Central Shenandoah Hazard Mitigation Plan 2020 Update

"Reducing the impact of disasters on citizens of the Central Shenandoah Region through planning, preparedness, mitigation, and education."

Prepared by the:
Central Shenandoah
Planning District Commission

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CSHMP Executive Summary

- The Central Shenandoah Hazard Mitigation Plan (CSHMP) identifies natural and other hazards that impact the five counties, five cities, and eleven towns within the Central Shenandoah Region.
- The identified hazards were analyzed to determine risk and vulnerabilities in the Region. The highest ranked hazards include Flooding/Dam Failure, Drought, Hurricanes, and Severe Winter Weather.
- This Plan also includes four categories of mitigation goals and strategies:

    1. Local Plans and Regulations
    2. Structure and Infrastructure Projects
    3. Natural Systems Protection
    4. Education and Awareness Programs

- The twenty-one jurisdictions of the Central Shenandoah Region were actively engaged in the planning process. The local jurisdictions shared their past mitigation projects and created strategies for future mitigation activities.
- The public's input was gathered during numerous presentations and a region-wide survey. The results of the survey are included in this Plan.
- Included in the Appendices of the CSHMP is a chapter on Climate Adaptation and the new Central Shenandoah Regional Wildfire Protection Plan.

The purpose of this plan is to increase the resilience of all the communities in the Central Shenandoah Region.

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APPENDICES

I. INTRODUCTION

1. Purpose

The Disaster Mitigation Act of 2000 (DMA2K) was enacted October 10, 2000.

The Central Shenandoah Hazard Mitigation Plan (CSHMP) was developed in accordance with the Disaster Mitigation Act of 2000 (DMA2K), requirements of the Federal Emergency Management Agency (FEMA) Section 322 local hazard mitigation planning regulations, and Title 44 Code of Federal Regulations (CFR) §201.6. DMA2K was enacted on October 10, 2000, when President Clinton signed the Act (Public Law 106-390). The legislation reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur. This Act is also the basis for FEMA mitigation planning requirements for state, local, and tribal governments as a condition of mitigation grant assistance. DMA2K amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 100-707) which was signed into law on November 23, 1988. In turn, the Stafford Act amended the Disaster Relief Act of 1974. The purpose of Title 44 CFR §201.6 is to provide information on the policies and procedures for local mitigation planning under the Stafford Act. It is also FEMA's official source for defining the requirements of original and updated mitigation plans.

The CSHMP is a regional plan covering 21 localities, including 5 counties, 5 cities and 11 towns.

The purpose of the Plan is to identify natural hazards that impact the Region and to offer mitigation strategies that will lessen the effects that these hazards have on the citizens, property, and businesses in the Region. The Plan was developed on a multi-regional basis which included the five counties of Augusta, Bath, Highland, Rockbridge, and Rockingham, the five cities of Buena Vista, Harrisonburg, Lexington, Staunton, and Waynesboro, and eleven incorporated towns Glasgow, Goshen, Craigsville, Grottoes, Bridgewater, Broadway, Dayton, Elkton, Mt. Crawford, Timberville, and Monterey.

The CSHMP was initially adopted in 2005.

The Central Shenandoah Hazard Mitigation Plan was initially adopted in 2005. The planning process was led by the Mitigation and Planning Work Group of the Shenandoah Valley Project Impact and supported by staff of the Central Shenandoah Planning District Commission (CSPDC). The Hazard Identification Risk Assessment (HIRA) was prepared by Virginia Tech's Center for Geospatial Information Technology. Funding for the development of the Plan was provided in large part through a grant from the Virginia Department of Emergency Management (VDEM) with matching funds provided by the Central Shenandoah Planning District Commission.

Updates to the Plan took place from 2010 through 2013, and most recently from 2019 to 2020.

An update of the Plan took place from 2010 through 2013. The update process was led by a Steering Committee made up of local government staff, regional representatives of State agencies, interested citizens, and other organizations. The update was supported by CSPDC staff, who also updated the 2013 HIRA. Funding for the update of the Plan was provided in large part through a Pre-disaster Mitigation Grant from the Federal Emergency Management Agency (FEMA) with matching funds provided by the Virginia Department of Emergency Management and local jurisdictions within the Central Shenandoah Planning District.

The most recent version of the Plan was updated from 2019 to 2020. The update was led by a Steering Committee composed of appointees and alternates from all twenty-one localities, as well as appointees and alternates from twenty-five other organizations including federal agencies, state agencies, other local government agencies, educational institutions, healthcare institutions, business and industry interests, and citizens groups. The update was supported by CSPDC staff. The HIRA was updated by staff of the CSPDC, with assistance from staff at the Northern Shenandoah Valley Regional Commission. Funding for the update of the Plan was provided by Pre-disaster Mitigation Grant from FEMA with matching funds provided by VDEM and the CSPDC.

II. PLANNING PROCESS

1. Planning Process

The planning process began in 1995 after devastating floods in the Region.

The planning process actually began in 1995 when local government officials recognized a void in flood planning and prevention after the devastating floods in 1995 and 1996. They called on the Central Shenandoah Planning District Commission (CSPDC) to develop a local mitigation strategy and offer planning and technical assistance to abate future damages.

Since 1995, CSPDC has helped secure nearly $10 million in funding for these projects.

Over the next several years and flood events, the CSPDC assisted many of the localities in identifying at-risk properties, applying for state and federal funds, and administering flood mitigation projects. Since 1995, the CSPDC has secured nearly $10,000,000 in federal, state and local funds to elevate, move, acquire or floodproof nearly 200 structures and provide a disaster preparedness and mitigation education program in the Region. In 1999, the Region began looking at ways to prevent floods from becoming disasters through a viable planning process with effective public input. A committee comprised of elected officials, local government staff, and private citizens as well as technical experts from various natural resource agencies was created to assess the problem, review possible solutions, and recommend actions for the Region to take.

Photo II-1: Flooding in Rockingham County, Hurricane Fran, 1996

Photo II-2: Town of Glasgow, Flood Mitigation Project, 1997-2002

The Central Shenandoah Valley Regional Flood Mitigation Plan was completed in 1999.

Led by the Central Shenandoah Planning District Commission, the Committee met over the course of a year and half to produce the Central Shenandoah Valley Regional Flood Mitigation Plan. The Plan addressed the flood hazards that put each of our 21 communities at risk. The Plan identified and illustrated flood risks and recorded the history of flooding. It described the projects and efforts that localities have implemented to reduce flood damage and more importantly it explains what still needs to done. The Plan offered sound and effective mitigation options and guidance with options for dealing with floods, setting priorities, and effectively planning to minimize future damage and protect floodplain resources.

The Region became a Project Impact Community, with the formation of Shenandoah Valley Project Impact.

From there, the Region was directed by the Federal Emergency Management Agency and the Virginia Department of Emergency Management to look at other natural hazards that impact the Central Shenandoah Valley. The Flood Mitigation Committee that was created in 1999 to oversee the Central Shenandoah Regional Flood Mitigation Plan was called back into action to address the requirements of the Disaster Mitigation Act of 2000. In the meantime, the Central Shenandoah Region became a Project Impact Community, and named this new program, Shenandoah Valley Project Impact. The purpose of Project Impact was to develop a sustainable long-term program of disaster-resistance education in the Shenandoah Valley. The Central Shenandoah Project Impact structure was made up of a Steering Committee and 4 work groups: 1) Mitigation and Planning; 2) Business Continuity, 3) Public Awareness and 4) Special Populations. Under this structure the former Flood Mitigation Committee was reinstated and reorganized and became Project Impact's Mitigation and Planning Workgroup. The purpose of this committee was to promote mitigation methods that protect homes, public buildings, critical facilities, and natural spaces in the Shenandoah Valley.

The main task of the Mitigation and Planning Workgroup was to develop the Hazard Mitigation Plan. The Mitigation and Planning Workgroup was comprised of elected officials, city, county, and town staff, business persons, and interested citizens. All local jurisdictions were involved in the planning process either through direct representation on the committee or through involvement with Shenandoah Valley Project Impact.

Others involved throughout the planning process included representatives of local government, nonprofit organizations, human service agencies, the business community, universities and colleges, local libraries, the Red Cross, and other organizations interested in disaster mitigation. These persons served on the Project Impact/Citizen Corps Council and met on a regular basis throughout the development of the plan.

The 2020 Steering Committee involved representatives from 21 localities and 25 other organizations.

From 2010 to 2013, a new Steering Committee was formed consisting of former members of the Mitigation and Planning Committee as well as others to help with the task of reviewing the data and information in the original Plan and making revisions and adding additional information where needed.

From 2019 to 2020, an update to the Plan was led by a Steering Committee composed of appointees and alternates from all twenty-one local jurisdictions, as well as appointees and alternates from twenty-five other organizations including federal agencies, state agencies, other local government agencies, educational institutions, healthcare institutions, business and industry interests, and citizens groups. The appointees and alternates are listed in Table II-1 and Table II-2.

91 individuals were nominated as appointees or alternates to serve on the Steering Committee.

Photo II-3: June 2019 Steering Committee Meeting, CSPDC Staff

Photo II-4: June 2019 Steering Committee Meeting

Table II-1: 2020 Steering Committee, Local Government Members

Local Government	Name / Title	Role
City of Buena Vista	Thomas Roberts, Director of Planning & Community Development	Appointee
City of Buena Vista	Lt. Waylon Miller, Emergency Management Coordinator	Alternate
City of Buena Vista	Chief Keith Hartman, Police Chief	Alternate
City of Harrisonburg	Paul Helmuth, Administrative Officer	Appointee
City of Harrisonburg	Ian Bennett, Fire Chief	Alternate
City of Lexington	Trent Roberts, Emergency Management Coordinator	Appointee
City of Lexington	Arne Glaeser, Director of Planning & Development/Floodplain Administrator	Alternate
City of Staunton*	Colten Lotts, Deputy Emergency Management Coordinator	Appointee
City of Staunton*	Scott Garber, Fire Chief/ Emergency Management Coordinator	Appointee
City of Staunton*	Perry Weller, Deputy Fire Chief/ Deputy Emergency Management Coordinator	Alternate
City of Waynesboro	Gary Critzer, Director, Emergency Management	Appointee
County of Augusta	Donna Good, EOC Director & Emergency Management Coordinator	Appointee
County of Augusta	Anthony Ramsey, Assistant Emergency Management Coordinator	Alternate
County of Augusta	Doug Wolfe, County Engineer/Floodplain Administrator	Alternate
County of Bath	Andy Seabolt, Emergency Manager	Appointee
County of Bath	Sherry Ryder, Planning and Zoning Administrator	Alternate
County of Highland	Harley Gardner, Emergency Services Coordinator	Appointee
County of Highland	Carl Williams, Deputy Chief of EMS	Alternate
County of Rockbridge	Captain Kevin Moore, Fire/Rescue	Appointee
County of Rockbridge	Chief Nathan Ramsey, Fire/Rescue	Alternate
County of Rockingham	Jeremy Holloway, Fire/Rescue Chief	Appointee
County of Rockingham	Jeff Michael, Deputy Chief	Alternate

Table II-1: 2020 Steering Committee, Local Government Members , continued

Local Government	Name / Title	Role
Town of Bridgewater*	Patrick Wilcox, Town Planner	Appointee
Town of Bridgewater*	Betsy Putney, Public Works Coordinator	Appointee
Town of Bridgewater*	John Ware, Environmental Agent	Alternate
Town of Broadway	Ross Clem, Project Manager	Appointee
Town of Broadway	Kyle O'Brien, Town Manager	Alternate
Town of Craigsville	Mayor Richard Fox	Appointee
Town of Craigsville	John Temple, Public Works Superintendent	Appointee
Town of Craigsville	Sgt. Corey Wood, Police Department	Appointee
Town of Dayton	Chief Daniel Hanlon, Police Dept	Appointee
Town of Dayton	Lt. Justin Trout, Police Dept	Alternate
Town of Dayton	Joe Paxton, Interim Town Manager	Alternate
Town of Elkton	Joshua Gooden, Mayor	Appointee
Town of Glasgow	Jon Ellestad, Interim Town Manager/ Floodplain Administrator	Appointee
Town of Glasgow	Eric Pollitt, Town Manager/ Floodplain Administrator	Appointee
Town of Glasgow	Chief Nathan Ramsey, Fire/Rescue	Alternate
Town of Glasgow	Captain Kevin Moore, Fire/Rescue	Alternate
Town of Goshen	Megan Deel, Clerk/Treasurer	Appointee
Town of Goshen	Lisa Landrum, Council Member	Alternate
Town of Grottoes	Nathan Garrison, Town Manager	Appointee
Town of Grottoes	AJ Hummel, Public Works Director	Alternate
Town of Monterey	Richard Robinson, Council Member	Appointee
Town of Monterey	Denise Simmons, Council Member	Alternate
Town of Mount Crawford	Eric Ensley, Council Member	Appointee
Town of Mount Crawford	Neal Dillard, Council Member	Alternate
Town of Mount Crawford	Dennis Driver, Council Member	Alternate
Town of Timberville	Austin Garber, Town Manager	Appointee

* CRS Community

Table II-2: 2020 Steering Committee, Non-Local Government Members

Organization	Name / Title	Role
Augusta County Service Authority	Brett Sinclair, Safety Manager	Appointee
Augusta County Service Authority	Tina Solak, Director of Human Resources	Alternate
Augusta Health	Francis Caruccio	Appointee
Augusta Health	Karen Clark	Alternate
Blue Ridge Community College	William Wilkerson, Chief of Police	Appointee
Blue Ridge Community College	Laura Dwyer, Administrative Assistant, Buildings and Grounds	Alternate
Bridgewater College	Milton Franklin, Chief of Police	Appointee
Central Shenandoah Health District, VDH	Hilary Cronin, District Emergency Planner	Appointee
Central Shenandoah Health District, VDH	Dr. Laura Kornegay, District Health Director	Alternate
Central Shenandoah Health District, VDH	Michael Keatts, Northwest Emergency Coordinator	Alternate
Cherry Orchard Homeowners Association	Deane Dozier, Director	Appointee
Dixie Gas and Oil Corporation	Steven Craig, Safety and Regulatory Compliance Manager	Appointee
Greater Augusta Regional Chamber of Commerce	Annette Medlin, President/CEO	Appointee
Greater Augusta Regional Chamber of Commerce	Kim Wilbur, Communications Director	Alternate
Harrisonburg-Rockingham Chamber of Commerce	Chris Ellis, BB&T, Chamber Public Policy Committee	Appointee
Harrisonburg-Rockingham Community Services Board	Dan Jenkins, Risk Management Specialist	Appointee
Harrisonburg-Rockingham Community Services Board	Holly Albrite	Alternate
Harrisonburg-Rockingham Regional Sewer Authority	Sharon Foley, Executive Director	Appointee
Harrisonburg-Rockingham Regional Sewer Authority	Anita Riggleman, Environmental & Safety Manager	Alternate
Holtzman Oil Corp.	Keith Taylor, Safety Director	Appointee
Holtzman Oil Corp.	Calvin R. Lokey	Alternate
James Madison University	Robbie Symons, Emergency Management Coordinator	Appointee
James Madison University	Dale Chestnut, Stormwater Coordinator	Alternate
Lexington-Rockbridge Chamber of Commerce	Tracy Lyons, Executive Director	Appointee
Sentara Rockingham Memorial Hospital	Scott Masincup	Alternate
Shenandoah National Park, NPS	David Robinson	Appointee

Table II-2: 2020 Steering Committee, Non-Local Government Members, continued

Organization	Name / Title	Role
Shenandoah Valley Project Impact	Nancy Sorrells	Appointee
Shenandoah Valley Project Impact	Sharon Angle	Appointee
Shenandoah Valley Project Impact	Steve Strawderman	Appointee
Shenandoah Valley Regional Airport	Gary Craun, Director of Operations/Chief	Appointee
Shenandoah Valley Regional Airport	Chris Cary, Captain	Alternate
USDA-NRCS	Kathy Holm, Assistant State Conservationist (Field Operations)	Appointee
USDA-NRCS	Philip Davis, Soil Conservationist	Alternate
Valley Community Services Board	Roger Ramsey, Facility Manager	Appointee
Virginia Department of Environmental Quality	Jennifer Welcher, Pollution Response Coordinator	Appointee
Virginia Department of Forestry	Patti Nylander, Senior Area Forester- Mountain Valley Area	Appointee
Virginia Department of Forestry	Clint Folks, Area Forester	Alternate
Virginia Military Institute	Jay Williams, Post Engineer	Appointee
Virginia Military Institute	David Williams, Director, Auxiliary Services	Alternate
Washington and Lee University	Paul Burns, Director of Environmental Health & Safety	Appointee
Washington and Lee University	Brendan Perry, Director of MEP Services	Alternate
Western State Hospital	Patrick Robertson, Risk Manager	Appointee
Western State Hospital	David Mawyer	Alternate

The 2020 Steering Committee held three meetings.

Information was gathered from the localities and stakeholders in the Region as a group through Steering Committee meetings and in one-on-one input sessions. The Steering Committee met three times during 2019 to develop the Plan. Below in Table II-3 is a list of the meeting dates, agenda topics, and the number of attendees. A list of attendees and meeting agenda packets can be viewed in Appendix A – Planning Process and Public Engagement. Surveys of individual Steering Committee members and in-depth group discussions were conducted in order to prioritize the hazards in the Region and revise the mitigation strategies from the previous HMP. CSPDC staff also consulted with individual local jurisdictions and stakeholder organizations representatives individually either in person or by phone to discuss their community's unique vulnerabilities and mitigation goals. CSPDC staff also consulted with individual members of the Steering Committee to gather information regarding critical facilities, damage assessments, capabilities, and mitigation strategies. Following this process, CSPDC staff incorporated the newly updated information and Steering Committee recommendations into the 2013 Plan to create the 2020 edition of the Central Shenandoah Hazard Mitigation Plan.

61 people attended the kick-off meeting.

Table II-3: Steering Committee Meetings

Meeting Date	Agenda Topics	Number of Attendees
04/03/2019	Regional Hazard Identification Regional/Local Mitigation Goals and Strategies Public Outreach	61
06/05/2019	Regional Hazard Identification 2019 Ranking Results - Ranking of Prior Hazards - Consideration of Other Hazards Regional/Local Mitigation Goals and Strategies Public Input and Outreach	37
10/07/2019	Project Status Update and Timeline Update on HIRA and Critical Facilities Maps Damage Assessments Regional Strategies Local Strategies VDEM and FEMA Review Process Locality Adoption Process	45

2. Staff Training

Throughout the course of the planning process, CSPDC staff participated in training related to the development of the Plan as well as sponsored a number of training workshops for the public.

Table II-4: Training Attended by Staff / Committee

Date	Topic
02/19/2019	Virginia Department of Conservation and Recreation Dam Safety/Floodplain Program Grant Training
03/06/2019	Virginia Department of Emergency Management Hazard Mitigation Grant Program Briefing
03/14/2019	Environmental Protection Agency Webinar: Integrating Water Quality/Nature-based Approaches into Hazard Mitigation Plans
03/28/2019	Webinar: Plain Language Communication for Results
05/15/2019	Federal Emergency Management Agency Region III Webinar: Floodplain Management and Hazard Mitigation Planning
06/12/2019	United States Forest Service Webinar: Planning in the Wildland Urban Interface
07/10/2019	Federal Emergency Agency Region III Webinar: Engaging the Arts in Mitigation Planning
08/13/2019	Natural Hazards Center Webinar: Aligning Mitigation Investment for the Whole Community
08/15/2019	Planning Information Exchange Webinar: Planning for Drought and Cascading Hazards
09/10/2019	Making Mitigation Work Series Webinar: Ethical/Efficient Infrastructure Resilience - The Battle For Better Building Codes
09/19/2019	Webinar: The Art of the Narrative: Creating CEDS and Other Plans that People Want To Read
10/08/2019	Making Mitigation Work Series Webinar: Moving Mitigation Forward - the Past, Present, and Future of Hazard Mitigation Assistance
10/30/2019	Environmental Protection Agency Webinar: Integrating the EPA and Hazard Mitigation Planning

3. Partnering/Mentoring Opportunities

Throughout the planning process, CSPDC staff partnered with staff from other Planning District Commissions, and students at James Madison University:

- CSPDC staff consulted with staff from the Northern Shenandoah Valley Regional Commission (NSVRC) in analyzing data with HAZUS software. This partnership and the assistance received is discussed in more detail in the HIRA section of the Plan.
- CSPDC staff shared ideas and strategies with staff from the Central Virginia Planning District Commission (CVPDC). CSPDC staff attended a Steering Committee meeting for the CVPDC's Hazard Mitigation Plan on July 11, 2019 in Lynchburg. During the meeting, the CVPDC Steering Committee discussed their Hazard Identification and Risk Assessment (HIRA). Staff from the CSPDC and the CVPDC also met to share information during the Resilient Virginia Conference held at the Darden School of Business at the University of Virginia in Charlottesville on July 18 - 19, 2019.
- Students from the School of Integrated Sciences at James Madison University spent Spring Semester 2019 assisting in the update of the Hazard Mitigation Plan. The students researched issues related to climate adaptation in the Region, sharing information about population, land use, changes to climate and weather patterns, hazard profiles and recommendations, and social impacts. The information was compiled into a chapter on Climate Adaptation that can be viewed in Appendix B.

Photo II-5: James Madison University Students.

III. PUBLIC PARTICIPATION

1. Public Participation

In 2000, the Central Shenandoah Region was designated a Project Impact Community by FEMA. Through Shenandoah Valley Project Impact (SVPI), thousands of citizens, businesses, and community organizations have been educated regarding disaster preparedness and mitigation. Through SVPI, many opportunities have been made available to gather public input into the planning process for the original Plan, the 2013 update, and this current update. Numerous presentations were made to civic groups, human service organizations, and other groups working with citizens (young and old) in the Valley. Educational materials have been distributed to thousands of citizens at community events. In January 2003, the Central Shenandoah Region also became a Citizen Corps Council enabling the Region to continue the work and programs initiated by Project Impact. In 2020, Shenandoah Valley Project Impact will turn twenty years old. Included in Table III-1 are events where the general public was given the opportunity to learn more about disaster preparedness, mitigation, and most importantly, the current update of the Plan.

The Region was designated as a Project Impact Community in 2000.

Shenandoah Valley Project Impact (SVPI) has provided disaster preparedness and mitigation education in the region.

Figure III-1: Project Impact Logo

Figure III-2: Citizens Corps Council Logo

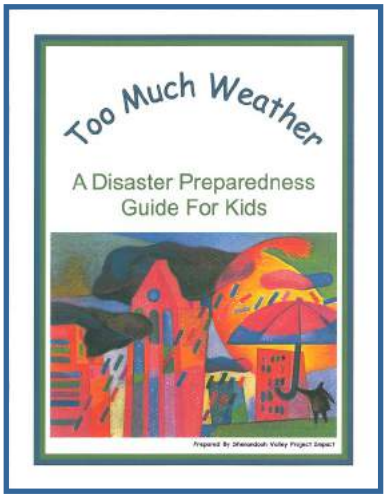


Figure III-3: Shenandoah Valley Project Impact, Disaster Preparedness Guide

The CERT Basic Course Has Been Offered 38 times and over 603 people have been trained.

Another avenue used to reach the public and gain their input into the planning process was through the Community Emergency Response Team (CERT) program. CERT is a national program offered through FEMA. The goal of CERT is for emergency personnel to train members of neighborhoods, community organizations or workplaces in basic response skills like disaster preparedness, fire safety, emergency first aid, search and rescue, and terrorism awareness. The Central Shenandoah Planning District began offering CERT classes in September 2003. Since then, 38 courses have been held resulting in a total of 603 volunteers trained in CERT. For this update of the Plan, CERT members provided input by filling out the public survey, participating in planning meetings, and assisting in public outreach activities.

Photo III-1 : Staunton-Augusta-Waynesboro CERT Volunteers

Photo III-2: CERT Volunteers participating in 2018 Shenandoah Valley Regional Airport Disaster Drill

Public participation again played a key role in the revision process for this update of the Plan. Public input was received by creating a new survey. The survey was widely distributed through an email blast, and a press release to a variety of media outlets in the Region, including local newspapers, radio and television stations. The survey and discussion of the Plan was also incorporated into many public education and awareness events (listed in Table III-1). The survey could be completed online, through a paper copy, or by a phone call with CSPDC staff. 557 surveys were completed and tabulated. A report of the survey results can be found in Appendix A - Planning Process and Public Engagement. Information from the public survey was used to guide the Steering Committee and CSPDC staff as they updated the Hazard Mitigation Plan. Public input from the survey included confirmation that the disasters respondents are most concerned about are the ones that occur the most frequently in the Region, are the ones ranked highest by steering committee and stakeholders, and are the ones that have the most emphasis in the Plan. Another valuable insight that was gained through the public survey is that the mitigation and preparedness education efforts in the Region are having a positive effect. Public education is one of the mitigation strategies included in the HMP. Also, during the update process, a copy of the original Plan was kept on the CSPDC website to allow for comment from the public as well.

During the adoption process of the update of the Plan by the 21 jurisdictions in the Region, the public will have another opportunity to provide input during the public comment period held at each Board of Supervisors, City Council, or Town Council meeting where adoption of the Plan will be on the agenda. The CSPDC will also have the Plan on their website for public comment as well. The CSPDC will issue a press release regarding the adoption process and the opportunity for additional public comment to the media throughout the Region. Any public comments received during the adoption process will be recorded and included in the Plan.

After the Plan has been approved by the Federal Emergency Management Agency and been adopted by the local jurisdictions, the Hazard Mitigation Plan will be kept on the CSPDC website for public comment throughout the five year plan update cycle. Over the five years between revisions of the Plan, public comment will be allowed and any comments received will be recorded.

Table III-1: Public Involvement Activities, 2019

Date	Event
03/05/2019	Valley Community Service Board Day Program Presentation - Staunton/Augusta County/Waynesboro
03/11/2019	Pleasant View/Spring Hill Ruritan Club - Augusta County
04/11/2019 - 05/23/2019	SAW Basic Training Course - Staunton/Augusta County/Waynesboro
04/24/2019	Harrisonburg Health and Safety Fair - Harrisonburg
04/27/2019	Dooms Fire Department Kids Fun Day - Augusta County/Waynesboro
05/14/2019	Gypsy Hill House Senior Apartments Presentation - Staunton
05/18/2019	Green Valley Book Fair Kids Safety Day - Rockingham County
05/28/2019	Plaza Apartments for Seniors/Persons with Disabilities - Staunton and Augusta County
06/14/2019	Historic Staunton Foundation Brown Bag Talk - Flooding Presentation - Staunton
07/16-2019 and 09/12/2019	Grace Lutheran Church Presentations - Waynesboro
09/17/2019	Bath County Local Emergency Planning Committee Meeting - Bath County
09/20/2019	Virginia Department of Health Staff Retreat Presentation - Regionwide
09/25/2019	Bath County Housing Study Community Meeting - Bath County
09/26/2019 11/14/2019	SAW Basic Training Course - Staunton/Augusta County/Waynesboro
09/28/2019	Girl Scout Preparedness Fair - Rockbridge County
10/06/2019	Touch-A-Fire Truck Event - Staunton/Augusta County/Waynesboro

IV. HAZARD IDENTIFICATION RISK ASSESSMENT (HIRA)

1. Purpose

In accordance with the requirements of **Title 44 Code of Federal Regulations (CFR) § 201.6** for local jurisdictions to have a Hazard Mitigation Plan (HMP), communities must conduct a hazard identification risk assessment (HIRA) to be included in the Plan. Having the HIRA in place allows local jurisdictions in the Region to better understand local hazards and the risks posed by them, begin to develop mitigation activities to lessen the impacts, and to acquire disaster-related grants in the aftermath of a disaster. The HIRA was developed to serve as a guide to all communities in the Region for assessing potential vulnerabilities to natural and other hazards. When developing this section, every effort was made to use the best data available to assure that the results of this analysis were as accurate as possible.

The planning area for this assessment includes the 21 jurisdictions of the Central Shenandoah Planning District Commission (CSPDC). All jurisdictions located in the CSPDC Region have been included in this portion of the study, as this analysis has been completed on a regional basis. It should be noted that the local jurisdictions included in the Plan were engaged participants in providing input throughout the entire planning process.

The purpose of the HIRA is to:

1. Identify hazards that that have impacted and/or could affect the Central Shenandoah Planning District Commission Region.
2. Profile hazard events and determine what areas and community assets are the most vulnerable to damage from these hazards.
3. Estimate losses and prioritize the potential risks to the community.

Methodology for Identifying and Prioritizing Hazards

One of the first steps in the planning process and the hazards identification risk assessment phase was to identify each of the hazards that can occur and impact the Region. CSPDC staff reviewed hazards that were included in the 2005 Plan and the 2013 update of the Plan. These hazards were previously identified based upon extensive research and review of historical data provided through studies, reports and existing plans. During those planning processes, hazards were prioritized by members of the Steering Committee and survey results collected from the general public.

At the April 2019 Steering Committee Meeting, CSPDC staff presented information on the previously identified hazards to members of the committee. The members were asked to rank the hazards based upon the impact that the hazard has on their community. Categories were provided for significant, high, medium, low or none. Members were also asked to identify and rank any hazards that had not been previously included.

The results of the rankings were shared at the June 2019 Steering Committee Meeting. CSPDC staff presented information on the other hazards that had been newly identified by the members of the committee. A second ranking occurred for the newly identified hazards with categories provided for significant, high, medium, low or none. Members that could not attend the meeting were also contacted and requested to submit their rankings.

CSPDC staff reviewed the results of the rankings and the comments submitted by the Steering Committee to identify and prioritize the hazards in our region. These hazards are the focus of the 2020 Plan and the mitigation strategies developed. The following hazards were identified and are described in detail below:

- Flooding or Dam Failure
- Drought
- Hurricane

- Severe Winter Weather
- Land Subsidence/Karst
- Wind (Tornado, Derecho, Straight-Line Winds)
- Wildfire
- Landslide
- Earthquake
- Hazardous Materials (Transportation and Industrial)
- Terrorism
- Power Outages

The CSPDC is the largest geographic planning district region in Virginia.

Project Study Area and Planning District Description

The Region is comprised of five Counties, five Cities and eleven incorporated Towns.

The Project Study Area is located in the historic Shenandoah Valley in western Virginia and includes the 21 jurisdictions of the Central Shenandoah Planning District Commission (CSPDC). Interstate 81 and Interstate 64 run through the Region, which is approximately 45 miles north of Roanoke, 68 miles south of the Virginia Inland Port, 100 miles west of Richmond, 125 miles southwest of Washington, D.C., and 200 miles northwest of the Port of Hampton Roads. With a land area of 3,439 square miles, the CSPDC is the largest geographic planning district in the Commonwealth. As shown in Figure IV-1, the Region is comprised of Augusta, Bath, Highland, Rockbridge and Rockingham counties, and the independent cities of Buena Vista, Harrisonburg, Lexington, Staunton and Waynesboro. The Region also has 11 incorporated towns including Bridgewater, Broadway, Craigsville, Dayton, Elkton, Goshen, Glasgow, Grottoes, Monterey, Mount Crawford, and Timberville.

Table IV-1 provides an overview of land area and demographic information for each of the communities in the Region, and Figure IV-2 illustrates population density by Census Block Group. The Region is home to an estimated population of 294,719 individuals (Weldon Cooper Center, 2017 Population Estimates). According to the American Community Survey 5-Year Estimates (2013-2017), there are 128,853 housing units in the Region and 58.3% are owner-occupied.

