are visibly angry or violent. This crowd often has leaders who attempt to arouse the members or motivate them to action. Members are noisy and threatening and will taunt authorities. They may be more impulsive and emotional and require only minimal stimulation to arouse violence.

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

- Aggressive Mob: An aggressive mob is one that attacks, riots and terrorizes. The object of violence may be a person, property, or both. An aggressive mob is distinguished from an aggressive crowd only by lawless activity. Examples of aggressive mobs are the inmate mobs in prisons and jails, mobs that act out their frustrations after political defeat, or violent mobs at political protests or rallies.
- Escape Mob: An escape mob is attempting to flee from something such as a fire, bomb, flood, or other catastrophe. Members of escape mobs are generally difficult to control and can be characterized by unreasonable terror.
- Acquisitive Mob: An acquisitive mob is one motivated by a desire to acquire something. Riots caused by other factors often turn into looting sprees. This mob exploits a lack of control by authorities in safeguarding property.
- Expressive Mob: An expressive mob is one that expresses fervor or revelry following some sporting event, religious activity, or celebration. Members experience a release of pent-up emotions in highly charged situations.

The worst-case scenario for the region would be an aggressive crowd or expressive mob protesting on or within a major thoroughfare, most likely formed near a major population hub, like Martinsburg. This scenario would also involve property damage

4.4.13.5. Vulnerability Assessment

Areas of Jefferson County that are most vulnerable to civil disturbance acts are area with higher populations and urban centers: Charles Town and the Town of Ranson. However, response training and anticipation to disturbances may minimize associated impacts and damages.

4.4.13.6. People

Jurisdictional losses for civil disturbance events are difficult to predict and can vary significantly in range. The two communities identified in this section are locations where such events are more likely to occur and therefore should be considered more vulnerable.

Impacts from violent acts to survivors most likely include common stress reactions that may last several days to a few weeks. These reactions may include the following:

- Emotional Reactions: Shock, fear, grief, anger, guilt, shame, helplessness, numbness, sadness.
- Cognitive Reactions: Confusion, indecisiveness, worry, shortened attention span, trouble concentrating.
- Physical Reactions: Tension, fatigue, edginess, insomnia, body aches, easily startled, tachycardia, nausea, loss of appetite.
- Interpersonal Reactions: distrust, conflict, withdrawal, irritability, loss of intimacy, feeling abandoned.

4.4.13.7. Social Vulnerability

Deciding which groups are vulnerable is challenging. There will always be variation between groups and the people within them in relation to the risks they face. However, the elderly, children, homeless persons, people with disabilities, religious groups and members of the LGBTQ community experience higher rates of exposure to violence.

4.4.13.8. Structures

In the case of small and large civil disturbance events, the county may incur losses related to work stoppages in addition to any acts of vandalism that my occur. Structures may be damaged, specifically commercial and government property. Damages to structures may result in short to long-term closures and disruption of services.

4.4.13.9. Systems

Adequate law enforcement minimizes the changes of a small assembly of people turning into a significant disturbance. This will ensure improved response times, optimal communications, and containment of the event as during these events major roadways can be blocked and disturb traffic and larger events may involve the interruption or removal of communication.

4.4.13.10. Resources and Community Activities

Public places are most often used for protest. These locations are chosen to attract the most attention for the issue at the center of the protest. By holding a protest in public or community centered area, organizers are hoping to draw attention to their cause or issue from passersby or even the media who may not be aware of its significance. The usage of parks and other community areas that have pre-planned events may conflict with the protest and may result in the cancellation of planned community events. Below are community activities that occur throughout the year or annually.

- Jefferson County Fair – July and August at Jefferson County Fairgrounds and weekly farm markets

- Historical Walking Tours of Harpers Ferry, WV – Available All Year (Note four (4) of the National Register Areas within Harpers Ferry are located in the 1-percent-annual chance floodplain.)
- Hollywood Casino Horse Races – Reoccurring – Located in Charles Town
- September 22 - 24 - Mountain Heritage Arts & Craft Festival at Jefferson County Fairgrounds
- October 7 - Freedoms Run (Note: held in in Harpers Ferry & Shepherdstown.)

4.4.14. Hazardous Materials Incident

A hazardous material may be defined as a substance or material which, because of its chemical, physical, or biological nature, poses a threat to life, health, or property if released from a confined setting. A release may occur by spilling, leaking, emitting toxic vapors, or any other process that enables the material to escape its container, enter the environment, and create a potential hazard. Hazardous materials can include toxic chemicals, infectious substances, bio-hazardous waste, and any materials that are explosive, corrosive, flammable, or radioactive. Related combustible hazardous materials include oxidizers and reactive materials, while toxins produced by etiological (biological) agents are types of poison that can cause disease.

Hazardous material releases pose threats to the natural environment, the built environment, and public safety through the diffusion of harmful substances, materials, or products. Hazardous material releases can occur wherever hazardous materials are manufactured, used, stored, or transported. Such releases can occur along transportation routes, including road and rail, or at fixed-site facilities. Hazardous material releases can result in human and wildlife injury, property damage, and contamination of air, water, and soils.

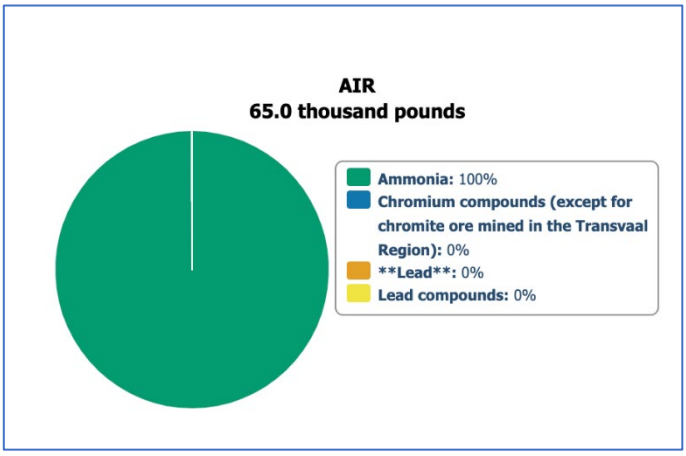
4.4.14.1. Location and Extent

Fixed-site facilities that use, manufacture, or store hazardous materials in Jefferson County pose risk and must comply with both Title III of the federal Superfund Amendments and Reauthorization Act (SARA), also known as the Emergency Planning and Community Right-to-Know Act (EPCRA). This legislation requires that all owners or operators of facilities that manufacture, produce, use, import, export, store, supply, or distribute any extremely hazardous substance, as defined by the EPA, at or above the threshold planning quantity, as established by EPA, shall report to the county where the facility is located and to the State that the facility is subject to the requirement to assist the Local Emergency Planning Committee (LEPC) in the development of an Off-site Emergency Response Plan. The community right-to-know reporting requirements keep communities abreast of the presence and release of chemicals at individual facilities. Due to the sensitive nature of SARA facility information, Berkeley and Morgan County will not release information regarding specific SARA facilities for this plan. However, reports from facilities that have release toxic material into the environment are accessible by the public under the Toxic Release Inventory (TRI). TRI was established under EPCRA and expanded under the Pollution Prevention Act of 1990. The Toxics Release Inventory (TRI) tracks the management of certain toxic chemicals that may pose a threat to human health and the environment. Certain industrial facilities in the U.S. must report annually how much of each chemical is recycled, combusted for energy recovery, treated for destruction, and disposed of or otherwise released on- and off-site. This information is collectively referred to as production-related waste managed. Some notable facilities which report through the EPA TRI are listed in Table 4-50.

Table 4-50: Top Five Facilities by Total Releases, Jefferson County, WV, 2021		
Facility/ Location	**Industry Sector**	**Thousands of Pounds**
US CBP Advanced Training Center 440 Koonce Road Harpers Ferry, WV, 25425	Sector 999-Other	**712**: Off-Site Disposal or Other Releases Note: 1,700 Off Site Disposal or Other Releases reported in 2020
Rockwool USA 665 Northport Avenue Kearneysville, WV, 25430	Sector 327-Non-Metalic Mineral Product	**85,345**: Air & Off-Site Disposal or Other Releases Note: Not reported as a top-five facility by total releases in 2020.
Ox Paperboard LLC 164 Eyster Rd Harpers Ferry, WV, 25425	Sector 322-Paper	Annual release **did not exceed 500 pounds** for the reporting year, 2021. Note- 11 Off-Site Disposal or Other Releases reported in 2020
Griffith Energy Services Inc. 110066 Middleway Pike Charles Town, WV, 25414	Sector 4247-Petroleum Bulk Terminals	Annual release **did not exceed 500 pounds** for the reporting year, 2021. Note- Annual release did not exceed 500 pounds for the reporting year, 2020
UFP Ranson LLC 249 16th Avenue Ranson, WV, 25438	Sector 321-Wood Products	Annual release **did not exceed 500 pounds** for the reporting year, 2021. Note- Not reported as a top-five facility by total releases in 2020.

Source: 2021 National Analysis Dataset (updated May 2023, released May 2023)

Figure 4-43: Chemicals Released into the Air, 2021 TRI – Jefferson County, WV



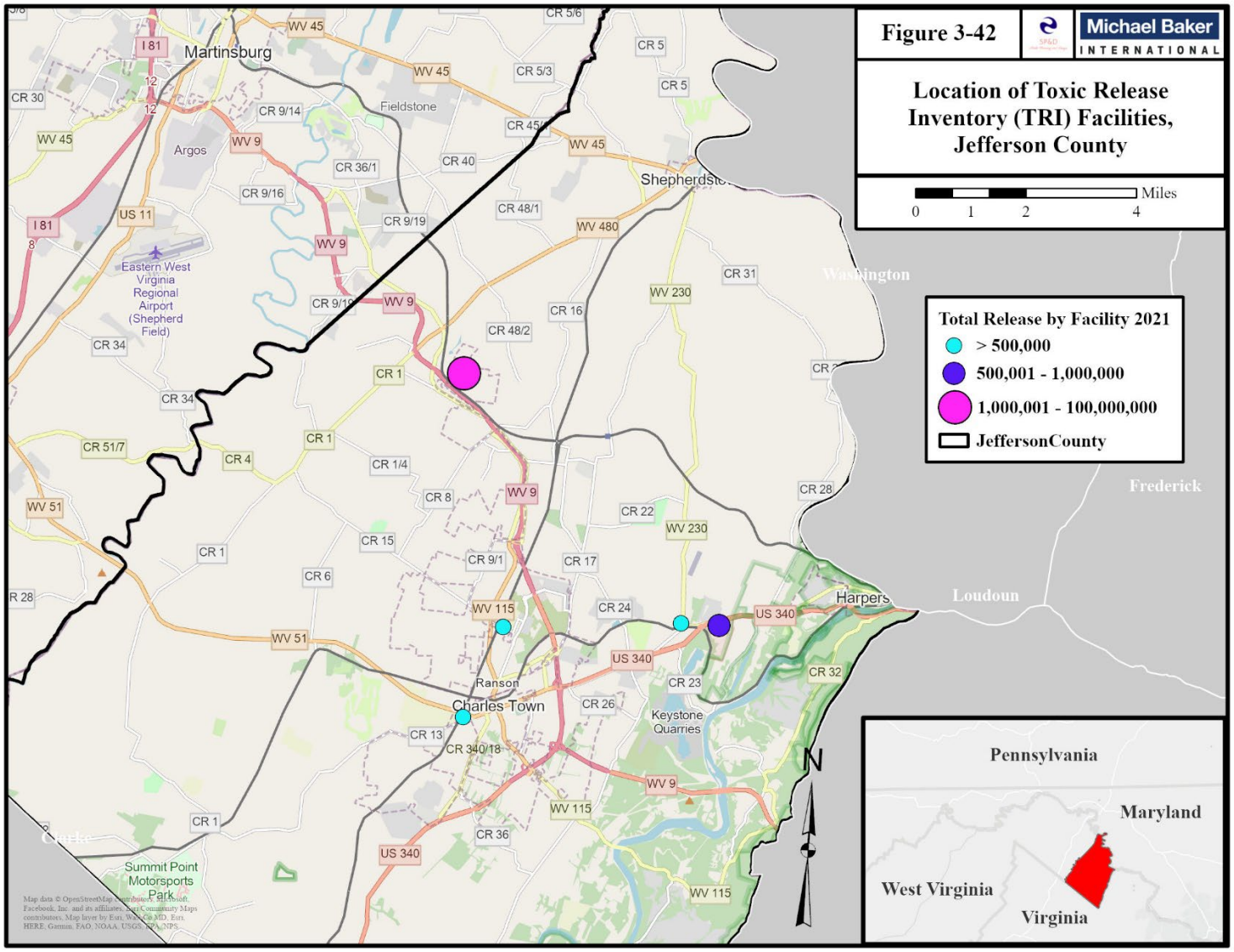
Ammonia, which is a Carcinogenic Chemical, was the top chemical released into the air in Jefferson County according to the 2021 TRI Factsheet: County – Jefferson, WV.

West Virginia ranks **16 out of 56** states/territories nationwide based on total releases per square mile (Rank 1 = highest releases.)

The extent of the damage from hazmat can be localized to just a cleanup on the road, or widespread, to include hazardous materials reaching source water via storm drains, and the river. In general, facilities that utilize hazardous materials are located near major thoroughfares and in more developed areas of Jefferson County.

In addition to fixed-site hazardous materials release, there are increasingly large numbers of chemicals, oils, radioactive materials, and other hazardous substances spilled because of highway, rail, and waterway accidents, storage tank leakage, pipeline break, and/or other accidents. On occasion, these events become a major disaster and force people to evacuate and/or lose their homes and businesses.

Figure 4-44: Location of Toxic Release Inventory (TRI) Facilities, Jefferson County



4.4.14.2. Past Occurrence

Since 2009, PHMSA has not reported any incidents occurring in Jefferson County. The National Response Center (NRC), by contrast, has reported 33 occurrences of hazmat incidents since 2010. The table on the following page details the type of incident, its cause, the date, and the location, when available.

Table 4-51 highlights all HazMat Incident Reports reported by the U.S. Department of Transportation from 2000- May 2023.

Table 4-51: NRC HazMat Occurrences

Type of Incident	Incident Cause	Incident Date	Location Nearest City
Fixed	Other/Unknown	3/4/2010	Harpers Ferry
Fixed	Other/Unknown	6/25/2010	Charles Town
Fixed	Dumping	11/5/2010	Charles Town
Storage Tank	Equipment Failure	4/29/2011	Shepherdstown
Mobile	Other/Unknown	11/29/2011	Morgan
Unknown Sheen	Other/Unknown	12/18/2011	Millville
Fixed	Other/Unknown	12/30/2011	Harpers Ferry
Storage Tank	Other/Unknown	6/10/2012	Shenandoah Junction
Railroad	Equipment Failure	8/26/2012	Shenandoah Junction
Mobile	Other/Unknown	11/1/2012	Charles Town
Unknown Sheen	Other/Unknown	3/7/2013	Shepherdstown
Fixed	Other/Unknown	1/4/2014	Ranson
Fixed	Natural Phenomenon	2/6/2014	Harpers Ferry
Fixed	Other/Unknown	3/1/2014	Charles Town
Railroad	Equipment Failure	5/2/2014	Shepherdstown
Railroad	Equipment Failure	6/15/2014	Charles Town
Fixed	Other/Unknown	7/30/2014	Charles Town
Fixed	Dumping	10/28/2014	Harpers Ferry
Fixed	Other/Unknown	2/9/2015	Kearneysville
Pipeline	Operator Error	6/9/2015	Charles Town
Fixed	Equipment Failure	11/11/2015	Charles Town
Aircraft	Other/Unknown	12/16/2015	Charles Town
Storage Tank	Other/Unknown	1/7/2016	Harpers Ferry
Railroad	Equipment Failure	10/13/2016	Charles Town
Railroad	Equipment Failure	2/13/2017	Harpers Ferry
2023 Plan Update			
Storage Tank	Unknown	1/26/2018	Summit Point
Fixed	Operator Error	3/17/2018	Harpers Ferry
Fixed	Dumping	4/28/2018	Harpers Ferry
Fixed	Dumping	8/17/2018	Kearneysville
Mobile	Equipment Failure	11/1/2018	Charles Town
Fixed	Other	1/3/2019	Ranson

Table 4-51: NRC HazMat Occurrences

Type of Incident	Incident Cause	Incident Date	Location Nearest City
Fixed	Dumping	7/30/2019	Charlestown
Fixed	Other	10/7/2019	Halltown
Unknown Sheen	Unknown	3/20/2020	Shepherdstown
Railroad	Derailment	1/25/2021	Ranson
Fixed	Other	3/20/2021	Charles Town
Fixed	Unknown	8/15/2021	Shepherdstown
Fixed	Equipment Failure	8/17/2021	Shepherdstown
Fixed	Operator Error	6/4/2023	Charles Town

Source: National Response Center 2010-2023

Note: In 2022 only one incident was recorded in the database, which involved a trespasser on railroad, which was not a release.

JCHSEM reached out to their neighboring jurisdictions to ask about hazards that originate in Jefferson County and affect the surrounding, and hazards that originate in surrounding counties and affect Jefferson County. The Loudoun County Office of Emergency Management (OEM) in Virginia expressed concern for incidents originating in Jefferson County that affect Loudoun; a train derailment in Harpers Ferry could affect the county. The Washington County Division of Emergency Services (DES) in Maryland mentioned that there are numerous rail lines along the Sandy Hook area (South Washington County) where Washington and Jefferson meet at the Potomac; if a train derailed or spill hazardous materials, there would be a potential impact to both counties.

4.4.14.3. Future Occurrence

While some hazardous material release incidents have occurred in Jefferson County in the past, they are generally considered difficult to predict. An occurrence is largely dependent upon the accidental or intentional actions of a person or group. Intentional acts are addressed under Section 3.3.16, Terrorism. Future occurrences could take place at any facility making use of or storing hazardous materials or any thoroughfare for hazardous materials into, out of, or through the county. Overall, the probability of future hazardous materials incidents are possible as defined by the Risk Factor Methodology (See Section 3.4.1).

The closing of the Halltown Paperboard Mill in Jefferson County in November 2022 marked the closure of the oldest continuously operating manufacturing plant in West Virginia. The closure comes after a fire damaged the facility in June 2022. A combination of the fire and other nationwide issues like labor shortage and supply chain disruption were cited as reasons for the plant's closure. If it is decided that the property is demolished or repurposed the County will have to take measures to ensure proper assessment, planning, cleanup and preparation of the property and possible hazardous material disposal.

4.4.14.4. Range of Magnitude

The hauling, storage, and use of hazardous materials play a vital role in the economy of our nation. These materials are stored and handled at fixed facilities and are transported over highway, railway, and water

transportation systems, as well as pipelines. It is estimated that over four billion tons of hazardous materials are transported annually and that 100,000 trucks haul hazardous materials on the country's highways each day. The majority of the transportation infrastructure utilized to move hazardous materials through Jefferson County is located in the central portion of the county; this is also the most populated area of the county, and the location for the majority of the high hazard areas for natural hazards, thus increasing the chance of a release. An incident causing the accidental release of a hazardous material is spontaneous, with little time of warning. Further, the recovery and clean-up activities involved in a hazmat incident may require several hours, days, or even weeks to complete. In order to determine the amount of hazardous materials transported through Jefferson County, a hazardous materials commodity flow study should be conducted. This was identified as a gap in the capability assessment and therefore included as a mitigation action item in Chapter 6.

Hazardous materials can be released as a secondary result of a natural disaster like an earthquake or flood. In either case, buildings or vehicles can release their hazardous materials inventories when structurally compromised or involved in traffic accidents. Additional potential causes of hazardous material releases may include terrorist incident and illegal drug labs or dumping. Illegal drug labs present a special concern because each must be treated as a chemical hazard site and decontaminated before the property can be used again. Illegal drug labs can be set up in homes, apartments, vacant buildings, shacks in the forest or even in a van parked on the street.

4.4.14.5. Vulnerability Assessment

Due to the wide variety of substances that are used, transported, and stored in the area, it is difficult to assign an overall impact of these substances to public health, the environment, the economy, and the infrastructure. Some spills cause minor if any damage to the area. For example, spilling a few gallons of gasoline on concrete during transfer causes minimal economic impact; rarely does the spilled substance cause any environmental impacts. This is not to say that all spills are minor, some can be very harmful to human health and the environment and costs thousands, if not millions of dollars to clean up.

Spills into waterways and those that reach the groundwater are of particular concern due to the threat they impose to drinking water and subsequently public health, the environment, and fauna in the area.

Additionally, transportation-based hazard incidents have the potential to result in cascading impacts. For example, a rail-based incident could isolate a community in Jefferson County as well as several other communities in the region. Officials from such operators as CSX Transportation concur. In a past interview, the company's hazmat manager out of Pittsburgh noted that a significant problem associated with rail incidents, particularly those involving hazardous materials, is that a stopped train can block several roadway intersections, essentially cutting some areas off. These blocks not only hinder evacuation from those areas but also emergency services access to those areas.

Hazardous materials incidents can occur rapidly over a large area. The chemical, physical, and biological

properties of hazardous materials pose a potential risk to life, health, the environment, and property when not properly contained.

Many factors determine the impact of a potential incident including quick and solid decision-making by emergency officials, location and type of release, evacuation and shelter-in-place needs, public health concerns, and relevant economic considerations. Additionally, while most incidents are generally brief, the resulting recovery and cleanup may take time to exact.

If evacuation is necessary due to a chemical emergency, road closures and traffic jams may result. If a large-scale evacuation is deemed necessary, it can pose serious long-term economic consequences to the involved population area. A delay in the resumption of industry commerce may cause economic losses for both business owners and employees. In addition, an evacuation ordered on short notice could cause serious problems for businesses requiring time to shut down specialized equipment.

There is also the monetary impact borne by responding public or private emergency response organizations. These agencies may be challenged by the expenses dictated by a hazardous material release and may need to wait an uncomfortable length of time for the responsible party to reimburse any outstanding costs, further straining the economic resources of the region.

Several emergency preparedness and response plans have been developed with regards to hazardous materials incidents for Jefferson County, including the Jefferson County Emergency Operations Plan and Emergency Support Function (ESF 10) Hazmat Response, and the Jefferson County Commodity Flow Study, 2012 and 2016. Several Extremely Hazardous Substances (EHS) facilities have developed off-Site Emergency Response Plans as well. Upon reviewing the information from the commodity flow study, it was apparent that liquefied petroleum gas presented a risk to several areas in Jefferson County. The update of both the 2016 Hazardous Materials Commodity Flow Study and the Hazardous Materials Response Plan have been included as new mitigation actions in this plan update.

4.4.14.6. People

Hazardous material releases can contaminate air, water, and soils, possibly resulting in death and/or injuries. Dispersion can take place rapidly when transported by water and wind. While often accidental, releases can occur because of human carelessness, intentional acts, or natural hazards. When caused by natural hazards, these incidents are known as secondary events. Hazardous materials can include toxic chemicals, radioactive materials, infectious substances, and hazardous wastes. Such releases can affect nearby populations and contaminate critical or sensitive environmental areas.

With a hazardous material release, whether accidental or intentional, there are several potentially exacerbating or mitigating circumstances that will affect its severity or impact. Mitigating conditions are precautionary measures taken in advance to reduce the impact of a release on the surrounding environment. Primary and secondary containment or shielding by sheltering-in-place protects people and

property from the harmful effects of a hazardous material release. Exacerbating conditions, characteristics that can enhance or magnify the effects of a hazardous material release include:

- **Weather conditions.** Affects how the hazard occurs and develops.
- **Micro-meteorological effects of buildings and terrain.** Alters dispersion of hazardous materials
- **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 is dependent not only on the circumstances described above, but also with the type of material 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 depending on the agent, a release can travel great distances or remain present in the environment for a long period of time (i.e., centuries to millennia for radioactive materials), resulting in extensive impacts on people and the environment.

A worst-case scenario event of a hazardous material release would be if a release occurred in the most populous areas. A hazardous material release would likely cause the evacuation of all nearby residents. Alternatively, a release on a major regional highway, such as 340, could injure motorists and/or shut down traffic for hours.

The environmental impacts of hazardous material releases include:

- Hydrologic effects – surface and groundwater contamination
- Other effects on water quality such as changes in water temperature
- Damage to streams, lakes, ponds, estuaries, and wetland ecosystems
- Air quality effects – pollutants, smoke, and dust
- Loss of quality in landscape
- Reduced soil quality
- Negative health effects on residents
- Damage to plant communities – loss of biodiversity; damage to vegetation
- Damage to animal species – animal fatalities; degradation of wildlife and aquatic habitat; pollution of drinking water for wildlife; loss of biodiversity; disease.

A major incident involving significant injuries may severely tax regional medical services, as medical facilities aren't generally designed to handle mass amounts of victims on short notice. Consequently, in the event of a major incident, hospitals and other medical facilities must still be able to provide their customary level of service to all patients, regardless of whether they were incident victims or not.

4.4.14.7. Structures

Areas that are home to one or more hazardous materials facilities should be considered vulnerable to hazardous materials releases from fixed facilities. Table 4-52 shows the most significant TRI facilities in Jefferson County. Within a 1.5-mile radius from each TRI facility shown in the table, there are 14,530 structures. This represents about 15 percent of all buildings in Jefferson County. Within a 1.5-mile radius from each TRI Facility listed, there are 221 critical facilities, representing about 26 percent of all critical facilities in Jefferson County. These findings are summarized in Table 4-52.

Table 4-52: Structures and Critical Facilities Vulnerable to Hazardous Materials Release

Jurisdiction	Total Structures	Structures in Hazardous Materials Area	% Structures in Hazardous Materials Area
Jefferson County Unincorporated	93,957	14,530	15%
Bolivar	1,552	0	0%
Charles Town	7,278	4,562	63%
Harpers Ferry	742	0	0%
Ranson	6,912	6,298	91%
Shepherdstown	1,312	0	0%
Jefferson County Total	111,753	25,390	23%
Jurisdiction	**Total Critical Facilities**	**Critical Facilities in Hazardous Materials Area**	**% Critical Facilities in Hazardous Materials Area**
Jefferson County Unincorporated	604	81	13%
Bolivar	6	0	0%
Charles Town	99	83	84%
Harpers Ferry	54	0	0%
Ranson	58	57	98%
Shepherdstown	31	0	0%
Jefferson County Total	852	221	26%

Source: 2021 National Analysis Dataset (updated May 2023, released May 2023), SP&D 1.5 Mile Buffers Zones, & Jefferson County Building Footprints and Address Points (2023)

4.4.14.8. Systems

A hazmat release while in transit is of great concern to the U. S. Department of Transportation. While most hazardous materials are stored and used at fixed sites, these materials are usually produced elsewhere and shipped to the fixed facility by rail car, truck, or onboard ships or barges. These vehicles are identified by signs or placards denoting the hazard. However, the possibility of release is present at any time. Hazardous materials are constantly being moved in West Virginia on road networks, rail systems and on waterway shipping lanes.

There are two major agencies that collect data as they relate to hazardous materials incidents the Pipeline and Hazardous Materials Safety Administration (PHMSA) governed by the U.S. Department of Transportation (DOT), and the National Response Center (NRC), governed by the U.S. Coast Guard (USCG).

The types of materials that can cause a hazmat release are wide-ranging and may include chlorine, sodium hydroxide, sulfuric acid, radioactive isotopes, anhydrous ammonia, gasoline and other hydrocarbons, as well as medical/biological waste from hospitals or clinics. Hazardous materials subject to reporting under the Emergency Planning and Community Right-to-Know Act (EPCRA) or Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA) include these four groups:

- Extremely Hazardous Substances (EHS) – These are materials with acutely toxic properties that may do irreversible damage or cause death to people or harm the environment when released or used outside their intended use. Examples include ammonia, chlorine, and sulfuric acid.
- Hazardous Substances – These are any materials posing a threat to human health and/or the environment, or any substance designated by the Environmental Protection Agency (EPA) to be reported if a designated quantity of the substance is spilled into the waters of the United States or is otherwise released into the environment.
- Hazardous Chemicals – If present at a chemical facility in certain amounts, these substances require a Material Safety Data Sheet (MSDS) under the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard. Such substances are capable of producing fires and explosions or adverse health effects such as cancer, burns, or dermatitis.
- Toxic Chemicals – Chemicals or chemical categories that appear on the list because of their chronic or long-term toxicity.

In 2016, Jefferson County updated the county commodity flow study (CFS) and included information on highways, railways, and covered facilities. The following is a brief description of the findings of the CFS.

Highway

Approximately 49.2% of the total placarded vehicles recorded were carrying Class 3 (Flammable Liquids). Class 2 (Gases) were the second-most frequently carried materials (30%), followed by Class 8 (Corrosives, 8.3%).

Conclusions drawn from the CFS regarding highways included the following.

- National hazardous material incident trends generally predicted the hazardous materials that would be seen locally.
- Class 3 Flammables are involved in the most incidents nationally and were the most frequently recorded materials in Jefferson County, making up nearly half of all observed placards.

- Class 8 materials were involved in the second most number of highway incidents nationally, but these materials represented only 5% of observed placards in Jefferson County.
- Class 2 materials are involved in the third most highway incidents nationally and are the second most prevalent materials observed in Jefferson County.
- Gasoline (UN 1203) was the single-most recorded material in the study. Though a multitude of materials was observed during the study, the highway analysis alone suggests that local responders should primarily prepare for incidents involving flammable liquids, gases, and Class 9 materials.
- Commodity flow studies are significantly affected by the time of day, week, and even year in which they are conducted (i.e., monitoring the study area one week earlier or later could yield different results based on the shipping schedules and needs of covered facilities).

Table 4-53: Highway Risk Analysis Summary

Roadway Name	Miles in Jefferson County	Accidents with Placarded Loads per Year
U.S. Route 340	32.38	0.425
State Route 9	15.8	0.147
State Route 45	2.58	0.009
State Route 115	4.13	0.011
State Route 51	8.81	0.012

Source: Jefferson County CFS (2016)

Railway

Due to the low probability of rail accidents involving hazardous materials and the past track record of very few hazmat rail accidents, Jefferson County is much more likely to experience a hazardous material event due to a roadway accident rather than to a rail accident. A significant number of materials transported by rail in Jefferson County are passing through the county, and not bound for a facility within the jurisdiction. Half of the materials listed are found only in the rail analysis.

Covered Facilities

Materials reported as part of the covered facilities analysis represent all hazard classes. Further, given the frequency of shipment information provided by covered facilities, it becomes clear that shipments of some materials could only be observed if field reconnaissance was completed for months or even up to a year. As such, it can be assumed that emergency responders should plan and prepare for hazardous material incidents from any hazard class.

4.4.14.9. Resources & Community Activities

It is more cost-effective to assess potential effects from a disaster and to implement preventative measures than to wait for a disaster to strike and then assess actual impacts. Determining which resources and community activities that are likely to be damaged in a disaster and applicable protection measures is advisable. This can be somewhat challenging with certain hazards that do not have a defined hazard area, as is the case with the transportation of hazardous materials. However, transporting hazardous materials means meeting strict safety standards and regulations set forth by the Federal Motor Carrier Safety Administration (US DOT FMCSA, 2022) and OSHA. Minimizing exposure to populated areas during the transport of hazardous materials can mitigate impacts to people and property in the event of a spill. Natural, historic, and cultural resources along transportation corridors may be at-risk, chemical transported dependent, to a hazmat incident. Both evacuation procedures and shelter-in-place emergency messaging for potential hazmat incidents are in-place in Jefferson County.

National Register of Historic Places located within the 1.5-mile radius of the significant (5) TRI facilities.

Table 4-54: National Register of Historic Places Vulnerable to Hazardous Materials Release

TRI Facility	Historic Building Name
US CBP Advanced Training Center 440 Koonce Road Harpers Ferry, WV, 25425	Allstadt House and Ordinary
	Halltown Colored Free School
	Halltown Union Colored Sunday School
Rockwool USA 665 Northport Avenue Kearneysville, WV, 25430	Hazelfield
	Tackley Farm
Ox Paperboard LLC 164 Eyster Rd Harpers Ferry, WV, 25425	Beall-Air
	Halltown Colored Free School
	Halltown Union Colored Sunday School
	Rion Hall
Griffith Energy Services Inc. 110066 Middleway Pike Charles Town, WV, 25414	Charles Town Mining, Manufacturing, & Improvement Company Building
	Gibson--Todd House
	Jacks-Manning Farm
	Jefferson County Courthouse
	New Opera House
	Charles Washington House
	Robert Worthington House
UFP Ranson LLC 249 16th Avenue Ranson, WV, 25438	Aspen Hill
	Charles Town Mining, Manufacturing, & Improvement Company Building
	Jefferson County Courthouse
	New Opera House

Source: 2021 National Analysis Dataset (updated May 2023, released May 2023), SP&D 1.5 Mile Buffers Zones, & 2020 National Register of Historic Buildings (Note: most recent update of National Register of Historic Buildings was in 2020.)

4.4.15. Terrorism

4.4.15.1. Location and Extent

This profile is intentionally generalized. Jefferson County Homeland Security and Emergency Management (JCHSEM) have identified a number of potential terrorist-related targets throughout the county and maintain files of such information separately from this document.

Terrorist attacks can occur anywhere. The term "terrorism" refers to intentional, criminal, malicious acts, but the functional definition of terrorism can be interpreted in many ways. Officially, terrorism is defined in the Code of Federal Regulations as "the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives" (28 CFR §0.85).

Acts of terrorism include threats of terrorism; assassinations; kidnappings; hijackings; bomb scares and bombings; cyber-attacks (computer-based attacks); and the use of chemical, biological, nuclear, and radiological weapons (FEMA, n.d.). An important consideration in evaluating terrorism hazards is the existence of facilities, landmarks, or other buildings of international, national, or regional importance. Several federal government buildings and Harper's Ferry, a significant landmark in terms of national importance are located in Jefferson County. Threats against the agricultural community and major transportation corridors, however, could be potential terrorist targets. The Eastern Panhandle could also be impacted by terrorism due to its proximity to the National Capital Region, which is one of the most target-rich areas of the country. Should a terrorist strike the National Capital Region, the region could see a mass influx of residents evacuating the area and major highways such as I-81 could become impassable due to the volume of traffic. The region could also suffer the indirect economic effects of the incident as many residents work in or close to D.C.

Any acts of terrorism can occur anywhere at any time of day. The National Terrorism Advisory System (NTAS) communicates information about terrorist threats by providing detailed information to the public, government agencies, first responders, airports and other transportation hubs, and the private sector. When there is a threat, an NTAS Alert will be announced by the Secretary of Homeland Security and will be shared with the public. It may include specific information about the nature of the threat, including the geographic region, mode of transportation, or critical infrastructure potentially affected, as well as steps that individuals and communities can take to protect themselves and help prevent, mitigate or respond to the threat. The alert indicates whether the threat is elevated or imminent. Elevated threats are when there is no specific information about the timing or location. Imminent threats are when it is believed the threat is impending or very soon. The alerts will be posted online and released to the news media for distribution. The United States Department of Homeland Security (USDHS) will also distribute alerts through its social media channels (USDHS 2013).

The West Virginia Fusion Center also exists to provide resources, expertise, and information to the center with the goal of maximizing the ability to detect, prevent, investigate, and respond to criminal and terrorist activity. Intelligence processes through which information is collected, integrated, evaluated, analyzed, and disseminated are a primary focus. Data fusion involves the exchange of information from different sources including law enforcement, public safety, and the private sector. Relevant and actionable intelligence results from analysis and data fusion. The fusion process helps agencies be proactive and protect communities.

Possible Causes

There is no single cause of acts of violence; it is typically a non-rational, complicated, intertwined, series of reasons that have the outcome of violence. In his article Causes of Terrorism, Nick Grothaus lays out the most common causes cited by leaders in the field of counterterrorism. These categories may apply to other types of violence not related to terrorism.

- Ethno-Nationalism: The desire of a population to break away from a government or ruling power and create a state of their own.
- Alienation/Discrimination: Individuals or groups face discrimination leading to further feelings of isolation. These people may become jaded towards society and feel excluded.
- Religion: Religion as a part of terrorism has been mainly attributed to Islamic fundamentalism although other religions have also had involvement in terrorist activities. For example, Christian Fundamentalists target abortion clinics, the Aryan Nation and the Church of Christ, Christians target the Jews and minorities (Post, 2007, pp. 211-212).
- Socio-Economic Status: Individuals and groups may be driven by a sense of relative depravation and lack of upward mobility within society.
- Political Grievances: A lack of political inclusiveness or grievances against a certain political order may cause individuals to join or create terrorist groups.

4.4.15.2. Range of Magnitude

The term “terrorism” refers to intentional, criminal, and malicious acts, but the functional definition of terrorism can be interpreted in many ways. The Federal Bureau of Investigation (FBI) classifies terrorism into two categories (FBI, 2023):

- **International terrorism:** Violent acts committed by individuals and/or groups inspired by or associated with designated foreign terrorist organizations or nations (statesponsored), and
- **Domestic terrorism:** Violent, criminal acts carried out by individuals and/or groups to further ideological goals stemming from domestic influences, such as those of a political, religious, social, racial, or environmental nature

FEMA defines the three main goals of terrorism as causing public fear, convincing citizens that the

government cannot protect against terrorism, and making the motivating causes known to the public. Terrorist attacks can take many forms. FEMA identifies the following as some of the common tactics of terrorism (FEMA, 2004):

- Agriterrorism—food contamination or destruction of crops via pest introduction or disease agents
- Arson/incendiary attack
- Armed attack
- Assassination
- Biological agent
- Chemical agent
- Cyberterrorism
- Conventional bomb
- Hijackings
- Intentional hazardous material release
- Kidnapping
- Nuclear bomb
- Radiological agent

The West Virginia State Fusion Center defines eight signs of Terrorism (West Virginia Fusion Center, 2023):

- **Surveillance:** Someone recording or monitoring activities. This may include the use of cameras, note taking, drawing diagrams, annotating on maps, or using binoculars or other vision-enhancing devices.
- **Elicitation:** People or organizations attempting to gain information about operations, capabilities, or people. Elicitation attempts may be made by mail, email, telephone, or in person. This could also include eavesdropping or friendly conversation.
- **Tests of Security:** Any attempts to measure reaction times to security breaches, attempts to penetrate physical security barriers, or monitor procedures in order to assess strengths and weakness.
- **Funding:** Suspicious transactions involving large cash payments, deposits, or withdrawals. Collections for donations, the solicitation for money, and criminal activity are common signs of terrorist funding.
- **Supplies:** Purchasing or stealing explosives, weapons, ammunition, etc. This also includes acquiring military uniforms, decals, flight manuals, passes or badges (or the equipment to manufacture such items), and any other controlled items.
- **Impersonation:** People who do not seem to belong in the workplace, neighborhood, business establishment, or anywhere else.
- **Rehearsal:** Putting people in position and moving them around according to their plan without actually committing the terrorist act.

- **Deployment:** People and supplies getting into position to commit the act. This is the person's last chance to alert authorities before the terrorist act occur.

The severity of terrorist incidents depends upon the method of attack, the proximity of the attack to people, animals, or other assets and the duration of exposure to the incident or attack device. For example, chemical agents are poisonous gases, liquids or solids that have toxic effects on people, animals, or plants. Many chemical agents can cause serious injuries or death. In this case, severity of injuries depends on the type and amount of the chemical agent used and the duration of exposure.

Biological terrorist incidents have a somewhat low probability of occurring in Jefferson County. These incidents include the release of diseases such as smallpox into the general population for destructive purposes. Biological events have an extremely high risk associated with them, as the effects of such an event can exceed the capabilities of the healthcare facilities located in Jefferson County and the loss of human life can be disastrous. While preparedness is improving, Jefferson County is not equipped on the local level to cope with a large-scale terrorist incident.

Chemical terrorist incidents are comparable to biological incidents in that they have a relatively low probability of occurring, yet are associated with an extremely high risk. Chemical incidents include the use of weapons that subject the general population to toxic chemicals similar to those that could be released during a hazardous materials incident. Chemical incidents are capable of subsequent losses to large percentages of the population. Jefferson County does contain public water systems, which makes the threat of small-scale biological and chemical attacks plausible.

An active shooter, as defined by the FBI, is an individual actively engaged in killing or attempting to kill people in a confined area (FBI, 2022b). In most cases, active shooters use firearms and there is no pattern or method to their selection of victims. No substantive research has yet been compiled to address the potential vulnerability to an active shooter incident. Some of these incidents have occurred in public places, and some in places that are considered more restricted like schools. There is no discernible pattern to the location chosen by the shooters.

Events involving explosive Weapons of Mass Destruction (WMDs) also have a relatively low probability of occurring in Jefferson County. However, in the event that a nuclear or other large explosive device was to discharge in or near the county, the inherent loss of life could be catastrophic. A WMD threat is ever present and the reduction of such threat is dependent upon the actions of other countries, which are unpredictable. As long as there are weapons, and the capability to deliver those weapons, the threat will remain. The Department of Defense estimates that as many as 26 nations may possess chemical agents and/or weapons and an additional 12 may be seeking to develop them.

Railroad facilities are another example of potential terrorist targets. Dams and water and sewage treatment facilities are likewise potential targets. Facilities in neighboring counties may also be susceptible to WMD-type attacks and may affect Jefferson County indirectly.

There are also several SARA Title III facilities and a few major transportation routes that traverse the region; making intentional hazardous material releases a potential threat to citizens and the environment. This hazard is addressed in Section 3.3.18. Critical facilities including police stations, hospitals, fire stations, schools, wastewater treatment plants, and water supply facilities, may be potential terrorist targets.

A terrorism event can cause public fear regarding the use of mass transportation or leaving their homes in the event of a biological or nuclear attack. Communication systems, both public and private, can fail because of an overwhelming amount of usage or damage to its infrastructure. Healthcare facilities can become quickly inundated and must be prepared to triage injured patients, handle mass casualties, and conduct decontamination operations.

The secondary hazards resulting from a terrorist attack depend on the size and scope of the incident. Some possible secondary hazards include widespread utility failure, health effects such as epidemics or pandemics, flooding (if a dam was destroyed), and environmental contamination. Also of concern is the disruption an attack may cause to the State's government facilities.

4.4.15.3. Past Occurrence

Nathan Clark, 25, was arrested in Charles Town, West Virginia, on August 12, 2019, after someone alerted authorities to posts Clark allegedly made online threatening to kill people (Ta, 2019). Authorities were alerted after someone allegedly found threatening comments Clark made online saying he was going to kill people. After a thorough investigation, Clark was charged with making terroristic threats. During the investigation, several PVC pipes and pistols were also confiscated at Clark's home.

4.4.15.4. Future Occurrence

The probability of terrorism occurring cannot be quantified with as great a level of accuracy as that of many natural hazards. Furthermore, these incidents generally occur at a specific location, such as a government building, rather than encompassing an area such as a floodplain. Thus, planning should be asset-specific, identifying potentially at-risk critical facilities and systems in the community. Once a comprehensive list of critical assets has been developed, it should be prioritized so that efforts can be directed to protect the most important assets first. Then, beginning with the highest-priority assets, the vulnerabilities of each facility or system to each type of hazard should be assessed.

For the purpose of developing a realistic prioritization of terrorism hazard mitigation projects, three elements should be considered in concert:

- Relative importance of the various facilities and systems in the asset inventory
- Vulnerabilities of those facilities
- Threats that are known to exist

Critical assets and infrastructures are systems whose incapacity or destruction would have a debilitating effect on the county:

- Emergency services
- Government services
- Water supply systems
- Transportation networks
- Telecommunications infrastructure
- Electrical power systems
- Gas and oil facilities

The Cabinet Secretary of the Department of Homeland Security serves as the Homeland Security Advisor (HSA) for West Virginia. The HSA is responsible for coordinating, designing, and implementing West Virginia's program for homeland security. As HSA, the secretary is the principal point of contact between the State of West Virginia and the federal government with respect to homeland security issues. The HSA keeps the governor advised of all homeland security matters and is the main point of contact for the governor on these issues.

Within the Department of Homeland Security resides the State Administrative Agency (SSA). Its primary responsibility is planning and implementation of measures in direct support of homeland security; federally, regionally and locally. The SAA provides guidance, direction and coordination in mobilizing, organizing, and preparing the State of West Virginia for acts of terrorism and man-made or natural disasters. The SAA develops and coordinates the implementation of a comprehensive state strategy and performs the functions necessary to carry out the mission.

4.4.15.5. Vulnerability Assessment

Since the probability of terrorism occurring cannot be quantified in the same way as that of many natural hazards, it is not possible to assess vulnerability in terms of likelihood of occurrence. Instead, vulnerability is assessed in terms of specific assets. By identifying potentially at-risk terrorist targets in a community, planning efforts can be put in place to reduce the risk of attack. All communities in Jefferson County are vulnerable on some level, directly or indirectly, to a terrorist attack. However, communities where specific potential targets are located should be considered more vulnerable. FEMA's Integrating Manmade Hazards into Mitigation Planning (2003) encourages site-specific assessments that should be based on the relative importance of a particular site to the surrounding community or population, threats that are known to exist and vulnerabilities including:

Inherent Vulnerability

- Visibility – How aware is the public of the existence of the facility?
- Utility – How valuable might the place be in meeting the objectives of a potential terrorist?

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

Tactical Vulnerability

Site Perimeter

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

Building Envelope

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

Facility Interior

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

Community Lifelines and Critical Facilities

All community lifelines and critical facilities are vulnerable to terrorism.

Socially Vulnerable and Total Populations

Because the entire population of Jefferson County is exposed and vulnerable to terrorism, the exposed population in socially vulnerable communities is equal to the statewide population. A survey found that persons with disabilities were more anxious about their personal risk from terrorism than were persons without disabilities, even when equally prepared. Another study reported that persons who increased their disaster preparations in response to the possibility of terrorist attacks included African Americans, Latinos, persons with disabilities or household dependents, and non–US-born populations (Eisenman, et al. 2009).

General Building Stock

All general building stock is vulnerable to terrorism.

Environmental Resources

Terrorism and targeted violence has the potential for harmful effects not only on economic and social life but also on the environment, particularly if such incidents impacts certain critical infrastructure such as water/wastewater, dams, or other systems that result in physical implications for the environment in which they reside. The environmental damage caused by terrorism includes but is not limited to terrestrial conflicts, terrorist camps and bases, training activities, and carbon dioxide emissions related to energy consumption (Bildirici and Gokmenoglu 2020).

Cultural Assets

All cultural assets are vulnerable to terrorism.

FUTURE CHANGES THAT MAY IMPACT STATE VULNERABILITY

Understanding future changes that impact vulnerability in the county can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The county considered the following factors to examine potential conditions that may affect hazard vulnerability:

- Change in the nature of terrorism/targeted violence threat actors of concern
- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate.

4.4.16. New Hazard - Cyber Security

Cyber terrorism is a broad term that refers to acts associated with the convergence of terrorism and cyberspace. Generally, cyber terrorism involves unlawful attacks or threats against computers, networks, and the information stored therein to intimidate or coerce a government or its people to achieve political or social objectives (Denning, 2000). These acts can range from taking control of a host website, to using networked resources to directly cause destruction and harm.

The Cyber Security and Infrastructure Security Agency web page maintains that cyber-attacks can come in many forms. Malware, Phishing, and Ransomware are becoming increasingly common forms of attack and can affect individuals and large organizations. Malware is any software used to gain unauthorized access to IT systems in order to steal data, disrupt system services or damage IT networks in any way. Ransomware is a type of malware identified by specified data or systems being held captive by attackers until a form of payment or ransom is provided. Phishing is online scam enticing users to share private information using deceitful or misleading tactics. CISA offers a variety of tools and resources that individuals and organizations can use to protect themselves from all types of cyber-attacks.

CISA is constantly monitoring cyberspace for new forms of malware, phishing, and ransomware. Offer numerous tools, resources, and services to help identify and protect against cyber-attacks. CISA also collaborates with governments at all levels as well as internationally and private sector entities to share information and collaborate in securing our networks on national and global scales. Defending against cyber-attacks requires coordination across many facets of our nation, and it is CISA's mission to ensure we are armed against and prepared to respond to ever-evolving threats.

4.4.16.1. Location and Extent

Cyber-attacks may not always constitute acts of cyber terrorism because some acts may have relatively small impacts and only produce annoyances. A cyber-attack is generally considered an act of cyber terrorism when the following motivations are present:

- **Effects-based:** When computer attacks result in effects that are disruptive enough to generate fear comparable to a traditional act of terrorism.
- **Intent-based:** When unlawful or politically motivated computer attacks are done to intimidate or coerce a government or people to further a political objective, or to cause grave harm or severe economic damage (Rollins and Wilson, 2007).

Cyber-attacks can be further divided into the following categories based on the complexity of the attack:

- **Simple-Unstructured:** Simple-unstructured attacks are the most common. These are amateurish attacks with relatively minimal consequences.

- **Advanced-Structured:** Advanced-structured attacks are more sophisticated and consequential and have a greater emphasis on targeting victims prior to an attack, resulting in a more debilitating effect.
- **Complex-Coordinated**: Complex-coordinated attacks are the most advanced and most troublesome type of attacks where success could mean a network shutdown (Denning, 2000).

Cyber terrorism can cause severe disruptions to transportation, public safety, and utility services, all of which are critical infrastructure that are highly dependent on information technology. Cyber terrorism can take many forms, including attacks through physical means, electronic means, and use of malicious code. Cyber terrorists can also have a wide range of personal, political, or cultural agendas. All state agencies, as well as individuals, businesses, and other institutions in the region, are potential targets for cyber terrorism. Potential threats include identity theft, loss of sensitive information, disruption of services, and other malicious activity.

Cyber terrorists can be difficult to identify because the internet provides a meeting place for individuals from various parts of the world. Individuals or groups planning a cyber-attack are not organized in a traditional manner, as they are able to effectively communicate over long distances without delay. Cyber-attacks are also unpredictable and typically occur without warning.

4.4.16.2. Past Occurrences

During the COVID-19 Pandemic of 2020-2021, more than 50,000 West Virginians received attempted unemployment scam in their mail or email. Scott Adkins, acting commissioner with Workforce West Virginia, said they received more than 50,000 fraudulent claims based around the Pandemic Unemployment Assistance (PUA) program (WSAZ 3, 2020). Many attacks seemed to stem from credit bureau data breaches that exposed personally identifying details, and public officials sought to shore up government defenses to avoid agencies falling to such a breach themselves. This led to the creation and signing by Governor Jim Justice of the Creating WV Cyber Incident Reporting Bill. The legislation is designed to lay the groundwork for tightening up cyber defenses and enable faster response to threats by helping state officials better understand the scope of problems impacting various agencies, learn about attacks soon after they happen, and regularly review defense strategies (Patterson-Gordon, 2021).

On May 7, 2021, the Colonial Pipeline suffered a ransomware attack that impacted equipment managing the pipeline. In response, the Colonial Pipeline Company halted all the pipeline's operations. This caused gas shortages across the east coast, with some (limited) effects in West Virginia. This was the largest cyberattack on an oil infrastructure target in the history of the United States.

Another large-scale attack was the Equifax data breach in 2017, which was estimated to potentially impact over 700,000 residents of West Virginia and over 145.5 million nationally. The information accessed included names, Social Security numbers, birthdates, addresses, and driver's license numbers (WHSV, 2019). Additionally, in 2014 the largest data breach in history impacted over 3 billion Yahoo user accounts,

including the names, email address, date of birth, and telephone numbers of over 500 million users (CSO, 2018). In terms of a data breach cyber-attack, this could be considered a worst-case scenario event. Large-scale data breach events are becoming more common.

Locally, the Jefferson County Commission experienced a cybersecurity event in December 2022. The Jefferson County Department of Information Technology took immediate action to isolate the impacted system, execute the department's cybersecurity protection protocols, and restrict any further unauthorized activity.

Per West Virginia State Code, this incident was reported to the WVOT in addition to the relevant federal and state law enforcement authorities for further investigation. No personal information was compromised, and Jefferson County residents experienced no disruption of County services.

In addition to large-scale acts of cyber terrorism, smaller cyber-attacks occur daily. Billions of emails are sent each day, and spam and phishing emails account for a significant share of all email traffic. Additionally, brute force attacks, which are trial and error attempts to obtain user passwords and pins, are frequently used by criminals attempting to crack encrypted data or gain access to private accounts. Firewalls can be effective at keeping security threats such as these out, but once a cybercriminal gains access to a system, they can attack from within. For example, gaining access to a state employees email account would allow a hacker to send additional phishing emails from within a network, which may not be as monitored as closely as attacks from outside the system. This is known as spear phishing.

4.4.16.3. Future Occurrences

Cyber terrorism is an emerging hazard that has the potential to impact the region's computer infrastructure and the systems and services that are provided to the public. Concerns about cyber terrorism throughout the United States are growing as its impacts could have potentially crippling effects. Security experts describe the threat of cyber terrorism as imminent.

West Virginia Office of Technology website details mitigation tactics that individuals and business owners can take to prevent breaches in cybersecurity, including daily cybersecurity tips and presentations (WV Office of Technology, 2021).

4.4.16.4. Range of Magnitude

In recent years, cyber terrorism has become a significant threat and can impact people, businesses, institutions, local governments, and state agencies to varying degrees. Impacts from a large-scale cyber terrorism event could disrupt the state's economy and potentially threaten its economic stability. The magnitude of a cyber terrorism attack will vary greatly based on the extent of systems affected and duration of the impact. Additionally, the magnitude will vary based upon which specific system is affected by an attack, the ability to preempt an attack, and an attack's effect on continuity of operations. The largest threat to institutions from cyber terrorism comes from any processes that are networked and

controlled via computer. The county and individual municipalities should address and take measures to reduce any vulnerabilities that could allow access to sensitive data or processes.

The West Virginia Office of Technology (WVOT) developed Executive Branch security standards, policies, and procedures for use by Executive Branch agencies, as well as to provide best practices guidelines for all other State and local organizations. With these policies in hand, agencies, with the assistance of the WVOT, develop their own procedures as needed. In addition, supplemental documents covering topics that are not included in the umbrella documents, or those that treat the same matters more stringently, are acceptable.

Under WVOT the West Virginia Cyber Security Office is charged with enhancing the overall information security posture of the Executive Branch of West Virginia State Government. The mission of the CSO is to support the goals of the State by assuring the availability, integrity, and appropriate confidentiality of information. Primary objectives include the development and implementation of proactive measures to prevent security problems, as well as an effective response to security incidents when those prevention methods are defeated. The CSO encompasses three main categories: information security management, risk management, and incident handling.

Goals

- Maintain compliance with legal regulatory requirements
- Implement practical measures to protect the State's data and systems from compromise
- Adopt best practices in order to safeguard all forms of information

WVOT And the Cyber Security Office is charged with a series of activities:

Technology Audits

Audit efforts are focused on areas presenting the highest degree of risk, and where risk mitigation will provide the greatest potential benefit to the Executive Branch. The Audit Program also reviews internal controls within the WVOT operations and will conduct audits of selected 3rd party providers at their off-site locations.

Technology Policies

The WVOT has created a general security policy, and other security-related policies and procedures, for the Executive Branch of West Virginia government. Agencies may establish more stringent policy supplements, but duplication of content should be avoided. Each agency developing a security policy supplement must submit it to the WVOT for review/approval.

Information Security Training

The State of West Virginia utilizes a learning management system to deploy required, security and privacy

training to all employees of the Executive Branch. Electronic security tips and awareness videos are released on a regular basis.

Security Operations Center (SOC)

- Traffic analysis, event correlation
- Threat analysis and alerts
- Vulnerability scanning of state network
- Web activity monitoring and site blocking
- Network violation management
- Support OISC Audit program

Computer Security Incident Response Team (CSIRT)

Maintains policies and procedures for incidents, maintain central point of contact for reporting incidents, and complete professional digital forensic investigations.

4.4.17. Vulnerability Assessment

4.4.17.1. People

All communities in Jefferson County are vulnerable on some level, directly or indirectly, to a cyber terrorism attack. However, in general, areas with higher concentrations of government or industry facilities may have higher risk.

4.4.17.2. Structures

All county and municipal facilities are vulnerable to cyber terrorism. While the physical structures of these buildings are generally not at risk, information systems and data stored within them are vulnerable. Government computer networks contain sensitive information that is integral to the security of the State and could be the target of a cyber-attack.

4.4.17.3. Systems

County and municipal governments possess and maintain resident personal and financial information, including tax filings, birth and death records, Social Security numbers, medical information, and more. Additionally, many critical facilities that are essential to Jefferson County's operations are reliant upon computer networks to monitor and control critical functions. For example, an attack on internet access or the power grid could have detrimental impacts on county services and functions. Additionally, a large-scale computer breach could lead to economic costs in lost productivity to the impacted agency/organization and potentially related businesses and industries. However, lost revenues and productivity would depend on the type of magnitude of the cyber terrorism event.

4.4.17.4. Resources and Community Activities

Generally, cyber terrorism has no direct effect on the environment; however, the environment may be affected if a hazardous materials release occurred because of critical infrastructure failure as a result of cyber terrorism. Similarly, an act of cyber terrorism on a nuclear facility could have devastating environmental consequences if the plant suffered an intentional catastrophic failure.

West Virginia is among the top 10 states nationwide to offer foundational computer science courses to public school students. West Virginia is a pioneer in creating a computer science K-12 pathway for all students. Governor Jim Justice signed Senate Bill 267 in 2019, which charged the WVDE with reaching all public-school students with computer science. This law makes the Mountain State one of the first to require all students to start their computer science education in elementary school and be exposed to a variety of computer science experiences throughout their K-12 career.

Local events:
https://www.dcnewsnow.com/news/local-news/west-virginia/jefferson-county-contracts-for-cyber-security-monitoring/

4.4.18. New Hazard - Utility Interruption

4.4.18.1. Location and Extent

Table 4-55: Major Utility Companies in Jefferson County

Company Name	Type of Utility
First Energy, Potomac Edison	Electricity
Mountaineer Gas Company	Natural Gas
AmeriGas Propane	Propane Gas
Roach Energy	
ThompsonGas – Bel Air& Huntfield	
Blossman Gas	
Shawley's LP Gas	
Suburban Propane	
Verizon	Telecom
Frontier Communications	
Xfinity - Comcast Cable	

Source: JCHSEM, 2023

Utility interruptions include any impairment of the functioning of telecommunication, gas, electricity, water, or waste networks. Interruptions or outages occur because of geomagnetic storms, fuel or resources shortage, electromagnetic pulses, information technology failures, transmission facility or linear utility accident, and major energy, power, or utility failure. The focus of utility interruptions as a hazard

lies in fuel, energy, or utility failure. These kinds of interruptions rarely spontaneously occur on their own; this hazard is often secondary to other natural hazard events, particularly transportation crashes and incidents, lightning strikes, extreme heat or cold events, and coastal and winter storms. The causes for outages are usually downed power wires or utility poles as a result of inclement weather or vehicle incidents. Additionally, outages can be caused by blown transformers or tripped circuit breakers. Most often, there is no cause reported and power is restored within the hour.

Utility interruptions in Jefferson County occur regularly but are usually small-scale, localized incidents. Utility interruptions are possible anywhere there is utility service lists the major utility companies in the region. Utility interruptions and power failures can take place throughout the region.

According to the 2021 5-year American Community Survey, in Jefferson County, 72.0 percent of housing units use electricity as their heat source, followed by 11.1 percent of homes using propane gas for heat (US Census Bureau, 2021). As a result, an interruption in any of those utilities could affect a significant number of residents. In addition, an increasing reliance on internet access and telecommunications could also impact many residents at any given time.

4.4.18.2. Past Occurrence

According to the State of West Virginia 2023 Hazard Mitigation Plan, Section 5.14 Utility Failure, between 2010 and 2022, a total of 12 utility failure events occurred across the state. These failures were due to various hazard events including thunderstorm wind, blizzards, high wind, extreme cold, flash flood, flood, and winter storm.

Jefferson County has a hazard history of utility interruptions as shown on Table 4-56. The table shows a sample of power outage events in the area reported in the National Centers for Environmental Information. It is not a comprehensive list, but it does represent the impact of recent utility interruptions.

Table 4-56: Recent Utility Interruptions in Jefferson County (2015-July 2023)

Date	Cause	Location	Narrative
7/5/2017	Tornado	Charles Town	The National Weather Service in Baltimore MD/Washington DC confirmed a weak tornado near Charles Town in Jefferson County WV on July 05 2017. Debris from the roof of one barn was thrown into power lines, snapping a telephone pole. Projectile impacts were also noted in nearby barn roofs from two- by-four pieces of wood that were lofted by the tornado
6/29/2019	Thunderstorm Wind	Charles Town	A tree was blown down near the intersection of Oak Lee Drive and Jack Rabbit Lane. Power lines were also blown down in the 1500 block of Flowing Springs Road.
7/6/2020	Thunderstorm Wind	Charles Town	Numerous trees and power lines were blown down in Shenandoah Junction, mainly along Daniels Road and Shenandoah Junction Road. Some trees were snapped.
7/6/2020	Thunderstorm Wind	Bolivar/Harpers Ferry	Multiple trees and power lines blew down in the Harpers Ferry area.

Table 4-56: Recent Utility Interruptions in Jefferson County (2015-July 2023)			
Date	**Cause**	**Location**	**Narrative**
9/3/2020	Thunderstorm Wind	Kearneysville	A tree blew down onto power lines near the intersection of WV-480 Kearneysville Pike/Duke Street and WV-48/1 Persimmon Lane.
5/3/2021	Tornado	Charles Town	No Data Available
5/26/2021	Thunderstorm Wind	Charles Town	A dozen power poles blew down on Middleway Pike just west of Charles Town. A tree and wires blew down on 4th Street in Charles Town. Two trees blew down on East Washington Street in Charles Town.
8/13/2021	Thunderstorm Wind	Bardane	A power pole snapped as the result of a falling tree near the intersection of Charles Town Road and East Burr Boulevard.
7/15/2023	Thunderstorm Wind	Ranson	An isolated line of thunderstorms Friday evening in Jefferson County caused widespread damage and a host of problems for residents and emergency responders. The calls were for downed trees, live powerlines, and five separate structure fires. Calls came for a transformer fire in Ranson.