Figure IV-1: Central Shenandoah Planning District Boundaries

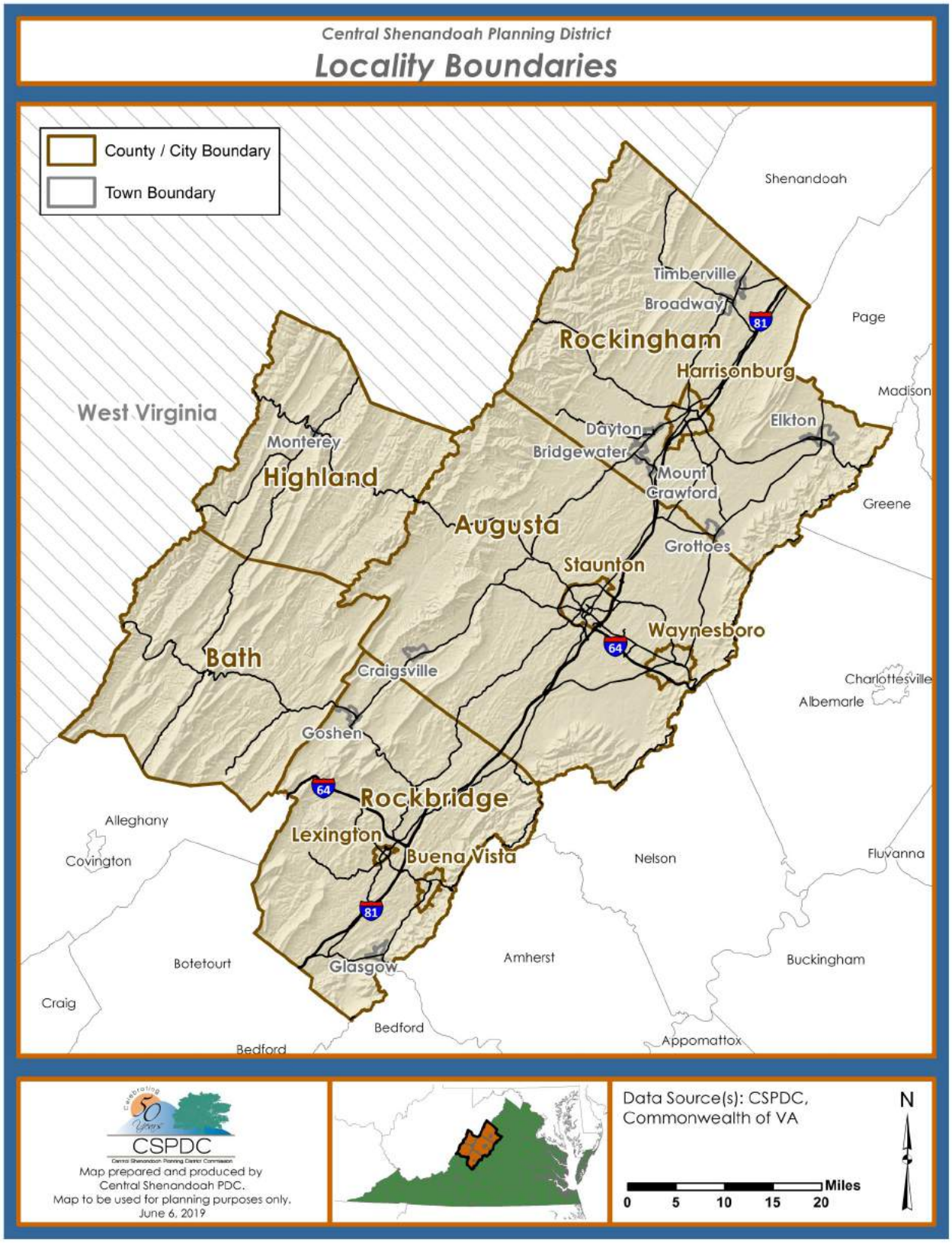


Table IV-1: Central Shenandoah Planning District Commission Demographics

Locality	Area (Square Miles)	2017 Population	2017 Population Per Square Mile	Median Home Value	Total Housing Units
Augusta County	971	74,390	76.61	$206,300	32,153
Craigsville, Town of	2.07	956	461.84	$118,400	475
Bath County	535	4,458	8.33	$151,100	3,353
Buena Vista City	7	6,495	927.86	$111,700	2,895
Harrisonburg City	17	53,064	3,121.41	$196,200	18,154
Highland County	416	2,213	5.32	$184,000	2,069
Monterey, Town of	0.3	156	520.00	$152,900	146
Lexington City	3	7,113	2,371.00	$252,500	2,248
Rockbridge County	600	22,440	37.40	$197,200	11,352
Glasgow, Town of	1.53	1,298	848.37	$98,600	549
Goshen, Town of	1.75	317	181.14	$96,300	205
Rockingham County	854	78,653	92.10	$206,700	34,891
Bridgewater, Town of	2.52	5,930	2,353.17	$220,000	2,170
Broadway, Town of	2.4	3,793	1,580.42	$197,200	1,644
Dayton, Town of	1.03	1,622	1,574.76	$214,200	659
Elkton, Town of	3.21	2,795	870.72	$180,600	1,395
Grottoes, Town of	2.07	2,734	1,320.77	$165,000	1,198
Mt. Crawford, Town of	0.49	403	822.45	$235,700	205
Timberville, Town of	1.29	2,592	2,009.30	$154,900	1,132
Staunton City	20	24,273	1,213.65	$162,500	11,782
Waynesboro City	15	21,620	1,441.33	$161,600	9,956

Source: U.S. Census, American Community Survey 5-Year Estimates, 2013-2017

Note: Town totals are included in County totals.

The top three industries by employment include Government, Manufacturing and Health Care and Social Assistance, with an average earnings of $45,859 across all industries and an estimated 144,466 people in the civilian labor force (Central Shenandoah Valley Regional Data Center, 2019).

The Region is part of the Valley and Ridge, and the Blue Ridge Physiographic Provinces.

The Region is bounded on the east by the crest of the Blue Ridge Mountains and on the west by the Allegheny Mountains and West Virginia Border. The Region is part of the Valley and Ridge Physiographic Province, which is characterized by gently rolling and hilly valleys, as well as gradual mountain slopes. The extreme eastern edge of the Region is within the Blue Ridge Physiographic Province which is distinguished by mountain peaks. The western edge of the Region is characterized by high, narrow, mountain ridges that run northeast to southwest forming relatively narrow river valleys. Elevations range from a high of 4,546 feet above sea level in Highland County, to a low of 720 feet above sea level near Glasgow in Rockbridge County.

Soils in the valley range from carbonate soils to alluvial soils along rivers and streams. Colluvial soils resulting from the weathering of the sandstone and shale mountains are found in the foothills paralleling the valley. The mountain areas are covered with shallow, rocky, excessively drained soils that derive from the weathering of acidic sandstone, shale, quartz, and granite parent material. The predominant geological structure underlying the Region is a complex formation of limestone, calcareous shale, and dolomite, with smaller amounts of sandstone, conglomerate, and chert.

Of the Region's 2.2 million acres of land, over 1 million acres of land are publicly held and protected.

Of the Region's 2.2 million acres of land, over 1 million acres are publicly held and protected. The Region contains a high quality and quantity of natural resources, made evident by large areas held in national forest and park land.

The region's land use is extremely diversified containing rural, agricultural areas to cities with the characteristics of small urban centers including universities, industries, and public transportation. Local jurisdictions deal with anticipated future land use issues through the mandated creation and updating of local Comprehensive Plans. Hazards and vulnerabilities are examined through the planning process.

The region's land use is mostly dominated by forest and agriculture. Much of the forested area in the Region is within either Shenandoah National Park or the George Washington and Jefferson National Forests. Forest resources are important in maintaining the local forestry industry, watersheds, wildlife habitats, and outdoor recreation. The dominant forest type in the Region is mixed hardwoods, specifically oaks, hickories, and maples.

The Region drains into the Potomac River basin and the James River basin.

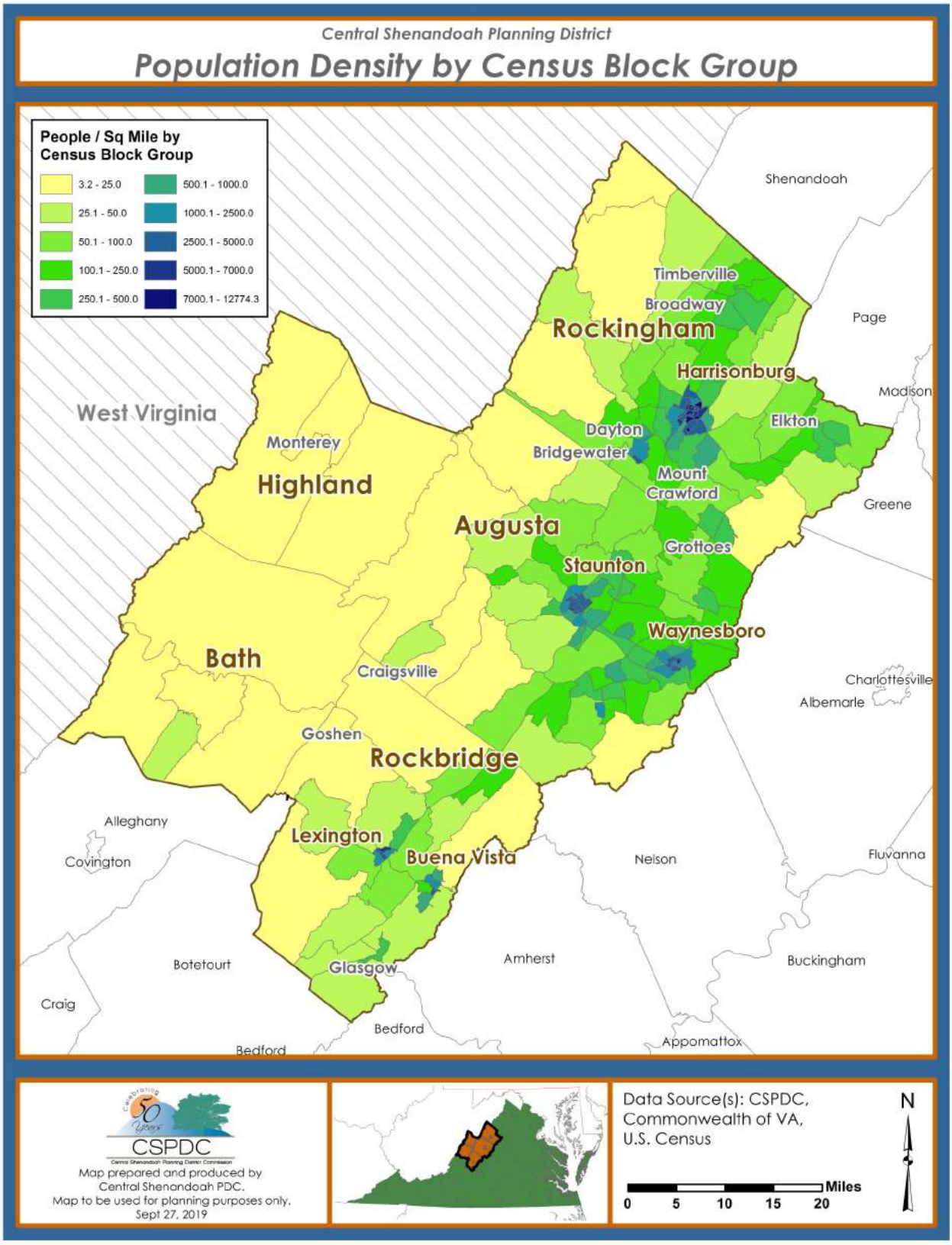
Figure IV-3 illustrates the location of the hydrologic basins and hydrography for the Region. Surface water in the Region drains into the Potomac River basin and the James River basin. The major tributaries to the Potomac River basin and the James River basin in the Region include the Bullpasture River, Calfpasture River, Cowpasture River, Little Calfpasture River, Jackson River, Middle River, the North Fork of the Shenandoah River, North River, South Fork South Branch Potomac River, the South Fork of the Shenandoah River, South River (Maury River tributary) and South River (South Fork Shenandoah River tributary).

Lake Moomaw is the second largest multi-purpose reservoir in western Virginia.

Many of these major waterways are used as public water supply sources. The Region is also home to several reservoir impoundments that have uses such as public water supply, flood control measures, or outdoor recreation opportunities. Lake Moomaw in Bath County, with a surface area of 2,530 acres, is the second largest multi-purpose reservoir in western Virginia and was completed in the 1980s with the construction of the Gathright Dam on the Jackson River by the U.S. Army Corps of Engineers.

This information about the Region will prove to be a key component in determining the risk to communities from natural hazards.

Figure IV-2: Central Shenandoah Planning District Population Density



Critical Facilities

According to the FEMA State and Local Plan Interim Criteria, a critical facility is defined as a facility in either the public or private sector that provides essential products and services to the general public, is otherwise necessary to preserve the welfare and quality of life in the local jurisdiction, or fulfills important public safety, emergency response, and/or disaster recovery functions.

Each of the 21 jurisdictions were requested to review the critical facility list for their community.

In the past, critical facilities were identified based upon data provided by the CSPDC, ESRI and the Virginia Tech Center for Geospatial Information Technology (CGIT). During this update of the Plan, each of the 21 jurisdictions was requested to review the local critical facility list for their community. Feedback was provided on revisions including additions or deletions of critical facilities from the list. For the CSPDC region, 1,153 critical facilities were identified. The coordinate locations for the critical facilities were intersected with floodplain data and other hazard data for the region. Figure IV-4 shows the location of critical facilities in the region in comparison to one percent annual chance of flood hazards in the FEMA floodplains.

In the CSPDC region, 1,153 critical facilities were identified.

Data Limitations

Inadequate information posed a problem for developing loss estimates for most of the identified hazards. The limiting factor for the data was the hazard mapping precision at only the jurisdiction level. Many of the hazards do not have defined damage estimate criteria. Available data for this Plan was very limited. The FEMA guidelines emphasize using "best available" data for this Plan. The impact of these data limitations will be shown through the different vulnerability assessment and loss estimation methods used for hazards.

Emergency Managers in the Region were contacted and information was requested on damage assessments for past events that have occurred in the Region since 2000. Information was requested on weather, rainfall/ precipitation totals, wind speeds, and financial damages for damages to structures, infrastructure or agricultural losses. Unit Coordinators with Virginia Cooperative Extension for each of the five counties within the Region were contacted and information on agricultural losses was requested. The responses that were received were incorporated into the Plan, but information received was limited. At the October 2019 Steering Committee Meeting, a

recommendation was made to the members of the Steering Committee to start tracking this information within their localities to assist with future Plan updates.

Critical facilities were determined based on best available data which were reviewed and updated by the 21 localities. Critical facilities, residential and industrial buildings within the 100 year floodplain were identified for flood analysis (CSPD Flood Mitigation Plan).

The HAZUS-MH model was used to estimate damage from flooding, hurricanes, and earthquakes in the Central Shenandoah region. The CSPDC had several issues with the HAZUS software and after attempting to contact the HAZUS help team, the CSPDC decided to partner with the Northern Shenandoah Regional Commission to run HAZUS reports for the CSPDC region. One of the main issues is that the current HAZUS software provided by FEMA is not compatible with the most recent version of ESRI's ArcMap software. The ESRI software must be uninstalled to install the HAZUS software, which makes the process very difficult. We recommend that FEMA improve HAZUS to be more compatible with current ESRI software.

The CSPDC also had difficulty accessing the FEMA's Repetitive Loss Property information for the Region. Some of this data is restricted or is unable to be shared publicly due to privacy concerns.

Future Conditions of Hazard Activity

Climate change is expected to have a major impact on hazard activity around the world, and in the Central Shenandoah region. Our region will experience more frequent, severe storms and natural disasters, resulting in disruptions in the economy and overall safety concerns for residents in our area. All hazards listed in this plan could be potentially affected by climate change and to address these growing issues, there is a separate chapter on Climate Adaptation. This chapter shares information about the region's population, land use, changes to climate and weather patterns, hazard profiles and recommendations, and social impacts. The Climate Adaptation chapter can be viewed in Appendix B.

Figure IV-3: Central Shenandoah Planning District Hydrologic Basins and Hydrography

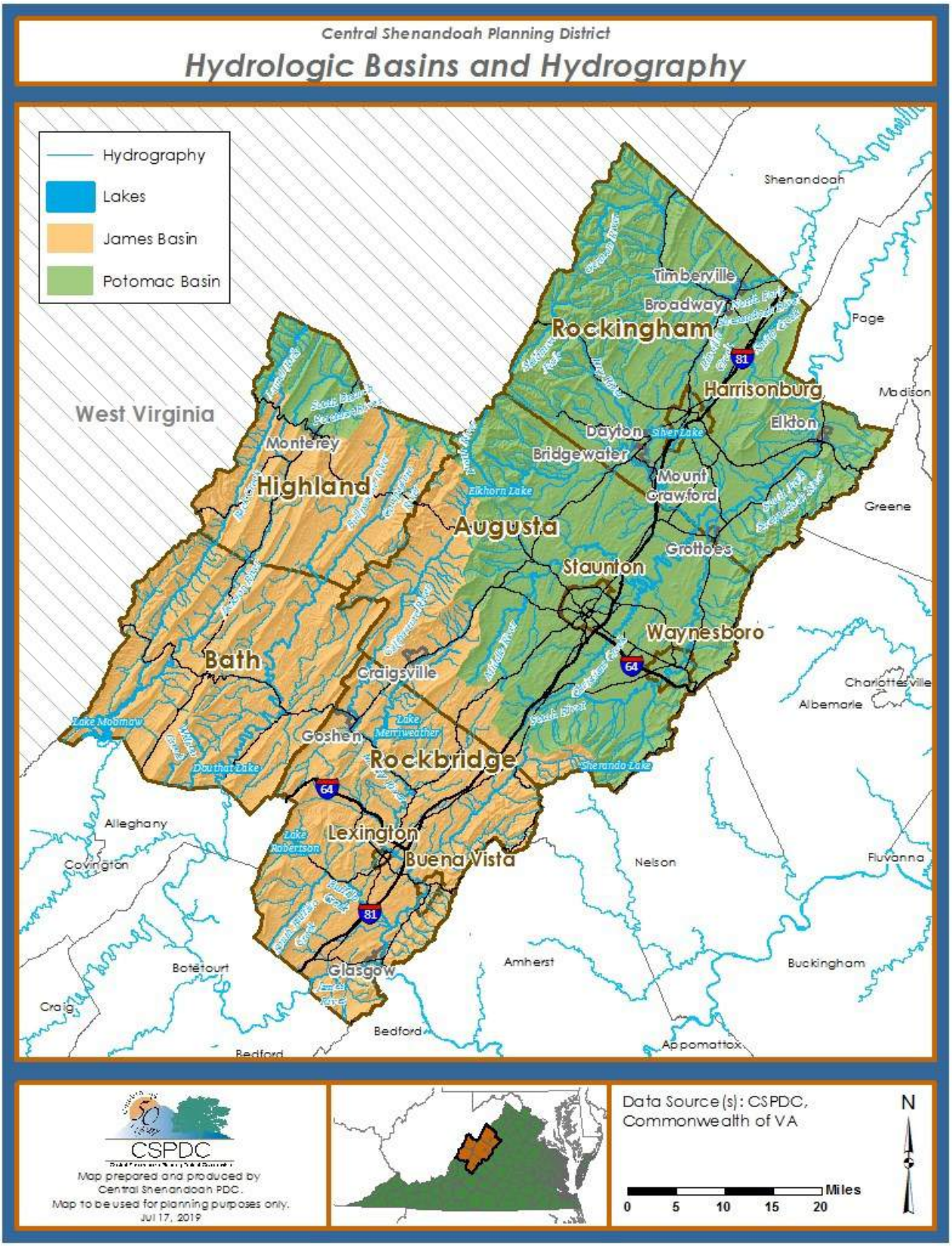
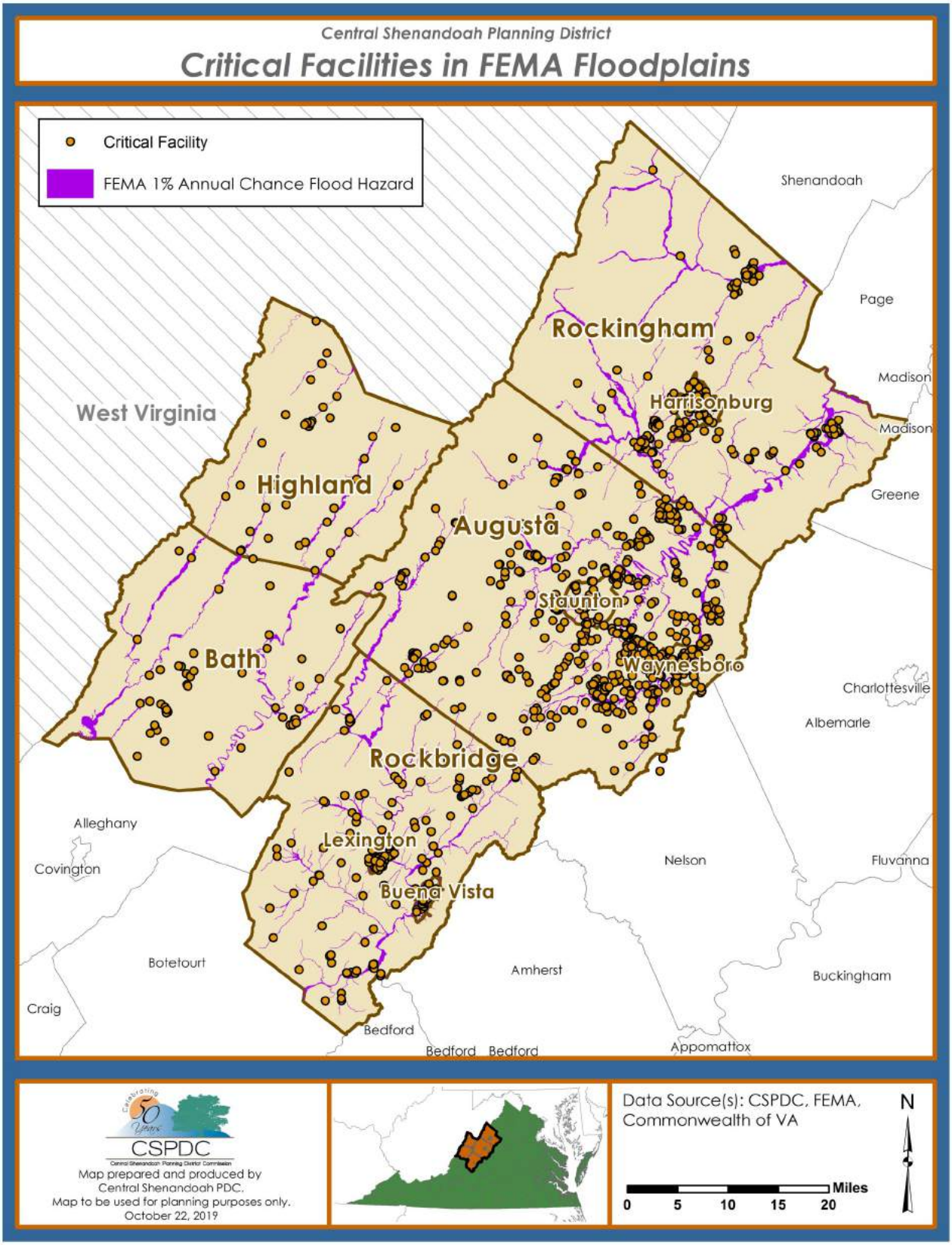


Figure IV-4: Critical Facilities in FEMA Floodplains



Glossary

A-Zone – An area that would be flooded by the Base Flood, and is the same as a Special Flood Hazard Area (SFHA) or a 100-year floodplain. A-Zones are found on all Flood Hazard Boundary Maps and Flood Insurance Rate Maps (FIRMS).

Acquisition – Removal of structures from the floodplain through purchase and demolition with the property to be forever maintained as open space.

Aftershock – An earthquake of similar or lesser intensity that follows the main earthquake.

Alluvium – Sand, mud and other material deposited by a flowing current.

Annual Flood – The flood that is considered the most significant flood event in a one-year cycle of a floodplain.

Backwater – Rise in water caused by downstream obstruction or restriction or by high stage on an intersecting stream. Also referred to as "heading up."

Base Flood – Sometimes referred to as a 100-year flood, it is a flood of the magnitude that has a one percent chance of occurring in any given year.

Base Flood Elevation (BFE) – Elevation of the 100-year flood. This elevation is the basis of the insurance and floodplain management requirements of the National Flood Insurance Program.

Basin – The largest watershed management unit. A basin drains to a major receiving water such as a large river, estuary or lake.

Benefits – Future losses and damages prevented by a project.

Benefit Cost Analysis (BCA) – An assessment of project data to determine whether or not the cost of the project is justified by its benefits.

Berm – Small levees, usually built from fill dirt.

Blizzard Warning – Winds or frequent gusts to 35 miles per hour or greater and considerable falling or blowing snow expected to prevail for a period of three hours or longer.

Buffer – Vegetated strips of land surrounding ecosystems.

Buyout – Commonly used term for property acquisition.

Catchment – The smallest watershed management unit. The area that drains an individual development site to its first intersection with a stream.

Channel – A natural or artificial watercourse with definite bed and banks to confine and conduct flowing water.

Check Dam - A small, low dam constructed in a gully or other watercourse to decrease the velocity of stream flow, for minimizing channel scour.

Community Rating System (CRS) – A system, administered by the Federal Emergency Management Agency (FEMA), where communities are recognized for their mitigation efforts that exceed the National Flood Insurance Program (NFIP)'s minimum standards for floodplain regulation. NFIP policyholders in the community are rewarded with reduced annual flood insurance premiums as part of this program.

Confluence – The section where one stream joins another stream.

Crest – The maximum stage or elevation reached or expected to be reached by the water of a specific flood at a given location.

Critical Facility – Facilities that are critical to the health and welfare of the population and are especially important following hazard events. Critical facilities include, but are not limited to, shelters, police and fire stations, and hospitals.

Debris/Debris Flow – Materials (broken bits and pieces of wood, stone, glass, etc.) carried by wind or floodwaters, including objects of various sizes.

Declaration – Presidential finding that a jurisdiction of the United States may receive Federal aid as a result of damages from a major disaster or emergency.

Design Wind Speed Map – A map of the United States development by the American Civil Engineers that depicts wind zones based on frequency and strength of past tornadoes and hurricanes.

Development – Any man-made change to improved or unimproved real estate, including, but not limited to, buildings or other structures, mining, grading, paving, excavation or drilling or storage of equipment or materials.

Digitize – To convert points, lines and area boundaries shown on maps electronically into coordinates for use in computer applications.

Disaster Resistant Communities – A community based initiative that seeks to reduce vulnerability to natural hazards for the entire designated area through mitigation actions. This approach requires cooperation between individuals and the business sectors of a community to implement effective mitigation strategies.

Drought - a period of abnormally dry weather that persists long enough to produce serious effects like crop damage, water supply shortages, etc.

Dry Floodproofing – Protecting a building by sealing its exterior walls to prevent the entry of flood waters.

Earthquake – A sudden slipping or movement of a portion of the earth's crust accompanied and followed by a series of vibrations.

Elevation – The process of raising a house or other building so that it is above the height of a given flood to minimize or prevent flood damage.

Emergency – Any hurricane, tornado, storm, flood, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, drought, fire, explosion, or other catastrophe in any part of the United States which requires Federal emergency assistance to supplement State and local efforts to save lives and protect property, public health and safety, or to avert or lessen the threat of a disaster.

Emergency Operations Plan (EOP) – Sets forth actions to be taken by the State or local governments in response to emergencies or major disasters.

Encroachment – Any physical object placed in a floodplain that hinders the passage of water or otherwise affects flood flow, such as landfills or buildings.

Enhanced Fujita Scale – Rates tornadoes with number value from EF0 to EF5 based on damage indicators and variables to assign wind speed rating.

Epicenter – The area of the earth's surface directly above the origin of an earthquake.

Erosion – The process of the gradual wearing away of land masses during a flood or storm or over a period of years through the action of wind, water, or other geologic processes.

Fault – An area of weakness where two sections of the earth's crust have separated.

Federal Emergency Management Agency (FEMA) – began as an independent agency of the Federal government established in 1979, reporting to the President. In 2003, FEMA became part of the U.S. Department of Homeland Security. FEMA's mission is to help people before, during, and after disasters. It reduces loss of life and property damage and protects critical infrastructure from all types of hazards through a comprehensive, risk-based emergency management program of mitigation, preparedness, response, and recovery.

First Floor Elevation – The elevation of the lowest finished floor of a structure.

Flash Flood – A sudden, violent flood that rises quickly and usually is characterized by high flow velocities. Flash floods often result from intense rainfall over a small area, usually in areas of steep terrain with little or no warning where water levels rise at an extremely fast rate.

Flood – A partial or complete inundation of normally dry land areas from 1) the overland flow of a lake, river, stream, ditch, etc.; 2) the unusual and rapid accumulation or runoff of surface waters; or 3) mudflows or the sudden collapse of shoreline land.

Flood Control – Measures taken to keep the flood waters away from specific developments or populated areas by the construction of flood storage reservoirs, channel alterations, dikes and levees, bypass channels, or other engineering works.

Flood Depth – Height of the floodwater surface above the ground surface.

Flood Duration – The length of time a stream is above flood stage or overflowing its banks.

Flood Frequency – A statistical expression referring to how often a flood of a given magnitude can be expected. (Note: the word "frequency" often is omitted to avoid repetition).

Examples:
10-year flood – the flood which can be expected to be equaled or exceeded on average once in 10 years; and which would have a 10 percent chance of being equaled or exceeded in any given year.
50-year flood - …. two percent chance…in any given year.
100-year flood - …. one percent chance…in any given year.
500-year flood - ….two-tenths percent chance…in any given year.

Flood Fringe – The portion of the floodplain that lies beyond the floodway and serves as a temporary storage area for floodwaters during a flood.

Flood Insurance Rate Map (FIRM) – An official map of a community prepared by FEMA on which areas that may or may not require flood insurance are delineated. These maps also provide flood elevations and velocity zones.

Flood Insurance Study (FIS) – A study prepared by FEMA that provides an examination, evaluation, and determination of flood hazards and, if appropriate, corresponding water surface elevations in a community or communities.

Flood Mitigation Assistance Program (FMA) - Provides pre-disaster grants to State and local governments for both planning and implementation of mitigation strategies. Each State is awarded a minimum level of funding which may be increased depending upon the number of NFIP policies in force and repetitive claims paid.

Floodplain – Land adjoining a stream (or other body of water) which has been or may be covered with water.

Floodplain Management – The operation of an overall program of corrective and preventive measure for reducing flood damage, including but not limited to emergency preparedness plans, flood control work and floodplain management regulations such as zoning ordinances, subdivision regulations, building codes and floodplain ordinances.

Floodproofing – Any combination of structural and nonstructural additions, changes or adjustments to properties and structures which reduce or eliminate flood damage to lands, water, and sanitary facilities, structures, and contents of buildings. May include structural elevation, relocation, acquisition, or other measures.

Floodwall – Flood barrier constructed of manmade materials, such as concrete or masonry designed to keep water away from a structure.

Flood Warning – A warning term that means flooding is already occurring or will occur soon in your area.

Flood Watch – A warning term that means that a flood is possible in your area.

Floodway – The channel of a river or other watercourse and the adjacent land areas required to carry and discharge the base flood without cumulatively increasing the water-surface elevation more than one foot at any point.

Floodway Fringe – The area between the floodway and the 100-year floodplain boundaries.

Freeboard – An additional amount of height usually expressed in feet above the Base Flood Elevation used as a factor of safety in determining the level at which a structure's lowest floor must be elevated or floodproofed to be in accordance with State or community floodplain management regulations.

Freezing Rain – Rain that freezes when it hits the ground, creating a coating of ice on roads, walkways, trees, and power lines.

Frost/Freeze Warning – Below freezing temperatures are expected.

Geographic Information System (GIS) - A computerized mapping and analysis tool. GIS can be a useful tool in mapping at-risk structures and infrastructure in the floodplain.

Greenways – Greenways are linear parks or corridors of open space that may extend across many communities. They can provide walking and biking links between parks, businesses, and culturally important sites. They embody a strategy for keeping riverside areas largely undeveloped, which provide recreational, cultural and aesthetic resources. Greenways can help to protect stretches of floodplain ecosystems.

Hail – Hail or hailstones are irregular pellets or balls of ice falling from a cumulonimbus clouds.

Hazard – A source of potential danger or adverse condition. Hazards include naturally occurring events such as floods, earthquakes, tornadoes, tsunami, coastal storms, landslides, and wildfires that strike populated areas. A natural event is a hazard when it has the potential to harm people or property.

Hazard Mitigation – A plan to alleviate or make less severe the effects of a major disaster. Hazard mitigation can reduce the severity of the effects of a flood on people and property by reducing the cause or occurrence of the hazard and reducing exposure to the hazard.

Hazard Mitigation Grant Program (HMGP) – Authorized under Section 404 of the Stafford Act; provides funding for cost-effective hazard mitigation projects in conformance with the post-disaster mitigation plan.

Hazard Mitigation Plan – A plan resulting from a systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards present in a community that includes the actions needed to minimize future vulnerability to hazards.

HAZUS – A GIS-based nationally standardized loss estimation tool developed by FEMA.

Headwater – Highest reaches of a stream in a drainage basin.

Hurricane – A severe tropical disturbance in the North Atlantic Ocean, Caribbean Sea, or Gulf of Mexico that achieves a sustained wind force of at least 74 miles per hour.

Hydrology – The science of the behavior of water in the atmosphere, on the earth's surface, and underground.

Hydrostatic Pressure – Forces imposed on an object, such as a structure, by standing water.

Increased Cost of Compliance (ICC) – Coverage under a standard NFIP flood insurance policy. ICC helps pay for the cost of mitigation, including demolition and relocation for a flood-insured structure that sustains a flood loss and is declared to be substantially or repetitively damaged.

Infrastructure – Public services that have a direct impact on the quality of life such public water supplies and sewer treatment facilities, and transportation networks such as airports, roads and railways.

Integrated Flood Observing and Warning System (IFLOWS) - A flood warning system developed by the National Weather Service that combines sensors, communication, and computer technology with advanced forecasting to provide timely guidance and advice to local emergency services staff.

Karst – A land area with topographic depressions such as sinkholes, springs, sinking streams, and caves caused by underground solution of limestone bedrock.

Landslide - Downward movement of a slope and materials under the force of gravity.

Levee – A man-made flood barrier constructed of compacted soil designed to contain, control, or divert the flow of water.