Source: National Centers for Environmental Information, July 2023; MetroNews

4.4.18.3. Future Occurrence

Utility interruptions will continue to occur annually with minimal impact. Widespread utility interruption events usually occur approximately once every five years, usually as a secondary effect of an extreme weather event. These interruptions should be anticipated, and first responders should be prepared during severe weather events. Research by the National Oceanic and Atmospheric Administration (NOAA) suggests that climate change may cause more extreme storms in West Virginia (Climate.gov, 2016).

Power outages can be expected at any time of year, on a nearly monthly basis. Iced power lines; falling tree limbs due to ice, wind, or lightning strikes; and vehicle incidents damaging power lines, or their support poles can all be reasons for power outages.

The region around Jefferson County is expected to see large increases in precipitation and numbers of very hot and very cold days (Climate Central, 2022). These factors can increase the occurrence of hazards such as flooding, hurricanes and tropical storms, landslides, tornados and windstorms, wildfires, and winter storms. Impacts from any of these hazards can lead to utility interruption on a range of scales. Overall, the probability of future utility outages impacting the region can be considered possible according to the Risk Factor Methodology.

Aging infrastructure also brings risk in the form of potential utility interruptions, particularly for places like Jefferson County with aging infrastructure. In many utility systems, significant portions of the equipment and facilities date from the growth periods of the 1950s and 1960s that followed World War II. As this equipment ages, it deteriorates from the constant wear and tear of service. Eventually the equipment reaches a point at which it will either fail on its own or because of outside forces (storms, loads it was designed to handle but no longer can, etc.). These failures cause service interruptions and can require

expensive emergency repairs. In addition, as repairs have taken place along transmission routes, there is often a mix of new and old equipment along the line, as repair and not replacement is generally the choice made to resolve an issue.

The wholesale replacement of a system is not a feasible solution for utility companies. This would require the interruption of services while the replacement occurs, as well as accessing the existing system (which may lie under roads, private property, or other inconvenient places). Utility companies face the challenge of managing the issue of the aging infrastructure. They are tasked with reducing the effects of aging equipment while also controlling the deterioration of the existing system as much as possible. This balance will be tenuous as transmission equipment continues to age and break down. These breakdowns will likely lead to more frequent utility disruptions as time goes by.

4.4.18.4. Range of Magnitude

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

The severity of a utility interruption can be compounded with extreme weather events, especially winter weather events. Interruptions can also be more severe for special needs populations that are dependent on electronic medical equipment. Utility interruptions can significantly hamper first responders in their efforts to provide aid in a compound disaster situation, especially with losses of telecommunications and wireless capabilities. Telecommunications interruptions will also hinder first responders' efforts. Additionally, an internet outage could be crippling to the economy, as many companies and government entities process payments and invoices electronically rather than with cash or physical checks.

In a possible worst-case scenario for Jefferson County, a winter storm event could cause widespread power outages, leaving citizens without heat in the midst of subzero temperatures for several days. The power outage would also put elderly populations or others at risk of health problems due to the lack of heat and the inability to call for assistance or leave their homes. Power lines could also be difficult to repair depending on the magnitude of the storm. A power outage during the summer could also have serious consequences for much the same reason. During the summer the temperatures in Jefferson County can occasionally exceed 100°F, and with no air conditioning this can put elderly and other vulnerable populations in danger of dehydration, heat exhaustion, or heat stroke.

4.4.18.5. Vulnerability Assessment

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

4.4.18.6. People

All of Jefferson County and its municipalities are exposed to utility failure. Residents might be displaced or require temporary to long-term sheltering due to interruptions to their daily lives as a result of utility failure. Loss of utilities to support access to heating, cooling, and potable water can result in increased health impacts. The population adversely affected by utility failure may also include those beyond the disaster area that rely on communication lines or water lines that run through the state.

According to the State of West Virginia 2023 Hazard Mitigation Plan, socially vulnerable populations may be impacted at a disproportionately higher rate than the rest of the population. Individuals that are socially vulnerable may have increased medical needs, which can be exacerbated due to overheating, heatstroke, or hyperthermia. Power failure leading to loss of heating and cooling in homes could exacerbate these health risks. Additionally, socially vulnerable individuals dependent upon electric-powered medical equipment could face severe impacts, including loss of life. Economically disadvantaged residents are at high risk for bracing intense cold and hot conditions because of the potential inability to afford backup generators, which may pose health issues, such as hypothermia or heat stroke (WV State HMP, 2023).

Figure 4-45: Transformer Fire in Jefferson County 7/15/23 (MetroNews, 2023)

4.4.18.7. Structures

Emergency medical facilities, including retirement homes and senior centers are particularly vulnerable to power outages. While back-up power generators are often used at these facilities, loss of electricity may result in hot or cold temperatures for which elderly populations are particularly vulnerable. Conservation and improved technology have resulted in more efficient use of energy sources. The increasing use of alternative fuel supplies, such as kerosene heaters, wood burning stoves, coal burners, etc., has also decreased our vulnerability to future shortages. However, severe weather extremes, accidents, labor strikes, terrorism, or nationwide shortages could cause significant energy shortage problems. Emergency management officials can reduce vulnerability to utility interruption through training and exercises, such as the "Dark Grid" exercise, which prepares emergency responders and community leaders for a coordinated response to widespread utility interruptions.

In addition, all critical facilities are vulnerable to utility interruptions, especially the loss of power. The establishment of reliable backup power at these facilities is extremely important to continue to provide for the health, safety, and well-being of Jefferson County and its citizens.

4.4.18.8. Systems

The region is also well known to have many areas with limited cellular and broadband access. Areas of concern are the rural portions of Jefferson County. The West Virginia Broadband Council provides Broadband Mapping Data and Resources (WV Broadband Enhancement Council, 2021). The West Virginia Broadband Enhancement Council was established in code during the 2017 Regular Legislative Session with the passage of House Bill 3093 and signed into law by Governor Jim Justice. The Code sets the many directives for the Council with the primary emphasis being on the development of broadband infrastructure in unserved and underserved areas of the State (WV Broadband Enhancement Council, 2021). Stakeholders and community members have noted concern about broadband and cellular interruption in receiving and sending emergency communications.

Since implementing an enhanced vegetation management program in 2014, Potomac Edison infrastructure has experienced significantly fewer tree-related outages in areas where tree trimming has been conducted to the new standards. The company services 1,550 miles of lines in its territory in the Eastern Panhandle. In 2020, the company saw a 45 percent reduction in tree-related outages compared to 2019, and the amount of time customers experienced service interruptions due to trees dropped by 75 percent. According to a PR Newswire article, to help minimize the impact of tree-related damages during severe weather, Mon Power, and Potomac Edison's tree contractors plan to clear vegetation along approximately 6,800 miles of power lines in 2023 to help enhance electric service reliability for West Virginia customers. They have already completed that work along more than 2,400 miles of power lines this spring (PRNewsWire, 2023). Actions like this can be taken by utility providers to reduce an area's utility interruption vulnerability.

4.4.18.9. Historic Resources & Community Activities

All of the building stock, including historic structures, are exposed to utility interruptions. Impacts sustained from these interruptions are likely to be secondary impacts. Should water distribution be reduced or not available, then structures could be at increased risk for structural fire since current fire suppression is dependent on accessing water supply from hydrants. Interruption of utility gas or water distribution could also reduce the effectiveness of facilities to operate at full capacity.

As previously mentioned, utility interruptions are secondary impacts. Therefore, community activities impacted by natural hazard events, there is a high possibility of utility interruption. While a slight disruption to events may occur as a result of utility interruptions in the region, long term disruptions or event cancelations are not anticipated from this hazard, based on past occurrences.

4.5. Hazard Vulnerability Summary

4.5.1. Methodology

Ranking hazards helps communities set goals and priorities for mitigation based on their vulnerabilities. A risk factor (RF) is a tool used to measure the degree of risk for identified hazards in a particular planning area. The RF can also assist local community officials in ranking and prioritizing hazards that pose the most significant threat to a planning area based on a variety of factors deemed important by the planning team and other stakeholders involved in the hazard mitigation planning process. The RF system relies mainly on historical data, local knowledge, general consensus from the planning team, and information collected through development of the hazard profiles included in Section 3. The RF approach produces numerical values that allow identified hazards to be ranked against one another; the higher the RF value, the greater the hazard risk.

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

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

Table 4-57 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 4-57: 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**	

Table 4-57: Summary of Risk Factor approach used to rank hazard risk				
Risk Assessment Category	**Degree of Risk**			**Weight Value**
	Level	**Criteria**	**Index**	
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**	

4.5.2. Ranking Result

Table 4-57 lists the Risk Factor calculated for each of the 18 hazards identified in the 2023 plan. Hazards identified as high risk have risk factors of 2.5. or greater. Risk Factors ranging from 2.1 to 2.4 were deemed moderate risk hazards. Hazards with Risk Factors 2.0 and less are considered low risk. Based on the results, there are 3 high risk hazards, 9 moderate risk hazards and 6 low risk hazards in Jefferson County.

Table 4-58: Jefferson County Ranking of Hazard Types Based on Risk Factor Methodology							
Risk Class	Hazard	Risk Assessment Category (1 = least severe, 4 = most severe)					Calculated Risk Factor
		Probability	Severity	Spatial Extent	Warning Time	Duration	
High	Public Health Crisis	2.2	2.5	3.3	1.5	3.1	2.5
	Cyber Terrorism	2.1	2.5	2.5	4.0	3.1	2.6
	Utility Interruption	2.1	2.3	2.7	3.8	2.7	2.5
Moderate	Drought	2.1	2.0	2.9	1.1	3.5	2.3
	Extreme Temperatures	2.3	1.9	3.3	1.5	3.1	2.4
	Flood	2.4	2.3	2.2	2.3	2.7	2.3
	Severe Thunderstorm & Hail	2.7	1.8	2.7	2.9	1.2	2.3
	Severe Winter Storm	2.2	2.1	3.3	1.7	2.7	2.4
	Wild & Urban Fires	1.7	2.3	2.1	3.5	2.2	2.2
	Hazardous Materials	1.9	2.4	2.0	4.0	2.5	2.3
	Terrorism	1.4	2.6	1.9	4.0	2.3	2.2
Low	Earthquake	1.0	1.8	2.1	3.6	1.1	1.7
	Invasive Species	2.0	1.3	2.1	1.5	3.5	1.9
	Landslide & Subsidence	1.9	2.1	1.8	3.3	2.1	2.1
	Severe Wind and Tornado	1.9	2.0	2.5	2.7	1.1	2.0
	Dam Failure	1.4	1.9	1.7	3.3	2.1	1.9
	Civil Disturbance	1.7	1.9	1.7	3.5	1.4	1.9

4.5.3. Potential Loss Estimates

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

Potential loss estimates have four basic components, including:

- **Replacement Value:** Current cost of returning an asset to its pre-damaged condition, using present-day cost of labor and materials.
- **Content Loss:** Value of building's contents, typically measured as a percentage of the building replacement value.

- **Functional Loss:** The value of a building's use or function that would be lost if it were damaged or closed.
- **Displacement Cost**: The dollar amount required for relocation of the function (business or service) to another structure following a hazard event.

Loss estimates provided in this section fall into three broad categories: historical losses, current-condition losses, and predictive losses. Historical loss estimates come from three primary sources: the NCEI NOAA storm events database, the NFIP, and the USDA's Risk Management Agency annual crop indemnities dating from 1980-2021. Current condition losses come from geospatial analysis of the value of buildings identified as vulnerable. Finally, predictive losses were generated using HAZUS-MH. Historical losses do not consider any of the aforementioned components, but they do provide insight into what future losses might be. The current-condition losses consider replacement value as well as exposure value. Hazus modeling takes into account all four components and provides the most comprehensive description of potential losses. For more details on the Hazus methodology used and additional results reports, see Appendix E.

4.5.3.1. Historic Losses

Historical losses were able to be determined for drought, flooding, coastal storms (hurricanes/tropical storms/tropical depressions), tornadoes and windstorms, lightning, and winter storms from NCEI NOAA, USDA RMA, and the NFIP. While these historic losses give a glimpse of potential losses in hazard events, they are not reported for all events and should be considered a broad estimate. NCEI 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 damages; rather, it indicates that no damages were reported to NCEI.

Agriculture is a vital part of Jefferson County's economy, and agricultural production is highly vulnerable to natural hazard events. As previously mentioned, losses are available from the USDA Risk Management Agency (RMA). The RMA operates and manages the Federal Crop Insurance Corporation, which provides crop insurance to American farmers. While not all crops are insured through RMA, their records provide strong insight into agricultural losses nationwide and in Jefferson County. Table 4-59 illustrates the total amount of indemnities paid through RMA since 2010 in Jefferson County by type of crop failure. Only crop failures related to the hazards discussed in this plan are listed. There has been over $4.1 million in indemnity paid out due to crop losses between 2010 and 2023 in Jefferson County. The greatest amount of indemnity paid out was due to crop losses from drought, which accounts for about 60 percent of the losses, followed by losses due to Wildfire, which accounted for over 2 percent of the losses.

Table 4-59: Historic Insured Crop Losses, 2010-2023 (USDA RMA, 2023)	
Reason for Loss	**Indemnity Amount**
Cold Wet Weather	$11,339.00
Cold Winter	$1,408.00
Drought	$2,545,042.86
Excess Moisture/Precipitation/Rain	$434,919.20
Freeze	$39,028.50
Frost	$12,213.50
Hail	$42,215.46
Heat	$466,451.75
Insects	$97,772.00
Wildfire	$529,379.43
Other (Snow, Lightning, Etc.)	$8,943.00
Total	**$4,188,712.70**

The final set of historic losses relates solely to prior flood losses and comes from the NFIP's records of claims paid. Table 4-60 shows the total amount of claims paid in each municipality according to FEMA's Community Information System (CIS). There has been over $9.54 million paid to residents of Jefferson County.

Table 4-60: Jefferson County NFIP Policies and Claim Information				
Community	**Policies in Force**	**Total Coverage**	**Prior Claims**	**Total Amount of Paid Claims**
Jefferson County	26	$38,169	23	$207,392.56
Bolivar	0	$0	1	$7,409.13
Charles Town	43	$39,196	46	$648,055.71
Harpers Ferry	44	$59,710	42	$1,216,787.65
Ranson	19	$11,506	20	$54,045.1
Shepherdstown	36	$67,690	20	$238,575.5
Total	**168**	**$216,271.00**	**152**	**$2,372,265.65**

4.5.3.2. Current Condition Losses

The current condition losses were derived using the total assessed value, including land and building values, from the building inventory used in the Hazus analysis. Table 4-61 details the total assessed values by type of land. The 2022 West Virginia Statewide Risk Assessment estimates that approximately 734 buildings in Jefferson County are located within the 1% annual chance flood hazard area. The assessment estimates that the building dollar exposure to be approximately $118,388,409. The following tables summarize the HAZUS data.

Table 4-61: Building Dollar Exposure: Residential versus Non-Residential

Community	Residential		Commercial Non-Residential		Other Non-Residential		Total Building Value	
	#	Value ($)	#	Value ($)	#	Value ($)	#	Value ($)
Unincorporated	505	$60,022K	14	$4,889K	7	$5,349K	526	$70,260K
Bolivar	3	$251K	0	$0K	1	$4,000K	4	$4,251K
Charles Town	23	$2,073K	4	$7,893K	0	$0K	27	$9,966K
Harpers Ferry	6	$722K	25	$6,243K	0	$0K	31	$6,965K
Ranson	3	$251K	0	$0K	1	$4,000K	4	$4,251K
Shepherdstown	23	$2,073K	4	$7,893K	0	$0K	27	$9,966K
Total	**654**	**$76,146K**	**67**	**$27,999K**	**13**	**$14,243K**	**734**	**$118,388K**

Source: Region 9 Tabular Community-Level Report Link: data.wvgis.wvu.edu - /pub/RA/State/CL/Community_Asset/

4.5.3.3. Predicted Losses

This plan employed a Hazus analysis for floods. For details on the Hazus methodology used and additional results reports, see Appendix E. Within the online interface, the user can toggle on the Building Exposure Cost risk map, to determine high general occupancy class and building exposure cost of each mapped structure.

4.5.3.4. 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. Jefferson County is expected to experience a variety of factors that will, in some areas, increase vulnerability to hazards while in other areas, vulnerability may be reduced. Jefferson County's population continues to grow primarily due to the county's proximity to the Washington D.C. Metro Area.

Many of the towns in the county are considered bedroom communities for the greater Washington, D.C. area.

Population change is perhaps the most significant indicator of changes in vulnerability in the future. As discussed in Section 1.3, the total population in the region is expected to increase. However, these changes are not equally distributed across Jefferson County either. Figure 2.4-1 demonstrates where Jefferson County anticipates and is encouraging future growth within the county. 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.

Population projections are useful in determining if a given area's population trends will continue. The State of West Virginia produces County population projections to aid county comprehensive planning. Projections developed for the region are shown in Table 4-62.

Roughly 17.3% percent of Jefferson County's population is over the age of 65. Older residents pose unique challenges when it comes to evacuation and/or mobility during the rescue and recovery processes that typically occur in the case of a hazard event. Officials may consider partnering with human services organizations to specifically plan for this vulnerable population.

Table 4-62: Population Projections to 2035 (State of West Virginia, 2015)

Data	Jefferson County
	Forecasted Population
2015	56,568
2020	59,552
2025	62,463
2030	65,144
2035	68,245

The rural nature of Jefferson County impacts vulnerability because remote and sparsely populated regions also face higher vulnerability to certain hazards because they may not have as easy access to care facilities or response personnel. For example, tele-communications services (high-speed internet cell phone, and 9-1-1), are sparse and non-existent in some parts of Jefferson County. These individuals may miss out on critical hazard information and warnings, as well as be unable to call for help. For instance, the less

populated municipalities face increased vulnerability to winter storms due to isolation, access issues, and longer emergency response times.

Jefferson County also has a Subdivision and Land Development Ordinance, and zoning ordinances for different areas. The Subdivision and land development ordinances (SALDOs) are intended to regulate the development of housing, commercial, industrial or other uses, including associated public infrastructure, as land is subdivided into buildable lots for sale or future development. Within these ordinances, guidelines on how land will be divided, the placement and size of roads and the location of infrastructure can reduce exposure of development to hazard events. Zoning ordinances allow for local communities to regulate the use of land in order to protect the interests and safety of the general public. Zoning ordinances can address unique conditions or concerns within a given community. They may be used to create buffers between structures and high-risk areas, limit the type or density of development and/or require land development to consider specific hazard vulnerabilities. These ordinances are detailed in the Capability Assessment Section (4.2).

In 2018 the Hagerstown/Eastern Panhandle Metropolitan Planning Organization (HEPMPO) completed a Long-Range Transportation Plan Update (LRTP). The current LRTP was adopted April 11, 2018 (HEMPO, 2018). The integration of both plans will influence future development in the region and its concentrated plan for growth. Concentrating growth may help to reduce isolation-based vulnerability of communities with few access routes, no municipal water supply, and low cell phone reception. On the other hand, higher densities mean that more people are likely to be impacted in a hazard event should it strike those more populated areas.

Jefferson County also has stormwater management ordinance that focuses on encouraging best management practices that help enforce environmentally sensitive development and encourage development that will limit runoff. Encouraging better development practices in relation to stormwater management could help make communities less vulnerable to the impacts of flooding. Through administration of floodplain ordinances, municipalities can ensure that all new construction or substantial improvements to existing structures located in the floodplain are flood-proofed, dry-proofed, or built above anticipated flood elevations. Floodplain ordinances may also prohibit development in certain areas altogether. The National Flood Insurance Program (NFIP) establishes minimum ordinance requirements which must be met in order for that community to participate in the program. However, a community is permitted and encouraged to adopt standards which exceed NFIP requirements.

There is one significant development change in the region that has occurred in the last five years and is expected to continue – construction of warehouses and industrial parks. This development is expected to be one of the most influential variables in the region's future vulnerability and risk.

The expansion of industrial parks can have cumulative and longer-lasting environmental impacts, some of which aren't fully known. As discussed in Section 2.4, this development is converting large amounts of land to impervious surface within the past five years. This significant amount of development affects

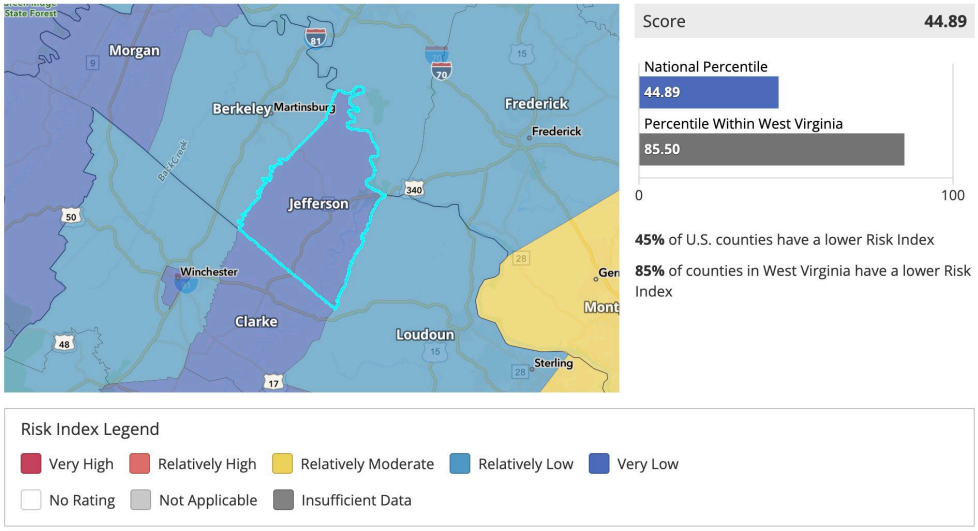
flooding, transportation, hazardous waste spills, as well as water supply, and other environmental concerns.

When planning for future development, there are several measures the region could take to help mitigate the impacts of industrial parks on transportation infrastructure and impervious surfaces. If continued investment and development in the warehousing industry is inevitable, then how the counties regulate new park locations and the industry as whole will become important in shaping Jefferson County's future vulnerabilities and risk, greater care and oversight could be taken to balance future warehouse development with watershed needs and conservation goals.

4.5.3.5. National Hazard Risk Perspective (NRI)

Information has been integrated into this plan update from FEMA's recently updated National Risk Index. The National Risk Index (NRI) is a dataset and online tool to help illustrate the United States communities most at risk for 18 natural hazards. The Risk Index leverages available source data for natural hazard and community risk factors to develop a baseline risk measurement for each United States county and Census tract. Using data and analysis from FEMA's National Risk Index, Jefferson County's risk index is very low compared to other counties in the United States.

Figure 4-1: National Perspective



According to the National Risk Index report for Jefferson County, hazard type risk ratings are calculated using data for only a single hazard type, and reflect a community's expected annual loss value, community risk factors, and the adjustment factor used to calculate the risk value. The report states that low risk is driven by lower loss due to natural hazards, lower social vulnerability, and higher community resilience.

Expected annual loss for hazard type ratings for Jefferson County compared to the rest of the United

States are shown in Figure 4-2. The National Risk Index provides risk ratings for 18 natural hazards, however 14 of 18 hazard types contribute to the expected annual loss for Jefferson County, WV.

In addition, the National Risk Index provides perspective on both community resilience and social vulnerability. According to the report, communities in Jefferson County have a Relatively Moderate ability to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions when compared to the rest of the U.S; Figure 4-3. Also, social groups in the county have a Very Low susceptibility to the adverse impacts of natural hazards when compared to the rest of the U.S; Figure 4-4.

Figure 4-2: Expected annual loss for hazard type ratings for Jefferson County

Hazard Type	Expected Annual Loss Rating
Hurricane	Relatively Low
Strong Wind	Relatively High
Tornado	Relatively Low
Riverine Flooding	Relatively Low
Lightning	Relatively Moderate
Heat Wave	Relatively Low
Earthquake	Very Low
Drought	Relatively Low
Cold Wave	Relatively Low
Winter Weather	Relatively Low
Wildfire	Very Low
Landslide	Relatively Low
Ice Storm	Relatively Low
Hail	Very Low
Avalanche	Not Applicable
Coastal Flooding	Not Applicable
Tsunami	Not Applicable
Volcanic Activity	Not Applicable

Figure 4-3: Ability to Prepare for Anticipated Natural Hazards

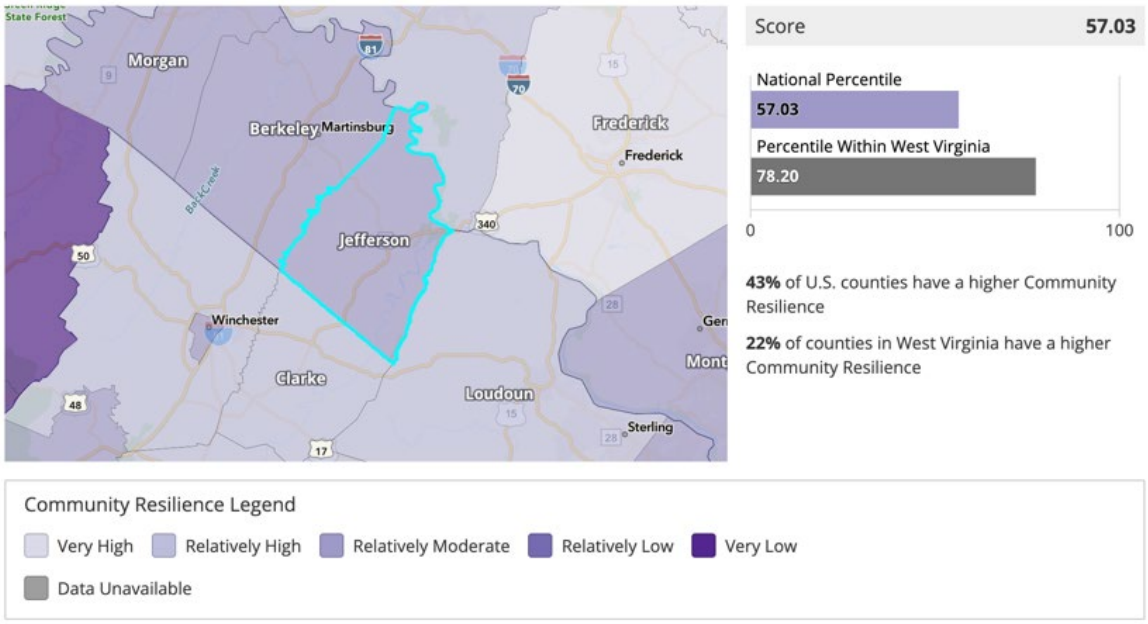
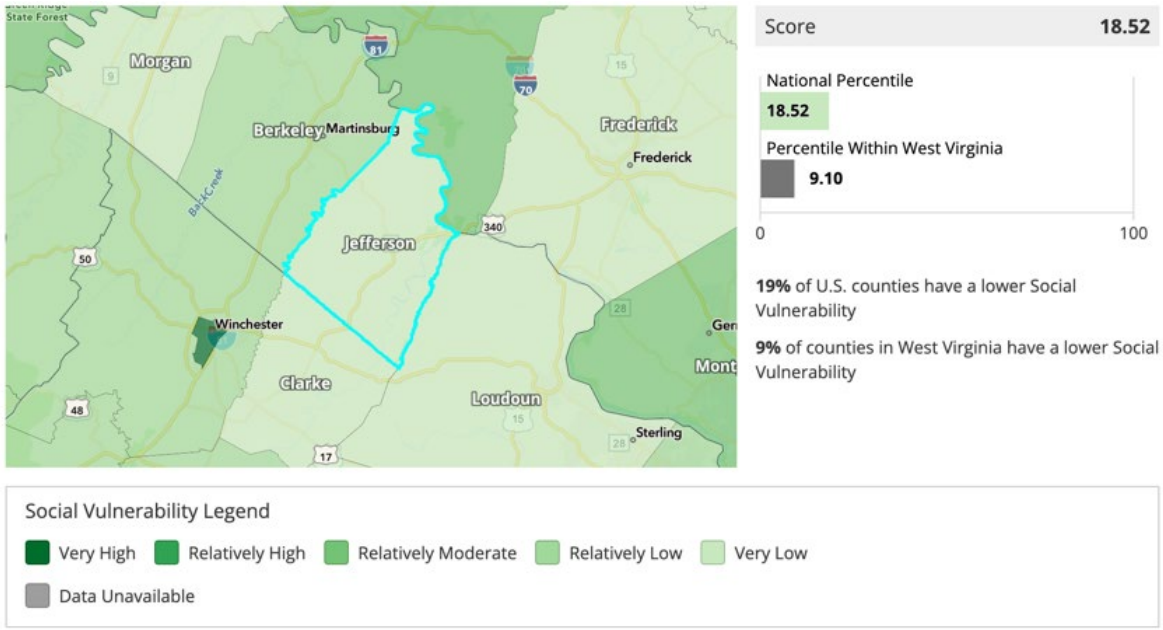


Figure 4-4: Susceptibility to the Adverse Impacts of Natural Hazards



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 participating jurisdictions to implement mitigation actions. It is important to perform a mitigation capability assessment in order to develop a comprehensive and implementable mitigation strategy. Capabilities include a variety of regulations, existing planning mechanisms, and administrative capabilities provided through established agencies or authorities.

The Capability Assessment comprises a number of main components:

1. Document Review - an inventory of the County's existing planning and regulatory tools and a review and incorporation of existing plans and other technical information as appropriate;
2. Participation in the National Flood Insurance Program; and
3. Municipal Capability Assessment - an analysis of municipal capacity from a planning, policy, staffing, training, outreach, and political standpoint.

Based on these components as well as the vulnerability analysis identified earlier in the plan, Jefferson County can assess their current resources and begin to address the legal, regulatory, administrative, financial, and other capabilities which it currently has at its disposal to address the potential hazards which make the County and its local municipalities vulnerable.

Through the planning process, this HMP has attempted to identify the presence of local plans, ordinances, and codes in each municipality and specify local, state, and federal resources available for mitigation efforts. This update hopes to provide an inventory of the most critical local planning tools available within Jefferson County and municipality and a summary of the fiscal and technical capabilities available through programs and organizations outside of the region. It also identifies emergency management capabilities and the processes used for implementation of the NFIP.

The Capability Assessment Survey was provided in both hard copy (at meetings) and electronic format (via e-mail and the project website) to each municipality. The capability assessment is a tool used to identify local capabilities and to recognize gaps and weaknesses that can be addressed through future mitigation actions. The results of the capability assessment provide useful information for developing an effective mitigation strategy.

Additionally, a number of documents have been reviewed as part of this Plan Update. While some reviews have been derived from the 2018 Plan and updated where applicable, additional documents have been identified and reviewed for purposes of integration into other local planning mechanisms. Several plans and ordinances at the County and municipal levels have been reviewed and a summary with options to

integrate the data, information, and hazard mitigation goals and actions into other planning mechanisms are included.

The Mitigation Strategy, including the goals and actions, is incorporated into relevant planning mechanisms based on their pertinence and relevance to specific plans and ordinances. For example, all structural projects should be included in the Capital Improvements Program. Land use and zoning related projects should be incorporated into the next update of the Community's Comprehensive Plan and Zoning Ordinance through collaboration with the Planning and Zoning departments. Likewise, information from relevant planning documents was used to inform and update the Hazard Mitigation Plan.