Lightning – Lightning is an electrical circuit that is generated in cumulonimbus clouds (thunderheads) which have a negative electrical charge at the base and a positive charge at the top.

Lowest Floor – Under the NFIP program, the lowest floor of the lowest enclosed area, including a basement. An unfinished or flood-resistant enclosure such as a garage or storage area is not considered a building's lowest floor.

Magnitude – Measurement of the relative size of the earthquake compared to other standard earthquakes based on a logarithmic scale.

Mitigation – Sustained action that reduces or eliminates long term risk to people and property from natural hazards and their effects.

Mitigation Reconstruction – The construction of an improved, elevated building on the same site where an existing building and/or foundation had been partially or completely demolished or destroyed. Mitigation reconstruction is only permitted outside of the regulatory floodway or Coastal High Hazard Area (Zone V) as identified by the existing best available flood hazard data.

Mudflows – Sometimes called debris flows; mudflows are rivers of rock, earth, and debris saturated with water. They develop when water accumulates rapidly in the ground, so that earth becomes a flowing river of mud (called a slurry).

National Flood Insurance Program (NFIP) – Provides the availability of flood insurance in exchange for the adoption and enforcement of a minimum local floodplain management ordinance. The ordinance regulates new and substantially damaged or improved development in identified flood hazard areas. The Federal Emergency Management Agency administers this program.

Open Space – An area of land that is free of development, i.e. houses and other buildings that alter the area's natural appearance and impede the area's ability to covey flood flows. Open space can be used for parks, ball fields, hiking trails, garden spaces and other compatible open space uses.

Palmer Drought Severity Index (PDSI) – A measurement index which tracks moisture conditions and severity of drought conditions ranging from –10 (dry) to +10 (wet). Values below –3 represent severe to exceptional drought.

Pre-FIRM/Post-FIRM – Pre-FIRM means that a building was constructed before the date of the initial Flood Insurance Rate Map (FIRM) issued to the community or before December 31, 1974, whichever is later. Post-FIRM means the building was constructed on or after the date of community initial FIRM, or after December 31, 1974, whichever is later.

Preparedness – Activities to ensure that people are ready for a disaster and respond to it effectively. Preparedness requires figuring out what will be done if essential services break down, developing a plan for contingencies, and practicing the plan.

Project Impact – A project introduced by FEMA to reduce the damage of disasters. It helped communities protect themselves by taking actions to reduce disruption and loss.

Rain Gardens – A water quality practice in which plants and soils are used to remove pollutants from stormwater. Also known as bio-retention.

Recovery – Activities necessary to rebuild after a disaster. Recovery activities include rebuilding homes, businesses, and public facilities; clearing debris; repairing roads and bridges; and restoring water, sewer and other essential services.

Recurrence Interval – The time between hazard events of similar size in a given location. It is based on the probability that the given event will be equaled or exceeded in any give year.

Relocation – The process of moving a house or other building to a new location outside the flood hazard area.

Repetitive Loss Property – 1. The National Flood Insurance Program defines Repetitive Loss as 2 or more claims of at least $1000 over a 10 year rolling period. This is the data that appears in this plan. 2. The Hazard Mitigation Assistance program defines Repetitive Loss as having 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, at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

Response – Activities to address the immediate and short-term effects of an emergency or disaster. Response activities include immediate actions to save lives, protect property, and meet basic human needs.

Retrofitting – Making changes to an existing house or other building to protect it from flooding or other hazards.

Richter Scale – A numerical scale of earthquake magnitude devised by seismologist C. F. Richter in 1935.

Riparian System – Ecosystem occurring in the interface between aquatic and terrestrial systems, in floodplains and adjacent to rivers and streams. Riparian systems are subject to direct influences of ground and or surface waters, and occasional flooding.

Riprap – Broken stone, cut stone blocks, or rubble that is placed on slopes to protect them from erosion or scouring caused by floodwaters.

Riverine – Relating to, formed by, or resembling a river, including tributaries, streams, brooks, etc. Riverine flooding occurs when a river or stream overflows its banks and causes considerable inundation of nearby land and roads.

Seismic – Describes activity related to earthquakes.

Seismic Waves – Vibrations that travel outward for the center of the earthquake at speeds of several miles per second.

Severe Thunderstorm Watch – A severe thunderstorm is expected in the next six hours within an area approximately 120 to 150 miles wide and 300 to 400 miles wide.

Severe Thunderstorm Warning – Indicates a severe thunderstorm is occurring or is imminent in about 30 minutes to 1 hour.

Sinkholes – Natural depressions in the landscape caused by solution and subsidence of earth materials.

Sleet – Rain that turns to ice pellets before reaching the ground. Sleet also causes roads to freeze and become slippery.

Special Flood Hazard Area (SFHA) - The shaded area on a FIRM map that identifies an area that has 1% chance of being flooding in any given year (100-year floodplain).

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. The statutory authority for most Federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stormwater – Water from precipitation that flows across the ground and pavement when it rains, floods, or when snow and ice melt. The water seeps into the ground or drains into what we call storm sewers.

Substantial Damage – Damage of any origin sustained by a structure whereby the cost of restoring the structure to its pre-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

Topography – The elevations of the land surface.

Tornado – A violently rotating column of air extend from thunderstorm to the ground.

Tornado Warning – A tornado has been sighted or indicated by weather radar. Take shelter immediately.

Tornado Watch – Tornadoes are possible.

Tropical Storm – A tropical cyclone with maximum sustained winds greater than 39 mph and less than 74 mph.

Urban-Wildland Interface Zone – The developed area that occupies the boundary between an urban or settled area and the undeveloped natural forest environment.

Vulnerability – A term used to describe how exposed or susceptible to damage an asset is. Vulnerability depends on an asset's construction, contents and the economic value of its function.

Watershed – The area of land that is drained by a river and its tributaries. Ridges or divides separate watersheds from each other.

Waterspout – A tornado that forms over water.

Wet Floodproofing – Protecting a building by allowing flood waters to enter so that internal and external hydrostatic pressure is equalized. Usually enclosed areas used for parking, storage, or building access are wet floodproofed.

Wetlands – Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

Wildfire - An uncontrollable fire spreading through vegetative fuels, exposing and possibly consuming structures.

Wildland Fire – A fire in which development is essentially nonexistent, except for roads, railroads, power lines and similar facilities.

Winter Storm Watch – A winter storm is possible in your area.

Winter Storm Warning – A winter storm is occurring, or will soon occur in your area.

2. Hazard Identification

Types of Hazards

While nearly all disasters are possible for any given area in the United States, the most likely hazards that could potentially affect the communities in the Central Shenandoah Planning District generally include:

- Flooding or Dam Failure
- Drought
- Hurricane
- Severe Winter Weather
- Land Subsidence/Karst
- Wind (Tornado, Derecho or Straight-line Winds)
- Wildfire
- Landslide
- Earthquake
- Hazardous Materials (Transportation and Industrial)
- Terrorism
- Power Outages

Probability of Hazards

Hazards were ranked by the Steering Committee to determine what hazards have the largest impact on their communities. The results are summarized in Table IV-2. Analysis level was determined by the type of data available and the scale of data available for the analysis.

Table IV-2: Central Shenandoah PDC Planning Consideration Levels

Hazard Identification Results	
Hazard Type	**Ranking**
Flooding or Dam Failure	Significant
Drought	High
Hurricane	High
Severe Winter Weather	High
Land Subsidence/Karst	Medium
Wind (Tornado, Derecho or Straight-Line Winds)	Medium
Wildfire	Medium
Landslide	Low
Earthquake	Low
Hazardous Materials (Transportation and Industrial)	Medium
Terrorism	Low
Power Outages	Medium

2020 Plan Update Steering Committee Comments

At meetings in April and June 2019, the Steering Committee charged with updating the Plan discussed the Hazard Identification and Rankings for the Region. Based upon review of the ranking results, it was determined the rankings would remain the same, especially since we have not had any large scale disasters since the previous Plan update. In addition to examining the rankings, the Steering Committee discussed other hazards where they felt the Region faces vulnerability including derechos, hazardous materials, livestock and poultry disease, opioid/drug abuse, infectious disease/pandemic, criminal behavior, power outages, environmental/water quality issues, dam failure, and civil unrest. As a result of this discussion and additional rankings, it was determined to include hazardous materials (transportation and industrial), dam failure (in the flood section), derechos and straight line winds (in the tornado section), and power outages. While some of these hazards may be limited in mitigation options it was important to include these topics because they are seen as vulnerabilities by the Region's communities.

Major Disasters

Since 1969, there have been 22 Major Disaster Declarations in the Region. As of July 23, 2019, individual communities in the Region have been included within the Major Disaster Declarations a combined total of 108 times. Table IV-3 includes information on the number of Major Disaster Declarations in the Region by individual community. Data for Towns is not separated from the County totals. Table IV-4 shows the types of hazards, the date of the declaration and disaster declaration number, and descriptions of the events for the 22 Major Disaster Declarations in the Region. For more detailed historical information on the individual events, refer to the hazard history sections found under each hazard type.

Since 1969, there have been 22 Major Disaster Declarations in the Region.

Table IV-3: Central Shenandoah PDC - Number of Major Disaster Declarations by Community (last updated 7/23/2019)

Communities	Number of Major Disaster
Augusta County	14
Bath County	14
Buena Vista City	12
Harrisonburg City	7
Highland County	14
Lexington City	7
Rockbridge County	15
Rockingham County	10
Staunton City	7
Waynesboro City	8
Total	108

Rockbridge County has had the highest number of Major Disaster Declarations in the Region, with 15.

Table IV-4: Central Shenandoah PDC - Major Disaster Declarations

Community	Date Of Declaration	Disaster Declaration Number	Description
Augusta, Bath, Rockbridge	8/23/1969	DR - 274	Hurricane Camille was a major storm that made landfall out of the Gulf as a category 5 and weakened to a tropical depression before reaching the state. Flooding and landslides, triggered by saturated soils, resulted in catastrophic damage.
Bath, Buena Vista, Harrisonburg, Lexington, Rockbridge, Rockingham, Staunton, Waynesboro	6/23/1972	DR - 339	Hurricane Agnes produced devastating flooding throughout the Mid-Atlantic States.
Buena Vista	10/7/1972	DR – 358	Severe Storms and Flooding
Augusta, Buena Vista, Rockbridge, Rockingham	10/10/1972	DR – 359	Severe Storms and Flooding

Table IV-4: Central Shenandoah PDC - Major Disaster Declarations—continued

Community	Date Of Declaration	Disaster Declaration Number	Description
Augusta, Bath, Buena Vista, Harrisonburg, Highland, Lexington, Rockbridge, Rockingham, Waynesboro	11/9/1985	DR-755	Hurricane Juan brought heavy rain, causing record-breaking floods.
Augusta, Bath, Buena Vista, Lexington, Rockbridge, Rockingham	5/19/1992	DR - 944	Severe Storms and Flooding
Bath, Buena Vista, Rockbridge	3/10/1994	DR - 1014	Severe Ice Storms, Flooding
Augusta, Highland	4/11/1994	DR-1021	Winter Storm brought ice, freezing rain and sleet.
Augusta, Bath, Buena Vista, Lexington, Rockbridge, Staunton	7/1/1995	DR-1059	A week-long period of ground saturating rains fell, resulting in flash flooding.

Table IV-4: Central Shenandoah PDC - Major Disaster Declarations—continued

Community	Date Of Declaration	Disaster Declaration Number	Description
Augusta, Bath, Buena Vista, Harrisonburg, Highland, Lexington, Rockbridge, Rockingham, Staunton, Waynesboro	1/13/1996	DR - 1086	Severe winter weather resulted in a blizzard, followed by two additional snowstorms bringing over a foot of snow. Snowpack was on the ground for an extended period of time. It was thawed by higher temperatures and heavy rain, resulting in severe flooding.
Augusta, Bath, Buena Vista, Harrisonburg, Highland, Rockbridge, Rockingham, Waynesboro	1/27/1996	DR - 1098	Flooding was caused by melting snow.
Augusta, Bath, Buena Vista, Harrisonburg, Highland, Lexington, Rockbridge, Rockingham, Staunton, Waynesboro	9/6/1996	DR – 1135	Hurricane Fran brought record-level flooding to many locations in the region.
Augusta, Bath, Highland, Rockbridge, Rockingham	2/28/2000	DR-1318	Winter Storms brought a blizzard to the East Coast that impacted the region from January 25 through January 30, 2000.

Table IV-4: Central Shenandoah PDC - Major Disaster Declarations—continued

Community	Date Of Declaration	Disaster Declaration Number	Description
Bath	7/12/2001	DR - 1386	Severe Storms and Flooding from July 8, 2001 through August 27, 2001.
Highland	3/27/2003	DR - 1458	Severe Winter Storm, Snowfall, Heavy Rain, Flooding and Mudslides from February 15, 2003 through February 28, 2003.
Augusta, Buena Vista, Harrisonburg, Highland, Rockbridge, Rockingham, Staunton, Waynesboro	9/18/2003	DR – 1491	Hurricane Isabel brought significant rainfall to the region, resulting in major flooding.
Bath, Highland, Rockbridge	7/13/2006	DR -1655	Severe storms, tornadoes, and flooding occurred from June 23 – July 6, 2006.
Augusta, Bath, Highland, Rockbridge, Staunton, Waynesboro	2/16/2010	DR – 1874	Severe winter storm and snowstorm occurred from December 18, 2009.
Augusta, Highland, Waynesboro	4/27/2010	DR – 1905	Severe winter storm and snowstorms occurred from February 5-11, 2010.

Table IV-4: Central Shenandoah PDC - Major Disaster Declarations—continued

Community	Date Of Declaration	Disaster Declaration Number	Description
Augusta, Bath, Buena Vista, Harrisonburg, Highland, Lexington, Rockbridge, Rockingham, Staunton	7/27/2012	DR-4072	Severe Storms and straight-line winds from derecho during the period from June 29-July 1, 2012.
Highland	11/26/2012	DR-4092	Impacts from Hurricane Sandy caused damage to utility infrastructure.
Highland	3/7/2016	DR-4262	Severe winterstorm and snowstorm.

Agricultural Disasters

The Region has a strong agricultural heritage and is home to some of Virginia's top agricultural producing counties. The total market value of products sold in the Region is over $1.1 billion. Rockingham County produces 20 percent of agriculture sales in Virginia. It is ranked number one in total market value of products sold; number one in livestock, poultry, and products; and number four in crops in Virginia. Augusta County produces 7 percent of agricultural sales in Virginia. It is ranked number two in total market value of products sold; number two in livestock, poultry, and products, and number ten in crops in Virginia. Table IV-5 provides an overview of 2017 Agricultural Census Data by County for the Region.

The total market value for agricultural products sold in the region is over $1.1 billion

Table IV-5: Central Shenandoah PDC - Agricultural Census Data

County	Number of Farms	Land in Farms (Acres)	Total Producers	Total Market Value of Products Sold
Augusta	1,665	290,911	2,841	$292,547,000
Bath	110	47,854	193	$6,747,000
Highland	275	92,950	419	$26,120,000
Rockbridge	752	134,789	1,241	$30,983,000
Rockingham	2,026	228,542	3,491	$795,919,000
Regional Total	4,828	795,046	8,185	$1,152,316,000

Rockingham County ranks #1 in total market value or products sold, and in livestock, poultry and products.

Source Data: National Agricultural Statistics Service (NASS), U.S. Department of Agriculture, 2017 Census of Agriculture, State and County Profiles.

The Farm Service Agency administers four types of disaster designations.

As a top agricultural producing region in Virginia, the Region is susceptible to impacts from natural disasters on the agricultural industry. The Farm Service Agency administers four types of disaster designations that provide for the ability of low-interest emergency loans to eligible producers. The four disaster designations include:

- U.S. Department of Agriculture Secretarial Disaster Designation;
- Presidential Major Disaster and Presidential Emergency Declaration;
- Farm Service Agency Administrator's Physical Loss Notification; and
- Quarantine designations by the Secretary under the Plant Protection Act or animal quarantine laws.

Eligible producers can receive low-interest emergency loans.

A locality may be considered for disaster designation if it has experienced an eligible disaster that has impacted farmers and caused production losses. For a Secretarial Disaster Designation for droughts, the locality may be eligible if any portion experiences the D2 Severe Drought intensity value for eight consecutive weeks, or if the locality experiences a higher drought intensity value for any period of time. For other natural disasters, the locality may be eligible if it experiences a 30 percent production loss of at least one crop, or if after surveying producers it is determined that emergency financing may not be available from other sources.

Table IV-6 provides information on U.S. Department of Agriculture Secretarial Disaster Declarations in the Region since 2012. Table IV-7 provides information on Presidential Major Disaster and Presidential Emergency Declarations in the Region since 2017.

Table IV-6: U.S. Secretary of Agriculture Disaster Designations, 2012-2019

Designation Number	Locality	Primary or Contiguous	Approval Date	Begin Date	End Date	Description of Disaster	Crop Disaster Year
S3418	Augusta Rockbridge Rockingham	Contiguous	10/10/2012	6/28/2012	7/3/2012	Excessive rain, hail, high winds and lightning associated with a Derecho Windstorm	2012
S3422	Rockbridge Rockingham	Contiguous	10/17/2012	1/1/2012	Continuing	Drought and related disasters, including excessive heat and high winds	2012
S3443	Rockingham	Contiguous	11/26/2012	6/29/2012	Continuing	Drought, excessive heat	2012
S3782	Augusta Bath Highland Rockbridge	Primary (Bath); Contiguous (Other Localities)	1/28/2015	8/22/2014	10/15/2014	Drought	2014
S3793	Augusta Bath Highland	Primary (Highland); Contiguous (Other Localities)	2/11/2015	6/1/2014	10/31/2014	Drought	2014
S4297	Rockingham	Contiguous	3/29/2018	6/30/2017	Continuing	Drought and Excessive Heat	2017
S4493	Augusta Harrisonburg Rockingham	Primary (Rockingham); Contiguous (Other Localities)	7/9/2019	4/15/2018	Continuing	Excessive rain, flash flooding, flooding and hail	2018

Source Data: Farm Service Agency, U.S. Department of Agriculture, Disaster Designation Information, U.S. Secretary of Agriculture Disaster Designation, 2012-2019

Table IV-7: Presidential Major Disaster and Presidential Emergency Declarations, 2017-2019

Designation Number	Locality	Primary or Contiguous Designation	Approval Date	Begin Date	End Date	Description of Disaster	Crop Disaster Year
4378	Augusta Highland	Contiguous	7/12/2018	5/28/2018	6/3/2018	Severe Storms, Flooding, Landslides, and Mudslides	2018
4401	Rockbridge	Contiguous	10/15/2018	9/8/2018	9/21/2018	Hurricane Florence	2018
4455	Augusta Highland Rockingham Harrisonburg Staunton Waynesboro	Contiguous	8/2/2019	6/29/2019	6/30/2019	Severe Storms, Flooding, Landslides and Mudslides	2019

Source Data: Farm Service Agency, U.S. Department of Agriculture, Disaster Designation Information, Presidential Major Disaster and Presidential Emergency Declarations, 2017-2019

Level of Hazard

Table IV-8 provides a breakdown of the natural hazards addressed in the Plan. The level of planning consideration given to each hazard was determined by the committee members. Based on the input of committee members, the hazards were broken into four distinct categories which represent the level of consideration they will receive throughout the planning process.

In order to focus on the most critical hazards that may affect the communities of the Region, the hazards assigned a level of *Significant*, *High* and *Medium* will receive the most extensive attention in the remainder of the planning analysis.

Table IV-8: Central Shenandoah PDC Natural Hazards HIRA Overview

Hazard	Type	Ranking	Data Reference
Flooding or Dam Failure	Riverine	Significant	FEMA, DCR, FEMA HAZUS-MH, NID, NHD
Drought	Including excessive heat	High	Drought Monitor Task Force, Water Systems, US Census, Commonwealth of Virginia, NCEI/NCDC
Hurricane	Wind	High	FEMA HAZUS-MH, NOAA
Severe Winter Weather	Including winter storms, ice storms, and excessive cold	High	NOAA National Weather Service Records, VirginiaView PRISM, Climate Source, Commonwealth of Virginia, NCEI/NCDC
Karst/Land Subsidence	Karst/Land Subsidence	Medium	USGS, VT Mines & Minerals
Wind	Tornado, Derecho or Straight-line Winds	Medium	NOAA, Commonwealth of Virginia, NCEI, NCEI/NCDC
Wildfire	Wildfire	Medium	Virginia Department of Forestry, USGS, DCR
Landslide	Landslide	Low	USGS
Terrorism	Terrorism	Low	Addressed in depth in community Emergency Operation Plans (EOP)
Earthquake	Earthquake	Low	FEMA, VDEM, FEMA HAZUS-MH
Hazardous Materials	Transportation and Industrial	Low	Addressed in depth in community Hazardous Materials Plan (HMP)
Power Outages	Power Outages	Low	No maps included.

3. Flooding or Dam Failure (Significant Ranking)

Flooding Hazard History

Listed below are flooding events that have occurred in the Region. In Appendix C - Flood History and Dam Risk Assessment and Inventory, flooding events have been broken down by the date of occurrence and when available, by individual community descriptions. When no community specific description is available, the general description should be used as representing the entire planning area.

- July 13, 1842
- 1846
- January 1854
- August 4, 1860
- September 28 - 30, 1870
- August 28, 1893
- September 29, 1896
- August 15, 1906
- November - December 1934
- March 16 - 17, 1936
- April 1937
- October 1942
- June 18, 1949
- September 10, 1950
- Hurricane Hazel - October 15, 1954
- Hurricanes Connie and Diane - August 1955
- Hurricane Gracie - September 29, 1959
- Hurricane Camille - August 19, 1969
- Hurricane Agnes - June 19, 1972
- October 7, 1972
- October 10, 1972
- Hurricane Juan - November 4 - 7, 1985
- May 19, 1992
- April 1993

- March 10, 1994
- June 22 - 28, 1995
- January 13, 1996
- January 27, 1995
- Hurricane Fran - September 6, 1996
- July 8– August 21, 2001
- February 15-February 28, 2003
- August 8, 2003
- Hurricane Isabel – September 18, 2003
- Hurricane Charley—August 2004
- Hurricane Frances—August 2004
- Hurricane Ivan– September 2004
- Hurricane Jeanne– September 2004
- Hurricane Cindy– July 2005
- November 29, 2005
- June 23 - July 6, 2006 "Mid-Atlantic United States Flood"
- Hurricane Hanna- August and September 2008
- January 25, 2010
- April 11-12, 2011
- April 16, 2011
- April 27-28, 2011
- Hurricane Sandy– October 2012
- May 9, 2013
- June 17, 2013
- April 15-16, 2018
- May 14, 2018
- May 21, 2018
- May 28-June 3, 2018
- June 21-June 22, 2018
- June 27-30, 2018
- August 30, 2018
- Hurricane Florence- September 2018
- June 29-June 30, 2019

Flooding Hazard Profile

A flood is a natural event for rivers and streams. Excess water from snowmelt, rainfall, or storm surge accumulates and overflows onto the banks and adjacent floodplains. Floodplains are lowlands, adjacent to rivers, lakes, and oceans that are subject to recurring floods. Under natural conditions, a flood causes little or no damage. Flood problems only exist when the built environment is damaged by nature's water or when property and lives are jeopardized. Floods in the Region are almost always associated with hurricanes, tropical storms, and tropical depressions. However, some of the Region's flooding is caused by sustained heavy rains, severe thunderstorms, and even rapid snowmelts.

The Region has received 15 Major Disaster Declarations due to flooding.

The Central Shenandoah Region experiences both riverine flooding and urban flooding. Most riverine flooding occurs from either the Shenandoah River or James River or their tributaries that are found throughout the Central Shenandoah Region. The Region's cities and towns experience flash flooding from stormwater runoff but a majority of their flooding is riverine due to the tributary creeks and small streams of the major river systems that run through them. Some of these streams are actually underground, buried as communities developed, especially during a "boom" in the late 1800s. Because of the historic nature of the Shenandoah Valley, most communities were developed long before floodplains were mapped.

Individual localities have been included in the Major Disaster Declarations a combined total of 81 times.

While the Region experiences nearly all types of natural disasters, including snow storms, ice storms, wildfires, and tornadoes, flooding is perhaps the most common and devastating type of disaster. It is also the most common hazard in the United States with hundreds of floods occurring every year causing an average of 150 deaths annually.

Since 1969, the Central Shenandoah Valley Region has received fifteen Major Disaster Declarations due to flooding. Individual localities in the Region have been included in the Major Disaster Declarations a combined total of 81 times. Floods in 1969, 1972, 1985, 1992, 1994, 1995, 1996, 2001, 2003, and 2006 have had severe and long-term effects on property owners, local businesses,

industry, and our economy. Flooding has also impacted agriculture in the region, with one Secretarial Disaster Declaration since 2012 and three Presidential Major Disaster and Presidential Emergency Declarations since 2017. The Secretarial Disaster Declaration included three localities, and the Presidential Major Disaster and Presidential Emergency Declarations included 10 localities.

Flooding can jeopardize lives and cause damage to buildings, infrastructure and the environment.

Floods typically are characterized by frequency. For example, the "1%-annual chance flood" is commonly referred to as a "100-year" flood. While more frequent floods do occur, as well as larger events that have lower probabilities of occurrence, for most regulatory and hazard identification purposes, the 1%-percent annual chance flood is used.

A 1% Annual Chance Flood is commonly referred to as a 100-Year Flood

Homes and businesses may suffer damage and be susceptible to collapse. Floods pick up chemicals, sewage, and toxins from roads, factories, and farms. Any property affected by the flood may be contaminated with hazardous materials. Debris from vegetation and man-made structures may also be hazardous following the occurrence of a flood. In addition, floods may threaten water supplies and water quality, as well as initiate power outages.

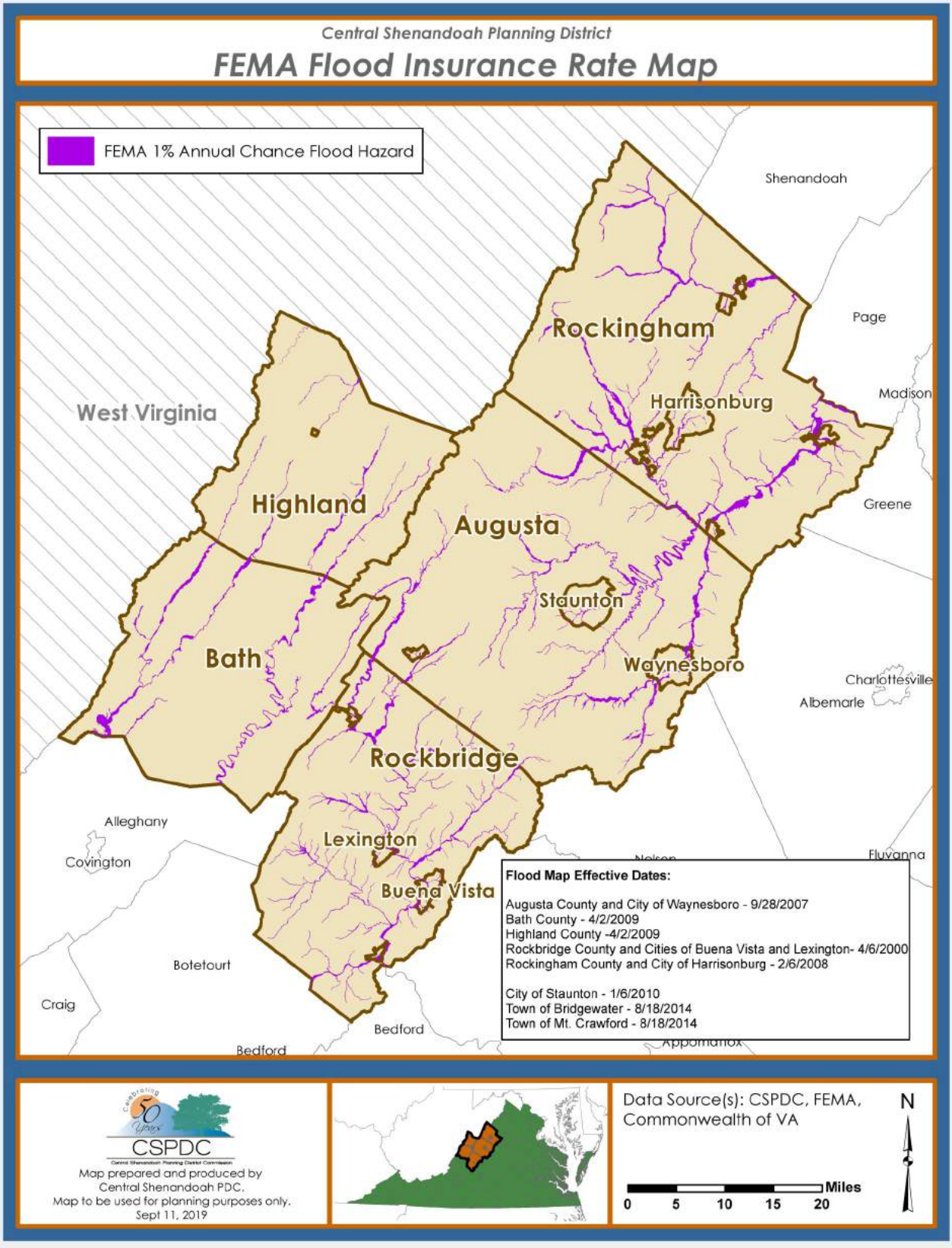
Secondary Effects

Flooding can pose some significant secondary impacts to the area where the event has taken place. Some of the impacts to consider include infrastructure and utility failure and impacts to roadways, water service, and wastewater treatment. These impacts can affect the entire Region, making the area vulnerable to limited emergency services.

Flood Maps

FEMA's National Flood Hazard Layer (NFHL) was used for all locality flood mapping and analysis. This layer is a geospatial database that contains current flood hazard data and supports the National Flood Insurance Program. This GIS data was used to better understand the region's level of flood risk.

Figure IV-5: Central Shenandoah PDC - FEMA Floodplains - 1% Annual Chance Flood



Vulnerability Analysis

There are 175 repetitive loss properties in the CSPDC region.

Many factors contribute to the relative vulnerabilities of areas within the floodplain. Some of these factors include development which increases the presence of people and property in the floodplain, flood depth, velocity, elevation, construction type, and flood duration. Specific areas that are susceptible to flooding were determined by the CSPDC when developing the Central Shenandoah Valley Regional Flood Mitigation Plan.

Approximately 6.61% of the CSPDC total structures are vulnerable to flooding.

FEMA's HAZUS software was used to complete a 100-year flood scenario for the CSPDC localities. Figure IV-5 shows the 1% Annual Chance Flood Hazard for the Region. For more detailed flood maps and critical facilities by locality, see Appendix D. These maps provide detailed information on areas susceptible to flooding. These areas were taken into account when completing the hazard identification and risk assessment.

FEMA-Designated Repetitive Loss Properties

FEMA provides a Repetitive Loss List of the properties in a community. A Repetitive Loss Property is a structure covered by a contract for flood insurance made available under the National Flood Insurance Program (NFIP). The NFIP defines Repetitive Loss as 2 or more claims of at least $1000 over a 10 year rolling period. This is the data that appears in the Plan. Please see Appendix E to view tables for the number of repetitive losses and severe repetitive losses for each locality or contact your local NFIP coordinator for specific information. There are 175 repetitive loss properties and 6 severe repetitive loss properties in the Region (Appendix E). Note that FEMA designates counties, cities and towns separately in the table.

Table IV-9: Structures at Risk Due to Flooding from the CSPDC Flood Mitigation Plan

Community	Structures at Risk	Total Structures	% of Structures at Risk	% of Structures not at Risk
Augusta County	2,851	69,338	4.11%	95.89%
Bath County	238	3,628	6.56%	93.44%
Highland County	85	2,106	4.04%	95.96%
Rockbridge County	1,183	12,195	9.70%	90.30%
Rockingham County	6,383	88,855	7.18%	92.82%
City of Buena Vista	815	2920	27.91%	72.09%
City of Harrisonburg	1,034	20,494	5.05%	94.95%
City of Lexington	36	2,298	1.57%	98.43%
City of Staunton	668	14,698	4.54%	95.46%
City of Waynesboro	1,048	13,512	7.76%	92.24%
Town of Bridgewater	206	3,223	6.39%	93.61%
Town of Broadway	114	2,625	4.34%	95.66%
Town of Craigsville	240	890	26.97%	73.03%
Town of Dayton	114	1,347	8.46%	91.54%
Town of Elkton	283	2,510	11.27%	88.73%
Town of Glasgow	197	553	35.62%	64.38%
Town of Goshen	61	228	26.75%	73.25%
Town of Grottoes	620	2,325	26.67%	73.33%
Town of Monterey	19	180	10.56%	89.44%
Town of Mt. Crawford	29	453	6.40%	93.60%
Town of Timberville	63	1,891	3.33%	96.67%
Total	**16,288**	**246,267**	**6.61%**	**93.39%**

Structures at Risk-Vulnerability

To determine an estimated number of structures vulnerable to flooding in the CSPDC region, a GIS analysis was performed. Using the Virginia Geographic Information Network (VGIN) structure layer, structures were overlaid with FEMA's flood zones with 1% and 0.2% annual chances. These structures that intersected with these zones were extracted and then calculated for each locality. Table IV-9 is a summary of these at risk structures.

The Town of Glasgow has the highest percentage of at risk structures at 35.62% . The City of Buena Vista is estimated to have 815 structures at risk to flooding, which is 27.91% of the City's total structures. Approximately 6.61% of the CSPDC total structures are vulnerable to flooding.

Estimating Losses

FEMA's HAZUS-MH software was used to generate 100 year flood scenarios for all of the 21 jurisdictions of the CSPDC Region to better understand the estimated damage and losses associated with flooding. On the county level, drainage areas of 10 miles were identified to develop a stream network. On the City and Town level, the drainage areas were delineated at 2 miles. It is noted that this version of HAZUS utilizes 2010 Census Data and totals produced by HAZUS only reflect data for those census tracts/blocks included in the study region.

HAZUS-MH software produces Quick Assessment (QA) reports providing locality statistics, including building exposure estimated in dollar amounts. The QA report also list the results of the 100 year flood scenario. A summary of the results from the HAZUS-MH Quick Assessment reports for each jurisdiction are shown in Table IV-10. See Appendix G to view flooding HAZUS reports.

Table IV-10: CSPDC HAZUS-MH 100 Year Flood Scenario Quick Analysis

HAZUS-MH 100 Year Flood Scenario Quick Analysis							
Locality	**Residential Building Exposure ($ Millions)**	**Total Building Exposure ($ Millions)**	**Displaced Households**	**People Seeking Shelter**	**Residential Property (Capital Stock) Losses ($ Millions)**	**Total Property (Capital Stock) Losses ($ Millions)**	**Business Income Interruption Losses ($ Millions)**
Augusta County	6,296	7,634	702	35	68	108	56
Craigsville	64	70	34	0	3	3	1
Bath County	739	818	91	0	30	52	23
Highland County	320	367	51	1	12	13	2
Monterey	25	37	0	0	0	0	0
Rockbridge County	2,182	2,612	300	6	44	105	57
Glasgow	81	116	8	0	1	9	2
Goshen	28	29	14	0	2	2	1
Rockingham County	6,609	7,870	809	25	75	117	63
Bridgewater	473	586	19	0	2	2	1
Broadway	311	379	23	0	2	6	7
Dayton	118	151	20	1	1	5	2
Elkton	241	295	5	0	0	0	0
Grottoes	186	228	35	2	1	1	1
Mt. Crawford	261	306	24	0	2	3	1
Timberville	219	238	14	0	2	2	1
City of Buena Vista	510	725	269	13	23	46	44
City of Harrisonburg	3,460	5,091	476	110	31	68	121
City of Lexington	715	958	25	1	2	3	2
City of Staunton	2,264	3,047	98	3	10	75	147
City of Waynesboro	1,831	2,667	567	65	63	280	182
CSPDC Total	**26,933**	**34,224**	**3,584**	**262**	**374**	**900**	**714**

Table IV-11: CSPDC Critical Facilities within FEMA Designated Floodplain

Type	Number of Facilities
CELL TOWER	3
CHILD DAY CARE	3
CHURCH	29
EMERGENCY GENERATOR	4
EMERGENCY RESPONSE	9
GOVERNMENT	15
IFLOWS GAUGE	8
INDUSTRY	13
JAIL	1
POWER UTILITY	2
PUBLIC WORKS	1
SCHOOL	2
SENIOR LIVING	1
TOWN HALL	1
WASTEWATER PUMP STATION	2
WASTEWATER TREATMENT	10
WATER TREATMENT	3
WELL	2
TOTAL	**109**

Critical Facilities

The impacts of flooding on critical facilities can significantly increase the overall effect of a flood event on a community. It should be noted that these facilities have been determined to be in the floodplain using Geographic Information Systems (GIS) and should be used only as a planning tool. In order to accurately determine if a structure is actually in the floodplain, site-specific information must be available. 109 critical facilities were determined to be within the FEMA designated floodplain. Table IV-11 denotes the critical facilities that are located within or in close proximity to the FEMA designated 100 year and 500 year floodplains. Using GIS, the critical facility points were intersected with the FEMA flood zones. A 30-foot buffer on the facilities provided a radial distance from the center of the building that was used to determine the proximity to the floodplain. While Table IV-11 shows 109 critical facilities are located near or in the floodplain, there is great diversity in the type of facility located within or in close proximity to the floodplain. See Appendix D for the maps of the critical facilities within the floodplain for each locality.

109 critical facilities were determined to be within the FEMA designated Floodplain.

Critical Facility Points were intersected with FEMA flood zones.

Dam Failure Hazard Profile*

Description

Flooding due to impoundment failure refers to a collapse, breach, or other failure that causes an uncontrolled release of water or sludge from an impoundment, resulting in downstream flooding. Dam or levee failures can occur with little warning in either wet or dry conditions. Intense storms may produce a flood in a few hours or even minutes from upstream locations. Flash floods can occur within six hours of the beginning of heavy rainfall, and impoundment failure may occur within hours of the first sign of breaching. Other failures and breaches can take much longer to occur, from days to weeks, because of debris jams or the accumulation of melting snow.

Levee/Floodwall Failure

FEMA defines a levee as "a man-made structure, usually a earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water to reduce the risk from temporary flooding. A levee designed to provide flood protection from at least the 1% annual chance flood is eligible for accreditation by FEMA. When accredited, the area protected by the levee will be mapped as a moderate risk zone instead of a high-risk zone on the Flood Insurance Rate Map (FIRM). In the CSPDC region, the Bridgewater Levee System in Rockingham County in Rockingham County had record of levee coordination with FEMA through the Provisionally Accredited Levee (PAL) process. It is important to note that many of the causes and effects of levee failure are similar to dam failure.

* *Information in the Dam Failure Hazard Profile is taken from the Commonwealth of Virginia Hazard Mitigation Plan, Chapter 3 - HIRA, Section 3.11 Flooding Due To Impoundment Failure and is in italics.*

Dams Impoundments in the Commonwealth of Virginia

Dams and associate lakes, ponds, and impoundments are part of the Commonwealth's overall water resource landscape. As such, a dam failure or breach can have an extensive impact on the magnitude of downstream flooding which could result in wide scale damages. The Virginia Department of Conservation and Recreation's Division of Dam Safety and Floodplain Management (Virginia DSFPM) administers the Virginia Dam Safety Program, under the authority of the Virginia Soil and Water Conservation Board (Virginia SWCB). The Virginia DSFPM by authority of the Virginia SWCB is the key regulatory entity for dams in Virginia not otherwise regulated by the Virginia State Corporation Commission, Virginia Department of Mining, Minerals, and Energy (DMME), United States Government, or as defined in Section 4VAC50-20-30 of the Virginia Impounding Structure Regulations. Any references to VA DSFPM shall be made with the understanding that the VA DSFPM administers the Virginia Dam Safety Program under direct authority of the Virginia SWCB.

The Virginia SWCB regulates impounding structures in the Commonwealth to ensure that they are properly and safely constructed, maintained, and operated. Per section 4VAC50-20-50 of the Virginia Impounding Regulations, "an impounding structure shall be regulated if the impounding structure is 25 feet or greater in height and creates a maximum impounding capacity of 15 acre-feet or greater, or the impounding structures is six feet or greater in height and creates a maximum impounding capacity of 50 acre-feet or greater and is not otherwise exempt from regulation by the Code of Virginia." The regulations, known as the Virginia Impounding Structure Regulations are promulgated to achieve these ends and are recorded in the Virginia Administrative Code Ongoing dam inspections and Virginia's participation in the National Dam Safety Program administered by FEMA and the US Army Corps of Engineers serve as a preventative measure against dam failures. Disaster recovery programs include assistance to dam owners and local officials in assessing the condition of dams following a flood disaster and assuring the repairs and reconstruction of damaged structures are in compliance with the National Flood Insurance Program (NFIP) regulations.

Per current Virginia Impounding Structure Regulations, an "impounding structure" or "dam" can be defined as the following: "a man-made structure, whether a dam across a watercourse or structure outside a watercourse, used to be used to retain or store waters or other materials." Dams are classified with a hazard potential depending on the downstream impacts during a dam failure event situation. Hazard potential is not related to the structural integrity of a dam or environmental impacts but strictly to the potential for adverse downstream effects if the dam were to fail. Regulatory requirements, such as the frequency of dam inspection, the standards for spillway design, and actions within established emergency plans, are dependent upon the dam's assigned hazard potential classification.

The Owner(s) of each regulated high, significant, or low hazard potential dam is required to apply to Virginia DSFPM for a Regular Operation and Maintenance Certificate every 6 years. The application must include an assessment of the dam by a licensed Virginia Professional Engineer, an Emergency Plan (EAP – Emergency Action plan or EPP - Emergency Preparedness Plan), the appropriate forms, and the appropriate fee(s), submitted separately. An executed copy of the Emergency Plan

be filed with the appropriate local emergency management official and the Virginia Department of Emergency Management. Please note the Emergency Plan may also be routinely updated by the dam Owner during the term of the six-year certificate if any relevant information has changed.

Virginia DSFPM issues Regular Operation and Maintenance Certificates to the dam Owner for a period of six years. If a dam has a deficiency but does not pose imminent danger, Virginia DSFPM may issue a Conditional Operation and Maintenance Certificate, during which time the dam Owner is to correct the deficiency. After a dam has been granted a Regular Operation and Maintenance Certificate by Virginia DSFPM, annual inspections are required either by a Professional Engineer or the dam Owner, and the Annual Inspection Report is submitted to the appropriate Virginia DSFPM Regional Dam Safety Engineer.

According to the National Inventory of Dams, there are 70 regulated dams in the Region.

Please See Appendix C for Dam Risk Assessment and Inventory of dams in the CSPDC region regulated and not regulated by the Virginia DSFPM.

Dam Failure Vulnerability Analysis

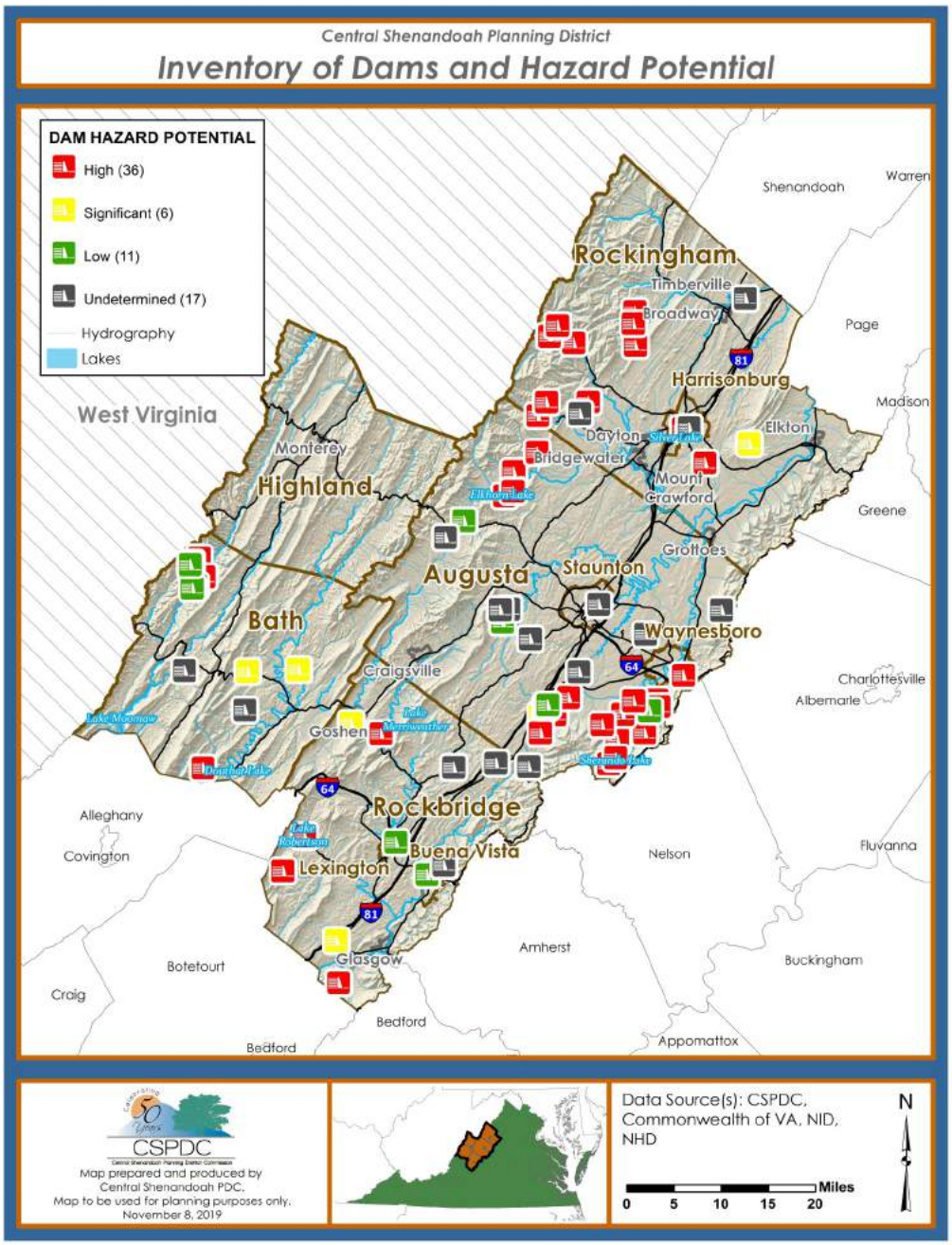
The Dam Safety Impounding Structure Regulations require that dams be classified based upon potential impacts from dam failure. The classifications are not based upon the condition of the dam itself. The classifications consider the potential for impact in the area downstream, known as the inundation zone, by assessing potential impacts on loss of life and property damage. The classification can also change over time if land use downstream changes. The classifications include:

36 dams have a high hazard potential and 6 dams have a significant hazard potential in the Region.

- **High:** Upon failure would cause probable loss of life or serious economic damage. (Annual owner inspection and Professional Engineer inspection every 2 years is required).
- **Significant:** Upon failure might cause loss or life or appreciable economic damage. (Annual owner inspection and Professional Engineer inspection every 3 years is required).
- **Low:** Upon failure would lead to no expected loss of life or significant economic damage. This classification includes dams that upon failure would cause economic damage only to the property of the dam owner. (Annual owner inspection and Professional Engineer inspection every 6 years is required).

Figure IV-6 displays data from the National Inventory of Dams (NID). The map shows regulated dams within the CSPDC region and indicates their hazard potential status. According to NID, there are 70 regulated dams in the CSPDC region and 36 dams have a high hazard potential. 6 dams are in the significant hazard level status. This results in 60% of total regulated dams in the region with a high or significant hazard status. NID also estimates that the average age of a dam in Virginia is 56 years old.

Figure IV-6: Inventory of Dams and Hazard Potential



4. Drought (High Ranking)

Hazard History

Table IV-12 includes descriptions of droughts that have occurred in Virginia and the Region. Events have been broken down by the date of occurrence and when available, by individual community descriptions. When no community specific description is available, the general description should be used as representing the entire planning area. Data compiled from the U.S. Drought Monitor for the time period from 2000 to 2019 showing the history of D1 Moderate Droughts through D4 Exceptional Droughts by locality in the Region can be reviewed in Appendix F. Since 2012, the U.S. Secretary of Agriculture has declared five Agriculture Disaster Designations for localities within the Region impacted by drought.

Table IV-12: CSPDC Drought Hazard History

Date	Damages
1930-1932	Considered the worst drought in Virginia history. Piedmont area recorded only 21 inches of rainfall in 1930. The three largest rivers (Potomac, Rappahannock and Rapidan) were reduced to mere puddles.
1938-1942	Less severe than the previous 1930 drought. Saw below average levels of rainfall and low stream flow levels in local rivers.
1962-1971	Also, less severe than the previous 30'-32' drought, however, the cumulative stream flow deficit was the greatest of all the major droughts because of its lengthy duration.
1976 - 1977	Ten months of below average precipitation. The drought began in November of 1976 when rainfall totaled to only 50% to 75% of normal. During the rest of the winter, the storms tracked across the Gulf. During the spring and summer the storms tracked across the Great Lakes. These weather patterns created significant drought throughout most of Virginia.
5/1980-8/1980	Warm and dry conditions prevailed through the beginning of the summer. June precipitation data show that much of Virginia received record low rainfall. No crop damage reported.

Table IV-12: CSPDC Drought Hazard History - continued

Date	Damages
1985 - 1986	Very little rainfall began in December and the trend continued throughout the summer. Total precipitation for January and February was 2 inches. Palmer Index values dropped below -2 by June. High temperatures along with scarce precipitation created a drought that lasted well into the fall.
6/1988 - 7/1988	A heat wave over the southeast produced warm and dry conditions over much of Virginia. Although the news reported stories of a drought in Virginia, the Drought Monitoring Team never stated in a report that these conditions were indicative of a drought. Palmer Drought Index values were above -2.
5/1993 - 8/1993	Very warm temperatures and little rain were noted beginning June 5, 1993. Precipitation shortages were greater than five inches for southwestern and southeastern Virginia from May through July. Surface soil moisture levels were low enough to result in significant agricultural damage. However groundwater remained at normal levels.
6/1999- 9/1999	Northern Virginia and Shenandoah Valley experienced one of the worst droughts of the 20th Century. Moisture shortages first became apparent in the summer of 1998. Record low stream flows on the Rappahannock. Crops, cattle and fisheries were all suffering. Farm ponds completely dried up and fish died in the tepid backwaters of the Chesapeake Bay. The drought was beginning to move into the Piedmont. The Shenandoah River was drier than it had been since the early 1930s drought. Considered “one of the most profound droughts in Virginia during the 20th century”.
2000-2004	Beginning in late 2000, some areas of the Region began to show moderate drought conditions. From November 2000 to October 2002, the Region experienced moderate, severe and extreme drought conditions. All locations within the Region were impacted at various times throughout this period. The Governor of Virginia banned lawn watering, car washing and the filling of swimming pools. Wells dried up in rural areas as the water table dropped drastically. In November 2002, the U.S. Secretary of Agriculture approved 45 counties for primary disaster designation.
2005	In the Fall of 2005, the counties of Augusta, Rockbridge and Rockingham, and the cities of Waynesboro, Staunton and Harrisonburg experienced moderate drought conditions.
2006	At various times throughout the spring and summer of 2006, the counties of Augusta, Rockbridge and Rockingham, and the cities of Lexington, Buena Vista, Waynesboro, Staunton and Harrisonburg experienced moderate drought conditions.

Table IV-12: CSPDC Drought Hazard History - continued

Date	Damages
2007-2009	From the Summer of 2007 to Spring 2009, moderate drought conditions were experienced by all localities within the Region at various times during that period. Highland County and Rockingham County also experienced moderate drought conditions in the Fall of 2009. The counties of Augusta and Rockingham experienced moderate drought conditions in October 2007.
2010-2011	From Summer 2010 to Spring 2011, all localities within the Region experienced moderate drought conditions at various times during that period. Rockingham County experienced severe drought conditions in August and September 2010. Rockingham County leaders applied for agriculture disaster designation.
2012-2013	Rockingham County experienced moderate drought conditions in July 2012. From November 2012 to January 2013, all localities within the Region experienced moderate drought conditions at various times during that period. Rockbridge County and Rockingham County received agriculture disaster designations as contiguous counties in two designations by the U.S. Secretary of Agriculture (S3422 and S3443).
2014	The U.S. Secretary of Agriculture declared two agriculture disaster designations for the Region (S3782 and S3793). The first included Bath County as a primary county, and the counties of Augusta, Highland and Rockbridge as contiguous counties. The second declared Highland County as a primary county, and the counties of Augusta and Bath as contiguous counties.
2016	In the Spring of 2016, the counties of Augusta, Highland and Rockingham experienced moderate drought conditions.
2017-2018	Moderate drought conditions in the Region began in February 2017 and ended in May 2017. All localities within the Region experienced moderate drought conditions at various times during that period. Moderate drought conditions were experienced in Augusta, Rockbridge, Rockingham, Lexington, Buena Vista, Staunton and Waynesboro from December 2017 to February 2018. Due to the drought, the Augusta County Service Authority provided two locations for people to purchase water. One water source was non-potable for livestock or gardening use. The second water source provided drinking water for purchase. The U.S. Secretary of Agriculture declared an agriculture disaster designation for Rockingham County as a contiguous county (S4297).

Table IV-12: CSPDC Drought Hazard History - continued

Date	Damages
2019	Following a long-term wetness that was experienced in the Spring and Summer of 2019, the region experienced a "flash drought" in the Fall of 2019. The "flash drought" was caused by a significant lack of rain and unusual high temperatures. A statewide drought advisory was issued by the Virginia Department of Environmental Quality. During the "flash drought," the counties of Augusta, Bath, Rockbridge, and Rockingham, and the cities of Lexington, Buena Vista, and Waynesboro experienced moderate drought conditions. Bath, Rockbridge and Buena Vista also experienced severe drought conditions in October 2019. The "flash drought" caused stress on

Droughts are a normal and recurrent feature of climate, and is a period of abnormally dry weather.

Droughts can have serious effects like agricultural losses and water supply shortages

Hazard Profile

Droughts are a normal and recurrent feature of climate that can affect vast regions and large population numbers. A drought is a period of abnormally dry weather that persists long enough to produce serious effects like agricultural losses; water supply shortages; and impacts on public health and energy production. Drought increases the risk of other hazards like fire, flash flood, and possible landslide and debris flow. The severity of the drought depends upon the degree of moisture deficiency, the duration, and the size of the affected area, as well as, the demands of human activity and agriculture on water supplies.

According to the National Weather Service, there are four types of drought:

- Meteorological drought, which "is based on the degree of dryness or rainfall deficit and the length of the dry period.".
- Hydrological drought, which is "based on the impact of rainfall deficits on the water supply such as stream flow, reservoir and lake levels, and ground water table decline."
- Agricultural drought, which "refers to the impacts on agriculture by factors such as rainfall deficits, soil water deficits, reduced ground water, or reservoir levels needed for irrigation."

- Socioeconomic drought, which "considers the impact of drought conditions...on supply and demand of some economic goods…"

A drought is a silent but very damaging phenomenon and unlike other natural disasters can last for years. Drought can have significant impacts on local and regional economies focused on agriculture and tourism. Statistics indicate that roughly every 22 years, a major drought occurs in the United States, most seriously affecting the Prairie and Midwestern states. The disastrous drought of the 1930s during which a large areas of the Great Plains became known as the Dust Bowl is one example.

The U.S. Drought Monitor releases weekly data that reflects drought status.

The U.S. Drought Monitor, managed by the National Drought Mitigation Center (NDMC), the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Department of Agriculture, releases weekly data that reflects the short-term and long-term drought status for the United States. It is utilized by federal, state and local agencies to determine drought status and responses. The data is used by the U.S. Department of Agriculture when determining eligibility for agriculture disaster declarations and low-interest loans.

Drought conditions are reflected in five classifications, from DO to D4.

The U.S. Drought Monitor uses several data sources to classify drought status, including the Palmer Drought Severity Index (PDSI), the Standardized Precipitation Index (SPI), the Keech-Byram Drought Index for fire, and indicators for vegetation health, soil moisture, hydrologic data, and other climatological inputs. The Palmer Drought Severity Index (PDSI) is a standardized index for meteorological drought that estimates dryness using temperature and precipitation data. The range on the PDSI is from –10 (dry) to +10 (wet). Values below –3 represent severe to exceptional drought. The PDSI is useful in determining long-term drought conditions.

Drought conditions are reflected in five classifications in the U.S. Drought Monitor. D0 Abnormally Dry are those areas going into or coming out of drought. D1 Moderate Drought through D4 Exceptional Drought classifies the four levels of drought. Table IV-13 provides an overview of the U.S. Drought Monitor classifications and possible impacts.

Table IV-13 Drought Severity Classification

Category	Description	Possible Impacts
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.
D1	Moderate Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested.
D2	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions.
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; water emergencies created by shortages of water in reservoirs, streams and wells.

Source: National Drought Mitigation Center (NDMC), U.S. Department of Agriculture (USDA) and the National Oceanic and Atmospheric Association (NOAA); U.S. Drought Monitor, Drought Classification

Table IV-13: CSPDC Drought Vulnerability (from 1990 Census)

Percent Population with Public/Private Water Systems				
Community	**High (< 25%)**	**Medium (25% - 50%)**	**Low (> 50 %)**	**Total**
Augusta County	18,936	8,105	27,636	54,677
*Craigsville, Town of	0	0	812	812
Bath County	1,333	851	2,615	4,799
Buena Vista City	0	0	6,406	6,406
Harrisonburg City	0	0	30,707	30,707
Highland County	1,722	913	0	2,635
*Monterey, Town of	0	222	0	222
Lexington City	0	0	6,959	6,959
Rockbridge County	9,788	6,409	2,153	18,350
*Glasgow, Town of	0	0	1140	1140
*Goshen, Town of	0	366	0	366
Rockingham County	28,040	11,204	18,238	57,482
*Bridgewater, Town of	0	0	3,918	3918
*Broadway, Town of	0	50	1159	1209
*Dayton, Town of	0	0	921	921
*Elkton, Town of	0	85	1850	1935
*Grottoes, Town of	0	0	1455	1455
*Mt. Crawford, Town of		228	0	228
*Timberville, Town of	0	1596	0	1596
Staunton City	0	0	24,461	24,461
Waynesboro City	0	0	18,549	18,549
Total	**59,819**	**27,482**	**137,724**	**225,025**

*Denotes town values that are also included in totals for the perspective County.

Vulnerability Analysis

The U.S. Drought Monitor is an assessment of prior drought conditions that occurs weekly; it is not a forecast of anticipated drought. Based upon best available data, the 1990 U.S. Census data has been utilized for the vulnerability analysis. It contains detailed information about source of water per Census block group. For purposes of this analysis, it was assumed that areas with populations having less than 25% of public/private water systems had a high vulnerability ranking. When a drought occurs, these areas would likely have a larger impact since most homes receive their water from wells, which may dry up during a drought.

Table IV-14 provides a summary of the 1990 population in three categories of drought vulnerability. Note that the Table contains information specific to the towns; this information has also been included with the county totals. As a result of using 1990 U.S. Census data at the block group level, there are some discrepancies with the town boundaries. Boundary adjustments into "high vulnerability" areas are a result of the older census data, which is a data limitation issue. This water source information is no longer updated by the Census, but it was determined that this drought analysis was the best available data available to the CSPDC at this time. Based on the percentage of the population in the high vulnerability category, Highland County has the highest percentage of people vulnerable to drought (65%) followed by the counties of Rockbridge (53%) and Rockingham (49%). Figure IV-7 shows these categories for each of the communities.

Figure IV-7: CSPDC Drought Vulnerability

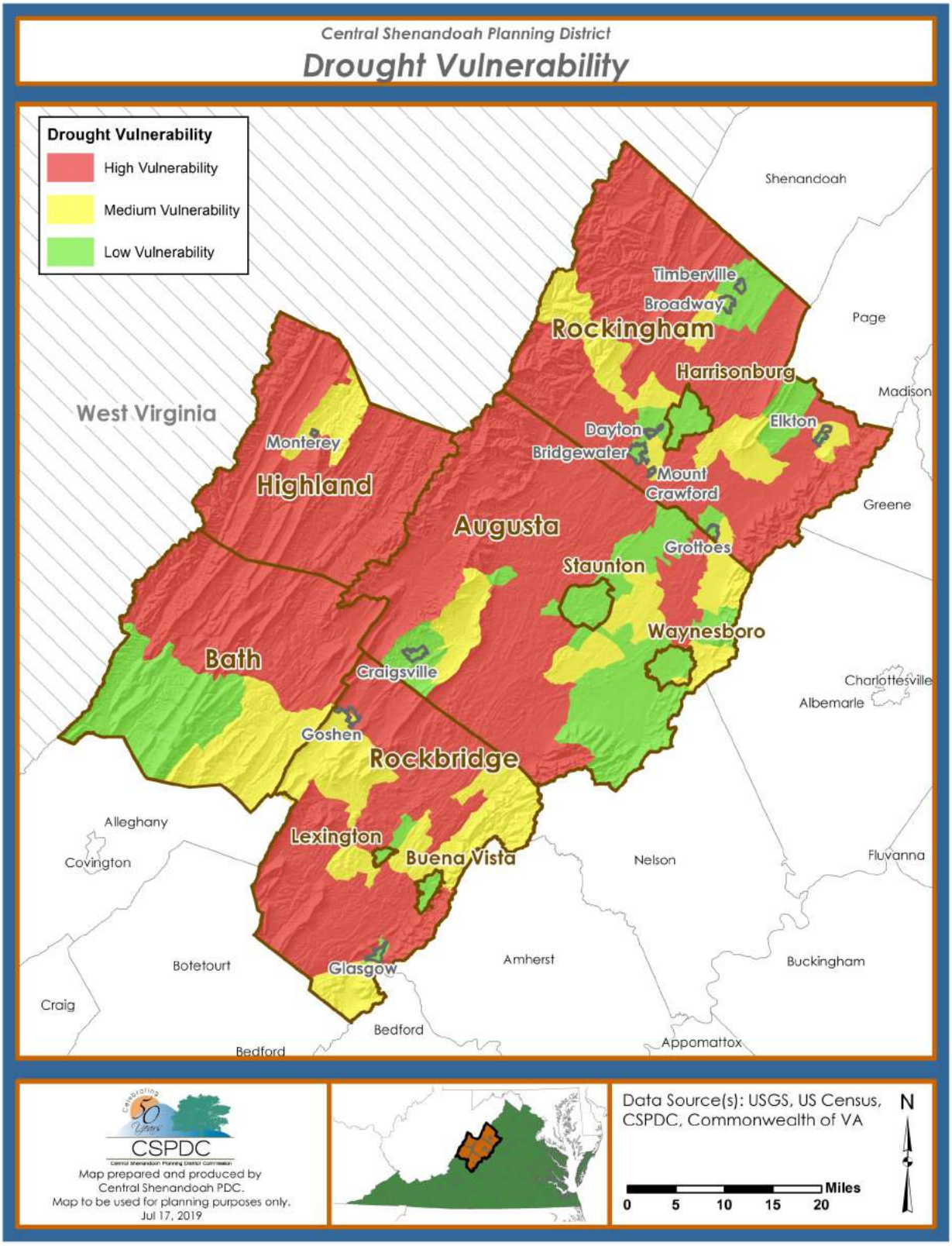
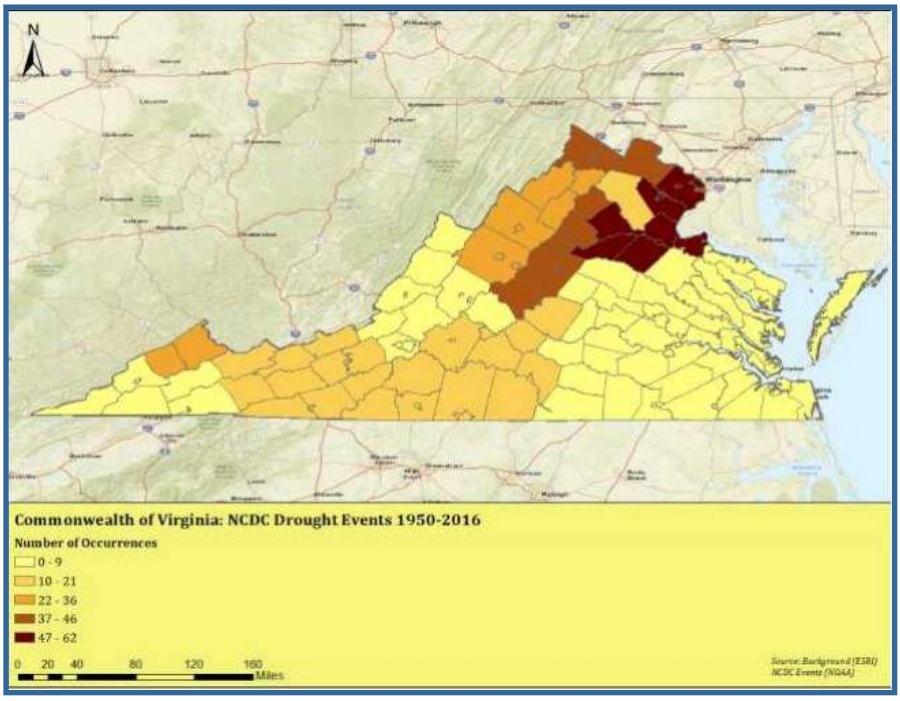


Figure IV-8 is a map included in the Commonwealth of Virginia's Hazard Mitigation Plan and shows National Climatic Data Center data for drought events in Virginia from 1950 –2016. Rockingham and Augusta Counties and the Cities of Staunton, Waynesboro, and Harrisonburg are all shown in the 22 to 26 occurrences range. As an alternative to the 1990 Census data, if the vulnerability analysis were based upon this historical data it would appear that these localities are more susceptible to drought than other localities in the Region.