5.2. Capability Assessment

A capability assessment involves an evaluation of Jefferson County's governmental structure, political framework, legal jurisdiction, fiscal status, policies and programs, regulations and ordinances and resource availability. These factors are evaluated with respect to their strengths and weaknesses in preparing for, responding to, and mitigating the effects of the profiled natural hazards. By doing so, reasonable conclusions can be drawn regarding the relative appropriateness of various hazard mitigation action items that may be identified as part of the hazard mitigation strategy. As such, the capability assessment plays an important role in the hazard mitigation planning process.

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

5.3. Planning and Regulatory Capability

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

There are numerous existing regulatory and planning mechanisms in place at the state, County, regional, and municipal level of government which support hazard mitigation planning efforts. These tools include the West Virginia Statewide Standard All-Hazard Mitigation Plan, floodplain and stormwater management ordinances, source water protection plans, the Jefferson County Comprehensive Plan, building codes,

Emergency Operation Plan, zoning ordinances and subdivision and land development ordinances. Information from several of these documents has been incorporated into this plan and mitigation actions have been developed to further integrate these planning mechanisms into the hazard mitigation planning process. These planning mechanisms are tools that can be used to implement adopted mitigation strategies. The subsections below provide details about how these tools are implemented in Jefferson County, followed by a comprehensive look at which municipalities have adopted these tools.

5.3.1. State of West Virginia Document Review

The 2018 Update of the West Virginia Statewide Standard Hazard Mitigation Plan goals and objectives that are applicable to this Multi-Jurisdictional Plan update include:

- Identify and implement projects that will reduce or eliminate long-term risk, directly reduce impacts from hazards, and maintain critical societal functions. This includes reducing flood risk to repetitive loss and severe repetitive loss properties.
- Incorporate mitigation concepts and objectives into existing and future policies, plans, regulations, and laws in the State.
- Promote and support a whole community approach to awareness of hazards, their risk, and potential mitigation actions to increase resiliency.

Hazard identification and risk assessment data for Jefferson County has been incorporated into the appropriate sections of this Plan update from the 2018 WV Statewide Standard Hazard Mitigation Plan.

The West Virginia State Building Code (WVSBC) is a statewide building code that took effect in West Virginia in 1990. Local governments are not required to enforce the WVSBC. However, no other code provisions pertaining to building construction, repair, or maintenance may be enforced in West Virginia. The code:

- Provides uniformity and compliance with minimum standards of building construction and property maintenance;
- Helps ensure the construction of safe buildings, protecting lives and personal property;
- Utilizes proven industry standards, including new technologies and commonly accepted construction practices and materials.

The West Virginia Statewide Flood Protection Plan (2005) was developed with both short and long-term goals, strategies, and implementation schedules for flood management. Specific goals include:

- Reduce the unnecessary loss of lives due to flooding;
- Reduce private and public property damage;
- Develop technical and legislative tools that will reduce excessive runoff from land conversion activities;

- Promote technical and legislative tools that will reduce excessive runoff from land conversion activities;
- Reduce personal and economic loss due to flooding while supporting state economic growth; and
- Protect the state's waterways and floodplain environments.

5.3.2. Regional/County Document Review

5.3.2.1. Comprehensive Plans

A comprehensive plan is a policy document that states objectives and guides the future growth and physical development of a municipality. The comprehensive plan is a blueprint for housing, transportation, community facilities, utilities, and land use. It examines how the past led to the present and charts the community's future path. Chapter 8A of the West Virginia Code establishes the scope and requirements of community comprehensive plans. A comprehensive plan is required if a governing body wants to enact a zoning ordinance, enact a subdivision and land development ordinance, require plans and plats for land development, or issue improvement location permits for construction.

With regard to hazard mitigation planning, Section §8A-3-4 of the West Virginia Code requires comprehensive plans to include a plan for future land use, which, among other provisions, suggests that the Plan give consideration to flood-prone and subsidence areas during development. The code also requires comprehensive plans to include a plan for community facilities and services and recommends considering storm drainage and floodplain management.

Existing Comprehensive Plans that were reviewed and included in this Update are the Jefferson County Comprehensive Plan (2022), Bolivar Comprehensive Plan (2014), Charles Town Comprehensive Plan (2018), Harpers Ferry Comprehensive Plan (2013, under review – expected 1/2024), Ranson Comprehensive Plan (2012), and Shepherdstown Comprehensive Plan (2015).

These plans serve as the official policy guide for influencing the location, type, and extent of future development by establishing the basis for decision-making and review processes on zoning matters, subdivision and land development, land uses, public facilities, natural resource protection, cultural resources, and housing needs over time.

5.3.2.2. Zoning Ordinances

Zoning ordinances allow for local communities to regulate the use of land in order to protect the interested and safety of the general public. Zoning ordinances can be designed to address unique conditions or concerns within a given community. They may be used to create buffers between structures and high-risk areas, limit the type or density of development, and/or require land development to

consider specific hazard vulnerabilities. Zoning ordinances contain both a map that delineates zoning districts and text documenting the regulations that apply in each zoning district.

The Jefferson County Planning Commission administers Salvage Yard Ordinance (1984), the Stormwater Management Ordinance (2013, Amended 2020), the Improvement Location Permit Ordinance (1975), the Zoning and Land Development Ordinance (2022), and the Subdivision and Land Development Regulations (2018).

Charles Town, Ranson, Bolivar, Harpers Ferry, and Shepherdstown have all adopted their own zoning ordinances.

5.3.2.3. Building Codes

Building codes are important in mitigation, because codes are developed for regions of the Country in consideration of the hazards present within that region. Consequently, structures that are built to applicable codes are inherently resistant to many hazards such as strong winds, floods, and earthquakes, and can help mitigate regional hazards like wildfires. In 1990, West Virginia Adopted the WV State Building Code. The code is not required for adoption, but protects the public health and promotes the safety, protection, and sanitation of new and existing buildings and structures. It also protects financial investments and property values; if construction does not comply with current recommended codes the structure may be at greater risk for damage and loss.

Jefferson County's Building Code Enforcement Ordinance requires that all structures within the County comply with the most recent version of the International Residential Code (IRC), or the International Building Code (IBC) adopted by the State of West Virginia. Permits are required for commercial, residential, and industrial structures, renovations, sheds, and swimming pools among other buildings or structures.

5.3.2.4. Floodplain Ordinances

Through administration of floodplain ordinances, municipalities can ensure that all new construction or substantial improvements to existing structures located in the floodplain are flood-proofed, dry-proofed, or built above anticipated flood elevations. Floodplain ordinances may also prohibit development in certain areas altogether. The NFIP establishes minimum ordinance requirements which must be met in order for that community to participate in the program. However, a community is permitted and in fact, encouraged, to adopt standards which exceed NFIP requirements.

The Jefferson County Floodplain Ordinance was signed into effect in November 2009, which is administered by the Floodplain Administrator. The Floodplain Administrator, also referred to as the Floodplain Manager, is either the Chief County Engineer or his/her designated agent/employee. The

ordinance requires permits for any construction within the Floodplain Area and sets standards for it. For permits to be approved, they must conform with local, state, and federal regulations.

Charles Town, Ranson, and Shepherdstown have all established local floodplain ordinances and have the responsibility to enforce and administer them. Harpers Ferry Floodplain Ordinance is found in Part 17 of its Building, Land Use and Subdivision Code. The Town of Bolivar has not adopted a Floodplain Ordinance. The City of Charles Town is responsible for administering local, state, and federal floodplain regulations. The Ranson Floodplain Ordinance designates the city manager or his designee as the floodplain administrator, responsible for the administration and implementation of the ordinance. The floodplain administrator is also responsible for the review and approval of floodplain development permits.

The Harpers Ferry Floodplain Ordinance tasks the Floodplain Administrator to review applications for any projects within the Floodplain Area and must only approve applications that have been granted a Floodplain Certificate of Compliance.

The Shepherdstown Floodplain Ordinance requires that the municipality administers an ordinance in order to meet the requirements for the NFIP.

The WV Flood Tool is the primary source for updated data and modeling for all jurisdictions. The Advisory Flood Heights available in the expert layer on this tool are used to provide information to property owners regarding best practices for existing structures, new building permits and new subdivisions.

5.3.2.5. Subdivision and Land Development Ordinances

West Virginia Code Section §8A-4 outlines guidance for creation and enactment of subdivision and land development ordinances (SALDOs). Relating to hazard mitigation, the Code states SALDOs must include standards for flood-prone and subsidence areas and standards for setback requirements, lot sizes, streets, sidewalks, walkways, parking, easements, rights-of-way, drainage, utilities, infrastructure, curbs, gutters, streetlights, fire hydrants, storm water management and water and wastewater facilities.

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

Jefferson County, Charles Town, and Ranson have each adopted subdivision ordinances. The Jefferson County Subdivision and Land Ordinance includes requirements to protect waterways, minimize erosion and the deterioration of floodplains, hillsides, wetlands, sinkholes, and regulate the water supply and sanitary waste disposal. The Charles Town Subdivision and Land Ordinance sets standards to minimize

erosion and protect streams, sinkholes, springs, floodplains, steep slopes, and karst features. Ranson is currently revising its zoning and subdivision ordinances. Charles Town has also adopted the Charles Town Subdivision and Land Development Ordinance. Harpers Ferry has subdivision and land development regulations that are currently under review.

5.3.2.6. Emergency Management

An Emergency Operations Plan (EOP) is a document upon which the disaster operations of a County are formulated. It is concerned with all types of emergency situations and how they may develop, be prevented, and resolved. Consequently, these plans also account for activities before, during and after emergency operations. Jefferson County has an EOP in place.

The Jefferson County EOP outlines certain emergency powers given to the County Commission, which includes issuing a state of emergency declaration. The EOP also identifies Prevention and Mitigation as the first two steps in emergency management. They are followed in order by Preparedness, Response, and Recovery.

Another part of the EOP includes emergency public information methods, which ranges from spreading written materials through civic groups to using a mass emergency notification system or social media. Services providers and local agencies can also help in disseminating important information to the public or to specific groups.

5.3.2.7. Drinking Water

Public water suppliers are required by the State of West Virginia to develop Source Water Protection Plans in order to identify possible sources of contamination and develop mitigation measures.

West Virginia American Water has two Source Water Protection Plans (SWPP): one for the Walnut Grove Water Treatment Plant (published December 30, 2015, and revised June 20, 2019), and one for the Deerfield Village Water System (published May 24, 2016). Both Source Water Protection Plans provide guidance for the Tier reporting system, which is a five-tiered emergency system that notifies the public on the safety levels of drinking water based on the acronym “ABCDE.” Additionally, the WV Bureau for Public Health conducted Source Water Assessments for both treatment plants to identify potential sources of contamination as required by the Safe Drinking Water Act.

As of July 2023, neither SWPP in Jefferson County has detailed, specific drought contingency measures.

5.3.2.8. Stormwater Management

The proper management of stormwater runoff can improve conditions and decrease the chance of flooding. Proper stormwater management planning results in sound engineering standards and criteria being incorporated into local codes and ordinances to manage stormwater runoff from new development in a coordinated, watershed-wide approach. Without such planning, stormwater is either not controlled by municipal or County ordinances or is addressed on a site-to-site or municipal boundary basis. Municipalities within the same watershed may require different levels of control of stormwater. The result is often the total disregard of downstream impacts or the compounding of existing flooding problems. Stormwater management plans are adopted in order to mitigate potential negative impacts from future land uses, improve the condition of impaired waterways, and address flooding associated with stormwater runoff.

Jefferson County administers the Stormwater Management Ordinance, which controls the discharge of pollutants into the municipality's stormwater system, including lakes, rivers, streams, ponds, wetlands, and groundwater. This ordinance allows the County to comply with the National Pollutant Discharge Elimination System administered by the West Virginia Department of Environmental Protection. The Stormwater Management Ordinance provides provisions that include, but are not limited to, establishing setback requirements, adopting a system of fees for services and permits, establishing standards for stormwater contaminants, reviewing plans, and issuing permits.

5.3.2.9. Other Plans

Numerous other plans and policies are also in place at the municipal and County level for topics such as economic development, snow removal, and parks and recreation. These types of plans can be implemented, amended, or repurposed to target hazard mitigation as well.

Table 5-1 is an overview of local plans and regulations including updates collected during the 2023 HMP process.

Table 5-1: Summary of Major Plans and Regulations in Jefferson County

Community	Comprehensive Land Use Plan	Floodplain Regulations	Subdivision Regulations	Zoning Regulations	Stormwater Management Plan and/or Ordinance	Building Codes
Jefferson County	✓	✓	✓	✓	✓	✓
Charles Town	✓	✓	✓	✓	-	✓
Ranson	✓	✓	✓	✓	✓	✓
Bolivar	✓	-	-	✓	✓	✓
Harpers Ferry	✓	✓	✓	✓	✓	✓
Shepherdstown	✓	✓	-	✓	✓	✓

5.3.2.10. Participation in the National Flood Insurance Program (NFIP)

Jefferson County and all local jurisdictions participate in the NFIP. Community participation in the NFIP allows for property owners to obtain flood insurance. Flood insurance provides a means for homeowners, renters, and business owners to financially protect themselves. This capability greatly improves resilience after a flood hazard event by allowing residents to repair and rebuild. Table 5-2 provides details about the participation of Jefferson County and their municipalities in the NFIP and the number of flood insurance policies and coverage that exist.

Table 5-2: Jefferson County NFIP Claims Information (FEMA CIS, 2023)

Community Number	Community	Prior Claims	Total Amount of Paid Claims	Effective FIRM
540066	Charles Town	46	$648,055.71	12/18/2009
540068	Ranson	20	$54,045.1	
540030	Bolivar	1	$7,409.13	
540067	Harpers Ferry	42	$1,216,787.65	
540069	Shepherdstown	20	$238,575.5	
	Total	129	$2,164,873.09	

For a community to participate in the NFIP, it must adopt and enforce floodplain management regulations that meet or exceed the minimum NFIP standards and requirements. These standards are intended to prevent loss of life and property, as well as economic and social hardships that result from flooding. Once FEMA provides communities with flood hazard information upon which floodplain management regulations are based, the community is required to adopt a floodplain ordinance that meets or exceeds the minimum NFIP requirements. Jefferson County administers the floodplain ordinance for both the unincorporated areas of the county and the Town of Harpers Ferry (West Virginia Code | §7-1-3V (wvlegislature.gov). Note, Harpers Ferry includes 6 structures within the regulated floodplain. The Jefferson County Floodplain Ordinance is available at: Flood Plain Ordinance. The Towns of Charles Town, Bolivar, Shepherdstown, and City of Ranson each administers their own floodplain ordinance are available at the Town/City Hall.

In terms of the substantial improvement/substantial damage provisions, all new or substantially improved structures shall have the lowest floor elevated to or above the flood protection elevation. The Jefferson County Flood Protection Elevation is the base flood elevation (BFE) plus three (3) feet of freeboard. Two (2) new mitigation action items, LPR #10 and #22 were included for Jefferson County and all municipalities.

As part of this plan update, community worksheets from the FEMA Region 3 Mitigation Plan Guidance: Checking In on the NFIP were completed. Questions and answers specific to floodplain mapping, floodplain management, and flood insurance are provided in Appendix G.

The NFIP's Community Rating System (CRS) provides discounts on flood insurance premiums in those communities that establish floodplain management programs that go beyond NFIP minimum requirements. Under the CRS, communities receive credit for more restrictive regulations; acquisition; relocation, or flood-proofing of flood-prone buildings, preservation of open space; and other measures that reduce flood 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 for property owners in both the SFHA and non-SFHA. 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 19 creditable activities that are organized under four categories: Public Information, Mapping and Regulations, Flood Damage Reduction, and Flood Preparedness. Management and coordination of the Jefferson County program occurs at the County level Jefferson County. Jefferson County entered the CRS program on October 1, 2006 and as of April 1, 2023 is a Class 7.

Greater municipal action could allow flood mitigation efforts to better address specific local flooding issues. Hedgesville does not participate in the program because the entire community is within a single low risk flood zone, Zone X. This leaves Hedgesville residents without the ability to purchase flood

insurance through the NFIP and with fewer flood mitigation resources. Additionally, older Jefferson County may be less likely to have flood insurance, as many tend to drop their NFIP coverage once they have paid off their mortgage.

5.4. 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, and fiscal staff to handle complex grant application processes.

It should be noted municipalities in Jefferson County tend to have limited administrative and technical staff needed to conduct hazard mitigation-activities. However, each municipality carries out its own daily operations and provides various community services according to their local needs and limitations. Administrative capabilities in Jefferson County include:

Jefferson County Development Authority help to plan, implement & coordinate development activities in a structured way. The mission of the Authority is to attract and retain business and industry in order to facilitate job creation and capital investment in Jefferson County. The Authority provides assistance that includes but is by no means limited to: The development of sites and available building stock; the strengthening and alignment of the workforce talent pipeline; the identification and procurement of funding resources; and the provision of any other services as needed to help businesses thrive here in Jefferson County.

Engineers perform duties as directed in the areas of construction, reconstruction, maintenance, and repair of streets, roads, pavements, sanitary sewers, bridges, culverts, and other engineering work. The municipal engineer reviews and/or prepares plans, specifications, and estimates of the work undertaken within the jurisdiction. The Jefferson County Office of Engineering is responsible for the engineering review of subdivision plans and commercial/industrial site plans for compliance with the Subdivision Ordinance, Floodplain Ordinance and the Improvement Location Permit Ordinance. The Office of Engineering administers the land development bonding policy and performs inspections of land development projects. In addition, the Office of Engineering Department is responsible for the administration of the Property Safety Ordinance. The Office of Engineering is also responsible for

managing engineering studies such as the: Mountain Community Water System Study, Westridge Hills Subdivision Test Wells Project, County-wide Groundwater Budget Study; and managing construction projects and drafting ordinances.

Floodplain Administrators (FPAs) 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. The Jefferson County Office of Engineering administers the Floodplain Ordinance which requires that any structures and/or the subdivision of land located in the flood hazard areas of Jefferson County comply with the regulations. The floodplain manager provides floodplain delineation determinations and base flood elevation determinations, reviews Letter of Map Amendment (LOMA) and Letter of Map Revision (LOMR) submissions and maintains the floodplain maps for Jefferson County. All municipalities participate in the NFIP and have a designated FPA. In some municipalities floodplain management duties are a component of a current job rather than a separate position. For Jefferson County, it is not out of the ordinary for a municipal official to hold more than one title. Those municipalities that noted having a Floodplain Administrator often listed their planning department or City Engineer as responsible.

Jefferson County Office of Homeland Security and Emergency Management coordinates Countywide emergency management efforts. They are responsible for managing activities that aim to reduce the loss and lives and property and protect the environment from the effects of natural or man-made disasters, catastrophes, or terrorist threats through prevention, mitigation, preparedness, response and recovery efforts. The OEM also contains a **Local Emergency Planning Committee (LEPC),** which is a County level planning committee that is responsible for the development and distribution of the chemical emergency preparedness and response plan, to provide training and assist emergency responders, other agencies and organizations with their training programs, for development of a public education program, and to develop and implement a compliance and enforcement program for the district.

The Jefferson County GIS Office performs mapping and spatial database maintenance work for various County departments including, E-911 Communications, Office of Emergency Services, Planning and Addressing. They are responsible for updating the Jefferson County portion of the State of WV Mapping and Addressing Website with all current feature class data as required by State Code.

Jefferson County Planning Commission act as advisory groups to the municipal governing body on issues and policies related to planning, land use regulation, and community development, and other duties as outlined in the West Virginia Code Chapter 8A Article 2.

Ordinance within its boundaries:

- The **City of Ranson Planning Division** is responsible for implementing the Ranson Zoning and Subdivision Ordinances, issuing use permits, handling rezoning and annexation permits, administering federal, state, and local floodplain and stormwater regulations. The Planning Division also develops and maintains the Comprehensive Plan and Land Development Plans and Plats.
- The **City of Charles Town** is responsible for administering the provisions of the Comprehensive Plan, the Zoning Ordinance, and the Subdivision and Land Development
- The **Town of Bolivar** primarily serves as an advisory body with some regulatory capabilities over development and land planning. The town is responsible for developing the Comprehensive Plan and administering zoning regulations.
- The **Corporation of Harpers Ferry** is responsible for carrying out the provisions of the Zoning Ordinance, Stormwater Management Ordinance, the Floodplain Ordinance, and the Building, Land Use and Subdivision Code within its boundaries. It is also responsible of handling rezoning and developing the Comprehensive Plan.
- The Corporation of **Shepherdstown Planning and Zoning Department** is responsible for carrying out the provisions of the Planning and Zoning Ordinance. The Corporation is also responsible for handling the Subdivision and Development Regulations, the Stormwater Management Program, the Floodplain Ordinance, and the Comprehensive Plan.
- Transportation planning in Jefferson County is conducted through the **Hagerstown/Eastern Panhandle Metropolitan Planning Organization** (HEPMPO). One of the primary roles and responsibilities of the HEMPO is the develop and update the Long-Range Transportation Plan, as mandated by federal transportation authorization legislation. HEPMPO works in conjunction with the Washington County Planning Department (MD) and the Region 9 Planning and Development Council (WV) to conduct the required planning and to work towards accomplishing the transportation goals of the region.
- **Jefferson County Emergency Communications Center** serves residents and businesses across the region with various types of emergency and non-emergency situations. This office acts as the primary contact for those needing assistance from public safety response personnel.
- **Eastern Panhandle Conservation District** provides local assistance to individuals and organizations that interact with the region's natural resources. Their mission is to work collectively to sustain and improve natural resources in the Eastern Panhandle

There are a number of associations and institutions in the region that support hazard mitigation planning:

- Elks Run Watershed Group
- Cacapon Institute
- The Mountain Institute
- Friends of Cacapon River

- Appalachian Trail Conservancy
- Eastern Panhandle Business Association
- Eastern Panhandle Empowerment Center
- Eastern Panhandle Transit Authority
- Eastern WV Community Foundation
- Jefferson County Community Ministries
- Jefferson County Farm Bureau

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

- West Virginia Department of Health and Human Resources;
- West Virginia Department of Agriculture
- West Virginia Division of Natural Resources
- West Virginia Geological and Economic Survey
- West Virginia Emergency Management Division
- Environmental Protection; and
- West Virginia Department of Transportation.
- West Virginia Development Office
- Region 9

Jefferson County can also partner with Federal agencies for technical assistance on mitigation activities. These agencies include but are not limited to:

- Army Corp of Engineers;
- Department of Housing and Urban Development (HUD);
- Department of Agriculture (DOA);
- Economic Development Administration;
- Emergency Management Institute (EMI);
- Environmental Protect Agency (EPA);
- Federal Emergency Management Agency (FEMA); and
- Small Business Administration.

Finally, regional organizations can enhance Jefferson County's mitigation capabilities. The Eastern Panhandle Regional Planning and Development Council (Region 9) encompasses Jefferson, Berkeley and Morgan counties and provides a variety of planning and project management services and can assist counties and municipalities in planning or implementation of mitigation projects.

Other local organizations that could act as partners for future mitigation activities include local business development organizations such as the Chamber of Commerce, and historical or cultural societies and

agencies, universities, medical providers, schools, churches, and community organizations. Table 5-3 provides a summary of administrative capabilities within each jurisdiction. Results for this capabilities analysis was gathered from County and municipal agencies during the 2023 plan update process.

Table 5-3: Summary of Administrative Capabilities in Jefferson County

COMMUNITY	ENGINEERING	PLANNING COMMISSION/ PLANNING DEPARTMENT	FLOODPLAIN MANAGER	GRANT ADMINISTRATOR	CODE ENFORCEMENT
Jefferson County	✓	✓	✓	-	✓
Charles Town	✓*	✓	✓	✓[2]	✓
Ranson	-	✓	✓	✓	✓
Harpers Ferry	-	-*	-*	-	✓
Shepherdstown	✓*	✓	-	✓[2]	✓
Bolivar	-[1]	✓	-[1]	-[1]	-[1]

*The municipality outsources this technical capability to consultants or relies on the County

[1] Did not complete second part of capabilities assessment survey – Available Staff and Technical Assistance

[2] Completed by Finance Department or Town Administrator

Municipalities were asked to measure (Limited, Moderate or High) the jurisdiction's capability to effectively implement hazard mitigation strategies under 4 areas:

- Planning and Regulator Capability
- Administrative and Technical Capability
- Fiscal Capability
- Community Political Capability

Respondents gave mixed rankings when asked to assess their capabilities. Harpers Ferry rated themselves Limited in all areas. Ranson rated themselves “high” in all areas and moderate in community political capability. Charles Town rated themselves moderate in all areas but limited in administrative and technical capability. Shepherdstown rated themselves moderate in planning and regulatory as well as administrative and technical. They rated themselves high in fiscal and community political capabilities, Bolivar did not answer the second part of the capabilities analysis.

5.5. Financial Capability

In general, the more financial resources a municipality has, the more technically capable it will be from a

resource availability perspective. This is not necessarily the case, however, when analyzing technical capability from a knowledge/skill level perspective. As such, technical capability must be analyzed by each municipality prior to implementing any hazard mitigation activity. It is important to note; however, that much like fiscal capability, shortfalls in technical capability may be overcome by cooperative arrangements, coordinated efforts, and/or resource efficiency.

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 many 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. After the COVID-19 pandemic, communities across the country will face new challenges in balancing community economic recovery while also implementing hazard mitigation.

Financial status is not the only factor in determining hazard mitigation capability. There are also numerous partnering opportunities and grant programs available to assist in offsetting the expenses of local hazard mitigation efforts. While some mitigation actions are less costly than others, it is important that money is available locally to implement policies and projects. Financial resources are particularly important if communities are trying to take advantage of state or federal mitigation grant funding opportunities that require local-match contributions. Based on the assessment results received, most municipalities within the County perceive fiscal capability to be limited; however, several communities listed their capability to be moderate.

5.5.1. Capital Improvement Program

The most common fiscal tool available to communities is the Capital Improvement Program (CIP). A CIP is a community planning and fiscal management tool used to coordinate the timing and financing of capital improvements over a multi-year period. A CIP includes a prioritized list of improvements to roads, parks, and other facilities that the community plans to undertake in a given period.

Jefferson County's annual CIP features only five general categories that are available for funding from impact fees. While none of the categories are directly associated with Hazard Mitigation Planning, CIP funds are directed to Parks and Recreation and the Emergency Services Agency improvement projects. In general, revenues available to fund capital projects may be classed into one of the following categories:

- Direct County support
- General Obligation/Construction Bonds
- State support
- Federal grants

- Impact fees
- Entity-specific user fees
- Donations and gifts

5.5.2. Community Development Block Grants

Jefferson County is also eligible for Community Development Block Grant (CDBG) funding from the US Department of Housing and Urban Development (HUD) but the 5 municipalities are not eligible. The program is designed to assist 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 state and local jurisdictions (referred to as "non-entitlement communities" and "entitlement communities"). The majority of CDBG funds are required to be spent to benefit low- and moderate-income citizens.

5.5.3. Water and Sewer Authority Fees

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

Sewer authorities include multipurpose authorities with sewer projects. The authorities issue bonds to finance acquisition of existing systems or to finance construction, extension, and improvements. Sewer authority operating revenues originate from user fees. The fee frequently is based on the amount of water consumed, and payment is enforced by the ability to terminate service or the imposition of liens against real estate. The Jefferson County Public Service District collects water and sewer fees to fund capital improvement projects.

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

- WV DOC Land & Water Conservation Fund
- WV DEP Abandoned Mine Lands & Reclamation Program
- WV DEP Watershed Project Grants/Nonpoint Source Projects
- WV DEP Rehabilitation Environmental Action Plan (REAP) Grants
- WV DOT Transportation Alternatives Program

- WV DOH Recreational Trails Fund Program
- WV DOF Municipal Tree Restoration Program
- WV DOF Mountaineer Treeways Program
- WV NRCS Conservation Technical Assistance
- WVDO Community Participation Program
- Center for Rural Health Development – WV Rural Health Infrastructure Loan Program

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

- The Building Resilient Infrastructure and Communities (BRIC) Program is a new funding program that will support states, local communities, tribes, and territories undertake hazard mitigation projects. BRIC is replacing the existing Pre-Disaster Mitigation (PDM) program that was previously housed under HMA programs.
- 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
- FEMA Severe Repetitive Loss Grant Program
- Housing and Urban Development (HUD) 5-H Homeownership Program
- HUD Community Development Block Grants (CDBG)

- HUD Community Development Block Grant Disaster Recovery Program (CDBG-DR)
- 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 Planning Assistance to States
- USACE Rehabilitation and Inspection Program (RIP)
- United States Department of Agriculture (USDA)/Farm Service Agency (FSA) Emergency Conservation Program
- USDA 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
- USDOT Pipeline and Hazardous Materials Safety Administration (PHMSA) Hazardous Materials Grant Program

Many of most significant mitigation grants are processed through the WVEMD, including:

- Emergency Management Performance Grants (EMPG)

- Hazardous Materials Emergency Planning (HMEP) Grants
- Severe Repetitive Loss Program
- Repetitive Flood Claims (RFC)
- Recovery Grants including Hazard Mitigation, Public Assistance (PA), and Flood Mitigation Assistance (FMA) Program
- Statewide Local Implementation Grant (SLIGP)
- Community Assistance Program State Support Services Element (CAPSSE)
- Cooperating Technical Partners (CTP)

Chesapeake Bay funding initiatives may be applicable to fund some types of water protection mitigation actions as well.

5.6. Education and Outreach

Education and outreach programs and methods are used to implement mitigation activities and communicate hazard-related information. Jefferson County may benefit from greater involvement in educational programs such as fire safety programs that fire departments deliver to students at local schools, participation in community programs, such as Firewise USA® or StormReady®, and activities conducted as part of hazard awareness campaigns, such as Tornado or Flood Awareness Month.

5.6.1. Firewise USA® Program

The National Fire Protection Association (NFPA) administers the Firewise USA® Program to encourage local solutions for safety by involving homeowners in taking individual responsibility for preparing their homes from the risk of wildfire. The program provides resources to help homeowners learn how to adapt to living with wildfire and encourages neighbors to work together to take action to prevent losses. The national Firewise USA® Recognition Program has nearly 1,000 active member communities in 40 states, as well as a participation retention rate of 80 percent over the past decade. The program, aimed at homeowners, provides specific criteria for communities regarding wildfire preparedness, and offers national recognition for their work.

5.6.2. StormReady®

StormReady® is an education and outreach program that helps arm communities with the communication and safety skills needed to save lives and property before, during, and after an event.

Jefferson County is a *StormReady®* designated County because of its commitment and capability to monitor and spread weather-related warnings and safety precaution measures to the public.

5.6.3. NOAA Weather-Ready Nation (WRMN) Ambassador

NOAA WRMN Ambassador is a designation which recognizes NOAA partners that are improving resilience against extreme weather events. Partners help unify efforts across government, non-profits, academia, and private industry toward making the community and the nation more ready. According to NOAA, Ambassadors:

- Promote Weather-Ready Nation messages and themes to their stakeholders;
- Engage with NOAA personnel on potential collaboration opportunities;
- Share their success stories of preparedness and resiliency; and
- Serve as an example by educating employees on workplace preparedness.