As discussed in the section on Agricultural Disasters, Rockingham County and Augusta County rank number one and number two in the total market value of products sold in the Commonwealth. They also rank number one and number two in livestock, poultry and products, and are both in the top ten for crops in Virginia. Droughts can cause considerable agricultural damages and financial losses impacting cropland, pastureland and livestock due to soil moisture content; available water supplies for irrigation or livestock watering; and available forage for feeding. Since 2012, the U.S. Secretary of Agriculture has declared five Agriculture Disaster Designations for localities within the Region impacted by drought.

Figure IV-8: Virginia NCDC Drought Events



Source: Virginia's Hazard Mitigation Plan, 2018

5. Hurricane (High Ranking)

Hazard History

See Appendix C, for detailed information on the flooding impacts of hurricanes in the Region.

This section discusses wind impacts related to Hurricanes. Information regarding impacts from flooding is included in the Flooding section. See Appendix C - Flood History and Dam Risk Assessment and Inventory for detailed information on the flooding impacts of hurricanes in the Region. Listed below are major hurricanes that have resulted in wind damages in the Region:

- Hurricane Camille - August 1969
- Hurricane Agnes - June 1972
- Hurricane Juan - November 1985
- Hurricane Fran - September 1996
- Hurricane Isabel – September 2003
- Hurricane Sandy - November 2012

Hurricanes that do not have a historical storm system track through the Region have still have resulted in catastrophic impacts, such as Hurricane Camille in 1969.

Figure IV-9 depicts the historical storm system track for tropical depressions, tropical storms and hurricanes that have passed through the Region from 1842 to 2017. The category of the hurricane shown on the map does not necessarily mean that the storm was at this intensity level when it traveled through the Region. Additionally, hurricanes that do not have a historical storm system track through the Region have still have resulted in catastrophic impacts, such as Hurricane Camille. Secondary impacts from storms have resulted in loss of life, injury, property damage and widespread infrastructure damage.

Hazard Profile

A tropical cyclone is the generic term for a non-frontal synoptic scale low-pressure system over tropical or sub-tropical waters with organized convection

and definite cyclonic surface wind circulation. Depending on strength, they are classified as tropical depressions, tropical storms or hurricanes. Tropical cyclones involve both atmospheric and hydrologic characteristics, such as severe windstorms, surge flooding, high waves, coastal erosion, extreme rainfall, thunderstorms, lightning, and, in some cases, tornadoes. Storm surge flooding can push inland, and riverine flooding associated with heavy inland rains can be extensive. High winds are associated with hurricanes, with two significant effects: widespread debris and power outages. Widespread debris is due to damaged and downed trees and damaged buildings.

Secondary Hazards

Secondary hazards from a hurricane event could include high winds, flooding, heavy waves, and tornadoes. Once inland, the hurricane's band of thunderstorms produces torrential rains and, sometimes, tornadoes. A foot or more of rain may fall in less than a day causing flash floods and mudslides. The rain eventually drains into the large rivers, which may still be flooding for days after the storm has passed. The storm's driving winds can topple trees, utility poles, and damage buildings. Communication and electricity may be lost for days. Roads may be impassable due to fallen trees and debris.

Hurricane Damage Scale

Hurricanes are categorized by the Saffir-Simpson Hurricane Wind Scale as listed below in Table IV-15. Included in the table are detailed descriptions of each category and the potential damage caused by each. The Saffir-Simpson Hurricane Wind Scale contains a 1 to 5 rating that estimates potential damage based upon sustained wind speeds. Major hurricanes are considered storms to be ranked a Category 3 or higher. Category 1 and Category 2 storms can still cause impacts and damages.

Figure IV-9: Central Shenandoah Planning District Hurricane Tracks

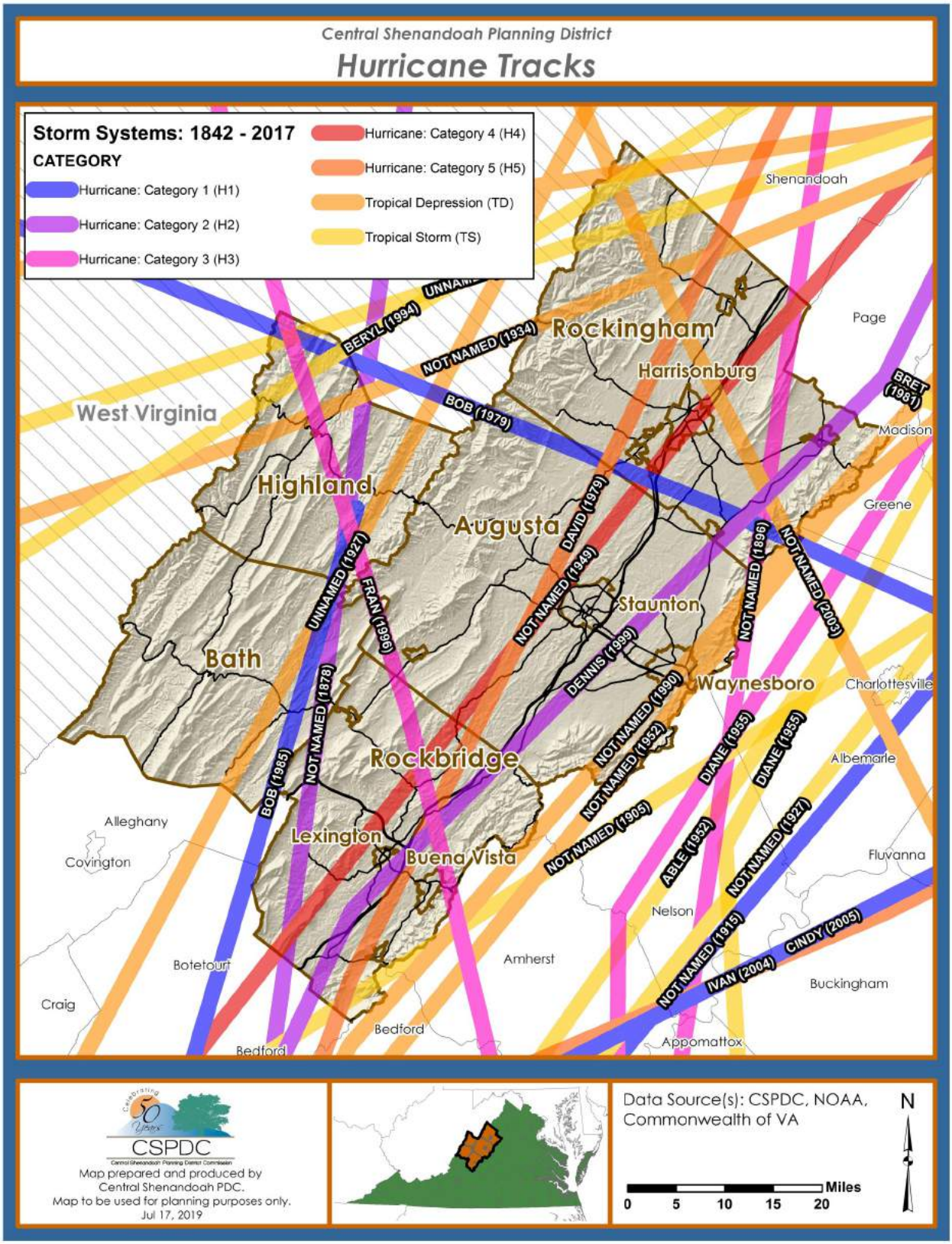


Table IV-15: Saffir - Simpson Hurricane Wind Scale

Hurricane Category	Sustained Winds (mph)	Description
1	74 – 95	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96 – 110	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3	111 – 129	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4	130 – 156	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5	≥ 157	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Source: Saffir-Simpson Hurricane Wind Scale, National Weather Service

Vulnerability Analysis

HAZUS-MH

FEMA's HAZUS-MH software (4.2) was used to generate hurricane damage and loss estimates for the CSPDC region. Level 1, with default parameters, was used for the hurricane analysis in this Plan. It is noted that this version of HAZUS utilizes 2010 Census Data and totals produced by HAZUS only reflect data for those census tracts/blocks included in the study region. HAZUS-MH uses historical hurricane tracks and computer modeling to identify the probable tracks of a range of hurricane events at the US Census tract level. Results from the model are used to develop the annualized damages. The impacts of various events are then combined to create a total annualized loss or the expected value of loss in any given year. The Hurricane Wind Probabilistic Model with HAZUS-MH predicts hurricane tracks, based on historical hurricane, for different return periods. All hurricane quick assessment and global risk report results can be found in Appendix G.

Building Types

The Global Risk probabilistic 100 year return period scenario report for the CSPDC Region includes estimated information such as building damage, debris generation and possible economic losses. Table IV-16 summarizes the expected damage by general building type. According to HAZUS, Masonry and Wood are the most common building types and expected damage would occur mostly with masonry buildings. The regional report also estimates that a large percentage of this damage would be to residential homes.

Table IV-16: CSPDC Expected Building Damage by Building Type (100 yr Event)

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	1,146	99.58	5	0.42	0	0.00	0	0.00	0	0.00
Masonry	27,676	99.82	50	0.18	1	0.00	0	0.00	0	0.00
MH	9,682	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	4,316	99.67	14	0.33	0	0.00	0	0.00	0	0.00
Wood	75,626	99.98	14	0.02	0	0.00	0	0.00	0	0.00

Source: HAZUS-MH 4.2

Loss Estimation

To estimate loss for each County and City in the CSPDC Region, HAZUS was used to generate the following hurricane reports for each locality:

- Quick Assessment
- Global Risk Reports (10, 20 , 50, 100 , 500, and 100 year return periods).

Table IV-17 is from the CSPDC's Quick Assessment report and estimates that the region as a whole would have a combined or annualized total Capital Stock loss of $379,000. Income losses are estimates at $20,000 which results in a total of loss of $399,000 for the region. To see annualized losses broken down by locality, see Table IV-18. The CSPDC also used the Hurricane Quick Assessment reports for each County and City in the Region to summarize building damage and economic losses for a 100-year Event. See Table IV-19 to view this information for each locality for a 100 year return period and see Appendix G to view the HAZUS reports.

Table IV-17: CSPDC Estimated Economic Loss ($)

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		*Business Interruption*
ReturnPeriod	*Residential*	*Total*	*(Income) Losses*
10	0	0	0
20	0	0	0
50	214	214	0
100	4,956	5,064	5
200	15,705	16,347	32
500	44,891	46,220	1,022
1000	76,205	78,679	4,886
Annualized	359	379	20

Source: HAZUS-MH 4.2

Table IV-18: CSPDC HAZUS-MH Annualized Expected Losses to Hurricanes by Locality ($)

Annualized Economic Loss (x1000) by Locality			
Locality	**Property Damage (Capital Stock) Residential**	**Property Damage (Capital Stock) Total**	**Business Interruption (Income) Losses**
Augusta County	111	116	6
Bath County	7	7	0
Highland County	3	3	0
Rockbridge County	41	43	2
Rockingham County	104	109	6
City of Buena Vista	9	10	1
City of Harrisonburg	35	39	3
City of Lexington	10	11	1
City of Staunton	31	33	2
City of Waynesboro	30	33	2

Source: HAZUS-MH 4.2

Table IV-19: CSPDC HAZUS-MH Hurricane Probabilistic Scenario Quick Assessment

HAZUS-MH Hurricane Probabilistic Scenario Quick Assessment (100 yr Return Period)							
Locality	**Residential Building Exposure ($ K)**	**Total Building Exposure ($ K)**	**Number of Residential Buildings Damaged**	**Number of Buildings Damaged**	**Residential Property (Capital Stock) Losses (x 1000)**	**Total Property (Capital Stock) Losses (x 1000)**	**Business Income Interruption Losses (x 1000)**
Augusta County	6,296,301	7,633,931	8	13	1,448	1,472	0
Bath County	739,486	817,609	0	1	20	20	0
Highland County	320,363	367,309	0	0	8	8	0
Rockbridge County	2,182,496	2,612,294	2	3	475	795	0
Rockingham County	6,609,137	7,869,924	9	13	1,071	1,105	1
City of Buena Vista	509,866	724,767	1	2	87	87	0
City of Harrisonburg	3,460,375	5,090,915	9	13	314	315	0
City of Lexington	714,506	957,848	2	2	141	141	0
City of Staunton	2,264,098	3,046,627	5	8	403	403	0
City of Waynesboro	1,830,829	2,666,599	4	6	410	410	0
CSPDC Total	**24,927,457**	**31,787,823**	**40**	**61**	**4,377**	**4,756**	**1**

Source: HAZUS-MH 4.2

6. Severe Winter Weather (High Ranking)

Hazard History

Listed below in Table IV-20 are major winter storm events that have occurred in the Region. Major events have been broken down by the date of occurrence and when available, by individual community descriptions. When no community specific description is available, the general description should be used as representing the entire Region.

Virginia has a historic record of significant winter that goes back over two hundred years thanks to George Washington and Thomas Jefferson.

Table IV-20: CSPDC Severe Winter Weather Hazard History

Date	Description and Damages
1/28/1772	A severe snowstorm struck the Mid-Atlantic, dropping anywhere from 30-36 inches across the region. The storm became known as the "Washington and Jefferson" snowstorm because they were mentioned in both their diaries.
1/15/1831	Snows of over 13 inches fell on the Shenandoah Valley.
1/19/1857	Extreme cold hampered cleanup from a 12+ inch snowfall. The storm also brought high winds with the snowfall, and a prolonged period of near-zero temperatures froze all rivers in the state. Snowfall was steady for over 24 hours. Train service in the Valley was suspended for ten days. Two buildings belonging to the Central Virginia Railroad caught fire but it was so could the fire hydrants froze and there was no way to put out the fires.
1/18/1881	Sleet and freezing rain fell all day and everything was coated with ice. Several citizens had injuries from falling. There were several collisions between sleds and horse-drawn coaches. To walk on the icy roads, people wrapped pieces of blanket around their feet.
2/1899	The Great Arctic Outbreak and Great Eastern Blizzard brought the harshest winter conditions ever experienced to the region. Mail service was postponed, countless pipes burst and railroads were shut down, causing fear that coal supplies would run out. **Harrisonburg:** 14" of snow, temperature of -23°F recorded **Highland County:** temperature of -29°F recorded in Monterey **Lexington:** temperature of -9°F recorded, North River froze completely over **Rockingham County:** 30" of snow in parts of the county, temperature of -36°F recorded in Timberville, temperature of -32°F recorded in Edom, temperature of -40°F recorded in Brock's Gap **Staunton:** 18" of snow, temperature of -18°F recorded

Table IV-20: CSPDC Severe Winter Weather Hazard History - continued

Date	Description and Damages
1/14/1912	An Arctic cold wave struck the region with subzero temperatures. Across the area, water pipes froze, kitchen ranges exploded, trains were delayed, and thousands of birds and small animals died. **Harrisonburg:** temperature of -15°F recorded **Rockingham County:** temperature of -18°F recorded at Bridgewater, temperature of -18°F recorded at Dayton, temperature of -20°F recorded at McGaheysville **Staunton:** temperature of -25°F recorded. One man froze to death.
11/25/1938	An average of 6" of snow fell across the Shenandoah Valley. **Rockingham County:** Between 50 and 75 cars were stranded on Rt. 33. Many people were traveling during this Thanksgiving holiday weekend.
3/5/1962-3/9/1962	A severe Nor'easter struck the entire east coast, dumping especially heavy snow on western Virginia. **Harrisonburg:** 20" of snow. **Lexington:** 20" of snow fell. **Rockingham County:** 27" of snow fell, stranding travelers overnight on U.S. Rt. 11 near Lacey Springs. **Staunton:** 26" of snow fell.
3/26/1978	An Easter weekend ice storm brought branches and whole trees crashing down onto power lines, with over 1" of ice accumulating in some places. Over 30,000 in the Shenandoah Valley were without power, and over 2,000 were without telephone service. Radio stations were knocked off the air and many basements were flooded.
2/11/1983	The Blizzard of '83 struck Virginia, dropping heavy snow with drifts up to 6 feet high. **Augusta County:** 18-20" of snow fell. **Harrisonburg:** 20" of snow fell. James Madison University and Eastern Mennonite University were closed, several tractor trailers jack-knifed on I-81. **Lexington:** 18" of snow fell. **Rockbridge County:** 15-24" of snow fell.

Table IV-20: CSPDC Severe Winter Weather Hazard History - continued

Date	Description and Damages
3/13/1993	The Storm of the Century struck the east coast, causing 4 feet of snow in some areas and drifts of up to 15 feet. One hundred and fifty (150) Americans lost their lives to the storm. In the Region, the storm dropped between 12" and 22" of snow, with near hurricane-force winds creating drifts of 8' to 10' deep. Extremely low wind chills caused problems for farmers trying to feed livestock and drifts prevented farmers trying to move the animals to sheltered places. **Harrisonburg:** Roofs of 2 businesses collapsed under the weight of the 10' snow drifts. **Rockbridge County:** 12"-22" of snow fell and 5,000 people lost power. **Rockingham County:** 13"-22" of snow fell; winds of up to 70 m.p.h. caused drifts of 6'-7'. **Staunton:** 18" of snow fell and 200 people were without power. The National Guard was deployed in Staunton.
2/8/1994–2/12/1994	A severe ice storm struck Virginia, bringing 1"-3" of solid ice, causing flooding and $105.8 million (2019 dollars) in damage. In the Region, Bath County Rockbridge County and the City of Buena Vista were included in a federal disaster declaration (DR-1014). Conditions were treacherous across the Central Shenandoah Valley Region, where 24 out of the past 54 days had winter precipitation.
3/1/1994-3/5/1994	A severe winter storm and ice storm hit Virginia. Augusta County and Highland County were included in a federal disaster declaration (DR-1021).

Table IV-20: CSPDC Severe Winter Weather Hazard History - continued

Date	Description and Damages
January 1996	The Blizzard of 1996 struck the east coast, killing 40. The blizzard paralyzed the I-95 corridor and reached westward into the Appalachians where snow depths of over 48 inches were recorded. To compound things, the blizzard was followed the next week by two additional heavy snowstorms bringing over a foot of snow. Snowpack was on the ground for an extended period of time. It was thawed by higher temperatures and heavy rain, resulting in severe flooding. The Governor declared a State of Emergency in Virginia, with the hardest hit area being the Shenandoah Valley, with over 40" of snow reported in areas of Shenandoah National Park. The Region reported an average of 28"-30" of snowfall. Local governments also declared states of emergency and all non-essential travel was banned. Several local governments and schools were closed for more than a week. Dozens of hikers were stranded in the Shenandoah Valley. Eight hundred (800) persons throughout the State required shelter. In Virginia, snow removal costs were estimated at $81.9 million (2019 dollars) and another $11.4 million (2019 dollars) was spent in repairs to damaged infrastructure. VDOT needed crawler tractors to plow the snow in higher elevations because the snow was too deep for regular plows. Two federal major disaster declarations (DR-1086 and DR-1098) were declared. DR-1086 included Augusta County, Bath County, the City of Buena Vista, the City of Harrisonburg, Highland County, the City of Lexington, Rockbridge County, Rockingham County, the City of Staunton and the City of Waynesboro. DR-1098 included all of the same localities, except for Lexington and Waynesboro. **Highland:** 24"-30" of snowfall was reported. **Staunton:** The National Guard's humvees were used by rescue personnel to assist with emergency calls.
1/25/2000-1/30/2000	Winter storms brought a blizzard to the East Coast that impacted the Region. Augusta County, Bath County, Highland County, Rockbridge County and Rockingham County were included in a federal major disaster declaration. (DR-1318)

Table IV-20: CSPDC Severe Winter Weather Hazard History - continued

Date	Description and Damages
2/14/2003– 2/18/2003	A complex storm system known as the "Presidents' Day Storm" dropped snow and sleet across the State of Virginia. In some places, schools were closed for a week. Across the northern Central Shenandoah Valley, 12 to 20 inches of snow and sleet fell. Across the southern Central Shenandoah Valley, 7 to 12 inches of snow and sleet fell. **Augusta County:** $2.1 million (2019 dollars) worth of damages reported. Barns and turkey sheds collapsed killing livestock. A 39 year old man died after sledding into the path of a car in Craigsville. **Bath County:** Received 5 to 8 inches of snow and sleet. **Highland County:** A turkey house collapsed near McDowell and killed 500 turkeys. Highland County was included in a federal major disaster declaration (DR-1458) for the severe winter storm, snowfall, heavy rain, flooding and mudslides that occurred during a period from February 15 through February 28. **Rockingham County:** Twelve (12) chicken/turkey houses collapsed killing 37,000 chickens/turkeys. A dairy barn collapsed in Grottoes, killing one cow and injuring 17.
2/12/2007	Complex storm of snow and sleet. In Northwestern and Central Virginia, snowfall ranged from 1 - 7 inches with sleet between 1/10 and 3/4 of an inch. There were dozens of automobile accidents, including pileups of dozens of cars on Afton Mountain. The storm caused 22 deaths in the U.S. In the Region, as many as 20,000 people lost power at the height of the storm. Ice was followed by gusty winds and bitter cold. Virginia Governor declared a State of Emergency for the State. **Augusta County:** Augusta County was the hardest area hit in the Central Shenandoah Region and the County declared a local state of emergency. **Bath and Highland County:** The storm brought sleet and ice causing downed trees, downed power lines and power outages.
1/17/2008	Severe winter weather resulted in snowfall in the region. Augusta County received between 2.5 inches and 8 inches of snow, as well as ice on trees. Highland County received 4.8 inches of snow. Rockingham County received between 3.5 inches and 6 inches of snow.

Table IV-20: CSPDC Severe Winter Weather Hazard History - continued

Date	Description and Damages
12/18/2009–12/20/2009	A strong area of low pressure tracked up the Mid-Atlantic Coast and tapped into moisture from the Gulf of Mexico and the Atlantic Ocean causing copious amounts of precipitation to develop. The severe winter storm that hit the Shenandoah Valley in December 2009 was one of the biggest snow falls in the past 13 years. Snow fall was recorded ranging from 18 inches to 28 inches of snow during the 2 day storm throughout the Valley. The Virginia State Police estimated the storm caused a 42% increase in calls for service. State Troopers responded to more than 4,000 traffic crashes and disabled vehicles. Officials reported only 2 traffic fatalities. Interstates 81 and 77 were hit the heaviest with traffic accidents. A federal major disaster declaration (DR-1874) included Augusta County, Bath County, Highland County, Rockbridge County, the City of Staunton and the City of Waynesboro. **Harrisonburg**: 13 inches of snow recorded. **Rockingham County**: Received up to 2 feet of snow. **Staunton:** Used 96' storm experience in preparation for 09' storm. They had 20 people in the armory on stand-by to get people out of trouble. Biggest community problem was the amount of disabled vehicles on the road.
2/5/2010 - 2/11/2010	Governor McDonnell declared Virginia in a state of emergency as the second severe storm of the season hit in February, dropping nearly 2 feet of snow throughout the state on February 5 - 6, 2010. This was followed by another system that dropped more snowfall on February 9 - 10, 2010. Gov. McDonnell assisted the state by deploying National Guard soldiers and emergency response teams. VDOT used up all $79 million budgeted for statewide snow removal and nearly exhausted their $25 million reserve. The National Weather Service described the storm as very heavy, wet snow with strong winds. Dominion Virginia power reported half of the 200,000 power outages came from the Charlottesville and Shenandoah Valley region, while Appalachian Power reported an additional 40,000 outages in the Valley. Virginia State Police responded to more than 2,000 traffic crashes and disabled vehicles along with 2 traffic fatalities. A federal disaster declaration (DR-1905) included Augusta County, Highland County and the City of Waynesboro. **Staunton** – accumulated 15 inches of snowfall. **Augusta County** - received 16 inches of snowfall. **Waynesboro** – accumulated 13.5 inches of snowfall. **Rockingham County** - received between 13 and 17 inches of snowfall. During the second snowfall, parts of Rockingham received an additional 6 inches. **Bath County** - totals were between 15 - 18 inches for both storms.

Table IV-20: CSPDC Severe Winter Weather Hazard History - continued

Date	Description and Damages
3/7/2013	Severe winter weather brought wet, heavy snow approaching 20 inches in the Region. The area received some of the highest snowfall levels in the state, including the highest level of 20.3 inches in Fishersville. A state of emergency was declared by Governor Bob McDonnell. Power outages were reported for more than 200,000 customers in the state, and the Town of Craigsville water and sewer plant was left without power. Slick roads resulted in abandoned vehicles, and police responding to hundreds of crashes, including two tractor trailer accidents. In the Highlands, 16 inches of snow was reported in Bath County and 14 inches of snow was reported in Highland County.
2/13/2014	A nor'easter brought more than 24 hours of steady snowfall to the Region closing schools, governments and businesses. Governor McAuliffe declared a state of emergency. More than 1,000 pieces of equipment were deployed in the VDOT Staunton District. No deaths or major injuries were reported in the Shenandoah Valley. The storm cancelled flights. Statewide, the Virginia State Police responded to more than 4,052 calls for service, with 1,095 crashes and 905 disabled vehicles. Bath County received 15 inches of snow.
3/17/2014	Winter weather brought snowfall to the region. 6 inches were reported in Augusta County and up to 13.5 inches were reported in Rockingham County.
3/7/2015	A strong storm steered by upper level winds from the northwest and Ohio Valley, resulted in a winter storm warning for the area. 11.5 inches of snow were reported in Waynesboro, and there were more than 200,000 power outages statewide. One of the heaviest areas for calls to service to the Virginia State Police was in Augusta County.
1/22/2016-1/23/2016	A nor'easter storm known as Winter Storm Jonas brought a blizzard to the Northeast and Mid-Atlantic, affecting nearly one-third of the U.S. population. The storm brought heavy snowfall to our region. Governor McAuliffe declared a state of emergency and deployed the Virginia National Guard. Heavy snowfall caused the roof of a bowling alley in Waynesboro to collapse, leading to its condemnation and later demolition. Areas of Bath and Highland County received 17-20 inches of snow. Highland County was included in a federal disaster declaration (DR-4262). The countywide per capita impact for Highland was $23.69.
12/17/2016	A light coating of ice fell in the region, impacting roadways in Augusta County.

Table IV-20 CSPDC Severe Winter Weather Hazard History - continued

Date	Description and Damages
11/15/2018	A winter ice storm brought widespread power outages to the entire Region. More than 40,000 customers were without power in Rockingham, Augusta, Staunton and Waynesboro. In Rockbridge County, around 1,800 Dominion customers were without power. In the BARC service area in Rockbridge and Bath counties, around 4,758 customers were without power due to downed trees and ice on the power lines. Businesses, including grocery food retailers, were also impacted causing financial losses of perishable food products. A CenturyLink fiber optic line was damaged by heavy ice in Rockbridge County, causing outages for customers. The storm caused road closures and impacted traffic signals in Rockbridge County, and an accident between a semi-tractor trailer and a pickup truck was reported in Buena Vista.

Hazard Profile

Winter storms may include a variety of cold weather conditions such as heavy snowfall, extreme cold temperatures, freezing rain, sleet, ice, and high winds. Blizzards are a type of winter storm with high winds and considerable blowing snow. Winter storms may last from just a few hours to several days and affect the entire Region. The impacts of winter storms include downed power lines and trees, hazardous walking and driving conditions, road closures, and business, government facilities and school closures. Health risks include hypothermia and frostbite if exposed to winter storm conditions and heart attacks due to overexertion. Winter storms are considered deceptive killers because most deaths are not directly related to the actual storm event. The leading cause of death and injury during winter storms is automobile accidents when freezing rain and sleet cause road surfaces to become extremely treacherous and dangerous to motorists. Other dangers related to winter weather and extreme cold include exposure, hypothermia, and asphyxiation due to improper use of heating systems. House fires occur more frequently in the winter months and during winter storms because of the use of alternative heating sources. Frozen water lines and limited access to waterlines poses a significant risk for fighting fires in the winter weather. Injury or death caused by chain-saw accidents and electrocution are also possible in the aftermath of the winter storm as residents try to remove fallen trees and power lines.

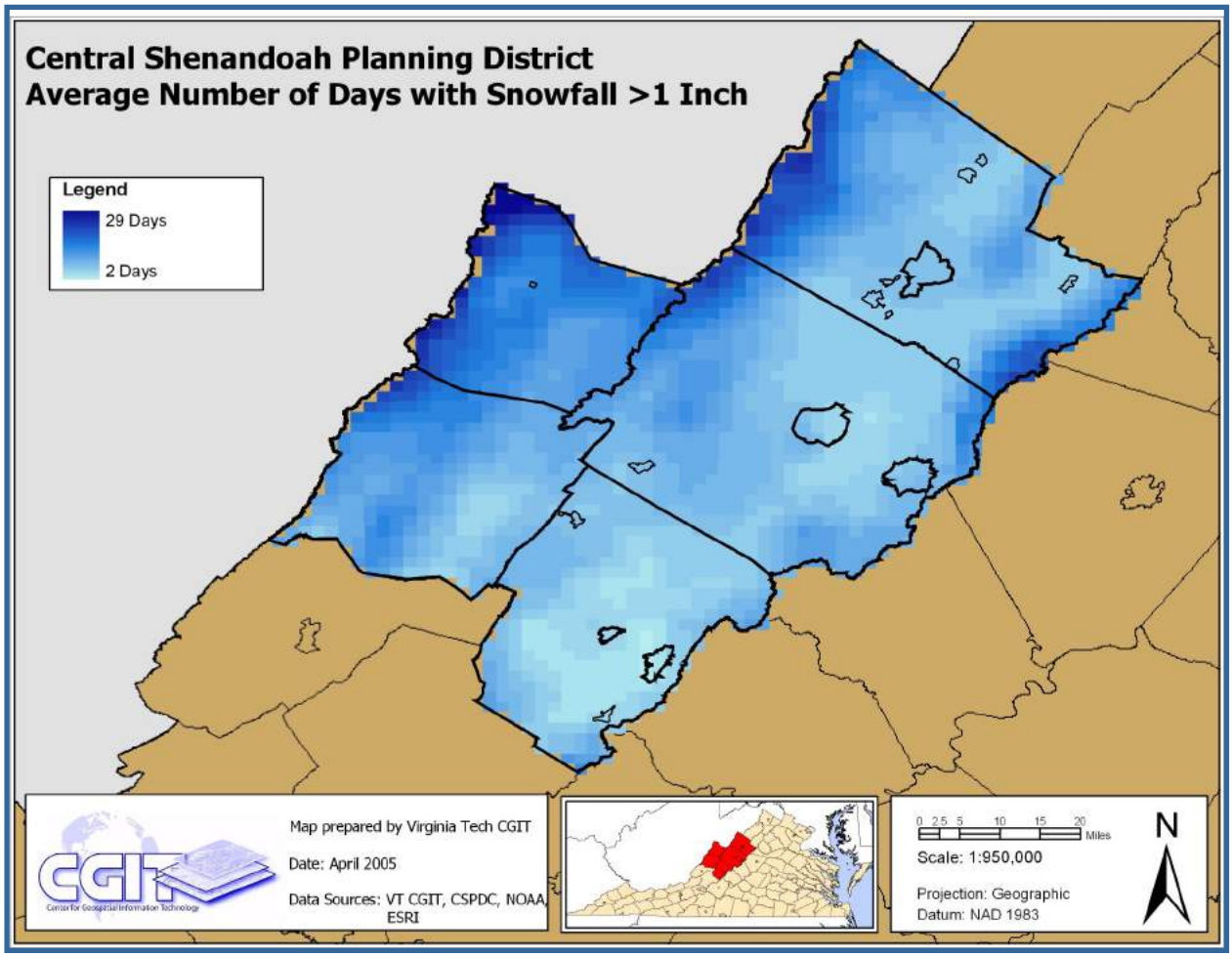
Winter storms also impact our economy. Public funds are generally associated with labor and equipment costs for snow removal, road clean-up and repair and utility restoration. Business losses are attributed to closures and the inability of employees and customers to travel. Electrical, communication and utility disruption also impact the private sector. Buildings may be damaged or destroyed when heavy snow loads collapse roofs. The agricultural economy can also suffer as a result of winter storms especially those that occur later in the season affecting crops and livestock.

Predictability and Frequency

Winter storms can be a combination of heavy snowfall, high winds, ice and extreme cold. These are classified as extra-tropical cyclones that originate as mid-latitude depressions. Winter weather impacts the Region between the months of November and April, with varied intensities from east to west. In the last Plan, winter weather hazard potential maps were created that capture this variability, gridded climate data was obtained from the Climate Source and through the VirginiaView program. This data was developed by the Oregon State University Spatial Climate Analysis Service (SCAS) using **PRISM** (**P**arameter -elevation **R**egressions on **I**ndependent **S**lopes **M**odel). This climate mapping system is an analytical tool that uses point weather station observation data, a digital elevation model, and other spatial data sets to generate gridded estimates of monthly, yearly, and event-based climatic parameters.