NOAA supports Ambassadors by:

- Providing outreach content about creating a Weather-Ready Nation;
- Exploring innovative approaches for collaboration; and
- Assisting with StormReady/TsunamiReady opportunities.

5.6.4. Farmland Preservation

Farmland preservation measures are important to hazard mitigation. Preserved farms protect soil from erosion and prevent the contamination of local surface water. In addition, farms and forest land are important for recharging the community's aquifer and providing habitat for local wildlife.

Since its creation in July of 2000, the Jefferson County Farmland Protection Board has successfully protected 6,540 acres of farmland across 56 farms by placing them under an easement. As of May 2023, the board's easement value totaled $39,306,124, with funding coming from a mixture of County, state, federal, and donation sources (Jefferson County FPB, 2023).

5.6.5. West Virginia Parcel Viewer

This program allows users to map parcel, floodplain, E-911 addresses, and zoning information among other things, from the State website at https://www.mapwv.gov/parcel/.

The WV Flood Tool, https://www.mapwv.gov/flood/map/, is a tool available for more in-depth information related to flooding and landslide susceptibility. This is a helpful tool for the State's residents to assess their level of flood risk more accurately.

5.7. Plan Integration

Plan integration recognizes that hazard mitigation is most effective when it works in concert with other plans, regulations, and programs. Per FEMA, plan integration is described as the regular consideration and management of hazard risks in a community's existing planning framework. Plan integration is the process by which communities critically analyze their existing planning framework and align efforts to build a safer, smarter community. Plan integration involves a two-way exchange of information and incorporation of

ideas and concepts between hazard mitigation plans (state and local) and other community plans. Specifically, plan integration involves the incorporation of hazard mitigation principles and actions into community plans and community planning mechanisms into hazard mitigation plans (FEMA, 2015).

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

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

Jefferson County will make recommendations to local jurisdictions on how to integrate the HMP into their Comprehensive Plans as they are updated and recommend additional areas for integration of the plan into the next update to the County's Comprehensive Plan. The County will also communicate with local governments to encourage them to incorporate the HMP into their local plans as applicable.

Plan integration is not only accomplished through 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 Jefferson County.

Overall, the administrative and technical capabilities of many of the jurisdictions within the County has been a limiting factor in HMP integration into local documents. Moving forward with HMP updates, Jefferson County should have a more apparent presence in the drafting and updating of municipal planning and enforcement documents, to reinforce the integration of the HMP. Jefferson County should make sure that HMP integration is on the LEPC agenda, and that representatives from each municipality are present at these meetings.

5.7.1. Jefferson County Comprehensive Plan

The Jefferson County Planning Commission is responsible for updating and maintaining the County Comprehensive Plan and Subdivision Ordinance. The 2015 (Amended 2022) Countywide Comprehensive Plan for Jefferson County, Envision Jefferson 2035 is currently being updated. Future comprehensive plan

updates should consider 2023 HMP findings to guide future growth and development away from the hazard-prone areas.

Statements regarding housing plans can recommend not only that the public sector make investments in infrastructure primarily within planned growth areas, but also recommend that investments be made primarily in areas which have not been identified as being hazard prone in Section 1: Land Use and Growth Management. For example, while manufactured housing is described on the comprehensive plan, it does not mention measures that could allow them to better withstand dangers like severe wind events. Also under this element, the Limitations of Existing Zoning Designations discusses an increase in development in areas that might not be sufficiently or adequately supported by water and sewer services as the population grows. Additionally, the growing distance of new developments could make it more difficult for emergency services to arrive when needed. Components of the County Comprehensive Plan can be incorporated into the HMP, and plans can share recommendations related to hazard mitigation. For example, Jefferson County's Comprehensive Plan mentions that both Wilt Road and John Rissler Road, which are connected to the WV 115 highway, both lead to dead ends while being located on the 100-Year Floodplain and experiencing period flooding. In the case of an emergency, it would be difficult to access the area and provide necessary assistance.

Jefferson County should continue to make hazard data available when the 2023 HMP update is complete. The updated hazard data can be used to help update the County and local comprehensive plans and other planning documents. Additionally, hazard related data from consistency reviews should be transmitted annually to be used as part of the Region's annual HMP review. This data can be used to help track plans and projects not only for the annual HMP review but for the 2027 HMP update.

5.7.2. Emergency Operations Plan

West Virginia Code §15-5 requires that state and local jurisdictions develop and maintain current emergency operations plans (EOPs) in order to be prepared for a variety of natural and human-caused hazards. Both County's EOPs are administered by the County's Office of Homeland Security and Emergency Management.

Jefferson County's EOP are all-hazards plans that comply 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 the County. The EOP, or portions thereof, would be implemented when emergency circumstances warrant it.

5.7.3. 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's EOPs notes above addresses various evacuation situations, such as evacuation plans for hazardous material spills and flooding. Emergency Action Plans developed for dams also contain evacuation.

5.7.4. Parks & Recreation Master Plan

The Jefferson County Parks and Recreation 2026 Master Plan outlines several generalized concept ideas that would likely have major positive impacts on the County's natural resources, which include numerous national parks and waterways. Moreover, the County aims to optimize the utilization of its natural resources by making them accessible to the public as recreational amenities.

For example, Jefferson County possesses an approximate 100 miles of dedicated trails, which tend to have some of the highest recreation participation rates. To increase public access and attraction to the trails, the County aims to connect existing trail segments to local neighborhoods and greater regional destinations.

The Potomac River, the Shenandoah River, and the Opequon Creek all surround Jefferson County, while the Evitts Run Creek, the Flowing Springs Creek, and the Cattail Run Creek run through it. Currently, the plan proposes to find cost-effective purchasing or land acquisition rights to waterfront properties, which will increase recreation access to tourists and residents, while also allowing the County to protect the health and stability of the waterways. Additionally, the plan has identified sites in which to extend public parkland, so the County can close its outdoor space deficit and account for the future needs that will accompany the predicted population growth.

6. Mitigation Strategy

6.1. Update Process Summary

The mitigation strategy serves as the long-term road map to reduce the potential losses, vulnerabilities, and shortcomings identified in the Hazard Identification and Risk Assessment section. A typical mitigation strategy includes a list of goals, with mitigation actions to address the goals, that are then prioritized based on the community's need.

Goals are long-term aspirations about the resiliency of the community given the potential effects of hazards.

Actions are the tasks that are proposed for realizing each goal.

Hazard mitigation goals are general guidelines that represent what the community wants to achieve through the implementation of mitigation projects. These goals work together to lessen loss of life, injury, and damage to property, the economy, and the environment from the identified hazards in Section 2.4 Hazard Profiles.

This section of the plan provides the following three components that comprise the Mitigation Strategy for Jefferson County and the municipalities of Bolivar, Charles Town, Harpers Ferry, Ranson, and Shepherdstown.

- **Goals** are general guidelines that explain what the jurisdiction would like to achieve. They are broad policy-type statements, long term, and represent global visions.
- **Mitigation Actions** are more specific than goals, and have identified responsible parties, timeframes, and potential funding sources. They are the specific actions to achieve goals.
- **Projects** are comprised of one or more mitigation actions and include information such as project discussion, partners, cost estimate, potential funding, benefits (losses avoided), and ideas for integration.

As part of the plan update process, information from the previous mitigation strategy portion of the plan was shared with the Hazard Mitigation Planning Committee (HMPC), which includes municipal representatives. Goals and objectives identified in the 2018 Plan were reviewed and updated, as well as mitigation actions. This process occurred at both the mid-point meeting and the mitigation workshop, and the steps undertaken are outlined in the meeting notes, found in Appendix D.

Note: Mitigation projects were developed for the 2018 Hazard Mitigation Plan, however a more in-depth process was included as part of this plan update. This included the four-hour mitigation workshop that included prioritization, however a second prioritization was conducted using an online survey, which yielded a listing of mitigation actions identified for further development, resulting in new project sheets included in this plan section. These project sheets will inform grant applications, particularly the initial Notice of Interest/Intent.

6.2. Mitigation Goals

During the Mitigation Workshop held July 27, 2023, the Hazard Mitigation Planning Committee (HMPC) members were provided goals from the 2018 Hazard Mitigation Plan for review, as well as goals from both the West Virginia State Hazard Mitigation Plan, and the 2022 Berkeley-Morgan County Hazard Mitigation Plan for reference. Members reviewed each of the goals and determined which goals should remain in the plan update. Also, HMPC made modifications, resulting in two (2) updated goals. Finally, HMPC members were also provided the opportunity to develop new goals for the plan update, resulting in three (3) new goals.

Table 6-1 indicates 2018 goals and updated 2023 mitigation goals.

Table 6-1: Mitigation Goals	
2018 Mitigation Goals	**2023 Mitigation Goals**
GOAL 1: Improve communication resiliency through planning, partnerships, and infrastructure development.	**GOAL 1:** Improve communication resiliency through planning, partnerships, and infrastructure development.
GOAL 2: Enhance resiliency of water resources by providing it where it is needed and managing it where it is abundant.	**GOAL 2:** Enhance resiliency of county and municipal water resources to reduce flood damage by limiting development in floodplains, effectively managing stormwater, and reducing the possibility of source water contamination.
GOAL 3: Promote all-hazards awareness, education, and training to the public, responders, and officials.	**GOAL 3:** Promote all-hazards preparedness, awareness, education, and training to the public, responders, and officials.
GOAL 4: Reduce the vulnerability of populations in risk areas from all hazards.	**GOAL 4:** Reduce the vulnerability of populations by creating and integrating programs and projects that are designed to reduce hazards in risk areas.
	GOAL 5: Promote hazard mitigation as a local community value in recognition of its importance to the health, safety, and welfare of the population.
	GOAL 6: Improve operating systems and backup servers to enhance cyber security measures.
	GOAL 7: Enhance hazardous materials response planning and response operations.

Mitigation actions provide detailed descriptions of specific work tasks to accomplish in order to achieve the mitigation goals. The 2018 mitigation actions were distributed to HMPC members and municipalities for status updates on each mitigation action.

6.3. Mitigation Actions and Projects

Mitigation goals form the foundation of actions developed by the Hazard Mitigation Planning Committee (HMPC). Mitigation actions provide detailed descriptions of specific work tasks to accomplish in order to achieve the mitigation goals. To further refine and categorize mitigation actions, the following six (6) categories have been applied to each mitigation action item, as applicable.

- **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 educate citizens, elected officials, and property owners about hazards and ways to mitigate the hazards and may also include participation in national programs. Examples include but are not limited to radio/television spots, websites with maps and information, provide information and training, NFIP outreach, StormReady, and Firewise Communities.
- **Emergency services and public health:** Actions to improve planning, preparedness, and training for emergency services and public health. Examples include training events, exercises, and plans.
- **Municipal:** Actions specific to municipalities, which include one or more of the mitigation categories above.

Table 6-2 provides a matrix identifying the mitigation techniques per category used for the hazards identified in the risk assessment for Jefferson County.

Table 6-2: Mitigation Techniques Used for All Hazards in Jefferson County

Hazard *(In Order of Risk Factor Ranking)*	Mitigation Technique				
	Plans and Regulations	Structure and Infrastructure	Natural Systems Protection	Education and Awareness	Emergency Service & Public Health
Public Health & Pandemic					X
Cyber Terrorism	X	X		X	
Utility Interruption		X		X	
Drought	X		X		
Extreme Temperatures	X		X		
Flood	X	X	X	X	
Severe Thunderstorm & Hail	X	X	X	X	
Severe Winter Storm	X				

Table 6-2: Mitigation Techniques Used for All Hazards in Jefferson County					
Hazard *(In Order of Risk Factor Ranking)*	**Mitigation Technique**				
	Plans and Regulations	**Structure and Infrastructure**	**Natural Systems Protection**	**Education and Awareness**	**Emergency Service & Public Health**
Wild & Urban Fires	X			X	
Hazardous Materials					X
Terrorism	X			X	
Earthquake	X				
Invasive Species			X	X	
Landslide & Subsidence	X	X	X	X	
Severe Wind and Tornado	X				
Dam Failure		X		X	X
Civil Disturbance	X				X
Karst	X				

Note: Each mitigation technique has numerous mitigation actions items that apply to all hazards.

In order to determine mitigation actions that should be carried over from the 2018 Plan, previous mitigation actions were reviewed by HMPC members and municipal representatives, Appendix H. While many of the mitigation actions were completed in part, the status of Jefferson County specific mitigation actions were identified as either ongoing, cancelled, or deferred. Whereas the status of municipal specific action items did include several identified as completed. See summarized mitigation status matrix below.

Table 6-3: 2018 Mitigation Status Matrix						
Status	**Jefferson County**	**Town of Bolivar**	**Town of Charles Town**	**Town of Harpers Ferry**	**City of Ranson**	**Town of Shepherdstown**
Ongoing	80	2	7	1	2	2
Cancelled	2	1	0	0	0	0
Deferred	10	0	0	2	0	0
Complete	0	0	0	1	1	1

During the Mitigation Workshop on July 27th, HMPC members were divided into small groups based on the previously mentioned six (6) mitigation action categories. Each group was provided mitigation action tables which listed actions from the 2018 HMP for review and update. Actions that were deferred or considered ongoing were carried over to the 2023 Action Plan. New mitigation actions developed during the planning process were provided, as well. Furthermore, participants were provided a blank mitigation action form to provide any new actions that had not been developed prior to the Mitigation Workshop.

Participants reviewed over eighty (80) mitigation actions for potential inclusion in the plan update. The review resulted in a total of thirty-eight (38) new mitigation actions. While thirty-six (36) mitigation actions were carried over from the previous plan. This review process yielded a total seventy-five (75) mitigation actions:

- Local Planning and Regulations- 22 Action Items (15 new)
- Structure and Infrastructure Projects- 8 Action Items (6 new)
- Natural Systems Protection- 6 Action Items (4 new)
- Education and Awareness Programs- 20 Action Items (7 new)
- Emergency Services/Public Health – 19 Action Items (7 new)
- Municipal- 49 Action Items (actions items were not identified separately in 2018 HMP)

Note: Action items carried forward from the previous plan are denoted in Tables 6-4 to 6-8 with an asterisk (*).

Next, mitigation actions that resonated the most with HMPC members were selected and developed into projects. Selected actions were developed into fourteen (14) project worksheets. The projects included one or more mitigation actions depending on the type and scope of the project. Mitigation project worksheets are included in this section and immediately follow each mitigation action category table.

Finally, following the Mitigation Workshop, a survey containing all fourteen (14) project worksheets was provided to all HMPC members and municipal representatives for additional ranking purposes. The basis for this survey is the STAPLEE evaluation method, which uses standard criteria for evaluation: Social, Technical, Administrative, Political, Legal, Economic, and Environmental. The survey consisted of the six (6) questions and asked members to answer with, Yes/No/or Unsure, which corresponded to a point system to determine whether the projects were a "high" priority. These six (6) questions included the following:

1. Do you think there would be community acceptance/general support for this mitigation project?
2. Do you think implementation of this mitigation project will enhance the health and safety of the community?
3. Do you think the community will be able to sufficiently staff and/or provide technical support to implement this mitigation project?
4. Do you think the benefits of this mitigation project will exceed the likely costs?
5. Do you think the maintenance requirements for this option will be affordable and not provide an undue burden on the County?
6. Is this project consistent with environmental goals?

As a result, four (4) projects were rated as "high" priority. These four (4) projects have been denoted as high priority on the project worksheets included on pages 18, 20, 40, and 42 and are as follows:

- Project 4: Snow Removal MOU and Debris Management Plan
- Project 5: Dark Grid Training & Exercises
- Project 13: Citizen Preparedness Training and Outreach
- Project 14: Hazard Materials Response Plan and Training

Note: The following pages include a divider sheet denoting the mitigation category and associated actions and projects. While mitigation funding sources for projects, please refer to Appendix A Mitigation Funding Sources as these action items are further developed during this planning cycle.

Definitions: *Short Term 1-3 years*

Long Term 3-5 years (or greater)

Local Planning and Regulations

Mitigation Action Items & Project Sheets

Table 6-4: Local Planning and Regulations Mitigation Action Items

ID #	Mitigation Action	Hazard(s)	Responsible Agency	Timeframe
LPR #1	Review all existing regulations, comprehensive plans, capital improvement plan (CIP) and Emergency Operation Plan (EOP) to ensure that designated growth areas are not in hazard areas. Review existing regulations to ensure adequacy in reducing the amount of future development in identified hazard areas.	All hazards	Engineering, Planning, and Zoning	Short-term
LPR #2	Encourage the use of laminated glass in windowpanes during all new construction.	Severe Weather, Tornado, Earthquake, Civil Disturbance, Terrorism	Homeland Security and Emergency Management	Long-term
LPR #3	Work with FEMA and WVDHSEM on the Map Modernization Program to improve 2009 FIRMS.	Flood	Homeland Security and Emergency Management	Short-term
LPR #4	Strengthen Community Rating System (CRS) program to enhance rating by undertaking outreach and training efforts such as: distribute letters to all property owners in the county regarding potential flood hazards as required for participation in the CRS. and provide training to municipalities on the CRS program and encourage them to participate.	Flood	Homeland Security and Emergency Management	Short-term
LPR #5	Consider implementing open space designations in landslide prone areas, to keep those areas undeveloped.	Landslide	Homeland Security and Emergency Management & Engineering, Planning, and Zoning & Parks and Recreation	Short-term
LPR #6	Reduce the risk of mobile home damage by suggesting the use of tie-downs with ground anchors appropriate for the soil type.	Severe Wind and Tornado	Engineering, Planning, and Zoning & Homeland Security and Emergency Management	Short-term
LPR #7	Consider passing ordinances to prioritize or control water use, particularly for emergency situations such as firefighting.	Wild and Urban Fires	Engineering, Planning, and Zoning	Long-term

***LPR #8**	Consider updating the County's floodplain management ordinance in advance of the FEMA FIRM/FIS map update to be compliant with the NFIP regulations (44 CFR 59 & 60). Please note that the ordinance update will be a requirement and must occur prior to the new effective map date to avoid suspension from the NFIP.	Flood	Engineering, Planning, and Zoning & Homeland Security and Emergency Management	Short-term
***LPR #9**	Add additional floodplain management and permitting information to the County website, i.e., permit application, links to state (www.mapwv.gov) and federal floodplain mapping (https://msc.fema.gov/portal/home) and insurance programs (www.floodsmart.gov). Both county and municipal website, as applicable.	Flood	Engineering, Planning, and Zoning & Emergency Management	Short-term
***LPR #10**	Develop and publish an updated Substantial Damage/Substantial Improvement (SI/SD) Administrative Procedure and post on the County website. Both county and municipal website, as applicable.	Flood	Homeland Security and Emergency Management	Short-term
***LPR #11**	Communities that develop a substantial damage management plan are eligible to obtain credit under Activity 510 (Floodplain Management Planning). Such a plan identifies steps that a community can take before a flood or other hazard-caused event to efficiently and effectively meet the NFIP requirement for assessing damage and making substantial damage determinations.	Flood	Homeland Security and Emergency Management	Short-term
***LPR #12**	Integration of hazard planning into both the County and Municipal planning frameworks, which will lead to development patterns and redevelopment that decreases hazard risk and vulnerability. To achieve and facilitate integration, Jefferson County and the Towns should review how planning documents, policies, codes, and programs are maintained and implemented, and the roles of people, agencies, and departments in evaluating and updating them. This depth of review will enable the County and the Towns to identify opportunities for plan integration, resulting in effective ways to reduce hazard vulnerability. Compare areas slated for growth including redevelopment with hazard risk areas.	All hazards	Engineering, Planning, and Zoning & Homeland Security and Emergency Management	Short-term
***LPR #13**	Increase CRS class rating from a 7 to a 6, thereby increasing flood insurance rate for residents living in the unincorporated areas of Jefferson County. Include review of the 2023 HMP in the next verification visit in order to obtain points under CRS Program's Activity: Floodplain Management Planning.	Flood	Homeland Security and Emergency Management	Short-term
***LPR #14**	Develop an Extreme Heat Emergency Plan identifying triggers, surveillance, and actions.	Extreme Temperature	Health Department & Homeland Security and Emergency Management	Short-term

***LPR #15**	2023 Mitigation Strategies should be reviewed in reference to the Capital Improvement Plan for integration purposes. Projects that reduce risk and vulnerability to the citizens of Jefferson County should be given prioritization.	All hazards	Engineering, Planning, and Zoning	Short-term
***LPR #16**	Establish best practices and recommendations for karst areas, including land use, resiliency, and infrastructure.	Karst	Engineering, Planning, and Zoning	Long-term
***LPR #17**	Adjust construction regulations to include areas where mapped and verified karst terrain exists, double layers of silt fencing may be implemented, as well as hay bales or core logs along the periphery of the standard workspace area to prevent outward migration of silt and reduce runoff velocity.	Karst	Engineering, Planning, and Zoning	Long-term
***LPR #18**	Establish a County Cyber Security and Risk Mitigation Plan to be implemented by county and 5 jurisdictions.	Cyber Terrorism	Homeland Security and Emergency Management & Information Technology	Long-term
***LPR #19**	Encourage the county and municipalities to adjust their zoning ordinance to discourage development on permeable soils to reduce the impacts of drought.	Drought	Engineering, Planning, and Zoning & Development Authority	Long-term
***LPR #20**	Enforce building codes to ensure structural stability during hazard events.	Severe Windstorm, Winter Storm, Earthquake, Hurricane	Engineering, Planning, and Zoning	Short-term
***LPR #21**	Work with the utility and cable companies to develop a plan for the preventive right-of-way maintenance of trees near powerlines particularly during the winter.	Winter Storm	Engineering, Planning, and Zoning	Long-term
LPR #22	Schedule a FEMA Region 3 Significant Damage/Significant Improvement training. WVEMD delivered SD/SI training that FEMA supports. CY2024 training TBD.	Flood	Homeland Security and Emergency Management	Short-term

Project 1: Review Codes for Hazard Mitigation Integration Opportunities	
Action Item(s):	**LPR #12:** Integration of hazard planning into both the County and Municipal planning frameworks, which will lead to development patterns and redevelopment that decreases hazard risk and vulnerability. To achieve and facilitate integration, Jefferson County and the Towns should review how planning documents, policies, codes, and programs are maintained and implemented, and the roles of people, agencies, and departments in evaluating and updating them. This depth of review will enable the County and the Towns to identify opportunities for plan integration, resulting in effective ways to reduce hazard vulnerability. Compare areas slated for growth including redevelopment with hazard risk areas.
Project Title:	**Review Codes for Hazard Mitigation Integration Opportunities**
Hazard(s):	All Hazards
Location(s):	Countywide & Municipalities
Project Discussion:	Having modern codes in place before a disaster can keep development out of high-risk areas and help the County and its municipalities achieve resilient recovery. Emergency managers and code officials should work with other local, county and state officials to ensure codes advance the mitigation goals of the county. The goals and objectives included in the Hazard Mitigation Plan are a good starting point when reviewing code for mitigation integration. When possible, higher standards should be included in zoning updates, comprehensive plans and capital improvement plans so the community can rebuild resiliently after disasters. The Alliance for National and Community Resilience created Community Resilience Benchmarks that encourage communities to review their existing buildings and suggest strategies for high-performance designs. Starting a review and adoption cycle at regular intervals, and not just after a disaster, will allow the County to respond to changes in climate, population, and growth. It also shows a commitment to improving the lives of County residents, businesses, and visitors now and in the future. When considering updating existing code to integrate additional or new hazard mitigation planning, consider the following implementation steps: 1. Identify the codes in effect in your community 2. Build a team (consider utilizing the HMPC as a starting point and expanding as needed). 3. Create a shared strategy for reducing disaster risk. 4. Map out the process for building code adoption.

<table>
<tr><th colspan="2">Project 1: Review Codes for Hazard Mitigation Integration Opportunities</th></tr>
<tr><td></td><td>5. Build the case for integrating hazard mitigation into modern building code adoption.
6. Advocate.
7. Draft the code.
8. Adopt the code without weakening amendments.
9. Enforce the code

WHAT IS A “WEAKENED” CODE?

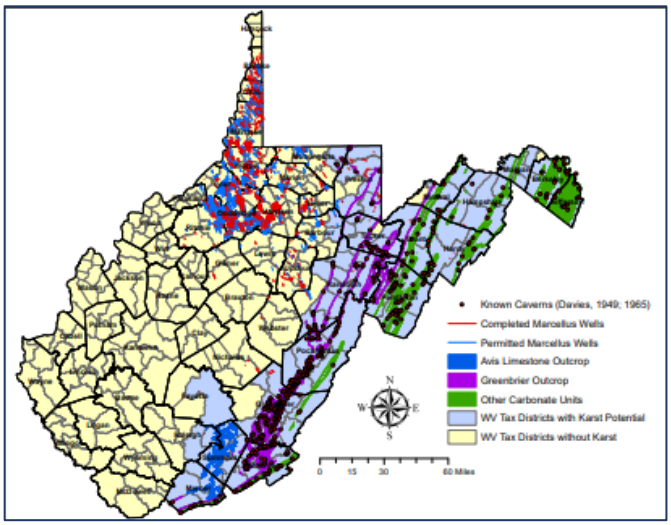
A weakened code occurs when a state or community adopts the latest code, but then passes amendments that

Finally, adopting hazard mitigation principles into modern codes is not enough to protect communities and save money prior to hazard events. To be effective, codes must be enforced. Local planners, emergency managers, and code enforcement officials collaborate directly with residents and are often their primary contact with government. Their roles are critical for educating the public about stronger codes and standards.

Working with residents in code enforcement means:
• Making a complex system easier to understand: When people are closer to the problems and solutions, we expect to see better results in community development.
• Increased support for codes and standards: Shared ownership and buy-in is achieved when residents affected by the policies engage in decision making.</td></tr>
<tr><td>Responsible Entity:</td><td>Jefferson County Department of Engineering, Planning, and Zoning
Jefferson County Office Of Homeland Security And Emergency Management</td></tr>
<tr><td>Partners:</td><td>Jefferson County Finance Department
Municipal Representatives
County Commission Office</td></tr>
<tr><td>Cost Estimate:</td><td>Staff Time</td></tr>
<tr><td>Potential Funding:</td><td>Annual Operating Budget</td></tr>
<tr><td>Benefits (Losses Avoided):</td><td>• Deconflicts legislation with current County protocols
• Supports projects aligned with plans and funding.
• Supports efforts to make the County more resilient to natural hazards by codifying hazard mitigation principles.</td></tr>
<tr><td>Ideas for Integration:</td><td>• Code of Ordinances
• Building Codes
• Comprehensive Plan
• Capital Improvement Plan</td></tr>
<tr><td>Timeline:</td><td>Ongoing</td></tr>
</table>

Project 2: Extreme Heat Emergency Plan	
Action Item(s):	**LPR 14:** Develop an Extreme Heat Emergency Plan identifying triggers, surveillance, and actions.
Project Title:	**Extreme Heat Emergency Plan**
Hazard(s):	Extreme Temperature
Location(s):	County & Municipalities
Project Discussion:	According to CDC Climate and Health Technical Report Series, extreme heat is a major public health concern in the United States. Temperatures are increasing across the country, with more frequent and severe heat waves in many regions. This trend is projected to continue. Exposure to heat may increase the risk of illness particularly among sensitive groups such as people who do not have access to air conditioning, older adults, young children, people working outdoors, athletes, the socially isolated, people with existing chronic conditions, and some communities of color. Extreme temperature events can pose a threat to the entire Jefferson County's population. Therefore, an Extreme Heat Emergency Plan should be developed for the county and its municipalities. An extreme heat emergency plan is a coordinated plan that describes and organizes activities to prevent heat-related morbidity and mortality. Potential components of an extreme heat emergency plan: • Overview of the anticipated impacts of extreme heat • Description of thresholds for activation • Identification of at-risk populations and geographies within the jurisdiction • Relevant local community considerations • Identification of preparedness, response, and recovery actions and partnerships necessary to mitigate adverse health consequences • Delineated roles and responsibilities, including how agency efforts will be coordinated with other partners and stakeholders • Evaluation and revision processes Additional elements of the plan to consider: • Implement a countywide public health monitoring system to identify heat illness events early, monitor trends, and track illnesses to intervene and prevent further harm. • Consider plans to provide shelters and cooling sites for residents. • Programs to subsidize electrical costs to enable residents to afford air conditioning and cooling. • Accelerate readiness and protection of communities most impacted by extreme heat, including through cooling schools and homes,

Project 2: Extreme Heat Emergency Plan	
	supporting community resilience centers, and expanding nature-based solutions. • Protect vulnerable populations through codes, standards, and regulations. • Increase public awareness to reduce risks posed by extreme heat. • Protect natural and working lands, ecosystems, and biodiversity from the impacts of extreme heat.
Responsible Entity:	Jefferson County Health Department Jefferson County Office Of Homeland Security And Emergency Management
Partners:	American Red Cross Jefferson County Emergency Medical Services Hospitals and Healthcare Coalitions Jefferson County Board of Education Faith-Based Organizations Local Businesses
Cost Estimate:	Staff Time
Potential Funding:	Annual Operating Budget
Benefits (Losses Avoided):	Prevents loss of life and illness.
Ideas for Integration:	Hazard Mitigation Plan Emergency Operations Plan
Timeline:	1-2 years

Project 3: Karst Mitigation Plan	
Action Item(s):	**LPR 16:** Establish best practices and recommendations for karst areas, including land use, resiliency, and infrastructure. **LPR 17:** Adjust construction regulations to include areas where mapped and verified karst terrain exists, double layers of silt fencing may be implemented, as well as hay bales or core logs along the periphery of the standard workspace area to prevent outward migration of silt and reduce runoff velocity.
Project Title:	**Karst Mitigation Plan**
Hazard(s):	Karst
Location(s):	Countywide & Municipalities
Project Discussion:	According to USGS, karst terrain is created from the dissolution of soluble rocks, principally limestone and dolomite. Karst areas are characterized by distinctive landforms and a unique hydrogeology that results in aquifers that are highly productive but extremely vulnerable to contamination. A karst landscape is characterized by the presence of sinkholes, springs, caves, ridges and sharp projections in the underlying bedrock, and highly irregular soil-rock interface.  *Source: Developing a Karst Map for West Virginia* According to the Jefferson County Foundation, Inc: Rezoning for Jefferson County Foundation, Inc. Heavy Industry fact sheet, the Jefferson Orchard site, and much of the surrounding land in Jefferson County, should not be rezoned for heavy industry, or any industry that produces toxic or hazardous emissions. It has been well defined that this portion of Jefferson County has mature karst hydrogeology. The karst landscape is a consequence of the presence of soluble bedrock, which consists of limestone in the case of Jefferson County. According to Conservation West Virginia, one of the chief complaints of the opponents of the Rockwool industrial development is that groundwater

Project 3: Karst Mitigation Plan	
	pollution from its operations can easily pollute drinking water sources for a large number of residents. A Karst Mitigation Plan addresses potential impacts and hazards related to local karst formations. Jefferson County Department of Engineering, Planning, and Zoning should collaborate with the partners mentioned below to develop the plan for Jefferson County.
Responsible Entity:	Jefferson County Department of Engineering, Planning, and Zoning
Partners:	Jefferson County Foundation, Inc. West Virginia Geological and Economic Survey Conservation West Virginia Geotechnical Engineer State of West Virginia, Department of Environmental Protection (DEP) Jefferson County Office Of Homeland Security And Emergency Management
Cost Estimate:	Staff Time
Potential Funding:	Annual Operating Budget
Benefits (Losses Avoided):	Prevention of loss and life
Ideas for Integration:	Hazard Mitigation Plan Emergency Operations Plan Comprehensive Plan
Timeline:	1-2 years

Structure and Infrastructure

Mitigation Action Items & Project Sheets

Table 6-5: Structure and Infrastructure Mitigation Action Items

ID #	Mitigation Action	Hazard(s)	Responsible Agency	Timeframe
SIP #1	Coordinate with local private contractors to develop mutual aid agreements for emergency snow removal, also develop a Debris Management Plan that can be implemented following a disaster occurrence.	All hazards	Homeland Security and Emergency Management	Short-term
SIP #2	Conduct a detailed vulnerability analysis on the county's infrastructure to see what losses could be incurred during a land subsidence event (in pertinent areas).	Land Subsidence	Homeland Security and Emergency Management	Short-term
***SIP #3**	Install signage for roadways (Mission Road and Riverside Drive) within inundation area of Shannondale Club Dam, ensuring that drivers are aware of dam hazard risk.	Dam Failure	Homeland Security and Emergency Management	Short-term
***SIP #4**	Conduct "Dark Grid" training and exercises. Emergency management officials can reduce vulnerability to utility interruption through training and exercises, such as the "Dark Grid" exercise, which prepare emergency responders and community leaders for a coordinated response to widespread utility interruptions.	Utility Interruptions	Homeland Security and Emergency Management	Short-term
***SIP #5**	Collaborate with the Towns and adjacent jurisdictions to conduct watershed assessment(s) to include new Atlas 14 precipitation table- rainfall intensity.	Flood	Engineering, Planning, and Zoning & Homeland Security and Emergency Management	Long-term
***SIP #6**	Establish a County Cyber Security and Risk Mitigation Plan to be implemented by county and 5 jurisdictions	Cyber Terrorism	Homeland Security and Emergency Management& Information Technology	Long-term
***SIP #7**	Provide annual cyber-security and awareness training to all County staff to reduce risk and occurrence of phishing and malware attacks	Cyber Terrorism	Homeland Security and Emergency Management	Short-term
***SIP #8**	Ensure public facilities have backup power and are properly grounded.	Thunderstorm	Homeland Security and Emergency Management	Long-term

Project 4: Snow Removal MOU and Debris Management Plan	
Action Item(s):	**SIP #1:** Coordinate with local private contractors to develop mutual aid agreements for emergency snow removal, also develop a Debris Management Plan that can be implemented following a disaster occurrence.
Project Title:	**Snow Removal MOU and Debris Management Plan**
Hazard(s):	Flood Landslide, Land Subsidence, Severe Wind & Tornado, Severe Winter Storm, Thunderstorm
Location(s):	Countywide & Municipalities
Project Discussion:	Memorandum of Understandings (MOUs) must be put in place prior to any emergency. The purpose of a MOU is to facilitate coordination and collaboration between local private contractors to develop mutual aid agreements which would minimize weather-related disruption to public safety and business throughout the county. A debris management plan establishes a framework for which the County will respond and coordinate the management and removal of debris generated by potential human-caused and natural disasters, such as extreme high wind and/or thunderstorm events. The plan also may address the potential role that state and federal agencies and other groups may assume during a debris management operation. "Guidance about Planning for Natural Disaster Debris" is available on the EPA's website; they also have several publications aimed at helping communities update their present debris management plan to address environmental issues. FEMA also offers guidance in the form of their "Public Assistance Debris Monitoring Guide" which provides guidance on monitoring debris removal operations and eligibility requirements associated with necessary work and reasonable costs to carry out a debris monitoring program.
Responsible Entity:	Jefferson County Office Of Homeland Security And Emergency Management Jefferson County Roads Department Jefferson County Solid Waste Authority Private Contractors
Partners:	Jefferson County Department of Fleet & Facilities Management Utilities Contractors West Virginia Division of Highways Landfills/Preapproved Disposal Sites
Cost Estimate:	Snow Removal MOU – Based on contract agreement with contractors. Debris Management Plan – Staff Time/Annual Operating Budget
Potential Funding:	FEMA Hazard Mitigation Grant Program (HMGP) FEMA Building Resilient Infrastructure and Communities (BRIC)
Benefits (Losses Avoided):	• Safe movement within the county for emergency responders, law enforcement, and residents. Pathway back to normalcy.