The winter storm analysis from the 2013 plan was kept for this Plan update. The CSPDC determined that the analysis and maps were still representative of the CSPDC region's snow and ice risk. In this analysis, a criterion of greater than 1 inch was selected for winter snowfall severity assessment because this depth will result in complete road coverage that can create extremely dangerous driving conditions and will require snow removal by the local community. This amount of snowfall in a 24-hour period can also lead to business closure and school delays or cancellation. Figure IV-10 shows the average number of days with snowfall greater than one inch for the Region.

Figure IV-10: CSPDC Average Number of Days with Snowfall > 1 inch



Ice Potential

Another challenge with winter weather in Virginia and the Region is the amount of ice that often comes as part of winter weather. Snowfall and ice potential are generated based on the percentage difference between the total precipitation from November to April and the corresponding liquid equivalent snowfall depth. Since snowfall is in a frozen state, it does not accumulate on the surface the same way that liquid rainfall would. In order to account for this difference, there are characteristic snow/rain relationships that have been created. For example, a value of 1 would mean that all of the precipitation at the location falls as liquid rainfall, and a value of 0.5 would mean that half of the precipitation falls as liquid rainfall and half falls as frozen precipitation. It is assumed that the lower the percentage, the greater potential that precipitation within these months is falling as snow. The values in the middle of the two extremes would represent regions that favor ice conditions over rain and snow. A five quantile distribution was applied to the output statewide grid to split the percentages into five characteristic climatological winter weather categories (snow, snow/ice, ice, rain/ice, and rain). This ice potential analysis was used in the last Plan to create a relative ice risk map. The CSPDC decided to continue using this map since it is the best known available data for the Region's ice potential. See Figure IV-12 for relative ice risk map.

Vulnerability Analysis

Figures IV-11 and IV-12 show relative risk or vulnerability based on the previous analysis. These were developed by assigning a high risk to those census blocks within the regions with the greatest potential for snowy days (> 1 in of snow) or ice. Division into high, medium and low were based on the levels predicted from potential maps. Future revision of this Plan will need to develop a method to calculate the potential loss from these winter storms.

Relative snowfall risk (Figure IV-11) illustrates Highland County and the Town of Monterey with the highest relative potential for snow, followed by a band of medium snow potential in the counties of Rockingham, Augusta and Bath and in the Town of Craigsville. The southeast portion of the Region has a relatively low potential for snow, with the exception being the eastern portion of Rockingham County and the Town of Grottoes.

Relative ice risk (Figure IV-12) characterizes the Region as low and medium potential for receiving ice as the dominant type of winter weather. Areas with medium potential for ice are clustered around Rockbridge and Augusta Counties, including the cities of Lexington, Waynesboro and Buena Vista and the towns of Goshen and Glasgow.

To view maps of relative ice and snowfall risk overlaid with the region's critical facilities, please see Appendix D.

Figure IV-13 is from the 2018 Commonwealth of Virginia, Hazard Mitigation Plan and is a map of winter weather event occurrences from 1950 to 2016 for the State. Five out of the 11 CSPDC localities are in the highest range of occurrences: Augusta, Rockingham and Highland Counties, and the Cities of Staunton, Waynesboro and Harrisonburg.

Figure IV-14 is from the National Oceanic and Atmospheric Administration (NOAA) and displays data for 3-Day snowfall extremes from 1914 to June 2018 in inches. According to this map, Rockingham County is more vulnerable to heavy 3-day snowfalls compared to the rest of the localities in the CSPDC Region.

Figure IV-11: Central Shenandoah PDC Snowfall Relative Risk

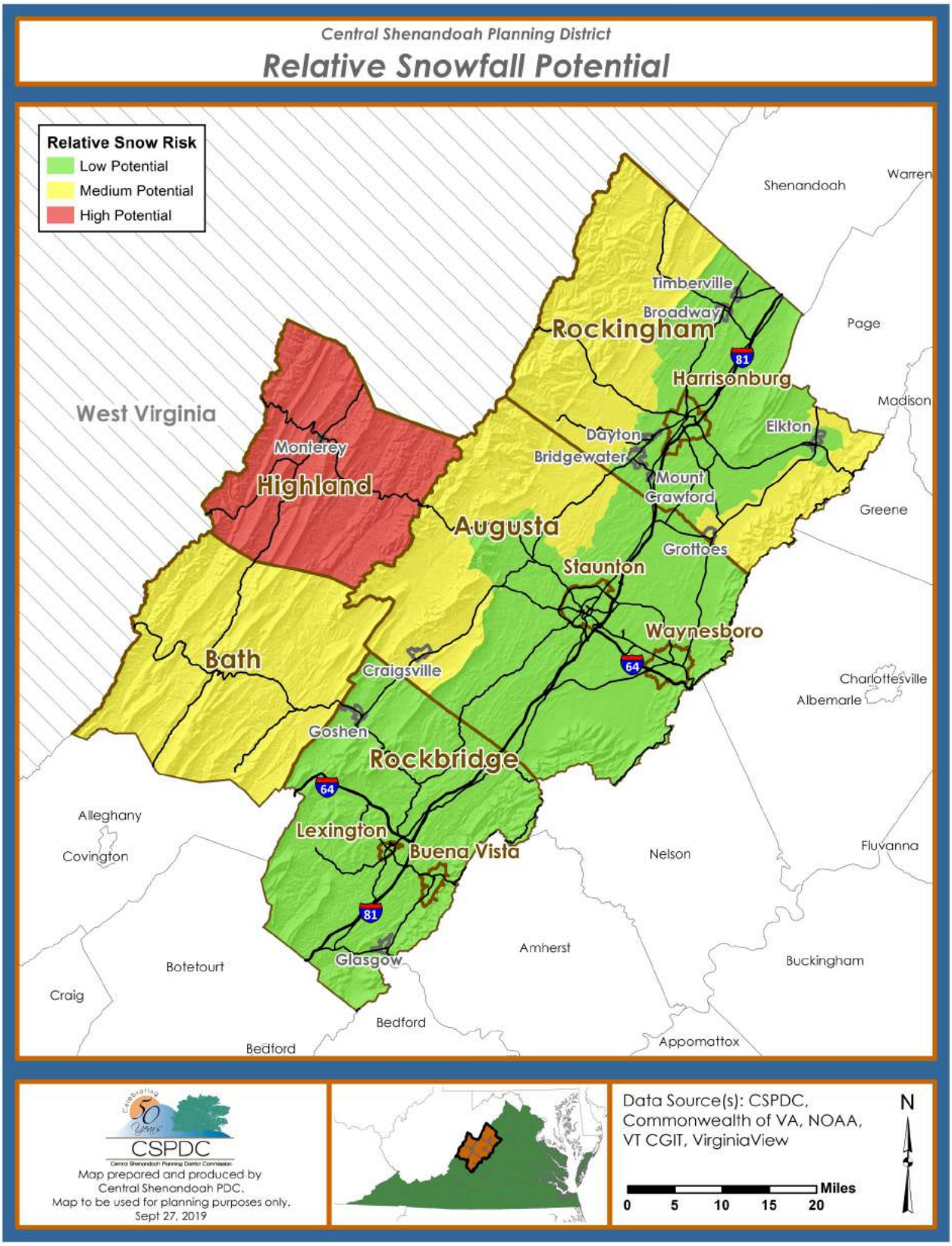


Figure IV-12: Central Shenandoah PDC Relative Ice Risk

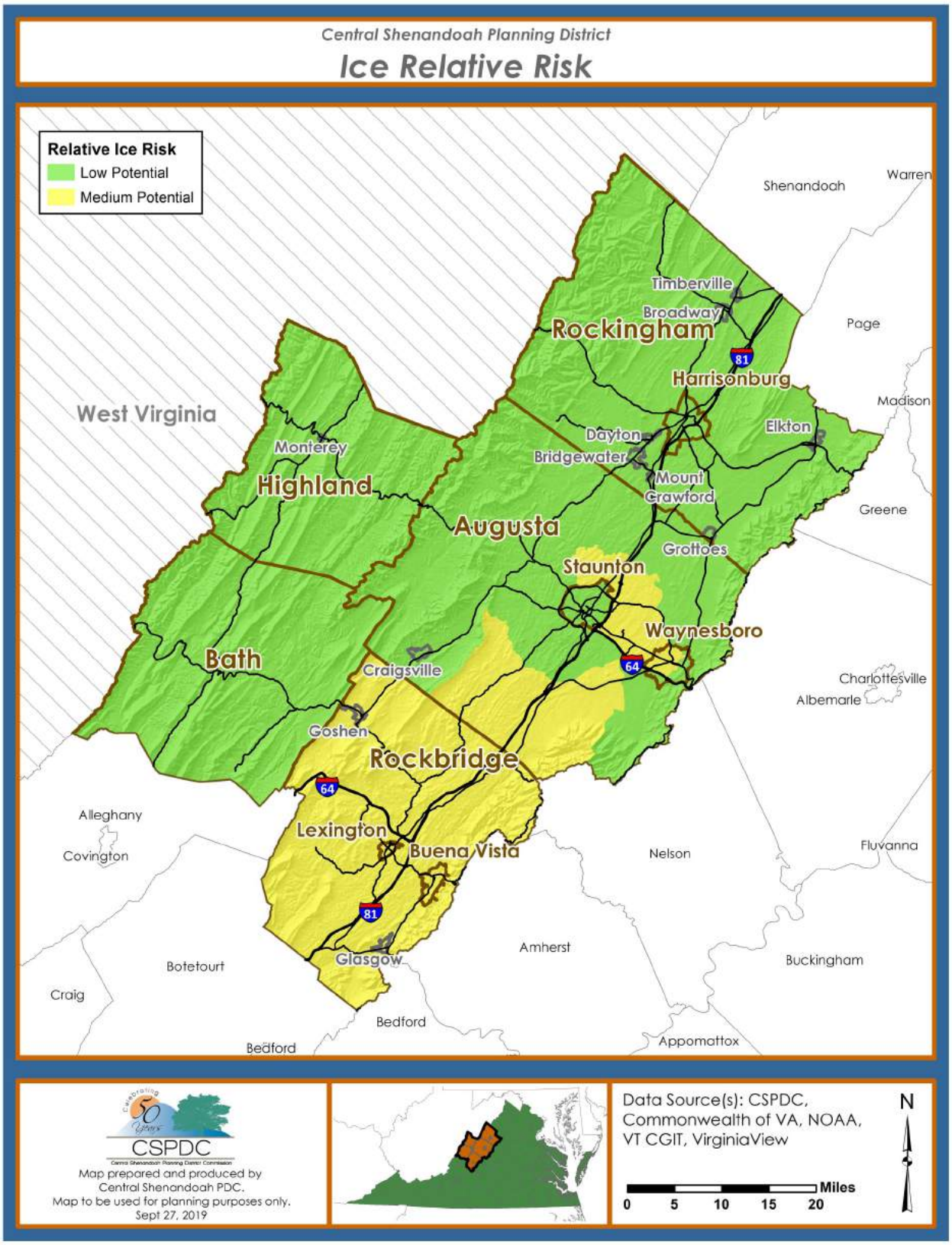
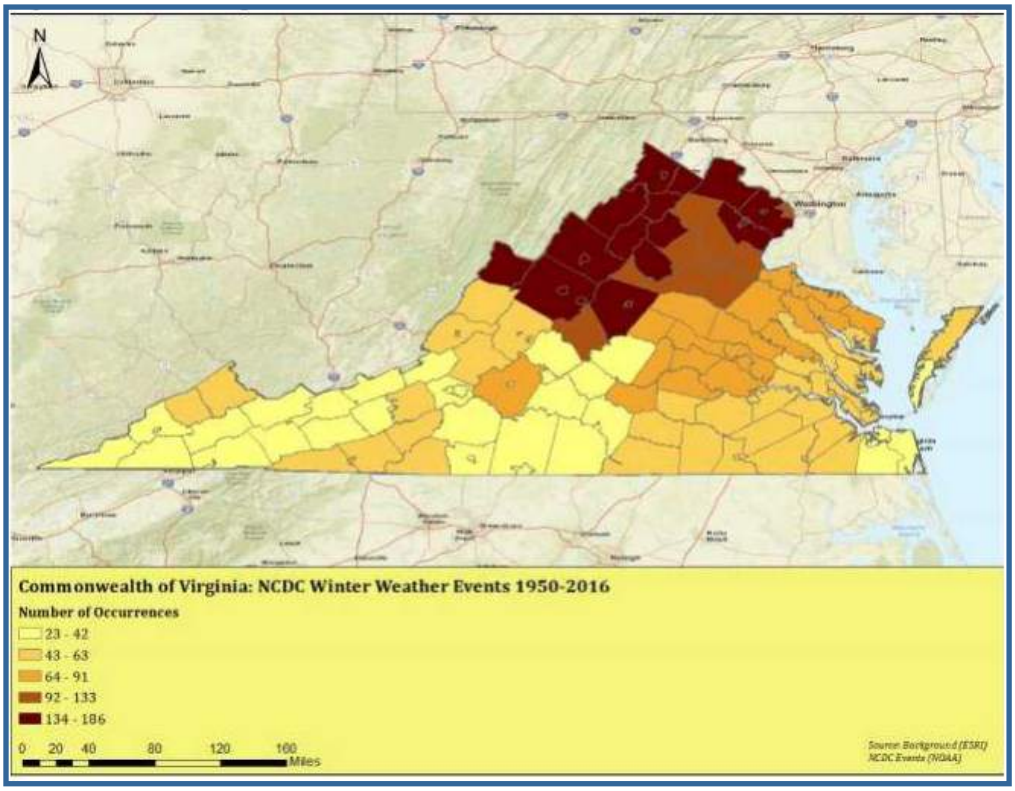
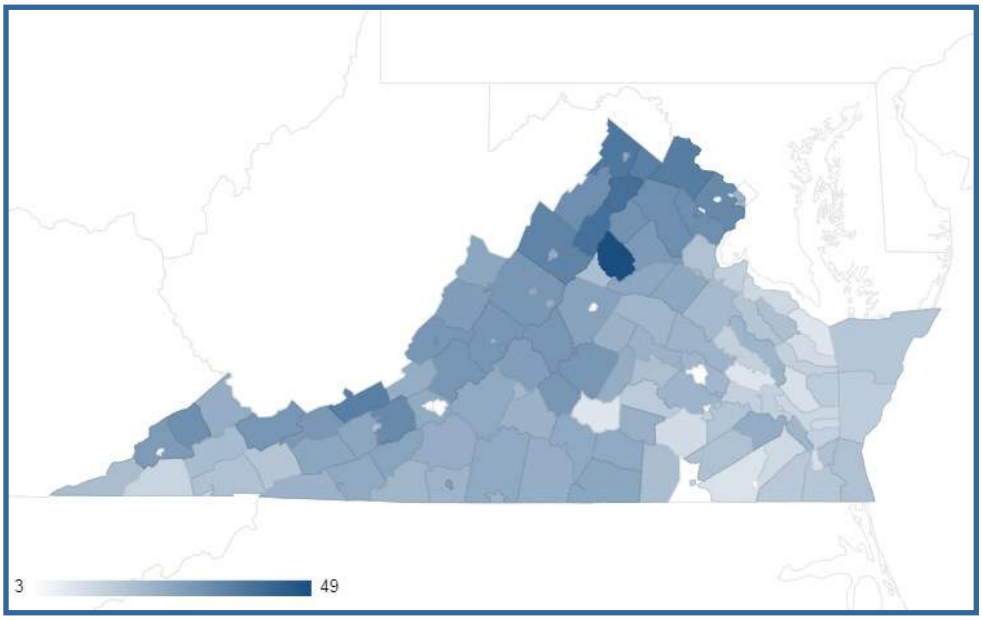


Figure IV-13: NCDC Winter Weather Events 1950-2016



Source: Commonwealth of Virginia, Hazard Mitigation Plan, 2018

Figure IV-14: NDCC and NOAA 3-Day Snowfall Extremes (1914 -June 2018) in Inches



Source: NDCC, NOAA

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7. Land Subsidence/Karst (Medium Ranking)

Hazard History

There is no existing long-term record of sinkholes for our region or for Virginia because sinkholes caused by karst are very site-specific and often occur in undeveloped areas. A number of sinkholes over the years have opened up on Interstate 81 which runs through the Region. Documented occurrences of sinkholes are included in Table IV-21.

Thirty-two sinkholes were reported after 7" of rain fell in April 2000 after a long dry spell.

Table IV-21: Central Shenandoah PDC Karst and Land Subsidence History

Date	Damages
8/11/1910—The Big Cave-In	**Staunton:** Three sinkholes opened up on Lewis and Baldwin Street and Central Avenue that were 60 feet deep. The sinkholes impacted homes, a fire station and a school. One worker was killed when he fell into one of the chasms caused by the sinkhole as it was being repaired.
4/16/1961 - 8/4/1961 2/1962 - 4/1962 3/2/1963 – 3/22/1963 11/21/1972 4/2/1982 4/12/1983	**Timberville:** Incidences of sinkholes opening up in the Town.
April 2000	Thirty-two sinkholes were reported after 7" of rain fell in April after a long dry spell.
3/1/2001	**Augusta County:** Interstate 81 was closed for a nine-mile stretch due to the sudden appearance of three sinkholes. The largest sinkhole measured 20 feet long, 11 feet wide and 22 feet deep, costing over $145,000 (2019 dollars) to repair.
10/28/2001	**Staunton:** A 45-feet deep sinkhole opened up at the corner of Lewis Street and Baldwin Street in Downtown Staunton, damaging three vehicles.
10/7/2005	**Timberville**: A sinkhole opened up in the Town.

In June 2017, A sinkhole opened up on Interstate 81 near Greenville closing the right lane of southbound I-81

Table IV-21: Central Shenandoah PDC Karst and Land Subsidence Hazard Histories—continued

Date	Damages
9/30/2015	**Augusta County**: A sinkhole opened up on a Dominion Virginia Power electric transmission line easement near Breezy Knoll Lane and Warren Oaks Lane. The sinkhole exposed telephone, cable and high voltage electric lines on the underground easement.
1/26/2016	**Staunton:** Following a snowstorm with 18 inches of snow in Staunton, fluctuating temperatures caused 9 water main breaks. Three occurred on Skymont Road, leaving several homes without water. During the same period, a sinkhole opened up on Skymont Road swallowing a car and condemning a house.
6/5/2016	**Augusta County:** A sinkhole opened up on Broad Run Road (Route 774) in Mount Sidney.
6/23/2017	**Augusta County:** A sinkhole opened up on Interstate 81 near Greenville closing the right lane of southbound I-81. The closure caused traffic backups of 10 miles on the interstate, and traffic congestion on Route 11.
9/27/2018	**Augusta County:** A sinkhole opened up on Hundley Mill Road in Staunton measuring about three feet wide, six feet long and fifteen feet deep. A 700-pound cow fell into the sinkhole. After attempts to rescue the cow alive by County authorities, a veterinarian and a backhoe operator were unsuccessful, the animal had to be euthanized.

Photo IV-1 and IV-2: The Big Cave-In Occurred in Staunton in August 1910, when three large sinkholes opened up, along Baldwin Avenue and Central Avenue.

Hazard Profile

Land subsidence is caused by the gradual settling or sudden sinking of the ground due to subsurface movement. It commonly occurs in areas with karst terrain, which is a type of topography formed by dissolution of soluble rock such as limestone and dolomite. The soluble rock dissolves when acidic water percolates through the soil. Karst terrain is characterized by the presence of sinkholes, caves, springs, sinking streams and solution valleys.

Land subsidence is caused by the gradual settling or sudden sinking of the ground.

Sinkholes are natural depressions of the land surface that are bowl-shaped, funnel-shaped or vertical sided. Sinkholes are formed when the land surface sinks or collapses because the soluble rock underneath dissolves. Sinkholes are a natural geological process but can be impacted by human activities that can cause issues with subsidence, flooding and pollution.

Sinkholes are a natural geological process, but can be impacted by human activities.

Human activities that impact the hydrology, such as groundwater pumping, mining, and leaking water from sewer and stormwater pipes, can accelerate the natural processes of land subsidence. Sinkhole flooding can be caused by natural conditions or man-made conditions. Increased surface runoff can result in sedimentation blocking the natural drain, resulting in ponding or flooding.

Groundwater contamination from pollution is a significant concern in areas with karst terrain. As water percolates through the underlying rock, contaminants can be transferred into the groundwater polluting water supplies. Examples of contaminants include chemical based products such as petroleum, herbicides, solvents and fertilizers; sewage from leaking septic systems or utilities; and household garbage. While it is prohibited by the Code of Virginia, the dumping of wastes, such as household garbage, agricultural waste, and dead livestock have occurred.

Land subsidence and sinkholes can result in damages to buildings and personal property, transportation infrastructure and utility infrastructure. Impacts to infrastructure can occur damaging roadways, bridges, railroads, storm drains, sanitary sewer, water lines, gas lines, power lines and telecommunications.

Hazard Areas

In Virginia, the areas mostly impacted by sinkholes are in the Valley and Ridge physiographic province.

In Virginia, the areas that are mostly impacted by sinkholes are in the Valley and Ridge physiographic province. The Valley and Ridge province has long parallel ridges and valleys underlain by limestone and dolomite rock. The vast majority of the localities in the Region are located in the Valley and Ridge province. Very small portions of the Region including the eastern boundaries of Augusta, Rockbridge and Rockingham Counties, and the cities of Buena Vista and Lexington are located in the Blue Ridge province, which runs along the Blue Ridge Mountains.

Transportation infrastructure within the Region has been impacted along the interstate corridors.

Interstate 81 also runs through the Valley and Ridge province, from Washington County in the south to Frederick County in the north. In the region, Interstate 81 runs through Rockbridge County, Augusta County, the City of Staunton, Rockingham County and the City of Harrisonburg. Interstate 64 also runs through Rockbridge County, the City of Lexington, Augusta County, the City of Staunton and the City of Waynesboro. In the area from the City of Lexington to the City of Staunton, Interstate 64 runs concurrently along Interstate 81 in Rockbridge and Augusta Counties.

Due to the karst terrain, transportation infrastructure within the Region has been impacted along the interstate corridors. Past sinkholes have resulted in the closure of Interstate 81/Interstate 64, resulting in significant traffic backups and congestion along alternate routes in the Region along a major trucking corridor. The Virginia Department of Transportation maintains an emergency contract for sinkhole repair, and repair costs can range anywhere from tens of thousands of dollars to hundreds of thousands of dollars per sinkhole. The interstate systems in the Region also increase the vulnerability of groundwater contamination from the transportation of hazardous materials. If an accident occurs that leaks hazardous materials, the chemicals can remain in the groundwater for many years.

In the Region, private and public water supplies can be impacted by groundwater contamination due to the karst terrain. Karst aquifers are vulnerable to contamination, especially in populated areas. Contaminated groundwater can impact local governments, private citizens, businesses, agriculture, and industry. Rockingham County and Augusta County are the top two agricultural producing counties in Virginia. The Region is also home to industries that rely on the water supply to operate.

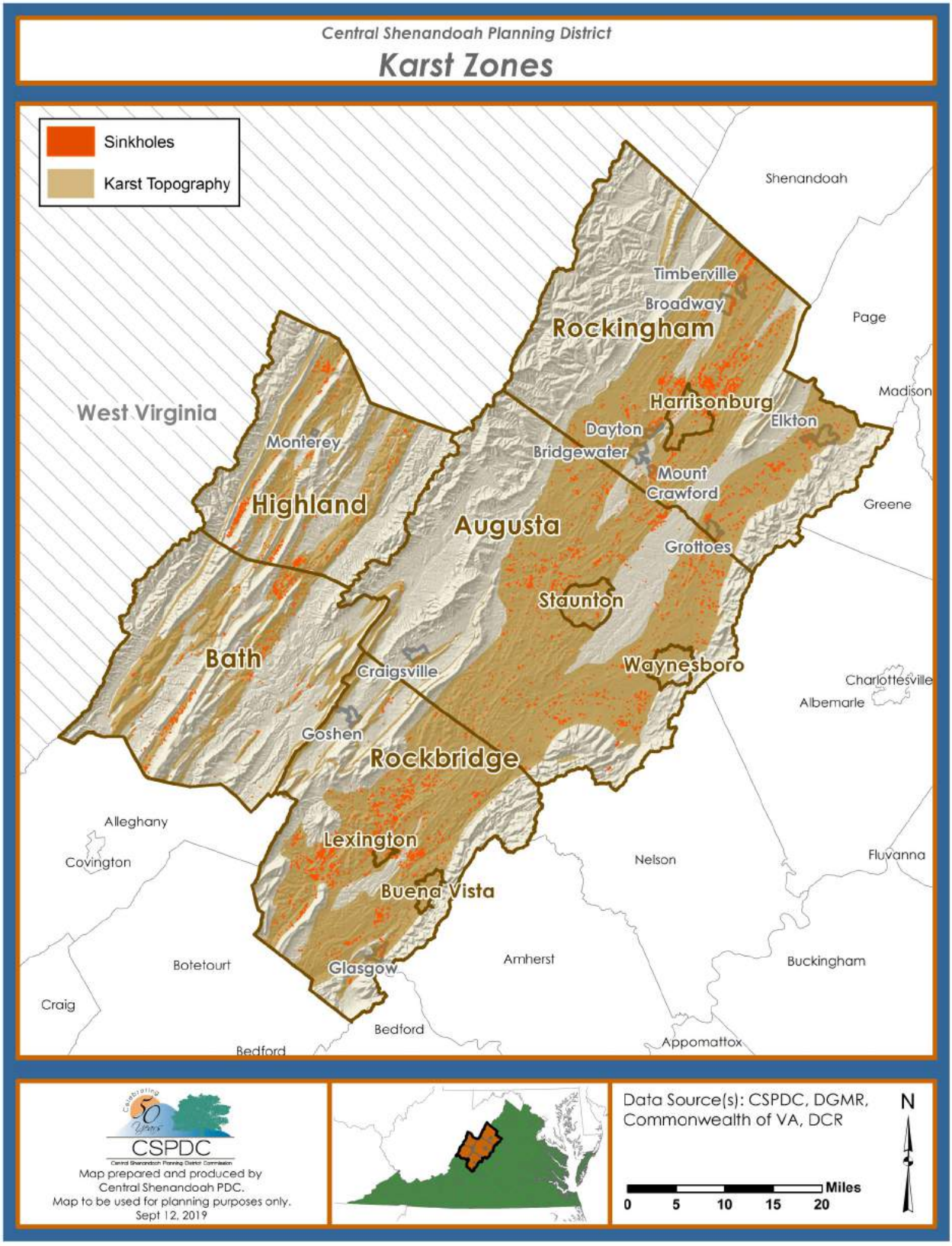
Karst aquifers are vulnerable to groundwater contamination, especially in populated areas.

Figure IV-15 shows the locations in the Region that contain karst topography. Sinkholes identified by the Virginia Division of Geology and Mineral Resources are also shown. The sinkhole data is meant to provide a general guide to the presence of sinkholes in the Region, and does not reflect the presence of all sinkholes. These areas are broadly defined and mapped with a general understanding of karst hazard risks. A more detailed study would be required to determine the actual vulnerable structures at individual sites within these risk areas.

Contaminated groundwater can impact local governments, private citizens, businesses, agriculture and industry.

As seen in Figure IV - 15, karst topography is more prevalent in the lower valley regions and the probability of sinkholes and land subsidence is higher in these areas; however, this map is generally a reference of karst geology and does not portray hazards associated with karst. Karst development is always changing, making it harder to predict the probability of hazardous events. Since karst topography is present throughout the region's urban areas, it can be assumed that risk of karst related events will be increased as there is more development around these urban areas. Many human induced sinkholes can be created by construction or changing the land's natural drainage and hydrology. Climate change is also a concern for increasing karst hazards in our region due to greater rainfalls and longer periods of saturated soil.

Figure IV-15: Central Shenandoah PDC Karst Zones



Vulnerability Analysis

Table IV-22 illustrates the number of critical facilities and structures in the mapped karst zones. The Cities of Lexington and Staunton have the largest amount of structures in the karst zone at around 99% of their total structures. Figure IV-15 also shows, generally, the distribution of karst-related sinkholes in the region. This sinkhole data was mapped by the Virginia Division of Geology and Mineral Resources (DGMR). Rockingham and Rockbridge counties have the highest amount of sinkholes in the CSPDC region according to this DGMR data.

Table IV-22: CSPDC Structures and Critical Facilities Near Mapped Karst Zones

Community	Structures in Karst Zones	Critical Facilities in Karst Zones
Augusta County	53,833	356
Bath County	1,385	22
Buena Vista City	2,540	40
Harrisonburg City	16,558	65
Highland County	979	17
Lexington City	2,302	53
Rockbridge County	10,260	104
Rockingham County	68,035	137
Staunton City	14,497	39
Waynesboro City	11,270	80
Total	**181,659**	**913**

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8. Wind (Tornado, Derecho, or Straight-Line Winds); (Medium Ranking)

Hazard History

Throughout its history, the Region has experienced wind damage from tornadoes, straight-line winds and a derecho. For information on wind damage from hurricanes, refer to Section IV-5 on hurricanes. Wind events have caused fatalities, injuries, and property damage in the Region. Table IV-23 details major wind events in the Region.

Table IV-23: Wind Hazard History

Date	Location	Description and Damages
6/14/1834	Rockbridge County	A tornado had a damage path 18 miles long and 16 miles wide. Trees were flattened and windows broken. Hail was "hen egg" size, measuring 8 - 9 inches in diameter. Wind/hail most destructive to residents within their memory.
6/4/1911	Staunton, Augusta County (Possibly started in Mt. Solon area, blew southeast to Staunton where it zigzagged north and east. It also hit Greenville, Fishersville, and Verona. From Augusta County, it crossed into Nelson and Amherst Counties)	The tornado damage path was 30 miles long and 7 miles wide – shaped like an hour glass. Hail ranged in size from marbles to goose eggs. Damages included broken windows, roofs blown off, barns destroyed, water damage to houses, and impacts on crops and livestock. People were injured but there were no fatalities. Many people were caught outdoors on Sunday afternoon outings. The Staunton property loss was estimated between $600,000 to $1.3 million (2019 dollars). The county crop loss was $27 million (2019 dollars). Turkeys/ chickens killed at farms. Boy Scouts helped clean up damaged houses. Four carloads of glass were sold to replace broken windows in Staunton.
9/22/1921	Augusta County (1 mi. west of Mint Springs - moved to Barterbrook)	An F2 tornado had a damage path 5 miles long and 100 yards wide. The damage amounts are not known. No reports of fatalities. A mother and child were severely injured when their home was destroyed and scattered a ½ mile.

Table IV-23: Wind Hazard History –continued

Date	Location	Description and Damages
5/2/1929 "Virginia's Deadliest Tornado Outbreak"	Bath County	A storm swept across 12 states from Florida to Missouri to Virginia. More than 200 were injured and 40 killed in the United States. There were five tornadoes in Virginia that resulted in 22 people killed and over 150 injured. There were approximately $7.5 million (2019 dollars) in damages. In the state, 4 schools were destroyed including one school at Rye Cove in Scott County where 12 children and 1 teacher were killed and 42 injured. A tornado occurred in the Cowpasture Valley in Bath County at an elevation of 1,500 feet. Ten people were injured but no one was killed. Roofs were blown off, barns destroyed and two schools were damaged. Students had already been released. Several homes and a church at Nimrod Hall were destroyed. Weather turned cold and snow fell after the storm. "In some places, where a house, a barn, a garage or other building stood, there is only a bare spot to indicate where a structure stood, not even a splinter of the building being left." – Lexington News-Gazette 5/7/1929
4/5/1952	Augusta County, Rockingham County	Two tornados occurred in the region. A tornado in Augusta County tracked 1 mile and had a damage path 150 yards wide. No fatalities and 2 people injured. In Rockingham County, a tornado had a damage path 4.9 miles long and 100 yards wide. No damage amounts are known.
4/28/1959	Highland County	An F1 tornado hit Highland County. The path is not known. Damage to property estimated at over $22,000 (2019 dollars)
7/1/1959	Augusta County	An F1 tornado hit Augusta County. It tracked 11.3 miles with a damage path of 100 yards. No fatalities or injuries were reported. Damage to property was over $220,000 (2019 dollars).
8/6/1960	Rockingham County	An F2 tornado occurred in Rockingham County where the damage path is unknown. There were no reported injuries. Damage amounts to property were over $217,000 (2019 dollars)
11/29/1963	Augusta County	An F2 tornado hit Augusta County where the damage path was one mile long. The width is not known. There were no fatalities or injuries. A house under construction was leveled and the roof came off another house. Damage estimated at over $420,000 (2019 dollars).
4/4/1974 "Super Outbreak"	Augusta County, Staunton, Bath County, Highland County	In Augusta County, an F2 tornado struck near Westview, and moved northeast to Weyers Cave. The damage path was 18 miles long and 200 yards wide. The tornado damaged over 90 barns, destroyed 2 homes, and damaged 4 homes, outbuildings and a school. The Verona area was hit hard and Fort Defiance High School lost part of the roof. Damages in Augusta County were $13 million (2019 dollars). There was roof damage to Staunton City Hall. In Bath County, Bacova Junction and Millboro were affected. In Millboro, roofs were blown off, windows broken, and barns damaged. There was a possible touchdown in the Big Valley area of Highland County. These tornadoes were the last of the Super Outbreak which totaled 148 tornadoes over 2 days affecting 13 states. Most of the tornadoes were recorded in a 24 hour period. The average path length of the tornadoes was 18.7 miles. Six of the tornadoes during the Super Outbreak were F5s. 330 people died in the United States with two deaths in Virginia. Nineteen counties in Virginia were hit with thunderstorms or tornadoes.