Project 4: Snow Removal MOU and Debris Management Plan	
	• A debris management plan serves to guide responsible agencies to better protect human health, comply with regulations, conserve disposal capacity, reduce injuries, and minimize or prevent environmental impacts after a hazard event that produces debris.
Ideas for Integration:	• Tabletop Exercise/Round Table with all partners regarding debris and debris management. • Secure annual contracts with vendors to support Debris Management efforts in Jefferson County.
Timeline:	Snow Removal MOU – Less than 90 days; Ongoing Debris Management Plan – 1-2 years (planning process).
High Priority	

Project 5: Dark Grid Training & Exercises	
Action Item(s):	**SIP #7:** Conduct "Dark Grid" training and exercises. Emergency management officials can reduce vulnerability to utility interruption through training and exercises, such as the "Dark Grid" exercise, which prepare emergency responders and community leaders for a coordinated response to widespread utility interruptions.
Project Title:	**Dark Grid Training & Exercises**
Hazard(s):	Utility Interruptions
Location(s):	Countywide & Municipalities
Project Discussion:	Significant power outages will have severe effects on public utilities, communication networks, emergency response centers, hospitals, government offices, and a large section of private sector; gasoline and groceries, etc. By simulating a Power Outage scenario and testing the capabilities that are related to the management of this threat we can better prepare community leaders and emergency responders for an optimal coordinated response to widespread utility interruptions. Jefferson County Office Of Homeland Security And Emergency Management should conduct a tabletop exercise initially for power outages. Once the TTX is completed, JCHSEM should plan a "Dark Grid" full scale exercise in order to prepare emergency responders and community leaders for a coordinated response to widespread utility interruptions.
Responsible Entity:	Jefferson County Office Of Homeland Security And Emergency Management
Partners:	Local government, utility owners, emergency response, hospitals, law enforcement
Cost Estimate:	Staff Time
Potential Funding:	Annual Operating Budget Upgrading Our Electric Grid and Ensuring Reliability and Resiliency
Benefits (Losses Avoided):	Enhanced capacity to respond to and recover from a power outage.
Ideas for Integration:	Emergency Operations Plan
Timeline:	1-2 years
High Priority	

Project 6: County Cyber Security	
Action Item(s):	**SIP #11:** Establish a County Cyber Security and Risk Mitigation Plan to be implemented by county and five jurisdictions. **SIP #13:** Provide annual cyber-security and awareness training to all County staff to reduce risk and occurrence of phishing and malware attacks.
Project Title:	**County Cyber Security**
Hazard(s):	Cyber Terrorism
Location(s):	Countywide & Municipalities
Project Discussion:	A cybersecurity threat mitigation strategy reduces the overall risk or impact of a cybersecurity incident by employing security policies and procedures. Preventing an attack from occurring before it can happen is imperative to public security. There are three components to cyber security risk mitigation: prevention, detection, and remediation. Before starting a risk mitigation strategy, a risk assessment should be conducted. A risk assessment is meant to find gaps within the infrastructure that is most vulnerable to exploitation before an attack. Prioritizing regular risk assessments ensures timely detection and resolution of potential weaknesses that could otherwise be exploited by outside attacks. The next step to prevention is to establish network controls to mitigate the risk of insider threats. A system of 'zero trust' is the most viable to prevent the risk of insider threats. 'Zero trust' assesses trust and user access permissions on an as needed basis depending on each person's job role. Another means of minimizing threats to security is through proactive action. Continuously monitoring network traffic by using tools that provide a comprehensive picture of an IT ecosystem at any time allows security personnel the ability to identify and deal with threats as they happen. Lastly, an incident response plan can be put in place to allow all portions of security and non-tech staff to understand what to do in the event of a data breach or attack. It has become increasingly difficult with the evolution of technology to prevent data breaches, so an incident response plan allows us to be proactively prepared. Using the Risk Mitigation Plan, annual cyber-security and awareness training should be conducted with county staff and municipal staff.
Responsible Entity:	Jefferson County Office of Information Technology
Partners:	All County Departments and Municipalities
Cost Estimate:	Staff Time
Potential Funding:	Annual Operating Budget Cyber Response and Recovery Fund

Project 6: County Cyber Security	
Benefits (Losses Avoided):	• Ensures public security, safety of sensitive data, functionality of government facilities and county resources. • Avoids electrical blackouts, failure of government equipment, breaches of security and confidential information, disruption of communication networks
Ideas for Integration:	Creating a plan to mitigate and improve the response to potential cyber threats.
Timeline:	Ongoing

Natural Systems Protection

Mitigation Action Items & Project Sheets

Table 6-6: Natural System Protection Mitigation Action Items

ID #	Mitigation Action	Hazard(s)	Responsible Agency	Timeframe
NSP #1	Review and update plans regarding stream and river setbacks and require riparian buffers of at least 35-50 feet with tree planting.	Flood	Engineering, Planning, and Zoning	Short-term
NSP #2	Consider planting various types of vegetation in landslide prone areas to increase soil stability through root length and strength and by absorbing precipitation.	Landslide	Engineering, Planning, and Zoning	Short-term
***NSP #3**	Stormwater BMP Project Assessment – County and Municipal Owned Critical Facilities. 1. Assess county and municipal-owned critical facilities and verify aerial observations related to suitability/space for stormwater BMP projects and lessening impervious surfaces at these locations. 2. Reduce the urban heat island effect, beginning with county and municipal-owned properties.	Extreme Heat, Thunderstorm, Flood	Engineering, Planning, and Zoning	Short-term
***NSP #4**	Complete a Green Infrastructure Plan for Jefferson County. Include identification of areas for bio-retention.	Flood	Engineering, Planning and Zoning	Short-term
***NSP #5**	Coordinate with USDA APHIS and other professional agricultural agencies to create early detection and prompt eradication program	Invasive Species	Engineering, Planning, and Zoning	Short-term
***NSP #6**	Coordinate efforts between Region 9 and adjacent counties to identify groundwater recharge areas and sensitive groundwater areas. Work closely with the municipalities to enforce infiltration and groundwater recharge requirements in these areas to reduce the impacts of drought.	Drought	Engineering, Planning, and Zoning	Short-term

Project 7: Green Infrastructure Plan	
Action Item(s):	**NSP #1:** Review and update plans regarding stream and river setbacks and require riparian buffers of at least 35-50 feet with tree planting. **NSP #2:** Consider planting various types of vegetation in landslide prone areas to increase soil stability through root length and strength and by absorbing precipitation. **NSP #3:** Stormwater BMP Project Assessment – County and Municipal Owned Critical Facilities. 1. Assess county and municipal-owned critical facilities and verify aerial observations related to suitability/space for stormwater BMP projects and lessening impervious surfaces at these locations. 2. Reduce the urban heat island effect, beginning with county and municipal-owned properties. **NSP #4:** Complete a Green Infrastructure Plan for Jefferson County. Include identification of areas for bio-retention. **NSP #6:** Coordinate efforts between Region 9 and adjacent counties to identify groundwater recharge areas and sensitive groundwater areas. Work closely with the municipalities to enforce infiltration and groundwater recharge requirements in these areas to reduce the impacts of drought.
Project Title:	**Green Infrastructure Plan**
Hazard(s):	Flood, Landslide, Extreme Heat, Thunderstorm, Drought
Location(s):	Countywide & Municipalities
Project Discussion:	In regard to stream and river setbacks, the current Jefferson County Zoning and Land Development Ordinance states: • *All development adjacent to a Sensitive Natural Area shall have a buffer of natural vegetation. The buffer shall meet the current Federal standard except as required.* • *Any development, other than residential development, which takes place after the adoption of this Ordinance must maintain a five hundred (500) foot buffer strip from the existing banks of the Potomac and Shenandoah Rivers.* The ordinance could be modified to state that a 35-50 feet riparian buffer be required along all waterways. A riparian buffer is a natural strip of vegetation next to a stream or a creek that protects it from pollution. A riparian buffer also helps protect sources of drinking water. In addition, a riparian buffer utilized within landslide prone areas can serve to prevent soil instability. Trees such as red bud, service berry and many of the fruit bearing trees are appropriate for riparian areas as well as a variety of shrubs such as silky dogwood, red osier dogwood, meadowsweet, and black haw viburnum. Both of which would work to anchor soils and protect waterways. Stormwater management reduces or eliminates the negative impacts of stormwater runoff. Today, stormwater management includes controlling flooding, reducing erosion, and improving water quality. This can be accomplished by implementing what are known as Best Management

Project 7: Green Infrastructure Plan	
	Practices (BMPs). BMPs are structural, vegetative, or managerial practices used to treat, prevent, or reduce water pollution. As part of the Plan Update, critical facilities were assessed for vulnerability and capabilities. The listing of these facilities are included in Appendix F. The initial step in the analysis is to examine critical facility parcels using satellite imagery to determine if the parcel has room for stormwater BMP projects such as planting projects and mitigating impervious surface projects. The next step in this process would be to verify these initial observations and determine if potential projects would be feasible at the recommended sites. An in-person assessment of each city-owned facility location would help determine site-specific suitability for these types of projects. If a site is determined to have space and be suitable for stormwater BMPs such as planting projects and mitigation of impervious surfaces, then some considerations are as follows: • What is the impact that these projects would have on current conditions at the site? And do the benefits outweigh the costs? • What level of coordination is possible with existing community groups for proposed planting projects? Additionally, planting projects, particularly tree planting projects, could help reduce the urban heat island effect. Properties should be examined for: • Increased tree plantings around buildings to shade parking lots and along public rights-of-way. • Encouraging installation of green roofs, which provide shade and remove heat from the roof surface and surrounding air. • When replacing or upgrading roofs at these locations, use cool roofing products that reflect sunlight and heat away from the building. Green infrastructure collects stormwater from streets, sidewalks, and other hard surfaces before it can enter the sewer system or cause local flooding. By reducing the amount of stormwater that flows into the sewer system, green infrastructure helps prevent sewer overflows and improves the health of local waterways. Natural groundwater recharge occurs as precipitation falls on the land surface, infiltrates into soils, and moves through pore spaces down to the water table. Natural recharge also can occur as surface-water leakage from rivers, streams, lakes, and wetlands. Widespread development has created a critical need to plan for and regulate possible environmental impacts. A green infrastructure plan is a strategically planned network of natural and semi-natural areas with other environmental features, designed and managed to deliver a wide range of ecosystem services, while also enhancing biodiversity.

Project 7: Green Infrastructure Plan	
	Incorporating all the elements above into the green infrastructure plan would assist in accomplishing the actions listed above.
Responsible Entity:	Jefferson County Department Of Engineering, Planning, And Zoning Jefferson County Department of Public Works Jefferson County Parks & Recreation
Partners:	West Virginia Rivers Coalition Conservations Districts United States Geological Survey (USGS) United States Department of Agriculture (USDA) Department of Natural Resources (DNR) Development Authority WVU Extension Shepherd University Developers Utility Companies
Cost Estimate:	Staff Time/Annual Budget for all actions Impervious surfaces mitigation projects: location and size dependent. Tree planting projects: the average cost of tree planting is $300 but can vary depending upon the type and location. Green roof cost: national average cost is between $15 and $50 per square foot. Green Infrastructure Planning Grant - $30,000-50,000
Potential Funding:	Stormwater BMP Project Assessment - FEMA Hazard Mitigation Grant Program (Flood Risk Reduction), Building Resilient Infrastructure and Communities (BRIC) Community Block Development Grant (CDBG) Green Infrastructure Plan - US Environmental Protection Agency's Section 319 Nonpoint Source Program 12 and the Urban Waters Small Grants Program (UWSG) National Estuary Program Grants
Benefits (Losses Avoided):	• Addresses the impacts of extreme heat • Filter stormwater • Mitigate summer air temperatures • Increase planting reduce harmful pollutants • Greener spaces have physical and mental health benefits to residents • Maintenance shortfalls for BMPs
Ideas for Integration:	• MS4 Reporting • Tree mitigation issues • Current tree canopy goals • Comprehensive Plan – County and Municipal
Timeline:	1 year – Initial Planning Phase 2-3 years – Final Plan & Implementation

Project 8: Invasive Species Detection & Eradication	
Action Item(s):	**NSP #5:** Coordinate with USDA Animal and Plant Health Inspection Service (APHIS), and other professional agricultural agencies to create early detection and a prompt eradication program.
Project Title:	**Invasive Species Detection & Eradication**
Hazard(s):	Invasive Species
Location(s):	County & Municipalities
Project Discussion:	According to USDA APHIS, nonnative species that cause harm are collectively known as invasive species. Human activity such as trade, travel and tourism have all increased substantially, increasing the speed and volume of species movement to unprecedented levels. Invasive species are often unintended hitchhikers on cargo and vehicles. Still more species are deliberately introduced as pets, ornamental plants, crops, food, or for recreation, pest control or other purposes. USDA's National Invasive Species Information Center has developed the Early Detection and Rapid Response (EDRR). The EDRR is a coordinated set of actions to find and eradicate new and emerging invasive species in a specific location before they can spread and cause harm. By researching and mapping trends in the migration of invasive and native species, practices, and regulations to prevent invasive species while supporting native species can be developed. Early detection is one of the most cost-effective and ecologically viable methods for controlling invasive species. Early interventions are more likely to be successful, while long-term management typically have higher association costs. The USDA's Reporting website provides information and resources for how and where to report suspected invasive species. The USDA's Take Action Against Invasive Species also provides information on how citizens can help to prevent and control invasive species. 
Responsible Entity:	Jefferson County Department Of Engineering, Planning, And Zoning
Partners:	WVU Extension Shepherd University USDA DNR Conservation Districts Farmland Protection Board
Cost Estimate:	Staff Time
Potential Funding:	Annual Operating Budget National Estuary Program Grants

Project 8: Invasive Species Detection & Eradication	
Benefits (Losses Avoided):	Biodiversity and ecosystem benefits.
Ideas for Integration:	List animals to monitor and map (background research); find a PHD student to lead
Timeline:	Ongoing

Education & Awareness Program

Mitigation Action Items & Project Sheets

Table 6-7: Education & Awareness Program Mitigation Action Items

ID #	Mitigation Action	Hazard(s)	Responsible Agency	Timeframe
EAP #1	Continue to work with non-governmental organizations (youth services, professional, religious) to promote mitigation education and awareness.	All hazards	Homeland Security and Emergency Management	Short-term
EAP #2	Create materials that are targeted towards tourist populations. Work with the Jefferson County Convention and Visitors Bureau, the US Park Service, and others to alert tourists to potential natural hazard areas and what to do if a natural or man-made hazard occurs during their visit to Jefferson County.	All hazards	Homeland Security and Emergency Management & Parks and Recreation	Long-term
EAP #3	Develop and deliver information to all county residents through community groups, publications town meetings, training seminars and the county website to promote preparedness through preparation and provide hazard related information that is easily accessible. The plan is to expand and update the website as needed and as appropriate in a timely manner to benefit all County residents. Website updates should include Increase education and awareness about shelter-in-place facts, earthquake awareness, including measures to take to safe-proof homes and proper procedures to take to safeguard against and prepare for winter storms. Send information to all municipalities for posting and/or dissemination.	All hazards	Homeland Security and Emergency Management	Short-term
EAP #4	Continue to work with the Jefferson County school system to promote hazard mitigation education and awareness and discuss ways to better integrate mitigation into the curriculum. Implement the Pillowcase Project in schools, libraries to teach children about disaster preparedness.	All hazards	Homeland Security and Emergency Management	Short-term
EAP #5	Form a partnership amongst county agencies to conduct periodic exercises for all hazards. Primary focus on school bus accident and MCI.	All hazards	Homeland Security and Emergency Management	Short-term
EAP #6	Conduct public awareness and education campaigns to target people living near dams and the implications of constructing dams.	Dam Failure	Homeland Security and Emergency Management	Long-term
EAP #7	Educate the public on the benefits of purchasing flood insurance and increase flood insurance users in Jefferson County. Create displays for use at public events (health fair, public awareness day, and county fair). This display would include pictures and information, such as that contained in FEMA's Retrofitting for Homeowners Guide, Elevating Your Flood Prone Home, Elevating Residential Structures, and information on the NFIP.	Flood	Engineering, Planning, and Zoning & Homeland Security and Emergency Management	Short-term

EAP #8	Develop and distribute educational materials concerning erosion and sediment control and slope stabilization to assets located in landslide prone areas, including the proper installation of erosion control blankets, turf reinforcement mats, silt fences, filter bags, channel dikes and dams and turbidity barriers.	Landslide, Flooding	Engineering, Planning, and Zoning & Homeland Security and Emergency Management	Long-term
EAP #9	Coordinate with the National Weather Service (NWS) to warn residents of impending severe wind, tornado, thunderstorm, hailstorm conditions.	Severe Thunderstorm	Homeland Security and Emergency Management	Short-term
EAP #10	Research and implement successful programs for preventing sexual assault on college campuses.	Civil Disturbance	Homeland Security and Emergency Management	Short-term
EAP #11	Meet with groups of potential volunteers to attempt to increase the number of trained responders. Groups will include all county fire departments, doctors, nurses and EMS personnel who may become first responders in a bio-terrorism event.	Civil Disturbance, Terrorism	Homeland Security and Emergency Management	Long-term
EAP #12	Encourage residents and businesses to maintain their property in or near forested areas (including short grass; thinned trees and removal of low hanging branches, cleaning of dead or dry leaves, needles, twigs, etc.), and to create a buffer zone (defensible space) between structures and adjacent forests.	Wild and Urban Fires	Homeland Security and Emergency Management & Engineering, Planning, and Zoning	Long-term
EAP #13	Create displays for children's programs that teach fire 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.	Wild and Urban Fires	Homeland Security and Emergency Management	Short-term
*EAP #14	Encourage the purchase of flood insurance. Specifically targeting properties outside of the mapped 1-percent annual chance flood zone also known as the Special Flood Hazard Area (SFHA). Use messaging centered on climate change and resulting flooding that is occurring outside of the SFHA.	Flood	Engineering, Planning, and Zoning & Homeland Security and Emergency Management	Short-term
*EAP #15	Develop 5-year training plan specific to Incident Management position-specific training.	All hazards	Homeland Security and Emergency Management	Short-term
*EAP #16	Target 65 and older population on fire safety.	Wild and Urban Fires	Homeland Security and Emergency Management	Short-term

*EAP #17	Educate the public on proper use of generators during a power outage. Carbon monoxide poisoning can be a major issue if generators, kerosene heaters, and propane heaters are used inappropriately.	Utility Interruptions	Homeland Security and Emergency Management	Short-term
*EAP #18	Utilize pamphlets and articles about the warning signs and the potential damages of thunderstorms and lightning strikes.	Thunderstorm	Homeland Security and Emergency Management	Short-term
*EAP #19	Create an informational brochure and/or digital media to inform/educate local farmers and residents on the potential effects of an infestation.	Invasive Species	Homeland Security and Emergency Management	Short-term
*EAP #20	Increase awareness of cyber threats and continue to provide public/private sector cyber security outreach.	Cyber Terrorism	Information Technology & Homeland Security and Emergency Management	Long-term

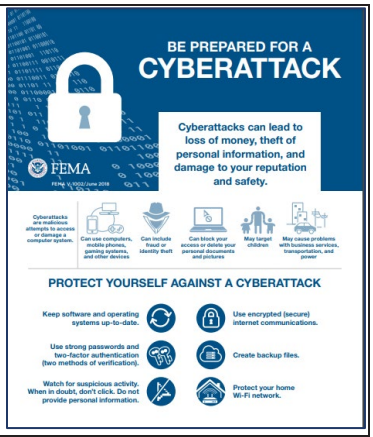
Project 9: National Flood Insurance Program	
Action Item(s):	**EPA #7:** Educate the public on the benefits of purchasing flood insurance and increase flood insurance users in Jefferson County. Create displays for use at public events (health fair, public awareness day, and county fair). This display would include pictures and information, such as that contained in FEMA's Retrofitting for Homeowners Guide, Elevating Your Flood Prone Home, Elevating Residential Structures, and information on the NFIP. **EPA #14:** Encourage the purchase of flood insurance. Specifically targeting properties outside of the mapped 1-percent annual chance flood zone also known as the Special Flood Hazard Area (SFHA). Use messaging centered on climate change and resulting flooding that is occurring outside of the SFHA.
Project Title:	**National Flood Insurance Program**
Hazard(s):	Flooding
Location(s):	Areas prone to flooding within the County.
Project Discussion:	The National Flood Insurance Program (NFIP) is a FEMA managed program delivered to the public by a network of more than fifty insurance companies and NFIP Direct. The program is built to provide insurance in an effort to help reduce the socio-economic impact of floods. When just one inch of water in a home can cost more than $25,000 in damage, flood insurance can be the difference between recovery and financial devastation. As of April 1, 2023, FEMA has fully implemented the National Flood Insurance Program's (NFIP) pricing methodology called Risk Rating 2.0. The methodology leverages industry best practices and innovative technology to enable FEMA to deliver rates that are actuarily sound, equitable, easier to understand and better reflect a property's flood risk.

	A major part of FEMA's NFIP transformation is Risk Rating 2.0, which fundamentally changes the way FEMA prices insurance and determines an individual property's flood risk. Risk Rating 2.0 focuses on equity in action, with individuals no longer paying more than their share in flood insurance premiums based on the value of their homes. An estimated two-thirds of policyholders with older pre-FIRM homes will see a premium decrease. With Risk Rating 2.0, FEMA now has the capability and tools to address rating disparities by incorporating more flood risk variables. These include flood frequency, multiple flood types—river overflow, storm surge, coastal erosion, and heavy rainfall and distance to a water source along with property characteristics such as elevation and the cost to rebuild. Under the old rating methodology policy holders had seen an average annual increase of just over 11% or $8 per month. If Risk Rating 2.0 is not implemented, 100% of NFIP policyholders will continue to see rate increases year after year. Premiums are ultimately driven by variables that an individual policyholder can control. Upon receipt of a premium, a policyholder can change the parameters (such as the level of coverage limits, deductibles, and other additional data or take a mitigation action) that impact their property's unique rate. Review the Risk Rating 2.0 State Profiles interactive map: Risk Rating 2.0: Projected Premium Changes by Zip Code - All NFIP Policies to view projected premium changes for all NFIP policyholders by zip code. The data in this dashboard are FEMA's analysis of NFIP policyholder data. The analysis considers only the differences between May 2020 premiums (based on the old rating system) and October 2021 premiums (Risk Rating 2.0); the analysis does not consider typical premium increases that might have occurred without Risk Rating 2.0. The projected premium changes displayed in the interactive map could be used to illustrate the policy savings from using Risk Rating 2.0. In addition, FEMA's Discount Explanation Guide and Rate Explanation Guide could be reviewed with policy holders. Also Risk Rating 2.0: Equity in Action is available for agents and provides answers to frequently asked questions and shareable marketing resources to help clients understand their property's unique flood risk. Partner with FEMA Region 3 and local Insurance Agencies to hold a workshop to discuss Risk 2.0, zip code level data on flood insurance policies, and mitigation practices which reduce risk and insurance rates.
Responsible Entity:	Jefferson County Office of Planning & Zoning Certified Floodplain Manager
Partners:	FEMA Region 3 Insurance Agencies Jefferson County Office Of Homeland Security And Emergency Management

Cost Estimate:	Dependent on the method of outreach, training opportunities, and the type of workshops conducted to discuss Risk Rating 2.0.
Potential Funding:	Homeland Security Grants FEMA Building Resilient Infrastructure and Communities (BRIC) Flood Mitigation Assistance Grant Program (FMA)
Benefits (Losses Avoided):	• Increases and helps to retain the amount of flood insurance policyholders in the County • Increases resilience to flood hazards • Outreach activities can increase the County's CRS rating, which in turn lowers premiums.
Ideas for Integration:	• Collaborate education and outreach efforts with local and regional conferences, including for topics such as stormwater management and realtors/flood insurance. • Planning documents
Timeline:	Ongoing

Project 10: Generator Safety Tips	
Action Item(s):	**EPA #17:** Educate the public on proper use of generators during a power outage. Carbon monoxide poisoning can be a major issue if generators, kerosene heaters, and propane heaters are used inappropriately.
Project Title:	**Generator Safety Tips**
Hazard(s):	Utility Interruptions
Location(s):	Countywide & Municipalities
Project Discussion:	Power outages can be expected at any time of year, on a nearly monthly basis. Iced power lines; falling tree limbs due to ice, wind, or lightning strikes; and vehicle incidents damaging power lines, or their support poles can all be reasons for power outages. OSHA's Fact Sheet about portable generators states the following hazards are associated with generators: • Shocks and electrocution from improper use of power or accidentally energizing other electrical systems. • Carbon monoxide from a generator's exhaust. • Fires from improperly refueling a generator or inappropriately storing the fuel for a generator. • Noise and vibration hazards. The American Red Cross provides information on How to Choose a Generator, Using a Generator at Home, and How to Prevent Carbon Monoxide (CO) Poisoning When Using a Generator. For public awareness, fire departments could provide this information on flyers or post on social media.

	Generator safety tips such as those provided by American Red Cross's Safe Generator Use webpage could be disseminated as well.
Responsible Entity:	Fire Departments Public Relations/Public Information Officer
Partners:	Jefferson County Office Of Homeland Security And Emergency Management
Cost Estimate:	Staff Time Material Cost Advertisement Cost
Potential Funding:	Annual Operating Budget
Benefits (Losses Avoided):	To keep operations running and maintain continuity within organizations. Educating the public on generator safety helps prevent property damage and loss of life.
Ideas for Integration:	Fire Department Outreach Public Announcement Advertisements
Timeline:	Ongoing
Project 11: Cyber Preparedness	
Action Item(s):	**EPA #22:** Increase awareness of cyber threats and continue to provide public/private sector cyber security outreach.
Project Title:	**Cyber Preparedness**
Hazard(s):	Cyber Terrorism
Location(s):	Countywide & Municipalities
Project Discussion:	Similar to traditional response to a natural disaster, communities must also be ready to respond to a "cyber disaster" as a cyber-attack can trigger physical consequences. These physical consequences could result in significant impacts to governments, businesses, and individuals. Cyber terrorism is the convergence of cyberspace and terrorism. It refers to unlawful attacks and threats of attacks against computerized systems, networks, and the information stored within. Cyber terrorism is done to intimidate or coerce a government or its people to further political or social objectives. It is important to be prepared for such attacks and to have the best possible preventative security measures in place. To know what to look for by studying prior history of bordering counties that have dealt with such attacks is a good start. Knowing what can be done in order to prevent the possibility of a breach in cyber security through reviewing past events, surveying, and assessing our current capabilities is key to mitigating potential future attacks. Putting a plan of action in place with this in mind helps keep servers secure and out of reach to those that mean harm.

	FEMA's Be Prepared For A Cyberattack fact sheet could be distributed to inform the public and private section ways to prevent a cyberattack, how to limit damage during an attack, and how to file a report after an attack. Furthermore, FEMA's Preparedness Community provides additional information on cyberattacks including protective actions. The link to FEMA Preparedness Community: Cyberattack could be disseminated with the fact sheet. 
Responsible Entity:	Jefferson County Office of Information Technology
Partners:	Jefferson County Office Of Homeland Security And Emergency Management
Cost Estimate:	Staff Time Material Cost Advertisement Cost
Potential Funding:	Annual Operating Budget State and Local Cybersecurity Grant Program (SLCGP) Cyber Response and Recovery Fund
Benefits (Losses Avoided):	To avoid loss of data, control, and other IT services.
Ideas for Integration:	Communications between agencies and quarterly meetings amongst different agencies.
Timeline:	Ongoing

Emergency Services & Public Health

Mitigation Action Items & Project Sheets

Table 6-8: Emergency Services & Public Health Mitigation Action Items

ID #	Mitigation Action	Hazard(s)	Responsible Agency	Timeframe
ES/PH #1	Conduct back-up power surveys for all critical infrastructure and an assessment of applicability of renewable energy sources as a potential backup power supply.	All hazards	Homeland Security and Emergency Management	Long-term
ES/PH #2	Pre-identify caregivers or volunteers to partner them with vulnerable populations to ensure vulnerable populations are taken care of before, during, and after emergencies.	All hazards	Homeland Security and Emergency Management	Long-term
ES/PH #3	Identify strengths and resources within the organization that can be utilized to implement mutual aid during emergencies. Create mutual aid agreements with identified partners.	All hazards	Homeland Security and Emergency Management	Long-term
ES/PH #4	Make arrangements or otherwise establish mass morgue facilities to be used following potential mass casualty events.	All hazards	Homeland Security and Emergency Management	Long-term
ES/PH #5	Pre-wire critical facilities for generators and provide backup generators for all critical facilities including fire departments, water/wastewater treatment plants, and designated shelters that do not yet have them.	All hazards	Homeland Security and Emergency Management	Short-term
ES/PH #6	Provide information about local, regional, state, and federal training opportunities to fire departments, EMS, ambulance services, and other emergency responders and continue existing education and training efforts of first responders and emergency personnel.	All hazards	Homeland Security and Emergency Management	Short-term
ES/PH #7	Teach Community Emergency Response Team (CERT) classes in Jefferson County. Work with municipalities to host classes within their jurisdiction.	All hazards	Health Department & Homeland Security and Emergency Management	Short-term
ES/PH #8	Ensure the public is aware of shelter locations in times of need through outreach campaigns that focus on shelter education and develop adequate emergency shelter and evacuation plans for animals (domestic pets, livestock, and wildlife). Establish a committee representative of all areas of the county that will include veterinarians, pet store owners, the Humane Society, animal shelters, the WVU Extension Service and other interested parties to work on animal -specific evacuation and sheltering needs.	All hazards	Health Department & Homeland Security and Emergency Management	Short-term
ES/PH #9	Train personnel and create an in-county hazmat team to reduce the use of out-of-county resources and increase in-county capabilities.	Hazmat	Homeland Security and Emergency Management	Short-term

ES/PH #10	Apply for Hazardous Materials Emergency Preparedness (HMEP) grant from WVDHSEM to finance the development of a Commodity Flow Study to determine what hazardous materials are used, stored, and shipped through the county.	Hazmat	Homeland Security and Emergency Management	Short-term
ES/PH #11	Form a partnership of agencies to implement an active shooter training program to be delivered to houses of worship, county agencies, volunteer organizations, etc.	Civil Disturbance	Homeland Security and Emergency Management	Short-term
*ES/PH #12	Work with dam operators/owners to conduct dam safety drill/exercise over the next five years.	Dam Failure	Homeland Security and Emergency Management	Short-term
*ES/PH #13	Complete new Hazardous Materials Response Plan.	Hazmat	Homeland Security and Emergency Management	Short-term
*ES/PH #14	Offer specialized training specific to Use-of-Force, Crowd Control, and Civil Disturbances.	Civil Disturbance, Terrorism	Homeland Security and Emergency Management	Short-term
*ES/PH #15	Complete an After-Action Report and Improvement Plan (AAR/IP) on the COVID-19 Incident.	Public Health & Pandemic	Health Department	Short-term
*ES/PH #16	Complete specific training to include Naloxone administration, Fit testing for (PPE), a pandemic influenza exercise and an anthrax exercise in the next five years.	Public Health & Pandemic	Health Department & Homeland Security and Emergency Management	Short-term
*ES/PH #17	Review Situational Awareness and Reporting tools for All-Hazards used for incident operations that lend themselves to the integration of community lifelines construct. Identify tools or modify situational reporting to incorporate lifelines. Incorporating the lifelines primarily impacts how incident information is organized and reported during response. The lifelines help characterize an incident, i.e., what is happening and why it is important.	All hazards	Homeland Security and Emergency Management	Short-term
*ES/PH #18	Obtain mobile message sign boards for strategic deployment use during various hazard incidents and for targeted public messaging.	All hazards	Homeland Security and Emergency Management	Short-term

Project 12: Optimus Prime Power	
Action Item(s):	**ES/PH #1:** Conduct back-up power surveys for all critical infrastructure and an assessment of applicability of renewable energy sources as a potential backup power supply. **ES/PH #5:** Pre-wire critical facilities for generators and provide backup generators for all critical facilities including fire departments, water/wastewater treatment plants, and designated shelters that do not yet have them.
Project Title:	**Optimus Prime Power**
Hazard(s):	All Hazards
Location(s):	Countywide
Project Discussion:	During significant storm events, many small communities are isolated without basic services such as electric, and/or water and sewer services. It is necessary for essential facilities, such as Town Halls or Fire Stations, to have reliable sources of sustained electrical power to achieve continued operations for citizens to seek shelter during these events. For optimal preparedness we can inventory vulnerable communities and inventory existing facilities that could function as resilience centers; example: Town Halls, Fire Stations, or schools. If said facilities are lacking in backup generators, we can provide these assets to keep our critical facilities active in times of need. Also, an annual survey/reminder to facilities for generator maintenance serves to prevent potential issues and maintains quality. The critical facilities listing provided in Appendix F should be assessed to determine which facilities currently have generators. Next a listing of facilities lacking back-up power should be prioritized. All facilities should be reviewed and conclude if pre-wiring is necessary.
Responsible Entity:	Jefferson County Department Of Fleet And Facilities Management Jefferson County Office Of Homeland Security And Emergency Management
Partners:	Electrical Contractors FirstEnergy
Cost Estimate:	$500,000
Potential Funding:	FEMA Building Resilient Infrastructure and Communities (BRIC) FEMA Hazard Mitigation Grant Program (HMGP)
Benefits (Losses Avoided):	Safety, security, health, and wellness of community.
Ideas for Integration:	Facilities Maintenance Plans
Timeline:	Ongoing

Project 13: Citizen Preparedness Training and Outreach	
Action Item(s):	**ES/PH #7:** Teach Community Emergency Response Team (CERT) classes in Jefferson County. Work with municipalities to host classes within their jurisdiction. **ES/PH #8:** Ensure the public is aware of shelter locations in times of need through outreach campaigns that focus on shelter education and develop adequate emergency shelter and evacuation plans for animals (domestic pets, livestock, and wildlife). Establish a committee representative of all areas of the county that will include veterinarians, pet store owners, the Humane Society, animal shelters, the WVU Extension Service and other interested parties to work on animal -specific evacuation and sheltering needs. **ES/PH #16:** Complete specific training to include Naloxone administration, Fit testing for (PPE), a pandemic influenza exercise and an anthrax exercise in the next five years.
Project Title:	**Citizen Preparedness Training and Outreach**
Hazard(s):	All Hazards
Location(s):	Countywide & Municipalities
Project Discussion:	The Community Emergency Response Team (CERT) program educates people about disaster preparedness for hazards that may impact their area and trains citizens in basic disaster response skills, such as fire safety, light search and rescue, team organization, and disaster medical operations. By working with municipalities to teach CERT classes within their jurisdictions, this could better prepare the public for hazards that threaten their homes and communities. It is important to establish and communicate to the public an adequate emergency action plan in times of need. This includes emergency shelter and/or evacuation plans for domestic pets, livestock, and wildlife. Appointing a committee representative from interested parties which may include veterinarians, pet store owners, the Humane Society, animal shelters, and the WVU Extension Service, to serve in communicating specific evacuation and sheltering needs. Participants of the CERT program could assist in shelter outreach campaigns. Naloxone is a synthetic drug, similar to morphine, which blocks opiate receptors in the nervous system. By training citizens in the ability to recognize the signs of an opioid overdose and administer the opioid overdose reversal drug naloxone, the casualties caused by the opioid crisis could diminish. Narcan training could be incorporated into the CERT training. Citizens could promote awareness through social media using slogans such as: **Prepare or Die, Narcan or Narcan't.** According to OSHA, fit testing for PPE is to be conducted at a minimum annually to ensure the effectiveness of PPE and the safety of these individuals

Project 13: Citizen Preparedness Training and Outreach	
	using said equipment. Proper PPE equipment for healthcare staff delivering patient care in the event of an outbreak such as influenza is extremely important. Training for an influenza and/or anthrax outbreak is vital to public safety as well. Exercises involving public education regarding these outbreaks better prepares us for the potential of such a disaster.
Responsible Entity:	Jefferson County Health Department Jefferson County Homeland Security and Emergency Management
Partners:	American Red Cross Local Emergency Planning Committee (LEPC)
Cost Estimate:	< $1,000
Potential Funding:	Hazardous Materials Emergency Planning (HMEP) Grant Program
Benefits (Losses Avoided):	Expanding public knowledge in first aid.
Ideas for Integration:	Pre-identify caregivers or volunteers to partner them with vulnerable populations to ensure vulnerable populations are taken care of before, during, and after emergencies.
Timeline:	Ongoing
High Priority	

Project 14: Hazard Materials Response Plan and Training	
Action Item(s):	**ES/PH #9:** Train personnel and create an in-county hazmat team to reduce the use of out-of-county resources and increase in-county capabilities. **ES/PH #13:** Complete new Hazardous Materials Response Plan.
Project Title:	**Hazard Materials Response Plan and Training**
Hazard(s):	Hazardous Materials Incident
Location(s):	Jefferson County
Project Discussion:	By providing first responders with the training and optimal equipment to manage hazardous materials and dangerous goods we can ensure the health and safety of our workers, workplaces, environments, and overall public health. First responders would have the ability to isolate, identify, and contain incidents before they have the opportunity to become a public health issue. Jefferson County could work with the West Virginia Emergency Management for hazmat training. According to West Virginia Emergency Management, WV DHSEM has entered into an agreement with WVU Fire Service Extension to provide basic and advanced hazardous material courses. In addition to providing our first responders with the necessary tools to properly deal with hazardous materials Jefferson County can implement a Hazardous Materials Emergency Response Plan for optimal preparedness.
Responsible Entity:	Jefferson County Homeland Security and Emergency Management Local Emergency Planning Committee (LEPC)
Partners:	West Virginia Emergency Management West Virginia Department of Transportation-Division of Highway United States Environmental Protection Agency State of West Virginia, Department of Environmental Protection (DEP) Mutual Aid: Berkeley, Washington, Loudon.
Cost Estimate:	$30,000
Potential Funding:	Hazardous Materials Emergency Planning (HMEP) Grant Program Consolidated Rail Infrastructure and Safety Improvement Grants Natural Gas Distribution Infrastructure Safety and Modernization Grants
Benefits (Losses Avoided):	Decreased response time, increased regional response.
Ideas for Integration:	Commodity Flow Study Emergency Operations Plan
Timeline:	1-3 years
High Priority	

Municipal

Mitigation Action Items

As part of the Mitigation Workshop held on July 26, 2023, municipal representatives worked together as a group to identify municipal specific action items. The following actions were selected as municipal action items for this plan update, Table 6-9. *Note, action items are inclusive of all municipalities unless otherwise specified within the mitigation action.* Table 6-10 includes Municipal Priority Mitigation Action Items.

Table 6-9: Municipal Mitigation Action Items

ID #	Municipal Mitigation Action	Hazard(s)
MUN #1	Consider joining FEMA's Community Rating System (CRS) to decrease the cost of flood insurance for residents within municipalities. Partner with the County to complete activities that will result in the obtainment of CRS points.	Flood
MUN #2	Develop Continuity of Operations Plan to ensure government services are provided prior, during, and after hazard incidents.	All hazards
MUN #3	Install generators and/or transfer switch for mobile generators, as applicable at City/Town Halls.	Utility Interruptions
MUN #4	Obtain mobile message sign boards for strategic deployment use during various hazard incidents and for targeted public messaging.	All hazards
MUN #5	Conduct back-up power surveys for all critical infrastructure and an assessment of applicability of renewable energy sources as a potential backup power supply.	All hazards
MUN #6	Review all existing regulations, comprehensive plans, capital improvement plan (CIP) and Emergency Operation Plan (EOP) to ensure that designated growth areas are not in hazard areas. Review existing regulations to ensure adequacy in reducing the amount of future development in identified hazard areas.	All hazards
MUN #7	Pre-wire critical facilities for generators and provide backup generators for all critical facilities including fire departments, water/wastewater treatment plants, and designated shelters that do not yet have them.	All hazards
MUN #8	Teach Community Emergency Response Team (CERT) classes in Jefferson County. Work with municipalities to host classes within their jurisdiction.	All hazards
MUN #9	Create materials that are targeted towards tourist populations. Work with the Jefferson County Convention and Visitors Bureau, the US Park Service, and others to alert tourists to potential natural hazard areas and what to do if a natural or man-made hazard occurs during their visit to Jefferson County.	All hazards
MUN #10	Develop and deliver information to all county residents through community groups, publications town meetings, training seminars and the county website to promote preparedness through preparation and provide hazard related information that is easily accessible. The plan is to expand and update the website as needed and as appropriate in a timely manner to benefit all County residents. Website updates should include Increase education and awareness about shelter-in-place facts, earthquake awareness, including measures to take to safe-proof homes and proper procedures to take to safeguard against and prepare for winter storms. Send information to all municipalities for posting and/or dissemination.	All hazards
MUN #11	Form a partnership amongst county agencies to conduct periodic exercises for all hazards. Primary focus on school bus accident and MCI.	All hazards
MUN #12	Coordinate with local private contractors to develop mutual aid agreements for emergency snow removal, also develop a Debris Management Plan that can be implemented following a disaster occurrence.	All hazards

ID #	Municipal Mitigation Action	Hazard(s)
MUN #13	Install Uninterruptible Power Supply (UPS) systems on traffic signals.	All hazards
MUN #14	Install sensory systems that immediately shut off the flow of gas to critical infrastructure throughout the county as soon as earth movements are felt.	Earthquake, Landslide & Land Subsidence, Karst/Sink Holes
MUN #15	Educate the public on the benefits of purchasing flood insurance and increase flood insurance users in Jefferson County. Create displays for use at public events (health fair, public awareness day, and county fair). This display would include pictures and information, such as that contained in FEMA's Retrofitting for Homeowners Guide, Elevating Your Flood Prone Home, Elevating Residential Structures, and information on the NFIP.	Flood
MUN #16	Strengthen Community Rating System (CRS) program to enhance rating by undertaking outreach and training efforts such as: distribute letters to all property owners in the county regarding potential flood hazards as required for participation in the CRS. and provide training to municipalities on the CRS program and encourage them to participate.	Flood
MUN #17	Consider implementing open space designations in landslide prone areas, to keep those areas undeveloped.	Landslide
MUN #18	Develop and distribute educational materials concerning erosion and sediment control and slope stabilization to assets located in landslide prone areas, including the proper installation of erosion control blankets, turf reinforcement mats, silt fences, filter bags, channel dikes and dams and turbidity barriers.	Landslide, Flooding
MUN #19	Form a partnership of agencies to implement an active shooter training program to be delivered to houses of worship, county agencies, volunteer organizations, etc.	Civil Disturbance
MUN #20	Meet with groups of potential volunteers to attempt to increase the number of trained responders. Groups will include all county fire departments, doctors, nurses, and EMS personnel who may become first responders in a bio-terrorism event.	Civil Disturbance, Terrorism
MUN #21	Consider passing ordinances to prioritize or control water use, particularly for emergency situations such as firefighting.	Wild and Urban Fires
MUN #22	Encourage the purchase of flood insurance. Specifically targeting properties outside of the mapped 1-percent annual chance flood zone also known as the Special Flood Hazard Area (SFHA). Use messaging centered on climate change and resulting flooding that is occurring outside of the SFHA.	Flood
MUN #23	Offer specialized training specific to Use-of-Force, Crowd Control, and Civil Disturbances.	Civil Disturbance, Terrorism
MUN #24	Target 65 and older population on fire safety.	Wild and Urban Fires
MUN #25	Conduct "Dark Grid" training and exercises. Emergency management officials can reduce vulnerability to utility interruption through training and exercises, such as the "Dark Grid" exercise, which prepare emergency responders and community leaders for a coordinated response to widespread utility interruptions.	Utility Interruptions

ID #	Municipal Mitigation Action	Hazard(s)
MUN #26	Educate the public on proper use of generators during a power outage. Carbon monoxide poisoning can be a major issue if generators, kerosene heaters, and propane heaters are used inappropriately.	Utility Interruptions
MUN #27	Complete an After-Action Report and Improvement Plan (AAR/IP) on the COVID-19 Incident.	Public Health & Pandemic
MUN #28	Collaborate with the Towns and adjacent jurisdictions to conduct watershed assessment(s) to include new Atlas 14 precipitation table- rainfall intensity.	Flood
MUN #29	Integration of hazard planning into both the County and Municipal planning frameworks, which will lead to development patterns and redevelopment that decreases hazard risk and vulnerability. To achieve and facilitate integration, Jefferson County and the Towns should review how planning documents, policies, codes, and programs are maintained and implemented, and the roles of people, agencies, and departments in evaluating and updating them. This depth of review will enable the County and the Towns to identify opportunities for plan integration, resulting in effective ways to reduce hazard vulnerability. Compare areas slated for growth including redevelopment with hazard risk areas.	All hazards
MUN #30	Develop an Extreme Heat Emergency Plan identifying triggers, surveillance, and actions.	Extreme Temperature
MUN #31	Identify public and/or critical facilities that lack grounding/surge protection devices.	Utility Interruptions
MUN #32	2023 Mitigation Strategies should be reviewed in reference to the Capital Improvement Plan for integration purposes. Projects that reduce risk and vulnerability to the citizens of Jefferson County should be given prioritization.	All hazards
MUN #33	Stormwater BMP Project Assessment – County and Municipal Owned Critical Facilities. 1. Assess county and municipal-owned critical facilities and verify aerial observations related to suitability/space for stormwater BMP projects and lessening impervious surfaces at these locations. 2. Reduce the urban heat island effect, beginning with county and municipal-owned properties.	Extreme Heat, Thunderstorm, Flood
MUN #34	Complete a Green Infrastructure Plan for Jefferson County. Include identification of areas for bio-retention.	Flood
MUN #35	Adjust construction regulations to include areas where mapped and verified karst terrain exists, double layers of silt fencing may be implemented, as well as hay bales or core logs along the periphery of the standard workspace area to prevent outward migration of silt and reduce runoff velocity.	Karst
MUN #36	Increase awareness of cyber threats and continue to provide public/private sector cyber security outreach	Cyber Terrorism
MUN #37	Establish a County Cyber Security and Risk Mitigation Plan to be implemented by county and 5 jurisdictions.	Cyber Terrorism
MUN #38	Prohibit or block cyber terrorism on public facilities and continuing routine server backups.	Cyber Terrorism
MUN #39	Provide annual cyber-security and awareness training to all County staff to reduce risk and occurrence of phishing and malware attacks	Cyber Terrorism

ID #	Municipal Mitigation Action	Hazard(s)
MUN #40	Monitor water supply and conserve water through public awareness campaigns conducted using news and radio stations. A survey of residential wells and public water customers should also be conducted to evaluate the status of residential drinking water in the county and identify trends.	Drought
MUN #41	Coordinate efforts between Region 9 and adjacent counties to identify groundwater recharge areas and sensitive groundwater areas. Work closely with the municipalities to enforce infiltration and groundwater recharge requirements in these areas to reduce the impacts of drought.	Drought
MUN #42	Encourage the county and municipalities to adjust their zoning ordinance to discourage development on permeable soils to reduce the impacts of drought.	Drought
MUN #43	Utilize pamphlets and articles about the warning signs and the potential damages of thunderstorms and lightning strikes.	Thunderstorm
MUN #44	Reinforce structures and infrastructure against hail and increase awareness before hailstorms with public announcements.	Hail
MUN #45	Work with the utility and cable companies to develop a plan for the preventive right-of-way maintenance of trees near powerlines particularly during the winter.	Severe Winter storm
MUN #46	Work with Harpers Ferry and Water Commission to ensure clean drinking water and establish disaster related processes. Note: This action items is specific to Bolivar only.	All Hazards
MUN #47	Review methods for reducing the amount sediment that enters into the Harpers Ferry Wastewater Treatment Plant from Elk Run. Note: This action items is specific to Harpers Ferry only.	Karst
MUN #48	Install fencing around Harpers Ferry Wastewater Treatment Plant to prevent possible contamination such as chemical injection into the open basin. Note: This action items is specific to Harpers Ferry only.	Terrorism
MUN #49	Ensure the newly upgraded computer control at the Harpers Ferry Wastewater Treatment Plant has cyber security in-place. Develop a cyber security threat mitigation strategy to reduce the impact of a cyber security incident. Note: This action items is specific to Harpers Ferry only.	Cyber Terrorism
MUN #50	Request the Town of Bolivar to complete the capabilities assessment survey as part of the annual plan update.	All Hazards

As a final step in the process, each municipality was asked to select the top 3-5 municipal mitigation actions that resonate the most for their specific jurisdiction. Table 6-9 lists the priority mitigation action items selected by each municipality.

Table 6-10: Municipal Priority Mitigation Action Items		
Bolivar		
ID #	**Municipal Mitigation Action**	**Hazard(s)**
MUN #2	Develop Continuity of Operations Plan to ensure government services are provided prior, during, and after hazard incidents.	All hazards
MUN #12	Coordinate with local private contractors to develop mutual aid agreements for emergency snow removal, also develop a Debris Management Plan that can be implemented following a disaster occurrence.	All hazards
MUN #45	Work with the utility and cable companies to develop a plan for the preventive right-of-way maintenance of trees near powerlines particularly during the winter.	Severe Winter Storm
MUN #46	Work with Harpers Ferry and Water Commission to ensure clean drinking water and establish disaster related processes. Note: This action items is specific to Bolivar only.	All Hazards
Charles Town		
ID #	**Municipal Mitigation Action**	**Hazard(s)**
MUN #1	Consider joining FEMA's Community Rating System (CRS) to decrease the cost of flood insurance for residents within municipalities. Partner with the County to complete activities that will result in the obtainment of CRS points.	Flood
MUN #10	Develop and deliver information to all county residents through community groups, publications town meetings, training seminars and the county website to promote preparedness through preparation and provide hazard related information that is easily accessible. The plan is to expand and update the website as needed and as appropriate in a timely manner to benefit all County residents. Website updates should include Increase education and awareness about shelter-in-place facts, earthquake awareness, including measures to take to safe-proof homes and proper procedures to take to safeguard against and prepare for winter storms. Send information to all municipalities for posting and/or dissemination.	All hazards
MUN #11	Form a partnership amongst county agencies to conduct periodic exercises for all hazards. Primary focus on school bus accident and MCI.	All hazards
MUN #13	Install Uninterruptible Power Supply (UPS) systems on traffic signals.	All hazards
MUN #30	Develop an Extreme Heat Emergency Plan identifying triggers, surveillance, and actions.	Extreme Temperature
Harpers Ferry		
ID #	**Municipal Mitigation Action**	**Hazard(s)**
MUN #37	Establish a County Cyber Security and Risk Mitigation Plan to be implemented by county and 5 jurisdictions	Cyber Terrorism
MUN #45	Work with the utility and cable companies to develop a plan for the preventive right-of-way maintenance of trees near powerlines particularly during the winter.	Severe Winter storm
MUN #46	Work with Harpers Ferry and Water Commission to ensure clean drinking water and establish disaster related processes. Note: This action items is specific to Bolivar only.	All Hazards
Ranson		
ID #	**Municipal Mitigation Action**	**Hazard(s)**

MUN #15	Educate the public on the benefits of purchasing flood insurance and increase flood insurance users in Jefferson County. Create displays for use at public events (health fair, public awareness day, and county fair). This display would include pictures and information, such as that contained in FEMA's Retrofitting for Homeowners Guide, Elevating Your Flood Prone Home, Elevating Residential Structures, and information on the NFIP.	Flood
MUN #16	Strengthen Community Rating System (CRS) program to enhance rating by undertaking outreach and training efforts such as: distribute letters to all property owners in the county regarding potential flood hazards as required for participation in the CRS. and provide training to municipalities on the CRS program and encourage them to participate.	Flood
MUN #22	Encourage the purchase of flood insurance. Specifically targeting properties outside of the mapped 1-percent annual chance flood zone also known as the Special Flood Hazard Area (SFHA). Use messaging centered on climate change and resulting flooding that is occurring outside of the SFHA.	Flood
MUN #35	Adjust construction regulations to include areas where mapped and verified karst terrain exists, double layers of silt fencing may be implemented, as well as hay bales or core logs along the periphery of the standard workspace area to prevent outward migration of silt and reduce runoff velocity.	Karst
MUN #45	Work with the utility and cable companies to develop a plan for the preventive right-of-way maintenance of trees near powerlines particularly during the winter.	Severe Winter Storm
Shepherdstown		
ID #	**Municipal Mitigation Action**	**Hazard(s)**
MUN #1	Consider joining FEMA's Community Rating System (CRS) to decrease the cost of flood insurance for residents within municipalities. Partner with the County to complete activities that will result in the obtainment of CRS points.	Flood
MUN #10	Develop and deliver information to all county residents through community groups, publications town meetings, training seminars and the county website to promote preparedness through preparation and provide hazard related information that is easily accessible. The plan is to expand and update the website as needed and as appropriate in a timely manner to benefit all County residents. Website updates should include Increase education and awareness about shelter-in-place facts, earthquake awareness, including measures to take to safe-proof homes and proper procedures to take to safeguard against and prepare for winter storms. Send information to all municipalities for posting and/or dissemination.	All hazards
MUN #25	Conduct "Dark Grid" training and exercises. Emergency management officials can reduce vulnerability to utility interruption through training and exercises, such as the "Dark Grid" exercise, which prepare emergency responders and community leaders for a coordinated response to widespread utility interruptions.	Utility Interruptions
MUN #37	Establish a County Cyber Security and Risk Mitigation Plan to be implemented by county and 5 jurisdictions.	Cyber Terrorism

7. Plan Maintenance

7.1. Update Process Summary

Once this plan has received approval from WVEMD and FEMA, the plan will be adopted by Jefferson County and all participating jurisdictions. This HMP Update is intended to be a 'living document.' Plan adoption is not considered the final step in the planning process, but rather as a first step to 'realization.' The plan monitoring and maintenance schedule is a cycle of events that involve periodic review, adjustments, and improvement. Plan monitoring also provides an opportunity to recognize other planning initiatives within the county that may benefit from the incorporation of risk and/or mitigation objectives detailed in this hazard mitigation plan. This section establishes a method to monitor how the plan will be evaluated and maintained in the future.

Monitoring, evaluating, and updating this plan is critical to maintaining its value and success in Jefferson County's hazard mitigation efforts. Ensuring effective implementation of mitigation activities paves the way for continued momentum in the planning process and gives direction for the future. This section explains who will be responsible for maintenance activities and what those responsibilities entail. It also provides a methodology and schedule of maintenance activities including a description of how the public will be involved on a continued basis.

7.2. Monitoring, Evaluating and Updating the Plan

Hazard mitigation planning in Jefferson County is the responsibility of all levels of government (i.e., county, and local), as well as the citizens of the County. As listed in FEMA 386-4, members of the hazard mitigation committee must continuously monitor and document the progress of the Plan's recommended actions. Under the direction of the Jefferson County Office of Homeland Security and Emergency Management the committee will meet annually and following each emergency declaration, with the purpose of reviewing the Plan. The Office of Homeland Security and Emergency Management will lead annual reviews of the plan and solicit new projects from the municipalities by sending out project opportunity forms and informing the municipalities of the opportunity to update their mitigation actions.

Each review process will ensure that the Hazard Vulnerability Analysis and Risk Assessment reflect current conditions in the counties 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. Upon each evaluation, committee members will consider whether applications should be submitted for existing mitigation grant programs. A decision to apply for funding will be based on appropriate eligibility and financial need requirements. All state and federal mitigation funding provided to the county or local municipalities will be reported in subsequent plan updates. The committee will complete a Progress Report to evaluate the status and accuracy of the

plan and record the findings. The Jefferson County Office of Homeland Security and Emergency Management will maintain a copy of these records.

The Hazard Risk table will be reviewed and any changes to rankings based on frequency or severity to profiled hazards will be documented. Municipal officials will be asked to provide mitigation action progress information each year and the Mitigation Action Plan will be updated accordingly. The committee will prepare an annual update report of the mitigation actions based on the annual report forms from the municipalities and County. The annual plan review will be scheduled each year during the week of the approval anniversary. The following questions will be considered as criteria for assessing the effectiveness of the plan:

- Has the nature or magnitude of hazards affecting the region changed?
- Are there new hazards that have the potential to impact the region?
- Is there updated, or more quantitative, risk assessment data available related to the identified hazards in the plan? Can this data be integrated into the analysis to better assess the vulnerability, and depict the risk, of communities to the hazards?
- Do the identified goals and actions address current and expected conditions?
- Have mitigation actions been implemented or completed?
- Has the implementation of identified mitigation actions resulted in expected outcomes?
- Are current resources adequate to implement the plan?
- Should additional local resources be committed to address identified hazards?
- Are there current or upcoming planning mechanisms or initiatives in which the mitigation strategy should be considered for integration?

In addition to conducting an annual review of the Plan, the committee will review the Plan within 30 days of a disaster. The Risk Assessment and Mitigation Strategy will be evaluated and any changes to community priorities or status will be documented. The plan will receive a full, detailed update every five years, as required to reflect the current risk, vulnerabilities, development trends and as mitigation actions are implemented. While an annual report will be completed each year, any state and Federal mandates from WVEMD and FEMA respectively, will be addressed in the five-year update. The municipalities will not be responsible for making any changes to the plan document as part of annual reviews; their role will consist of information for the review and report only. A copy of each Annual Plan Review will be provided to WVEMD and FEMA and included as official documentation in the next 5-year HMP update.

Additional agencies throughout the region, such as the county-level offices of emergency management and LEPCs, will actively integrate the information contained in this risk assessment into other planning initiatives, such as the maintenance of their jurisdiction- specific Emergency Operations Plans (EOPs). These documents should support the strengthening of capabilities to respond to the hazards identified by the risk assessment. As mitigation projects are implemented and risk is thus reduced, the emergency services community may need to “re-plan” its response to address what has become a more critical risk.