Table IV-23: Wind Hazard History –continued

Date	Location	Description and Damages
6/5/1975	Augusta County, Rockbridge County	An F0 Tornado struck near Lyndhurst. The weak tornado tracked 0.2 miles with a damage path of 30 yards wide. It destroyed a small building and 25-30 trees. Damage estimated at over $9,000 (2019 dollars). No deaths or injuries were reported. A tornado struck near Collierstown damaging trees and fences. Damage was estimated at over $4,000 (2019 dollars).
8/15/1975	Rockingham County	An F1 tornado struck the Melrose area which is 6 miles northwest of Harrisonburg. The damage path was 1 mile long and 27 yards wide. No injuries were reported. The tornado overturned a trailer, ripped off a roof, and carried away outbuildings. Damages were over $119,000 (2019 dollars)
10/2/1979	Town of Dayton	An F1 tornado had a damage path 1.1 miles long and 37 yards wide. No injuries were reported. It snapped off tree tops and utility poles, and broke windows. The storm flipped an unoccupied trailer. Damages were over $88,000 (2019 dollars).
5/4/1990	Augusta County	An F2 tornado had a damage track 7 miles long and 27 yards wide. It hit Augusta Springs and Swoope. The tornado tracked a mile through the community of Augusta Springs. It lifted 2,500 feet over mountains and set back down again on other side. 2 people were killed in a mobile home in Swoope. Three people were injured in Swoope and 7 were injured in Augusta Springs. Damages were $4.9 million (2019 dollars). The tornado formed in a thunderstorm along a warm front well out ahead of the expected threat area.
6/10/1995	Waynesboro, Augusta County	A strong F2 touched down on the west side of Waynesboro. It tracked 3.5 miles through the County and southwest portion of the City, and had an average damage path of 300 yards wide. No deaths or injuries were reported. It hit an industrial area, peeling off roofs and damaging 15-20 homes. The tornado flipped a 22.5 ton crane and mowed down over 100 pine trees in a park. Quarter sized hail accompanied the storm. Damages were $3.3 million (2019 dollars).
6/24/1996	Town of Broadway	An F1 tornado had a damage path that was 0.5 miles long and 100 yards wide. No injuries. were reported. The tornado tore roofs off 2 homes and 2 poultry houses, and damaged trees. Several chimneys were blown off homes. Damage estimates were over $65,000 (2019 dollars).
7/11/1999	Harrisonburg, Rockingham County	An F0 tornado had a damage path that was 0.1 mile long and 15 yards wide. No injuries were reported. The storm damaged a store's tin roof and singles on a home. Damages were estimated at more than $3,000 (2019 dollars).

Table IV-23: Wind Hazard History –continued

Date	Location	Description and Damages
7/31/1999	Augusta County	An F1 tornado struck 5 miles east of Staunton. The damage path was 0.1 mile long and 100 yards wide. It destroyed a barn, damaged a greenhouse, and took down trees. No injuries were reported. The storm produced 3/4 inch diameter hail. A 100 pound beam from a barn roof was buried in the ground and the roof rolled into a ball by the force of the wind. Damage estimates were over $23,000 (2019 dollars).
5/9/2003	Augusta County	An F0 tornado touched down in Verona, then moved southeast to Hermitage. The tornado downed a 195-foot radio tower. The path of the tornado was 5 miles long and 100 yards wide. The storm also downed trees in New Hope and produced hail near Mt. Solon.
6/23/2006-7/6/2006	Augusta County	Severe storms and tornadoes resulted in flooding in Augusta County.
2/10/2008	Augusta County	High wind resulted in significant damage to trees, utility lines and utility poles in Augusta County.
8/2/2008	Town of Elkton, Rockingham County	An EF0 tornado touched down on the banks of the South Fork of the Shenandoah River along Park Avenue. The tornado's path was 1/4 mile long and 70 yards wide. This series of strong thunderstorms also produced large hail. Witnesses spotted swirling wind and a funnel cloud. Hail and damaging winds also occurred in other parts of Rockingham County downing trees.
4/16/2011	Augusta County, Bath County, Highland County, Lexington, Rockbridge County, Town of Glasgow	An EF1 tornado reached wind speeds in excess of 95 mph traveling 4.1 miles in Augusta County. The tornado damaged 37 structures and downed numerous trees and powerlines. Preliminary damage estimates from Augusta County listed storm damage to 12 residences, 3 businesses, 15 outbuildings, 2 mobile structures and 5 barns. Preliminary damage cost is estimated at over 2.5 million dollars (2019 dollars). An EF0 tornado touched down near Vesuvius in Rockbridge County causing minor damage to a barn and a house, and slightly moving another barn off its foundation. The twister left a path about 100 yards wide and 1.3 miles in length. Wind speeds were estimated at 80 mph. Rockbridge also experienced 3.5 inches of rain and reports of quarter size hail. Numerous trees were reported downed in Lexington and countywide in Rockbridge. In Glasgow, the Maury River reached near flood stage at 18 feet. As many as 33 roads were closed due to high waters and fallen trees, the worst being Rt. 631, Furrs Mill Road. A swift water rescue was required to retrieve two women and two small children stranded in a van. 350 Dominion Power customers lost power. In Bath County, downtown Hot Springs flooded. Flooding, mud and rock slides also occurred in other areas of Bath County damaging roads, driveways, homes and the Warm Springs Pools at the Homestead. Highland County experienced power outages, downed trees and flooded roadways. Highland County Supervisors declared the County a disaster area.

Table IV-23: Wind Hazard History –continued

Date	Location	Description and Damages
4/28/2011	Augusta County, Bath County, Rockbridge County, Rockingham County	Four tornadoes touched down in Augusta County and Rockingham County. The strongest was an EF-2 that started in Fulks Run and traveled 33.2 miles into Shenandoah County, damaging homes and farm buildings; downing trees and causing 2 injuries. An EF-1 tornado occurred in Churchville in Augusta County, and traveled for 4 miles damaging homes, downing trees and destroying outbuildings. Two EF-1 tornados occurred in Rockingham. A tornado in Keezletown was on the ground for 2.7 miles causing tree damage and damage to two homes, farm buildings and an outbuilding. A tornado in Linville traveled for 0.9 miles causing tree damage. Other reported storm damage from the Region included reports of downed trees in Bath County, Rockbridge County, Augusta County and Rockingham County. A tree fell on a trailer in the Colen Hollow area of Rockbridge and damage was reported to houses in Rockingham. The storm brought heavy rains and flooding in Bath County. It caused downed trees and powerlines, washed debris in the road and damaged roads in Burnsville and Williamsville. Rt. 614 Muddy Run Road in front of the Burnsville Volunteer Fire Department and Rescue Squad was washed out. Flooding damaged a home in Williamsville.
6/29/2012	Entire Region	Severe storms and straight-line winds from a derecho impacted the entire Central Shenandoah Region bringing high winds, excessive rain, hail and lightning. In the days afterwards, it was followed by excessive heat. The derecho traveled over 600 miles in about 10 hours. Peak wind gusts were 80-100 mph. In the Valley, a quarter million people lost power. The storm damaged homes, businesses, trees and powerlines. Nine localities were included in a federal major disaster declaration (DR-4072) including Augusta County, Bath County, Buena Vista, Harrisonburg, Highland County, Lexington, Rockbridge County, and Staunton. Three localities- Augusta County, Rockbridge County and Rockingham County- were included in an federal agricultural disaster declaration (S3418).
5/14/2018	Augusta County, Rockbridge County, Rockingham County, Staunton and Waynesboro.	A series of severe thunderstorms with high winds, heavy rain and hail caused flash flooding in the central Shenandoah Valley, resulting in downed trees and power outages. Several homes or businesses in the Region were damaged. In Verona, a family was displaced when flooding caused their basement wall to collapse leading to the condemnation of their home. Homeowners insurance denied the claim since the property was not covered by flood insurance. Strong winds struck a local bank branch during business hours, damaging the building, while employees and customers took shelter in the bank vault. A tree fell damaging a home in Waynesboro. Hail was reported in Verona, and half dollar size hail was reported in Rockbridge County. Trees were reported downed in other areas of Augusta County, Rockingham County and the City of Staunton. 21,000 Dominion Power customers were without power in the region.
10/31/2019	Rockingham County	An EF-0 tornado touched down at 6:04 p.m. on Halloween night in Rockingham County near Timberville. It had a maximum wind speed of 75 mph and a damage path of 0.5 miles long and 25 years wide. There were no injuries and no fatalities. The tornado was produced by a segment of thunderstorms and damaged corn crops and a grove of trees. It destroyed a barn and a small shed. A piece of lumber from the barn impaled the windshield of a nearby vehicle. The path of the tornado ended shortly before it would have crossed several propane tanks at Southern States. Further west on VA-211, straight line winds caused scattered tree limb damage. Prior to the tornado hitting, the entire Region had been placed into a risk level 3 for severe weather with the timeframe of largest concern being during peak trick-or-treating hours. Many festivities in the region were rescheduled as a result.

Hazard Profile

From 1991 to 2010, Virginia averaged 18 tornadoes per year.

In the Region, damaging winds have typically been associated with tornadoes, hurricanes or straight-line winds. In 2012, the Region also experienced a derecho. For information on wind hazards from hurricanes, refer to Section IV-5 on hurricanes.

Tornadoes are classified into six categories using the Enhanced Fujita Scale.

Tornadoes are classified as a violently rotating column of wind that extends between a thunderstorm cloud and the earth's surface. The rotating column of air often resembles a funnel shaped cloud. The widths of tornados are usually several yards across, with infrequent events being over a mile wide. Tornadoes can occur at any time throughout the year, but tornado activity normally spans from March through May with a peak in April. Tornadoes may be produced by thunderstorms, hurricanes or tropical storms. Those tornadoes produced by hurricanes or tropical storms are typically on the eastern half of the outer bands. From 1991 to 2010, Virginia averaged 18 tornadoes each year. The total number may be higher as incidents may occur over areas with sparse populations, or may not cause any property damage.

Tornadoes and their resultant damage can be classified into six categories using the Enhanced Fujita Scale, as shown in Table IV-24. The Enhanced Fujita Scale replaced the original Fujita Scale in 2007. The scale assesses damage in comparison to damage indicators and varying degrees of damage. This assessment is used to estimate wind speeds and assign the rating.

A majority of Virginia's tornadoes are EF-0 and E-F1 on the Fujita Scale/ Enhanced Fujita Scale, as shown in Table IV-24, which result in light or moderate damage. Table IV-23, the Wind Hazard History Chart for the Region has information on twenty-eight tornadoes documented since 1834. In reviewing Table IV-23, the Region has experienced ten F-1 or EF-1 tornadoes, seven F-2 or EF-2 tornadoes, six F-0 or EF-0 tornadoes, and six tornadoes whose rankings are not documented in the table. Figure IV-16 shows the location and intensity of tornado touchdowns in the Region since 1950.

Since tornadoes are less frequent for the Region, the Hurricane Wind analysis covers more probable high wind occurrences. It is also interesting to note that there are no recorded tornadoes in the national forests and parks. This is a result of tornadoes only being recorded when impacts affect people or property. Some areas in the Region appear to be slightly more prone to tornadoes than others. It is thought that this is caused by topographical influences on thunderstorms such as the change in low-level wind flow and humidity caused by the orientation of the mountains. One such area is near the cities of Staunton and Harrisonburg. It should be noted that areas with denser population are more likely to report a tornado than less populated areas.

While the tornadoes that have occurred in the Region do not compare to the numbers or strength of the tornadoes that have touched down in Tornado Alley in the Midwest, the tornadoes that have occurred in the Region have caused property damage, injuries and fatalities. The tornadoes that the Region does experience are most frequently spawned from thunderstorms and have little to no warning time. Tornadoes did affect the Region in three significant events- Virginia's Deadliest Tornado Outbreak in 1929, the Super Outbreak of 1974 and the 2011 Super Outbreak.

Photos IV: 3-5: Structural damages from the April 2011 Tornadoes in Rockbridge County and Augusta County.

Table IV-24: Enhanced Fujita Scale

EF Rating	3 Second Gust (MPH)	Damage Level
EF-0	65 to 85	Light Damage
EF-1	86 to 110	Moderate Damage
EF-2	111 to 135	Considerable Damage
EF-3	136 to 165	Severe Damage
EF-4	166-200	Devastating Damage
EF-5	Over 200	Incredible Damage

Damage Level	Description
Light 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 supposed to be rated EF0 as a matter of policy; however, some NWS local offices have adopted an "EFU" (for "unknown") rating for such tornadoes.
Moderate Damage	Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
Considerable Damage	Roofs torn off from 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.
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 are badly damaged.
Devastating Damage	Well-constructed and whole frame houses completely leveled; some frame homes may be swept away; cars and other large objects thrown and small missiles generated.
Incredible Damage	Strong-framed, well-built houses leveled off foundations and swept away; steel-reinforced concrete structures are critically damaged; tall buildings collapse or have severe structural deformations; cars, trucks, and trains can be thrown approximately 1 mile.

Source: National Weather Service; The Weather Channel; and Wikipedia.

Figure IV-16: Central Shenandoah PDC Tornado Touchdowns

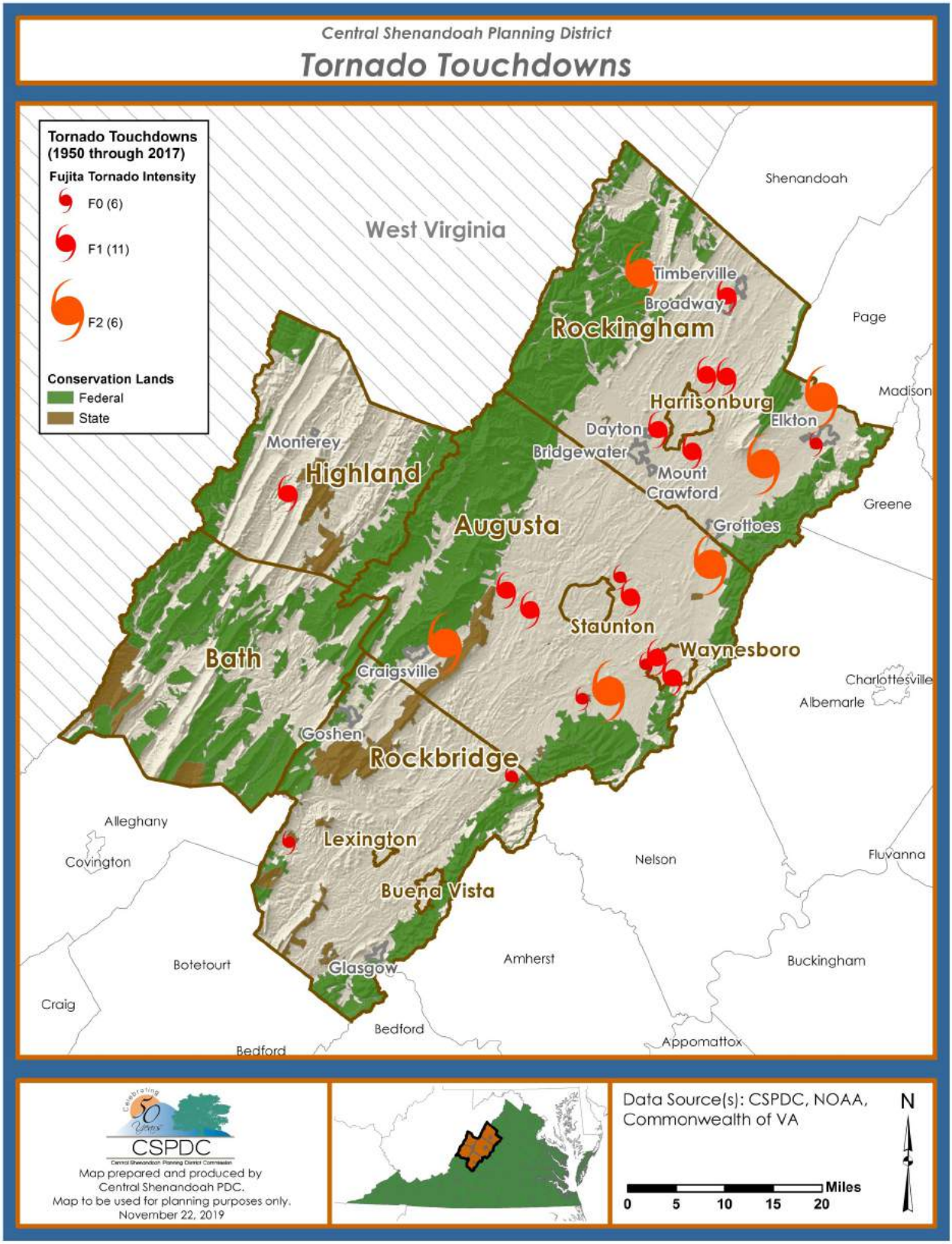
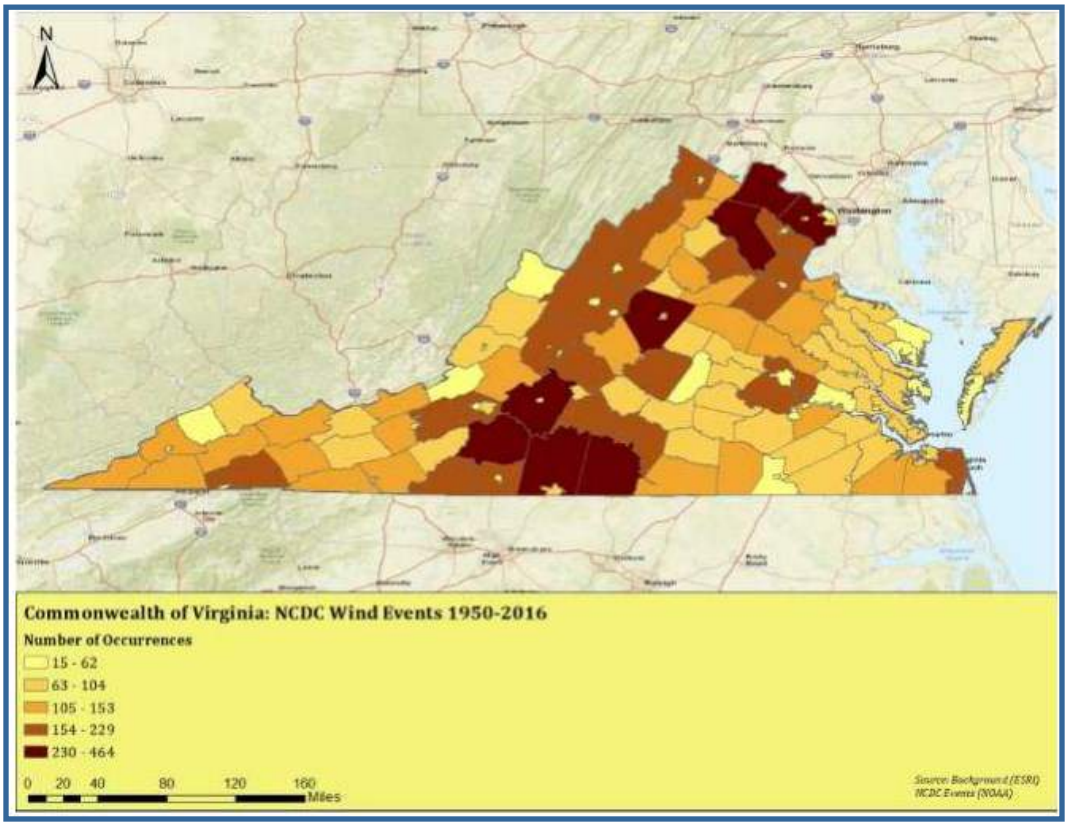


Figure IV-17: NCDC Significant Non-Rotational Wind Events in Virginia (1950 –2016)



Source: Commonwealth of Virginia, 2018 Hazard Mitigation Plan

In addition to tornadoes, the Region has also experienced non-rotational wind events including isolated "downburst" or "straight-line" winds, as well as a derecho.

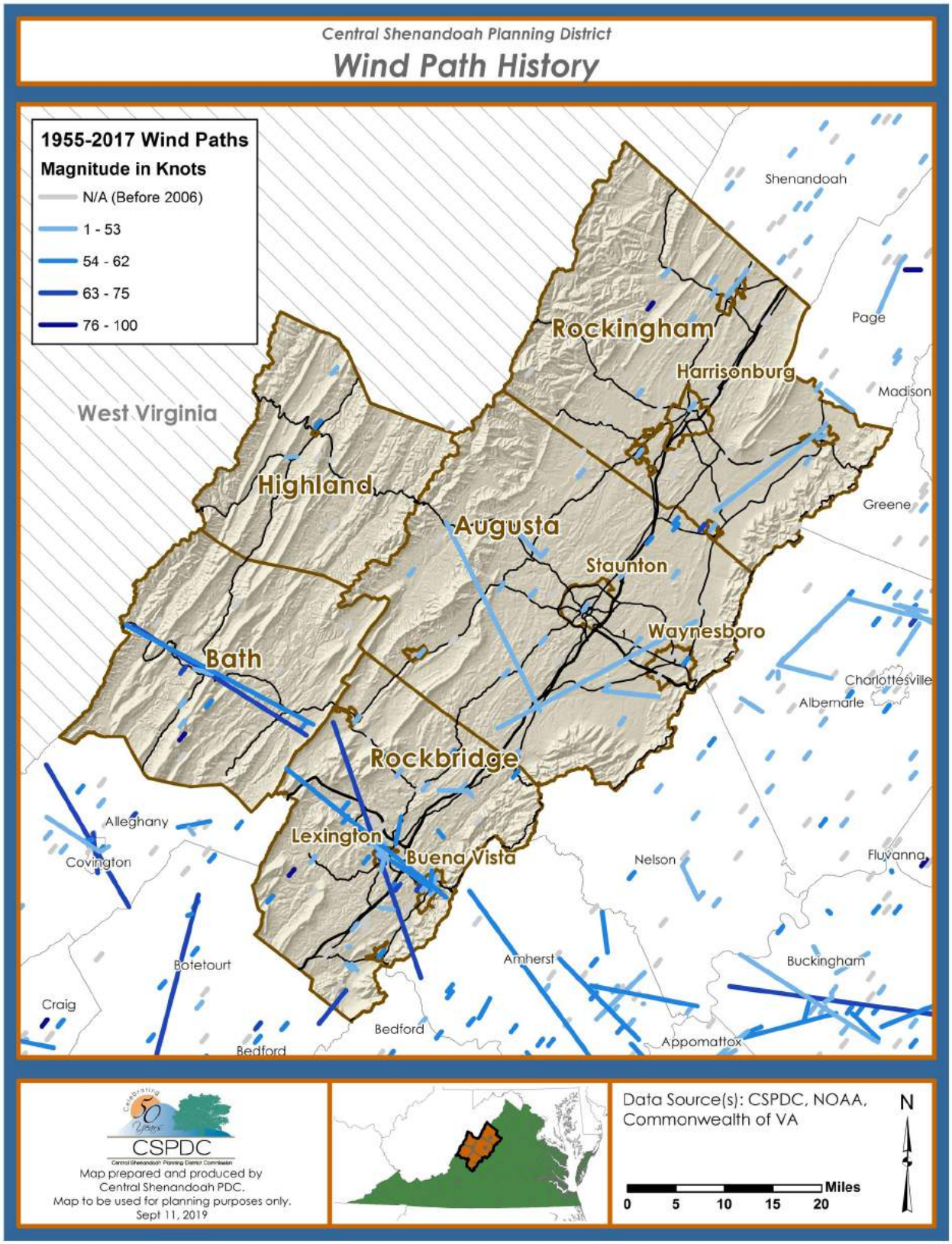
Straight-line winds are associated with thunderstorms and can cause extensive property damage. A more severe type of damage occurs from straight-line winds experienced during a derecho. A derecho is a wind storm that is widespread and long-lived. It is associated with rapidly moving thunderstorms that are in a curved shape, and called bow echoes. Wind speeds during a derecho do vary and are not constant. A storm may be classified as a derecho if the storm includes several wind gusts of 75 mph or greater, wind gusts of at least 58 mph along most of its length, and extends for more than 250 miles. During the storm, straight-line wind damage from downbursts, microbursts and burst swaths occurs, but the damage is similar to that produced by a tornado.

Derechos are more common from May through August during warm weather and intense heat waves. They can be hazardous causing injuries, fatalities and widespread property damage. Due to their rapid movement and short notice, those participating in outdoor activities, as well as those driving vehicles are more vulnerable and at risk. Examples of damages that can occur during a derecho storm include downed trees, utility poles and electrical lines; damaged or overturned vehicles and mobile homes; structural damages to buildings; and injuries or fatalities to people from flying debris. Widespread damage caused to utility poles and electrical lines can cause long-lasting power outages, while the area is also dealing with high temperatures.

While derechos are rare in our region, other occurrences of straight-line wind are more common. Figure IV-17 is from the Commonwealth of Virginia Hazard Mitigation Plan and shows the number of occurrences for wind events in the state using National Climatic Data Center (NCDC) data. According to this map, Rockingham, Augusta, and Rockbridge counties are in the 154 to 229 event range, which are the highest occurrences for the region. The wind events depicted are non-rotational, and do not include weather events such as tornados or hurricanes. Figure IV-18 is a map of wind path history from 1955 to 2017 with magnitudes for the Region using data from the NOAA. Strong wind paths can be seen in Bath and Rockbridge Counties between 76 to 100 knots.

The entire region's population and infrastructure are vulnerable to tornados, derechos and straight-line winds based on the historical occurrences and volatility. Previous tornado events appear to be more common in less mountainous landscapes in the region, especially in Augusta and Rockingham counties, although tornadoes have been known to occur in mountainous areas. However, historical occurrences of derechos and straight-line winds have impacted the entire region. Tornadoes and derechos may occur less frequently in the region but can have a high impact. The severity of damage will depend on the intensity of the wind event and the population density of the storm's path. With the climate changing, this could increase the number of thunderstorms and other wind events in the future.

Figure IV-18: CSPDC Wind Path History



9. Wildfire (Medium Ranking)

Hazard History

From 1995 to 2001, there were 386 wildfires in the Region.

The Virginia Department of Forestry (VDOF) website provided fire incidence data for fire years 1995-2001. The data provided by VDOF was summarized into the following tables.

Table IV-25 provides information on the number of wildfires per county. Table IV-26 is a summary of the number of acres and total damages of wildfires in the Region. Note that the tables do not include data for Towns or Cities; this data was not available through VDOF. Table IV-27 illustrates the cause of fire, broken down by County. The data shows that 27% of fires were caused by debris, followed by 21% caused by incendiary devices and 21% caused under miscellaneous conditions.

The Rocky Mountain Fire in 2016 was the second largest forest fire in the history of Shenandoah National Park.

See Table IV-28 for a list of wildfires that have occurred recently in the Region. This list includes the fires of Rocky Mountain, Goshen Pass and Tye River, which burned thousands of acres.

Table IV-25: Wildfire Statistics by Fire Year 1995-2001

County	1995	1996	1997	1998	1999	2000	2001	Total
Augusta County	17	6	2	20	9	18	24	96
Bath County	5	2		4	6	3	6	26
Highland County	2	1	2	1	4	1	1	12
Rockbridge County	5	3	5	6	5	1	7	32
Rockingham County	36	20	17	18	40	13	76	220
Total	**65**	**32**	**26**	**49**	**64**	**36**	**114**	**386**

Source: Virginia Department of Forestry

Table IV-26: Wildfire Summary 1995 - 2001

Fire Year	1995		1996		1997		1998		1999		2000		2001			
County	Total Acres	Total Damage	Total Acres	Total Damage	Total Acres	Total Damage	Total Acres	Total Damage	Total Acres	Total Damage	Total Acres	Total Damage	Total Acres	Total Damage	Acres Total	Damages Total
Augusta County	61.3	$1,600	6.2	$2,500	2.5	$1,500	482.3	$206,275	113.2	$10,000	214.5	$35,700	355.8	$31,801	1235.8	$289,376
Bath County	17	$4,100	3	$8,500	0	$0	17.3	$2,825	53	$11,200	23	$23,500	93	$58,800	206.3	$108,925
Highland County	29	$1,700	2	$500	2	$500	35	$7,000	35.3	$4,000	0.3	$0	5	$500	108.6	$14,200
Rockbridge County	4.9	$405	0.3	$20	481.1	$6,360	4.6	$170	100.3	$5,150	2	$1,900	31	$112,950	624.2	$126,955
Rockingham County	166.7	$75,560	8.3	$33,725	16.1	$100	24.4	$2,100	151.6	$5,950	10	$0	147	$728,095	524.1	$845,530
Total	**278.9**	**$83,365**	**19.8**	**$45,245**	**501.7**	**$8,460**	**563.6**	**$218,370**	**453.4**	**$36,300**	**249.8**	**$61,100**	**631.8**	**$932,146**	**2699**	**$1,384,986**

Source: Virginia Department of Forestry

Table IV-27: Wildfire Causes 1995-2001

County	Lightning	Camp	Smoking	Debris	Incendiary	Equip. Use	R&R	Child	Misc.	Total
Augusta County	2	3	14	25	17	4	5	3	23	96
Bath County	2	4	1	6	2	5	0	1	5	26
Highland County	5	1	0	2	0	1	0	0	3	12
Rockbridge County	5	0	3	10	1	1	0	2	10	32
Rockingham County	4	4	11	61	61	26	1	12	40	220
Total	**18**	**12**	**29**	**104**	**81**	**37**	**6**	**18**	**81**	**386**

Source: Virginia Department of Forestry

Table IV-28: Recent Wildfires in the Region

Name	Year	Locality	Description
Rocky Mountain Fire (SNP)	2016	Rockingham County	This fire started on 4/16/2016 in Shenandoah National Park and burned 10,326 acres. It was the second largest forest fire in the history of Shenandoah National Park. On April 29 the fire was fully contained.
Goshen Pass Wildfire	2017	Rockbridge County	3,100 Acres were burned from this fire that started on 4/10/2017 in the Goshen area.
Tye River Fire	2018	Rockbridge County Augusta County	This fire was caused by a vehicle fire that quickly spread onto National Forest lands and nearby private lands. The fire was first reported on 5/3/2018 and burned approximately 2,057 acres.

Source: Virginia Department of Forestry

Hazard Profile

A wildfire is an uncontrollable fire spread through vegetative fuels, exposing and possibly consuming structures. They often begin unnoticed and spread quickly and are usually signaled by dense smoke that fills the area for miles around. Naturally occurring and non-native species of grasses, brush, and trees fuel wildfires. Wildfire behavior is based on three primary factors:

1. Fuel - The type, and amount of fuel, as well as its burning qualities and level of moisture affect wildfire potential. The continuity of fuels, expressed in both horizontal and vertical components is also a factor.

2. Topography – The topography is important because it affects the movement of air, fueling the fire over the ground surface. The slope and shape of terrain can change the rate of speed at which the fire travels. In general terms, the steeper the slope of the land, the faster a fire can spread up the slope.

3. Weather – The weather affects the probability of wildfires and has a significant effect on its behavior. Temperature, humidity and wind affect the severity and duration of wildfires. Areas that have experienced prolonged droughts or are excessively dry are also at risk for wildfires.

People start more than four out of every five wildfires, usually due to debris burns, arson, or carelessness. Lightning strikes are the next leading cause of wildfires.

Hazard Areas

Figure IV-19 shows the wildfire vulnerability map with data developed by the Virginia Department of Forestry (VDOF). In 2002 and 2003, VDOF examined which factors influence the occurrence and advancement of wildfires and how

these factors could be represented in a GIS model. VDOF determined that historical fire incidents, land cover (fuels surrogate), topographic characteristics, population density, and distance to roads were critical variables in a wildfire risk analysis. The resulting high, medium, and low risk category reflect the results of this analysis. The large percentage of high risk areas are in national forests and parks. These areas of concern are managed and monitored by the Virginia Department of Forestry.

71% of the woodland homes are considered to have high potential for a wildfire in the Region.

Vulnerability Analysis

Tables IV-29 and IV-30 illustrate the number of homes in woodland homes and communities, as designated by the Virginia Department of Forestry. In the Region, 71% of the woodland homes are considered to have high potential for a wildfire, while 63% of woodland communities in the planning area are considered at high risk for wildfire.

Approximately 14% of the Region's critical facilities are located in a high risk area for wildfires.

The CSPDC also used VDOF data to create the Wildland Fire Incident map seen in Figure IV-21. This data shows a high number of incidents in Augusta and Rockingham counties. There are a total of 522 incidents in the region.

Critical Facilities at Risk

Table IV-31 shows the percentages of critical facilities in fire risk zones. Approximately 14% of the Region's critical facilities are located in a high risk area. Figure IV-20 shows the locations of critical facilities in relation to fire risk zones.