The committee will complete a Progress Report to evaluate the status and accuracy of the plan and record the findings. As directed by FEMA 386-4, 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.

7.3. Continued Public Involvement

The Jefferson County Office of Homeland Security and Emergency Management will ensure that the plan is posted and maintained on the County website and will continue to encourage public review and comment on the plan through information posted to the website and public notices in the local newspaper.

The citizens of Jefferson County are encouraged to submit their comments to elected officials and/or members of the Hazard Mitigation Steering Committee. To promote public participation, Jefferson County welcomed comments on the HMP for the entire planning 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 plan.

The Comprehensive Plan; Building Code, Municipal Floodplain Management Regulations, Emergency Operations Plan, and Zoning Ordinance are identified for incorporation of hazard mitigation actions once the Plan is adopted. Each of these mechanisms will continue to be used to meet the intent of this Plan, as appropriate. Likewise, as these planning mechanisms are updated, they will be considered for incorporation into the plan during the annual review process and/or the five-year cycle update.

The region and participating jurisdictions may propose additional mitigation actions for inclusion throughout the five-year cycle but must submit new mitigation actions through the Office of Homeland Security and Emergency Management which will request a plan amendment by contacting the WVEMD State Hazard Mitigation Planner. FEMA must officially approve all additions and will amend the plan by issuing an Amendment Approval letter.

7.4. 7.4 Plan Integration

There are a variety of plans that can serve as conduits through which agencies can implement mitigation actions. During a committee meeting, members discussed the types of plans their agencies kept and how they could include mitigation actions or how the plans inform mitigation. The committee also mentioned comprehensive plans, however, these are described in more detail below due to their close alignment with hazard mitigation.

Table 7-1: Jefferson County Plan Integration

Agency/Plan Owner	Plan	Incorporation of Mitigation
Eastern Panhandle Transit Authority	Transit Development Plan, 2015	• Directs development toward appropriate, low hazard areas • Provides for additional evacuation routes during emergencies and incidents
Hagerstown Eastern Panhandle Metropolitan Planning Organization	Long Range Transportation Plan, 2018	• Ensures hazard acknowledgment in long-range transportation planning • Considers response elements to the hazards identified in the mitigation plan, as appropriate, concerning transportation (e.g., evacuation) • Ensures planned transportation projects do not add to vulnerabilities (e.g., ensure projects utilize proper drainage, are properly elevated, etc.) • Considers the incorporation of green infrastructure/low-impact development as transportation projects are undertaken (e.g., permeable pavements, green streets, and alleys, etc.)
HIDTA	HIDTA Baltimore-Washington Mapping	• Identifies high risk areas for drug trafficking • Provides real-time overdose surveillance data • Outlines drug abuse prevention initiatives
JC Board of Education	Emergency Operations Plan	• Establishes and maintains effective response programs • Supports continuity of critical infrastructure and key resources • Identifies specific risk areas or certain hazards

Table 7-1: Jefferson County Plan Integration		
Agency/Plan Owner	Plan	Incorporation of Mitigation
JC GIS	Address Compliance Program, 2017	• Locates critical facilities within the county with accurate coordinates for use by responders • Pinpoints all structures in the county for quicker emergency response
JC Health Department	Eastern Compliance Program, 2017	• Identifies possible reportable diseases • Establishes protocols for responding to disease outbreaks
JC Health Department & JC Ministries	Peer Recovery Coaches Program	• Identifies strategies for implementing projects for assisting people recovering from substance abuse
JC LEPC	Advanced Commodity Flow, 2017	• Provides detailed information on the hazardous materials transported by rail in the county • Identifies mitigation, prevention, and response activities for the different substances that pass through the county
JC LEPC	Commodity Flow Study, 2016	• Provides information on the variety of hazardous materials in the county (via highway, rail, and within covered facilities)
JC LEPC	Emergency Operations Plan	• Establishes and maintains effective response programs • Supports continuity of critical infrastructure and key resources • Identifies specific risk areas or certain hazards
JC LEPC	Hazardous Materials Response Plan	• Identifies methods by which hazmat teams and first responders can respond safely to hazardous materials incidents • Identifies partners
JC LEPC	Propane Risk Assessment, 2012	• Provides general information regarding propane in the county • Identifies safety mechanisms to dealing with propane for first responders
JC LEPC	Threat and Hazard Identification Risk Assessment	• Outlines the threats and hazards in the county • Identifies gaps in resources

Table 7-1: Jefferson County Plan Integration		
Agency/Plan Owner	Plan	Incorporation of Mitigation
JC LEPC	Tier II Assessment	• Identifies the types of facilities that exist in the county • Identifies the types of materials that the facilities handle
Shepherd University	Emergency Operations Plan	• Establishes and maintains effective response programs • Supports continuity of critical infrastructure and key resources • Identifies specific risk areas or certain hazards
Shepherdstown Fire	Community Risk Reduction Plan	• Provides information on mitigative actions that people can take to reduce their risks from fires
Various	Source Water Protection Plan	• Outlines strategies for protecting various water sources

The following table outlines the elements that comprehensive plans incorporate and how they relate directly to hazard mitigation.

Table 7-2: Comprehensive Plans' Relevance to Hazard Mitigation	
Plan Element	Relevance to Hazard Mitigation
Goals & Objectives	Definition*: This section establishes goals and objectives that serve as a guide for the development and economic and social well-being of the local jurisdictions. The goals and objectives tell the world how the community wants to function and look in the future. This section provides an opportunity for local officials to acknowledge the reciprocal benefits of hazard mitigation to community-level comprehensive planning. This section also serves as a statement of the community's stance on resilience at it moves forward.
Land use	Definition: The land use element outlines the most appropriate and desirable patterns of growth and development. This section can include risk areas as key points of information for consideration as to these appropriate and desirable patterns. Incorporating mitigation in this section does not automatically imply banning development from all high hazard areas; rather, it can identify those areas where certain types of resilient construction techniques would be beneficial.

Table 7-2: Comprehensive Plans' Relevance to Hazard Mitigation	
Plan Element	Relevance to Hazard Mitigation
Transportation	Definition: The transportation element describes and presents transportation patterns and includes the entire spectrum of transportation facilities (transit, roads, bicycle and pedestrian amenities, and transit-oriented development) applicable to the jurisdiction. This section can recognize the importance of the transportation infrastructure to overall emergency and disaster preparedness. Within such a discussion, maintaining critical arterial routes can be prioritized as a mitigative measure.
Community Facilities	Definition: The community facilities element identifies the location, character and extent of public and semi-public buildings, lands, and facilities. This section provides another perspective from which to consider high-risk areas.
Development Regulations	Definition: The development regulations section identifies development tools that are the best available mechanisms to implement the plan, including streamlined review for development in designated growth areas. This section can discuss how local ordinances and regulations can be amended to account for hazard risks. As with the land use element, these regulations may recommend or require certain types of resilient construction.
Sensitive Areas	Definition: The sensitive areas element sets goals, objectives, principles, policies, and standards to protect sensitive areas from the adverse effects of development. The Land Use Article requires jurisdictions to protect streams and their buffers; the 100-year floodplain; habitats of threatened and endangered species; and steep slopes, wetlands, and agricultural and forest lands intended for resource protection or conservation. This section gives communities the option of designating high risk areas as sensitive areas.
Implementation	Definition: Recognizing the importance of designing land development regulations that implement the plan, this section is supposed to address recommendations for land development regulations. This section can include a series of actions that may be duplicated in the hazard mitigation plan (and vice versa). It allows communities to acknowledge those initiatives that overlap both community development and hazard mitigation goals.

Table 7-2: Comprehensive Plans' Relevance to Hazard Mitigation	
Plan Element	Relevance to Hazard Mitigation
Development Capacity Analysis	Definition: This section is an estimate of the total amount of development that may be built in an area under a certain set of assumptions, including land use laws and policies (e.g., zoning), environmental constraints, etc. This section can include high risk areas as a type of environmental constraint.
Municipal Growth	Definition: This element requires municipalities to identify areas for future growth consistent with their long-range visions. This section supports the multi-jurisdictional approach of this hazard mitigation plan by integrating discussions of high risk areas and their relation to areas targeted for future growth. It also provides space to consider such measures as resilient construction in municipal areas.
Water Resources	Definition: This element identifies drinking water supplies needed by projected populations. This section supports the continued operation of critical infrastructure, particularly water systems. By identifying drinking water supply needs and potential upgrades necessary to meet those needs, this section gives local officials the opportunities to discuss upgrades and other means of ensuring reliability of water during emergencies.

In Jefferson County, the county and all the jurisdictions have comprehensive plans. The following table outlines how each one of these specific plans relates to the hazard mitigation plan.

Table 7-3: Goals That Relate to Hazard Mitigation in Jefferson County Comprehensive Plans	
Goal	Hazard(s) Addressed
Jefferson County Planning and Zoning Envision Jefferson 2035 Comprehensive Plan, 2015	
Encourage the adaptive reuse of existing buildings and previously used sites within Jefferson County in context with their surroundings, paying particular attention to brownfield and greyfield sites (p.32)	Hazmat: removes pollution left by facilities.
Reduce stormwater runoff, nutrients, sediment, and waste materials that reach the Potomac and Shenandoah Rivers, as well as other water bodies through development oversight provisions (p.32)	Hazmat: reduces pollution in the water.

Table 7-3: Goals That Relate to Hazard Mitigation in Jefferson County Comprehensive Plans	
Goal	Hazard(s) Addressed
Encourage developers to build or redevelop structures that meet standards set by regional or national sustainable building organizations using emerging technologies and materials that will lower operating costs (p. 49)	All natural hazards: encourages stronger buildings that withstand weather and geological events.
Encourage local vocational institutions and educational or training entities to continue to train and educate builders, contractors, and construction workers in universal design techniques, energy efficiency, and "green" housing techniques (p. 61)	All hazards: reduces vulnerability to power outages and encourages stronger buildings.
Encourage public entities to utilize alternative and renewable energy sources for a variety of energy needs (p.93)	All hazards: reduces vulnerability to power outages from hazards.
Coordinate with the WVDOH and state and local emergency service agencies to identify additional points of ingress and egress for mountain communities off of Mission Road (p.113)	All hazards: allows for safe and effective evacuation routes during emergencies.
Review and amend the Zoning Ordinance and Subdivision Regulations to require developers design residential and non-residential subdivisions using conservation principles that would protect natural features (p.124)	All hazards: protecting natural features reduces impacts from natural hazards.
Coordinate with the West Virginia Department of Environmental Protection (WVDEP) to identify and regularly monitor hazardous materials storage sites that could potentially impact Jefferson County's waterways and ground water resources (p. 124)	Hazmat: encourages reduction of pollution in water.
Collaborate with the NRCS to support and maintain an accurate map of karst features including sinkholes and the underground cave network of Jefferson County to help property owners and developers identify sensitive areas (p. 124)	Land subsidence: identifies locations land subsidence for education.
Work with the West Virginia Division of Highways (WVDOH) to ensure that the protection of natural resources is considered when making decisions related to the location of future highway projects (p.124)	Landslides, land subsidence: directs development away from hazardous areas.

Table 7-3: Goals That Relate to Hazard Mitigation in Jefferson County Comprehensive Plans	
Goal	Hazard(s) Addressed
Reevaluate the requirements related to stream buffering along the County's waterways during site plan and subdivision development, taking into consideration the Chesapeake Bay requirements (p.125)	Hazmat: protects waterways from hazardous materials.
Partner with the Board of Health and property owners to ensure that septic systems are well-maintained in order to protect the County's groundwater resources (p. 125)	Public health crisis: reduces public health vulnerability.
Bolivar Comprehensive Plan, 2013	
Set aside and maintain more open spaces for all residents to enjoy (p. 43)	All hazards: protecting natural features reduces impacts from natural hazards.
Continue to enforce current land use/zoning ordinances (p. 43)	All hazards: encourages stronger buildings that withstand weather and geological events events.
Confine commercial enterprises to the commercially-zoned Washington Street corridor (p.43)	All hazards: directs development to established areas where vulnerabilities are known and identified.
Continue to focus on Stormwater management projects (p.44)	Flood: improves flooding from Stormwater systems.
Adopt new Stormwater management ordinances, combining them with existing ordinances to create a comprehensive and practical set of rules for all future development (p.44)	Flood: directs future development to use best practices to reduce vulnerability.
Charles Town Comprehensive Plan, 2018	
Identify and preserve those natural and scenic resources that characterize the city (p. 164) (p. 171) (p. 175)	All hazards: protecting natural features reduces impacts from natural hazards.
Increase the forest cover of the watershed (p.152)	Flood & severe thunderstorm: protecting natural features reduces impact from hazards and cascading effects.
Establish an official land use plan and evaluate existing zoning regulations to ensure compatibility (p.170)	All hazards: directs development to established areas where vulnerabilities are known and identified.
Provide for a diversity of land use types that are sustainable for the overall prosperity of the city (p.88)	All hazards: sustainability will aid in hazard mitigation.

Table 7-3: Goals That Relate to Hazard Mitigation in Jefferson County Comprehensive Plans	
Goal	Hazard(s) Addressed
Maintain and enhance emergency service response times (p.113)	All hazards: quick responses by responders will reduce threats to life and injuries
Provide safe and reliable water and wastewater service for all customers of the city (p. 138)	Public health crisis: increasing reliable water service reduces illness.
Meet all environmental standards and requirements applicable to its water and sewer system (p. 143)	Public health crisis: increasing reliable water service reduces illness.
Mitigate localized flooding from short intense storms as well as major catastrophic storm events (p.143) (p.159)	Flooding: mitigation projects reduce the impacts from flooding.
Harpers Ferry Comprehensive Plan, 2013	
Maintain the stream valleys in Harpers Ferry to protect water quality and provide additional hiking opportunities for residents and tourists (p. 8)	Flood: providing open spaces reduces the impacts on structures.
To have 40 percent of the land area in the town under tree canopy within 20 years, as recommended by American Forests to preserve, maintain and enhance the tree canopy in Harpers Ferry (p.10)	Extreme temperatures and flooding: trees provide shade that reduce heat and roots that can absorb excess water.
To have well built, safe and affordable housing for all the residents of Harpers Ferry (p.18)	Natural hazards: well-built houses are stronger and less vulnerable to the impacts of natural hazards.
To ensure a sufficient supply of potable water to the Town's current and future residents, including during drought conditions, natural disaster, or public emergencies (p. 25)	All-hazards: water is vital during emergencies; having systems in place that continue to provide it is crucial.
To control storm water run-off in a manner that protects the natural and built environment and minimizes peak run-off (p. 27)	Flooding: minimizing runoff reduces flooding downstream.
To reduce the Town's dependence on nonrenewable energy resources through conservation and development of renewable energy sources (p.28)	All-hazards: having power that is not reliant on non-renewable energies can be more reliable during emergencies.
Ranson Comprehensive, 2012	
Redevelop the city's brownfield sites (p.30)	Hazardous materials: sites that have been adequately cleaned can be redeveloped and utilized.

Table 7-3: Goals That Relate to Hazard Mitigation in Jefferson County Comprehensive Plans	
Goal	Hazard(s) Addressed
Revise the Zoning and Subdivision Ordinance via the SmartCode (p. 31, 32)	All hazards: revising codes to ensure they promote sustainable development reduces impacts from hazards.
Incentivize redevelopment and expansion in areas most appropriate to promote well designed and coordinated communities, and to prevent sprawl (p.34)	All hazards: planning development in certain adequate areas can reduce vulnerability from hazards.
Work with the City of Charles Town, Jefferson County, and other public utilities to enhance stormwater management planning for lands within shared drainage sheds and achieve consistent standards between the County and municipalities (p.66)	Flooding: partnerships that encourage flood mitigation can reduce the impacts of floods from drainage problems.
Facilitate infill and redevelopment of Old Town through the construction of sustainable municipal stormwater management facilities (p.66)	Flooding: adequate Stormwater management will reduce flooding.
Implement a Storm Water Management Program (SWMP) and associated ordinance (p.66)	Flooding: adequate Stormwater management will reduce flooding.
Require that all new commercial and residential development with lots smaller than one acre to construct a closed section storm drain system (p.66)	Flooding: adequate Stormwater management will reduce flooding.
Review storm water regulations on a regular basis to make them equal or better than those of Jefferson County (p.66)	Flooding: adequate Stormwater management will reduce flooding.
Establish a Stormwater Utility Board for the City of Ranson that will be charged with implementing watershed-based stormwater management practices (p.67)	Flooding: adequate Stormwater management will reduce flooding.
Develop a fee structure for implementation of Stormwater Management Capital Projects that will reduce flooding, improve water quality, and include projects for regional stormwater detention and flood control (p.67)	Flooding: adequate Stormwater management will reduce flooding.
Safeguard critical public infrastructure from potential security threats (p.73)	Violent disturbance and terrorism: protecting critical facilities reduces vulnerabilities.
Reduce electrical demand through energy saving design practices and alternative energy generation (p.75)	All hazards: energy that does not depend on the grid is essential during emergencies.

Table 7-3: Goals That Relate to Hazard Mitigation in Jefferson County Comprehensive Plans	
Goal	Hazard(s) Addressed
Seek opportunities to develop land for unstructured recreation in a natural setting, particularly around low land and ravines (p.77)	All hazards: open areas reduce vulnerabilities to structures and people.
Buffer any hazardous materials and proposed development and direct stormwater runoff, treated or untreated, from sinkholes (p.85)	Hazardous materials: buffers can protect source water and rivers.
Preserve or acquire the 100-year floodplains and the buffers of the streams identified on the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps (FIRM) (p.86)	Flooding: preserving and maintaining buffers along streams reduces the impacts to structures during flooding.
Encourage the use of natural drainage swales rather than visibly engineered, visually intrusive stormwater management channels in the more rural Transect zones (p.86)	Flooding: green infrastructure encourages the reduction of flooding in problem areas.
Identify and preserve wetlands by requiring wetland surveys for new developments and utilize the U.S. Corps of Engineers' recommendations for mitigation (p.86)	All hazards: preservation of wetlands can avoid development and avoid impacts from hazards on structures.
Shepherdstown Comprehensive Plan, 2014	
Growth and development will be balanced with the need to preserve open space and critical environmental and natural resources (p. 2-34)	All hazards: planned development can reduce vulnerability from a variety of hazards.
The Town will expand its corporate limits to include both adjacent developed areas as well as lands that have significant potential for future development and to meet open space goals (p. 2-42)	All hazards: adding open space gives opportunity to reduce the impacts from hazards.
Growth will be directed to those areas that have sufficient transportation and utility infrastructure capacity, as well as convenient access to other public services that are necessary to serve it (p.2-52)	All hazards: planning smart growth will ensure that new developments have the required emergency services.
Water and sewer infrastructure will be maintained to the highest standards, and operated in a manner that provides the highest quality service to utility customers and the lowest impact on the environment (p. 6-7)	Flooding and public health crisis: a well maintained sewer and water system will reduce flooding from Stormwater and avoid diseases.

Table 7-3: Goals That Relate to Hazard Mitigation in Jefferson County Comprehensive Plans	
Goal	Hazard(s) Addressed
The safety of the public will be assured through the provision of a level of police and fire protection that is sufficient to meet the needs of the community (p 6-9)	All hazards: an adequate police and fire presence will ensure the community's safety during emergencies.
The integrity and quality of land, water, air and other natural resources will be protected from negative impacts to preserve the overall environmental healthof the community (p. 8-6)	All hazards: a healthy environment can reduce the impacts from natural hazards and aide in recovery.
The community will have access to clean, efficient and sustainable energy resources (p. 8-15)	All hazards: sustainable energy sources can reduce the impacts of hazards.
Significant amounts of open space on the rural fringes of the community will be permanently protected from development and ultimately create a larger interconnected system of preserved land (p. 8-18)	All hazards: adding open space gives opportunity to reduce the impacts from hazards.

8. Plan Adoption

The Plan was submitted to the West Virginia Department of Homeland Security and Emergency Management on October 13, 2023 and forwarded to FEMA for final review and approval-pending-adoption on November 1, 2023. FEMA granted approval-pending-adoption on December 4, 2023. Full approval from FEMA was received after each jurisdiction adopted the plan.

This section of the plan includes copies of the local adoption resolutions passed by Jefferson County, and municipal governments. Adoption resolution templates are provided to assist the county and municipal governments with recommended language for future adoption of the plan.

A completed Mitigation Plan Review Tool can be seen in Appendix C.

U.S. Department of Homeland Security
Federal Emergency Management Agency
Region 3

One Independence Mall
615 Chestnut Street, 6th floor
Philadelphia, PA 19106-4404

FEMA

January 26, 2024

Gabriel Reed
State Hazard Mitigation Officer
West Virginia Emergency Management Division (WVEMD)
1700 MacCorkle Ave., SE, 6th Floor
Charleston, WV 25314

Dear Gabriel Reed:

FEMA has reviewed the Jefferson County Hazard Mitigation Plan (HMP), based on standards in Title 44 of the Code of Federal Regulations, Part 201. The items reviewed address the planning process, hazard identification and risk assessment, mitigation strategies, and plan maintenance. The plan received a "satisfactory" rating on all required criteria. It is Approvable Pending Adoption (APA) as of January 4, 2024.

Prior to final approval, each jurisdiction that took part in the Jefferson County HMP must send FEMA a resolution of adoption. Also note, each plan participant must adopt within **one year** of the APA date. Plan participants that adopt the plan after one year must validate that their information in the plan remains current. If it is not, they must make the necessary updates before submitting the adoption resolution to FEMA.

I commend you for your continued commitment to reducing future disaster losses. If you have questions, please contact me at (215) 931-5532.

Sincerely,

Sarah Wolfe, Branch Chief
Floodplain Management and Insurance Branch
FEMA Region 3

Enclosure

cc: Ginger Barnett, Mitigation/Recovery Chief, WVEMD
Stephen Allen, Director, Jefferson County Homeland Security and Emergency Management
Dick Myers, Deputy Director, Jefferson County Homeland Security and Emergency Management

BOLIVAR, WV

EST. 1825

TOWN OF BOLIVAR

RESOLUTION – TOWN OF BOLIVAR

WHEREAS natural, technological, and man-made hazards can affect the Town of Bolivar; and

WHEREAS significant structural, historical, and economic losses could result from an occurrence of a natural, technological, or man-made hazard events; and

WHEREAS undertaking mitigation projects during pre-disaster periods could decrease the total losses Bolivar incurs as a result of said hazard occurrences.

AND WHEREAS the Bolivar Town Council has a strong interest in reducing losses from future hazard occurrences; and

WHEREAS the hazard mitigation plan is a federal and state requirement to maintain eligibility for hazard mitigation funding, and, by that requirement, must be updated a minimum of every five years; and

WHEREAS a cooperative, joint effort is a proven, efficient way to plan for and reduce hazard susceptibility in all government jurisdictions in Jefferson County, West Virginia.

THEREFORE the Bolivar Town Council has partnered with the county to update the existing *Jefferson County Multi-Jurisdictional Hazard Mitigation Plan* in an effort to further identify, define, and characterize the hazards affecting the Town as well as to continue identifying and prioritizing projects that could lessen hazard vulnerability.

NOW BE IT RESOLVED THAT the Bolivar Town Council does hereby adopt the updated *Jefferson County 2023 Multi-Jurisdictional Hazard Mitigation Plan* this 6th day of February, 2024

SIGNED: Stephen K. Richards
Mayor

P. Jean Reed, Recorder
Witness

304-535-2476
60 PANAMA STREET, PO BOX 37, HARPERS FERRY, WV 25425
BOLIVARWV.ORG

Resolution #2024-003

City of Charles Town

101 East Washington Street, P.O. Box 14, Charles Town, WV 25414
Phone: (304) 725-2311 ♦ Web: www.charlestownwv.us

RESOLUTION – CITY OF CHARLES TOWN

WHEREAS, natural, technological, and man-made hazards can affect the City of Charles Town; and

WHEREAS, significant structural, historical, and economic losses could result from an occurrence of a natural, technological, or man-made hazard events; and

WHEREAS, undertaking mitigation projects during pre-disaster periods could decrease the total losses Charles Town incurs as a result of said hazard occurrences.

AND WHEREAS, the Charles Town City Council has a strong interest in reducing losses from future hazard occurrences; and

WHEREAS, the hazard mitigation plan is a federal and state requirement to maintain eligibility for hazard mitigation funding, and, by that requirement, must be updated a minimum of every five years; and

WHEREAS, a cooperative, joint effort is a proven, efficient way to plan for and reduce hazard susceptibility in all government jurisdictions in Jefferson County, West Virginia.

THEREFORE, the Charles Town City Council has partnered with the county to update the existing *Jefferson County Multi-Jurisdictional Hazard Mitigation Plan* in an effort to further identify, define, and characterize the hazards affecting the city as well as to continue identifying and prioritizing projects that could lessen hazard vulnerability.

NOW BE IT RESOLVED THAT, the Charles Town City Council does hereby adopt the updated *Jefferson County 2023 Multi-Jurisdictional Hazard Mitigation Plan* this 1st day of April, 2024.

Robert M. Trainor
Mayor

Attest:

John Nissel
City Clerk

1000 Washington Street
P.O. Box 217
Harpers Ferry, WV 25425
304-535-2206
www.harpersferrywv.com

Corporation of Harpers Ferry

Gregory F. Vaughn, Mayor
Nina Ana Armstrong, Recorder

RESOLUTION – TOWN OF HARPERS FERRY

WHEREAS natural, technological, and man-made hazards can affect the Town of Harpers Ferry; and

WHEREAS significant structural, historical, and economic losses could result from an occurrence of a natural, technological, or man-made hazard events; and

WHEREAS undertaking mitigation projects during pre-disaster periods could decrease the total losses Harpers Ferry incurs as a result of said hazard occurrences.

AND WHEREAS the Harpers Ferry Town Council has a strong interest in reducing losses from future hazard occurrences; and

WHEREAS the hazard mitigation plan is a federal and state requirement to maintain eligibility for hazard mitigation funding, and, by that requirement, must be updated a minimum of every five years; and

WHEREAS a cooperative, joint effort is a proven, efficient way to plan for and reduce hazard susceptibility in all government jurisdictions in Jefferson County, West Virginia.

THEREFORE the Harpers Ferry Town Council has partnered with the county to update the existing *Jefferson County Multi-Jurisdictional Hazard Mitigation Plan* in an effort to further identify, define, and characterize the hazards affecting the Town as well as to continue identifying and prioritizing projects that could lessen hazard vulnerability.

NOW BE IT RESOLVED THAT the Harpers Ferry Town Council does hereby adopt the updated *Jefferson County 2023 Multi-Jurisdictional Hazard Mitigation Plan* this 12th day of February, 2024.

SIGNED: _____ _____

Gregory Vaughn, Mayor Witness

JEFFERSON COUNTY COMMISSION

124 East Washington Street, P.O. Box 250, Charles Town, WV 25414
Phone: (304) 728-3284 Fax: (304) 725-7916
Web: www.jeffersoncountywv.org

RESOLUTION – JEFFERSON COUNTY COMMISSION

WHEREAS natural, technological, and man-made hazards can affect Jefferson County; and

WHEREAS significant structural, historical, and economic losses could result from an occurrence of a natural, technological, or man-made hazard events; and

WHEREAS undertaking mitigation projects during pre-disaster periods could decrease the total losses Jefferson County incurs as a result of said hazard occurrences.

AND WHEREAS the Jefferson County Commission has a strong interest in reducing losses from future hazard occurrences; and

WHEREAS the hazard mitigation plan is a federal and state requirement to maintain eligibility for hazard mitigation funding, and, by that requirement, must be updated a minimum of every five years; and

WHEREAS a cooperative, joint effort is a proven, efficient way to plan for and reduce hazard susceptibility in all government jurisdictions in Jefferson County, West Virginia.

THEREFORE the Jefferson County Commission has undertaken a project to update the existing *Jefferson County Multi-Jurisdictional Hazard Mitigation Plan*, previously adopted in 2002, 2008, 2013 and 2018, in an effort to further identify, define, and characterize the hazards affecting Jefferson County as well as to continue identifying and prioritizing projects that could lessen hazard vulnerability.

NOW BE IT RESOLVED THAT the Jefferson County Commission does hereby adopt the updated *Jefferson County 2023 Multi-Jurisdictional Hazard Mitigation Plan* this 18 day of January, 2024.

SIGNED: _____ _____

President, Jefferson County Commission Witness

Resolution 2024-04

A Resolution of The City of Ranson City Council for the Adoption of the Multi-Jurisdiction Hazard Mitigation Plan

WHEREAS natural, technological, and man-made hazards can affect the City of Ranson; and

WHEREAS significant structural, historical, and economic losses could result from an occurrence of a natural, technological, or man-made hazard events; and

WHEREAS undertaking mitigation projects during pre-disaster periods could decrease the total losses Ranson incurs as a result of said hazard occurrences.

WHEREAS the Ranson City Council has a strong interest in reducing losses from future hazard occurrences; and

WHEREAS the hazard mitigation plan is a federal and state requirement to maintain eligibility for hazard mitigation funding, and, by that requirement, must be updated a minimum of every five years; and

WHEREAS a cooperative, joint effort is a proven, efficient way to plan for and reduce hazard susceptibility in all government jurisdictions in Jefferson County, West Virginia.

THEREFORE, the Ranson City Council has partnered with the county to update the existing Jefferson County Multi-Jurisdictional Hazard Mitigation Plan in an effort to further identify, define, and characterize the hazards affecting the city as well as to continue identifying and prioritizing projects that could lessen hazard vulnerability.

NOW BE IT RESOLVED THAT the Ranson City Council does hereby adopt the updated Jefferson County 2023 Multi-Jurisdictional Hazard Mitigation Plan.

BE IT FURTHER RESOLVED that this resolution shall take effect immediately upon adoption.

Signed and approved this 5th day of March 2024.

Keith D. Pierson, Mayor

ATTEST:

Darla Armstrong,
City Clerk

AFFIX CITY SEAL

RESOLUTION – CORPORATION OF SHEPHERDSTOWN

WHEREAS natural, technological, and man-made hazards can affect the Corporation of Shepherdstown; and

WHEREAS significant structural, historical, and economic losses could result from an occurrence of a natural, technological, or man-made hazard events; and

WHEREAS undertaking mitigation projects during pre-disaster periods could decrease the total losses Shepherdstown incurs as a result of said hazard occurrences.

AND WHEREAS the Shepherdstown Town Council has a strong interest in reducing losses from future hazard occurrences; and

WHEREAS the hazard mitigation plan is a federal and state requirement to maintain eligibility for hazard mitigation funding, and, by that requirement, must be updated a minimum of every five years; and

WHEREAS a cooperative, joint effort is a proven, efficient way to plan for and reduce hazard susceptibility in all government jurisdictions in Jefferson County, West Virginia.

THEREFORE the Shepherdstown Town Council has partnered with the county to update the existing *Jefferson County Multi-Jurisdictional Hazard Mitigation Plan* in an effort to further identify, define, and characterize the hazards affecting the Town as well as to continue identifying and prioritizing projects that could lessen hazard vulnerability.

NOW BE IT RESOLVED THAT the Shepherdstown Town Council does hereby adopt the updated *Jefferson County 2023 Multi-Jurisdictional Hazard Mitigation Plan* this 13th day of February 2024.

SIGNED: _____ _____

Mayor Witness