Photos IV: 6-7: Goshen Pass Wildfire, April 2017 (Source: VDOF)

Table IV-29: Woodland Communities Wildfire Risk

County	Low Potential	Medium Potential	High Potential	Total	% High Risk
Augusta	0	21	19	**40**	**48%**
Bath	0	4	4	**8**	**50%**
Highland	N/A	N/A	N/A	**N/A**	**N/A**
Rockbridge	1	6	9	**16**	**56%**
Rockingham		1	25	**26**	**96%**
Total	**1**	**32**	**57**	**90**	**63%**

Table IV-30: Woodland Homes Wildfire Risk

County	Low Potential	Medium Potential	High Potential	Total	% High Risk
Augusta	0	493	580	**1,073**	**54%**
Bath	0	120	65	**185**	**35%**
Highland	0	20	10	**30**	**33%**
Rockbridge	300	82	458	**840**	**55%**
Rockingham	0	25	1,523	**1,548**	**98%**
Total	**300**	**761**	**2,636**	**3,697**	**71%**

Photos IV: 8-9: Tye River Wildfire, May 2018 (Source: Sandra Berry)

Table IV-31: CSPDC Critical Facilities Wildfire Vulnerability

County	Low Potential	Medium Potential	High Potential	Grand Total	% High Risk
Augusta County	72	325	94	**491**	19%
Bath County	5	38	13	**56**	23%
Buena Vista City	35	4	2	**41**	5%
Harrisonburg City	45	19	8	**72**	11%
Highland County	13	22	3	**38**	8%
Lexington City	48	1	3	**52**	6%
Rockbridge County	11	96	14	**121**	12%
Rockingham County	57	78	18	**153**	12%
Staunton City	28	7	3	**38**	8%
Waynesboro City	70	17	4	**91**	4%
Total	**384**	**606**	**159**	**1,153**	14%

Figure IV-19: Wildfire Vulnerability

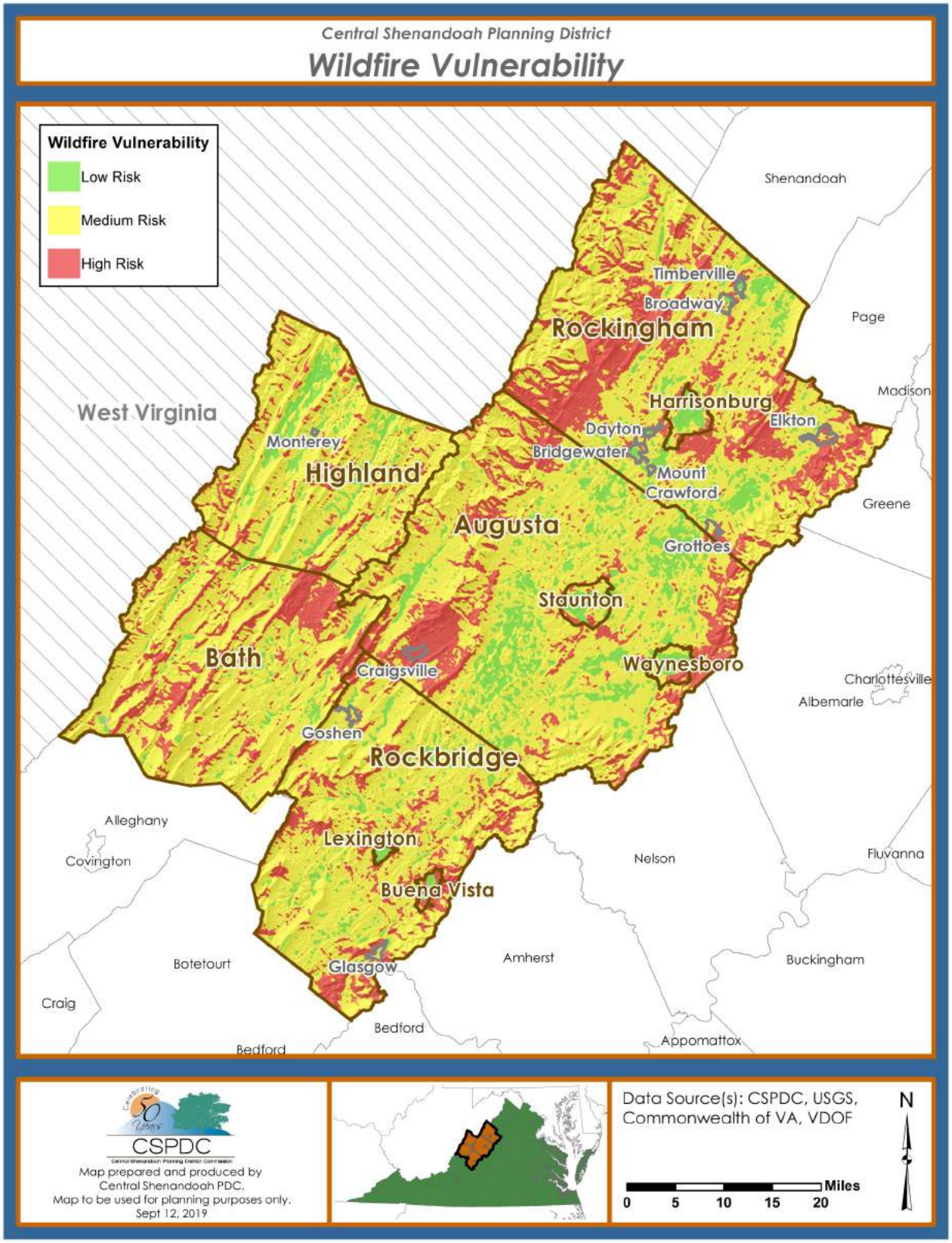


Figure IV-20: Wildfire Vulnerability And Critical Facilities

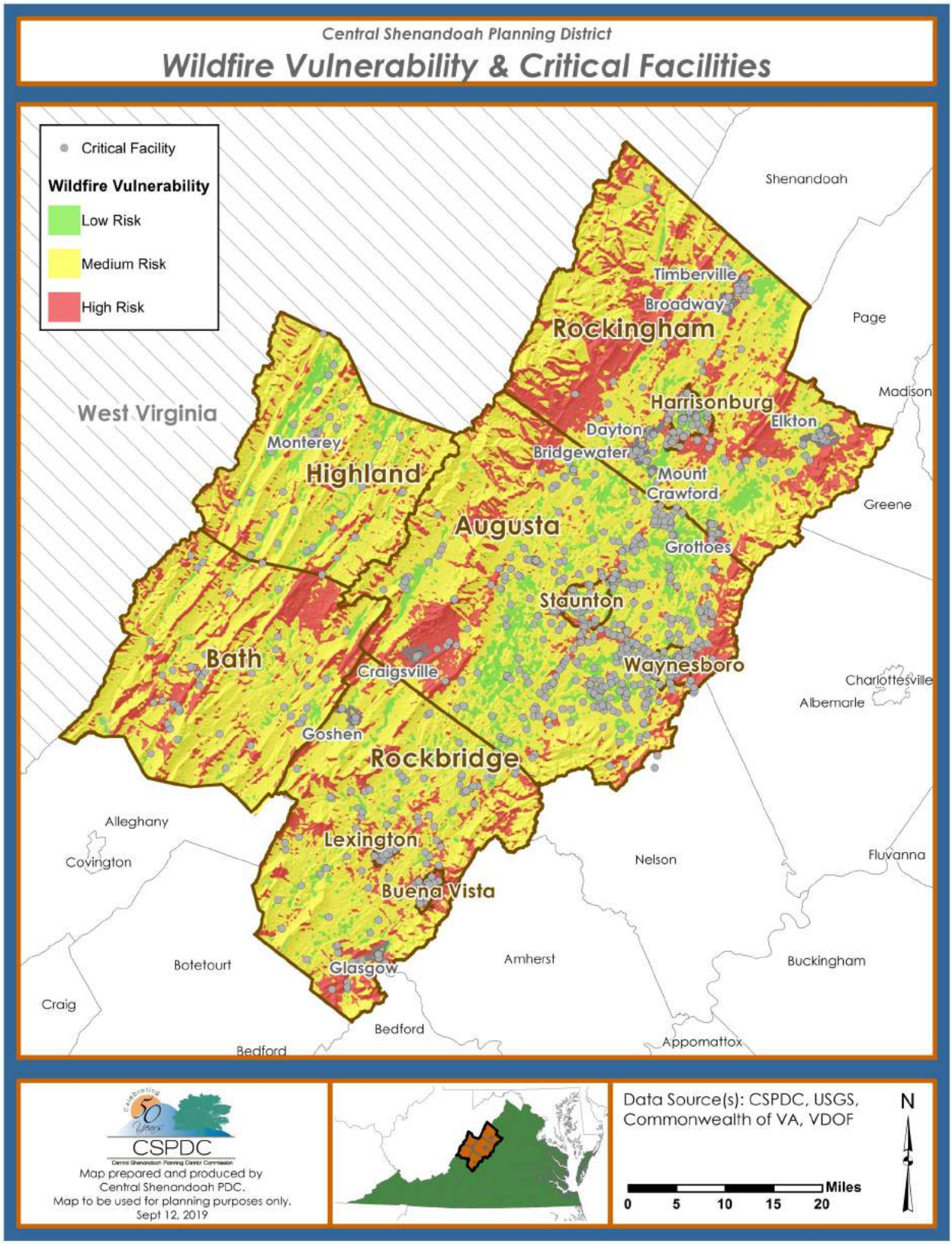
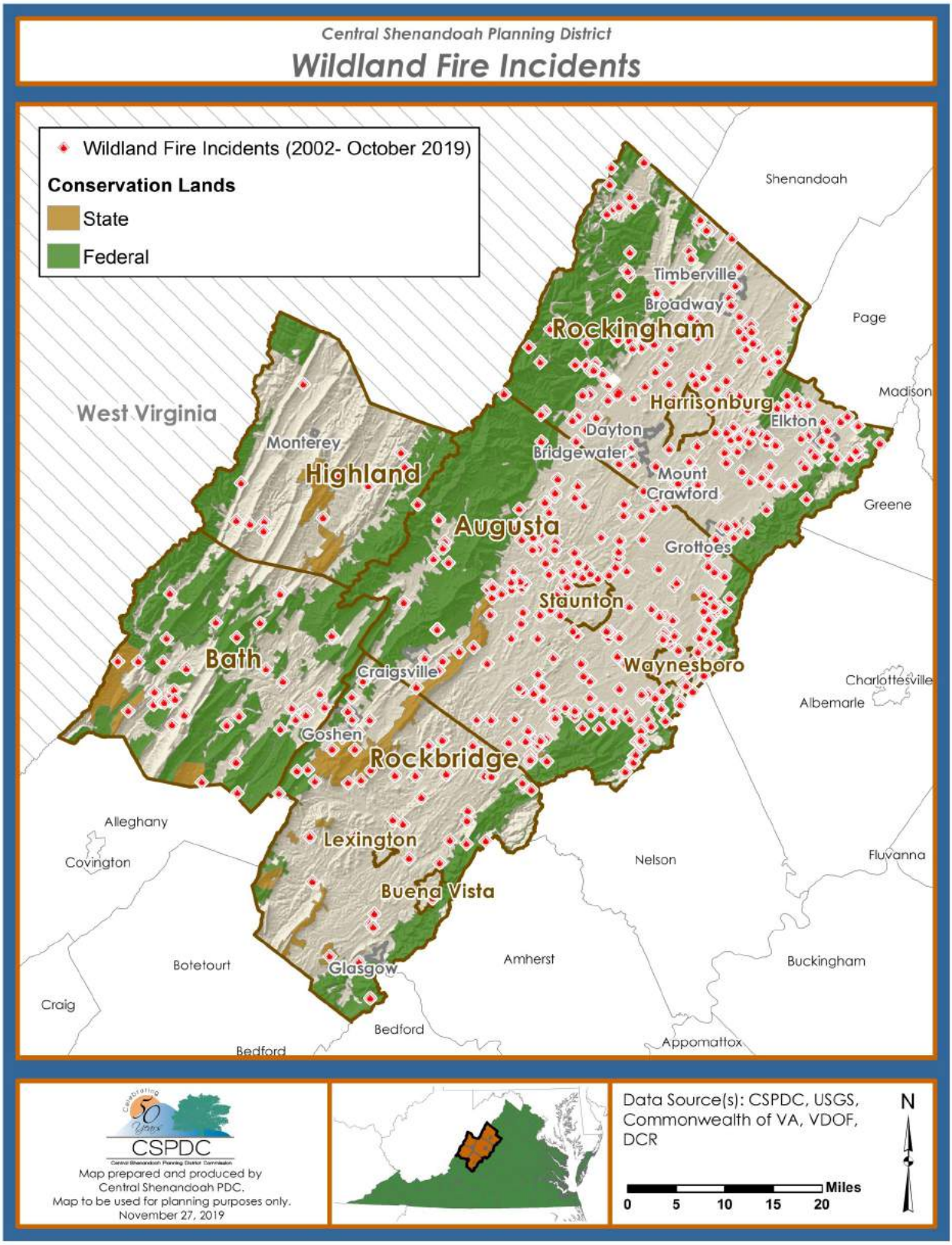


Figure IV-21: Wildland Fire Incidents



Central Shenandoah Valley Community Wildfire Protection Plan

The CSPDC completed the 2020 Central Shenandoah Valley Community Wildfire Protection Plan. This Plan was created to provide a strategy for the community to decrease vulnerability to wildfires that may occur in the Region. The Plan consists of several components including hazardous fuels reduction and fire prevention, vulnerability mitigation, and effective response to incidents that occur. Please see Appendix H to view this Plan.

Photo IV: 10: Rocky Mountain Fire, April 2016 (Source: Bob Adamek)

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10. Landslide (Low Ranking)

Hazard History

The best predictor of future landslides is past landslides in the same place. Figure IV-22 illustrates potential risk areas for the Region. Additionally, areas with steep slopes, poor drainage, and erosion have a greater probability of landslides. Developed hillsides and slopes denuded by wildfires can also lead to landslides. One area in our Region where rock slides are common is Interstate 64 at Afton Mountain, both in Nelson (outside the CSPDC region) and Augusta counties. Many thousands of dollars have been spent removing debris from the highway and installing barriers since the highway was constructed in the late 1960s. The worst landslide in and adjacent to our Region occurred as a result of Hurricane Camille in 1969, where catastrophic debris flows were responsible for the deaths of more than 150 people in the Virginia Blue Ridge. Table IV-32 provides an overview of the history of some of the landslides, mudslides and rockslides in the region. Additional events may have occurred but are not listed.

Table IV-32: History of Landslides

Date	Description and Damages
August 19, 1969	Hurricane Camille was a major storm that made landfall out of the Gulf as a category 5 and weakened to a tropical depression before reaching the state. Flooding and landslides, triggered by saturated soils, resulted in catastrophic damage. Augusta County, Bath County and Rockbridge County were included in a federal major disaster declaration (DR-274).
February 15-February 28, 2003	A severe winter storm brought snowfall, heavy rain, flooding and mudslides. Highland County was included in a federal major disaster declaration (DR-1458).
April 11-April 12, 2011	Heavy rains caused mud and rock slides in Bath County, downing trees and blocking roads. The Cowpasture River crossed Route 42, and flooding, rock slides and mud slides occurred in areas near Burnsville, Williamsville, Bacova, and Bolar. No homes were damaged, but several road washouts occurred. Flooding occurred in northern Augusta County.

Table IV-32: History of Landslides - continued

Date	Description and Damages
April 16, 2011	An EF1 tornado reached wind speeds in excess of 95 mph traveling 4.1 miles in Augusta County. The tornado damaged 37 structures and downed numerous trees and powerlines. Preliminary damage estimates from Augusta County listed storm damage to 12 residences, 3 businesses, 15 outbuildings, 2 mobile structures and 5 barns. Preliminary damage cost is estimated at over 2.5 million dollars (2019 dollars). An EF0 tornado touched down near Vesuvius in Rockbridge County causing minor damage to a barn and a house, and slightly moving another barn off its foundation. The twister left a path about 100 yards wide and 1.3 miles in length. Wind speeds were estimated at 80 mph. Rockbridge also experienced 3.5 inches of rain and reports of quarter size hail. Numerous trees were reported downed in Lexington and countywide in Rockbridge. In Glasgow, the Maury River reached near flood stage at 18 feet. As many as 33 roads were closed due to high waters and fallen trees, the worse being Rt. 631, Furrs Mill Road. A swift water rescue was required to retrieve two women and two small children stranded in a van. 350 Dominion Power customers lost power. In Bath County, downtown Hot Springs flooded. Flooding, mud and rockslides also occurred in other areas of Bath County damaging roads, driveways, homes and the Warm Springs Pools at the Homestead. Highland County experienced power outages, downed trees and flooded roadways. Highland County Supervisors declared the County a disaster area.
July 12, 2018	Augusta County, Highland County, and Rockingham County were included in an agricultural disaster designation (4378) for severe storms, flooding, landslides and mudslides.
June 29-June 30, 2019	Severe storms resulted in flooding, landslides and mudslides. Augusta County, Highland County, Rockingham County, Harrisonburg, Staunton and Waynesboro were included in an agricultural disaster designation (4455).

Hazard Profile

A landslide is a downward movement of a slope and masses of rock, earth or debris materials under the force of gravity. Some move slowly causing gradual damage, while others move rapidly destroying property unexpectedly. They are activated by rainstorms, snowmelts, earthquakes, fires, volcanoes and by human modification to the land such as mining and construction. They are common all over the United States and cause up to 2 billion dollars in damages and from 25 to 50 deaths annually. Common types of landslides include rock slides, slumps, mudslides, debris flows, avalanches, and earth flows. Types of landslides vary depending on the amount of water and type of materials that they carry. Landslides usually affect infrastructure such as roads and bridges,

but they can also affect individual buildings and businesses, especially those located close to dangerous topographic features such as the top or bases of slopes or in valleys.

Landslides occur in every state and U.S. territory and are common throughout the Appalachian Region, particularly where there are steep slopes, clay-rich soils, periodic heavy rains and vegetation loss caused by wildfires. A debris flow event can be expected to occur somewhere in the southern Appalachian Mountains on the order of once every three years.

Several natural and human factors may contribute to or influence landslides. How these factors interrelate is important in understanding the hazard. The three principal natural factors are topography, geology, and precipitation. The principle human activities are cut-and-fill construction for highways, construction of buildings and railroads, and mining operations.

The USGS recognizes four major impacts caused by land subsidence:

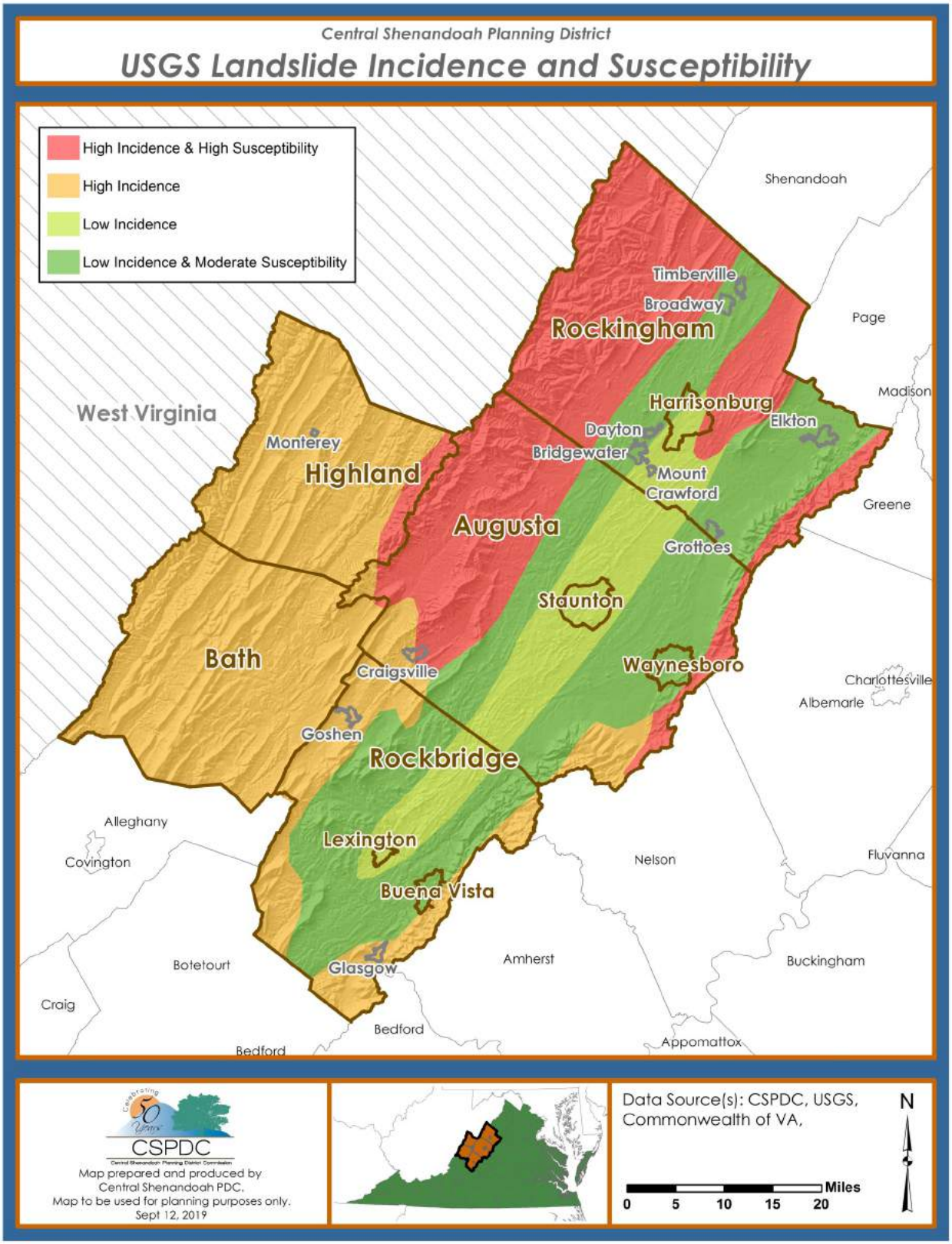
- changes in elevation and slope of streams, canals, and drains;
- damage to bridges, roads, railroads, storm drains, sanitary sewers, canals, and levees;
- damage to private and public buildings;
- and failure of well casings from forces generated by compaction of fine-grained materials in aquifer systems.

Landslides can cause serious damage to highways, buildings, homes, and other structures that support a wide range of economies and activities. Landslides commonly coincide with other natural disasters. Expansion of urban development contributes to greater risk of damage by landslides.

Hazard Areas

According to the landslide susceptibly and incidence map (Figure IV-22) Augusta and Rockingham Counties have the highest susceptibility and incidence risk in the region. The remaining areas are characterized as areas of high incidence. These areas are broadly defined and mapped with a general understanding of landslide hazard risks. A more detailed study would be required to determine the actual vulnerable structures at individual sites within these risk areas.

Figure IV-22: USGS Landslide Susceptibility



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11. Earthquake (Low Ranking)

Hazard History

Since 1853, there have been 9 earthquakes with epicenters within, or within close proximity to the Region.

Since 1853, there have been 9 earthquake epicenters within, or within very close proximity to the Region. Some of these earthquakes were of a low intensity level and may not have been felt by humans or caused property damage. Refer to Table IV-33 and Figure IV-23 for the earthquake description and damages, as well as the epicenter location.

The highest magnitude level with an epicenter in the Region was 4.6 Mb recorded during an 1853 earthquake.

The Region has also been impacted by earthquakes with epicenters in other areas. Table IV-34 and Table IV-35 provide an overview of historic and modern earthquakes felt within the region with epicenters in other locations of Virginia. Historic earthquakes are those that were documented based on observations and historical records. Modern earthquakes are those that have been recorded since a network of seismometers was installed in 1963. Figure IV-24 shows the epicenter locations of all earthquakes in Virginia from 1744 to 2017. Based on review of records, property damage in the region has thus far been minimal.

Table IV-33: Historic and Modern Earthquake Epicenters located within or within close proximity to the Region

Date	Description and Damages
May 2, 1853	A 4.6 magnitude (Mb) earthquake had an epicenter near the Highland County, Virginia/Pendleton County, West Virginia border with a VI intensity. It occurred at 9:20 a.m. and was felt across a multi-state area from Washington D.C., Virginia, West Virginia and Ohio. Reports indicate the earthquake was felt in an area between 61,400 sq. miles and 72,000 sq. miles. No damage was reported.
February 8, 1910	A 3.2 magnitude (MAG) earthquake had an epicenter near New Market, VA, in close proximity to the Rockingham County/Shenandoah County border. It was felt in the Shenandoah Valley over an area of 500 to 1,000 square miles. The main shock was felt at 9:00 a.m., with two aftershocks following at 9:05 a.m. and 9:30 a.m.

Table IV-33: Historic and Modern Earthquake Epicenters located within or within close proximity the Region - continued

Date	Description and Damages
June 10, 1927	A 3.6 magnitude (MAG) earthquake had an epicenter in southeastern Augusta County at 2:16 a.m.. It was felt over a 2,500-2,900 square mile area which included Augusta County, Charlottesville, Richmond, and Campbell County. No damage was reported, but the earthquake did rattle windows and wake people up in Richmond.
November 5, 1980	A 2.8 magnitude (ML) earthquake had an epicenter in Bath County near the Virginia/West Virginia state line at 4:48 p.m. with a depth of 3.8 km.
June 6, 1981	A 0.5 magnitude (Mc) earthquake had an epicenter in southeastern Highland County, near the Augusta County border at 4:06 a.m. with a depth of 14 km.
November 23, 1981	A 2.1 magnitude (MLD) earthquake with a depth of 9.8 km had an epicenter in Augusta County, north of the City of Staunton at 8:15 a.m. Loud noises were reported, with descriptions ranging from a blast or sonic boom to a low rumble or muffled explosion. The earthquake caused houses to shake, with rattling windows and picture frames.
June 16, 1982	A 2.1 magnitude (MLD) earthquake with a depth of 10.9 km had an epicenter in Augusta County, northeast of the City of Waynesboro at 1:41 p.m.
May 29, 1984	A 1.3 magnitude (MLD) earthquake with a depth of 7.4 km had an epicenter in Augusta County, northeast of the City of Waynesboro. It was located near Jarmans Gap and occurred at 6:29 a.m.
December 27, 1997	A 2.2 magnitude (Mc) earthquake had an epicenter in southwestern Bath County, near Healing Springs at 2:45 a.m.

Source: Anne C. Witt, Wendy S. Kelly,, Matthew J. Heller, and David B. Spears, 2017, Virginia Department of Mines, Mineral and Energy, Division of Geology and Mineral Resources, "GIS Fault Mapping of Virginia Seismic Zones"

Table IV-34: Historic Earthquakes Felt Within the Region

Date	Description and Damages
February 21, 1774	An earthquake with an estimated magnitude (Mb) of 4.5 and a probable epicenter southeast of Richmond was felt over an 130,000 sq. km. area of Virginia and North Carolina. Near the epicenter, serious structural damage to homes were reported. The earthquake caused houses to shake across the state, and a loud noise was heard in Richmond. Aftershocks were reported on February 22 and February 23. A portion of the Region is estimated to have been included in the felt area.
March 9, 1828	An earthquake with an estimated magnitude (Mb) of 5.0 and a MMI intensity of V was felt over a 500,000 sq. km. area of Pennsylvania, Maryland, Delaware, Washington, D.C., West Virginia, Ohio, Kentucky, Tennessee and South Carolina. The probable epicenter was southwestern Virginia. A loud rumbling was reported; and dishes, windows and doors shook.
August 27, 1833	An earthquake with an estimated magnitude (Mb) of 5.0 and a maximum intensity of VI had a felt area of 150,000 sq. km. in Virginia, Maryland, and North Carolina. No damage was reported, but a loud rumbling sound was reported, and two coal miners were killed. Documents record that in our region, the earthquake was felt in Lexington.
April 29, 1852	An earthquake with an estimated magnitude (mbLg) of 4.9 and a maximum intensity of VI had a felt area of 490,000 sq. km. in Virginia, Maryland, North Carolina, Ohio, Pennsylvania and Tennessee. The probable epicenter was Wytheville and two separate shocks were reported. In the region, the earthquake caused buildings to violently shake in Staunton.
May 2, 1853	An earthquake with an estimated magnitude (Mb) of 4.6 and a maximum intensity of VI had a felt area of 190,000 sq. km. The probable epicenter was located west of the Central Virginia Seismic Zone, and was felt as far away as Ohio. No damage was reported.
December 22, 1875	An earthquake with an estimated magnitude (MbLG) of 4.5 and a maximum intensity of VII was felt over a 130,000 sq. km area including Virginia, Maryland and North Carolina. The probable epicenter was 50 miles northwest of Richmond. The shock caused property damage in Richmond. Prior to the August 23, 2011 earthquake, this earthquake was the most damaging earthquake to occur with an epicenter in the Central Virginia Seismic Zone. The region was included in the felt area and had estimated intensity levels of III to IV.

Table IV-34: Historic Earthquakes Felt Within the Region—continued

Date	Description and Damages
May 31, 1897	An earthquake with an estimated magnitude (Mw) of 5.5 and a maximum intensity of VII was felt over an 780,000 sq. km. area from Georgia to Pennsylvania, and as far away as Indiana. It is on record as one of Virginia's largest earthquakes. The epicenter was in Giles County, in southwest Virginia. Property damage to homes were reported near the epicenter, and in a wide area around the epicenter in Virginia, West Virginia, Tennessee and North Carolina. The earthquake also disturbed springs and triggered landslides. In addition to the main shock on May 31, 1897, a foreshock and a series of aftershocks were recorded. The foreshock occurred on May 3, 1897 and caused property damage in southwest Virginia and North Carolina with an intensity of VII. The series of aftershocks did not cause any significant damage. They were reported on June 28, September 3 and October 20, 1897. The June 28 aftershock was felt in Lexington.
February 13, 1899	An earthquake with an estimated magnitude (Mb) of 4.7 and a maximum intensity of V was felt over an 80,000 sq. km. area. The epicenter was near Wytheville. As many as four separate shocks were felt, causing buildings to shake, furniture to move and a rumbling noise reported. No property damage was reported. Portions of the region were included in the estimated felt area.
April 9, 1918	An earthquake with an estimated magnitude MI of 4.6 and a maximum intensity of VI was felt over an 180,000 sq. km area including Virginia, West Virginia, Maryland, Pennsylvania, Delaware and New Jersey. As many as three shocks, and several aftershocks were reported. The epicenter was near the Town of Luray and in the Shenandoah Valley, the earthquake resulted in property damage from broken windows and cracked plaster.

Source: Wendy S. Kelly, Anne C. Witt, Matthew J. Heller, and Martin C. Chapman, 2017, Virginia Department of Mines, Mineral and Energy, Division of Geology and Mineral Resources, Publication 185, "Seismic History of Virginia"

Table IV-35: Modern Earthquakes Felt Within the Region

Date	Description and Damages
December 9, 2003	An earthquake with a magnitude (MbLg) of 4.5 and a maximum intensity of VI was felt in Virginia, North Carolina, South Carolina, Tennessee, Kentucky, West Virginia, Ohio, Pennsylvania, New Jersey, Delaware and Maryland. The earthquake had a focal depth of 10 km and the epicenter was 60 km west of Richmond, The earthquake included two 4.5 magnitude shocks that occurred 12 seconds and 300 meters apart. No structural damage was reported. Earlier in the year, the shock had been preceded by a 3.6 magnitude shock with an epicenter a few kilometers away.
August 23, 2011	An earthquake with a magnitude (Mw) of 5.8 and a maximum intensity of VIII was felt over the entire eastern United States and into Canada. The epicenter was located near the Town of Mineral in Louisa County, within the Central Virginia Seismic Zone. It is the most damaging earthquake ever felt in Virginia and had a depth of 8 km. Total damages from the earthquake exceeded $343 million (2019 dollars), and eight counties were declared as a federal disaster area (DR-4042). In Louisa County, over 1,500 damage reports were received. Seven homes were destroyed, and 120 homes received major damage. Louisa County Public Schools experienced more than $68 million (2019 dollars) in damages, with two schools damaged beyond repair and condemned. Students were in school when the earthquake hit. Fortunately, no major injuries or fatalities were reported. The school system had to shut-down for several weeks. An automatic shutdown occurred at North Anna Nuclear Generating Station, located only 11 miles from the epicenter. No critical facilities at the nuclear station were affected, and the station experienced only minor damage. Public infrastructure was damaged, including damage to two small dams, the failure of a water main in the Town of Mineral, and power outages. Disturbance in wells and groundwater levels were reported. Damage was reported as far away as Maryland, and the National Cathedral and the Washington Monument were damaged. In the Central Shenandoah Valley Region, minimal damage occurred which included cracks in the foundations of structures and falling pictures. Following the earthquake, a series of over 500 aftershocks were recorded.

Source: Wendy S. Kelly, Anne C. Witt, Matthew J. Heller, and Martin C. Chapman, 2017, Virginia Department of Mines, Mineral and Energy, Division of Geology and Mineral Resources, Publication 185, "Seismic History of Virginia"

Figure IV-23: Earthquake Epicenters located within, or in close proximity to the Region

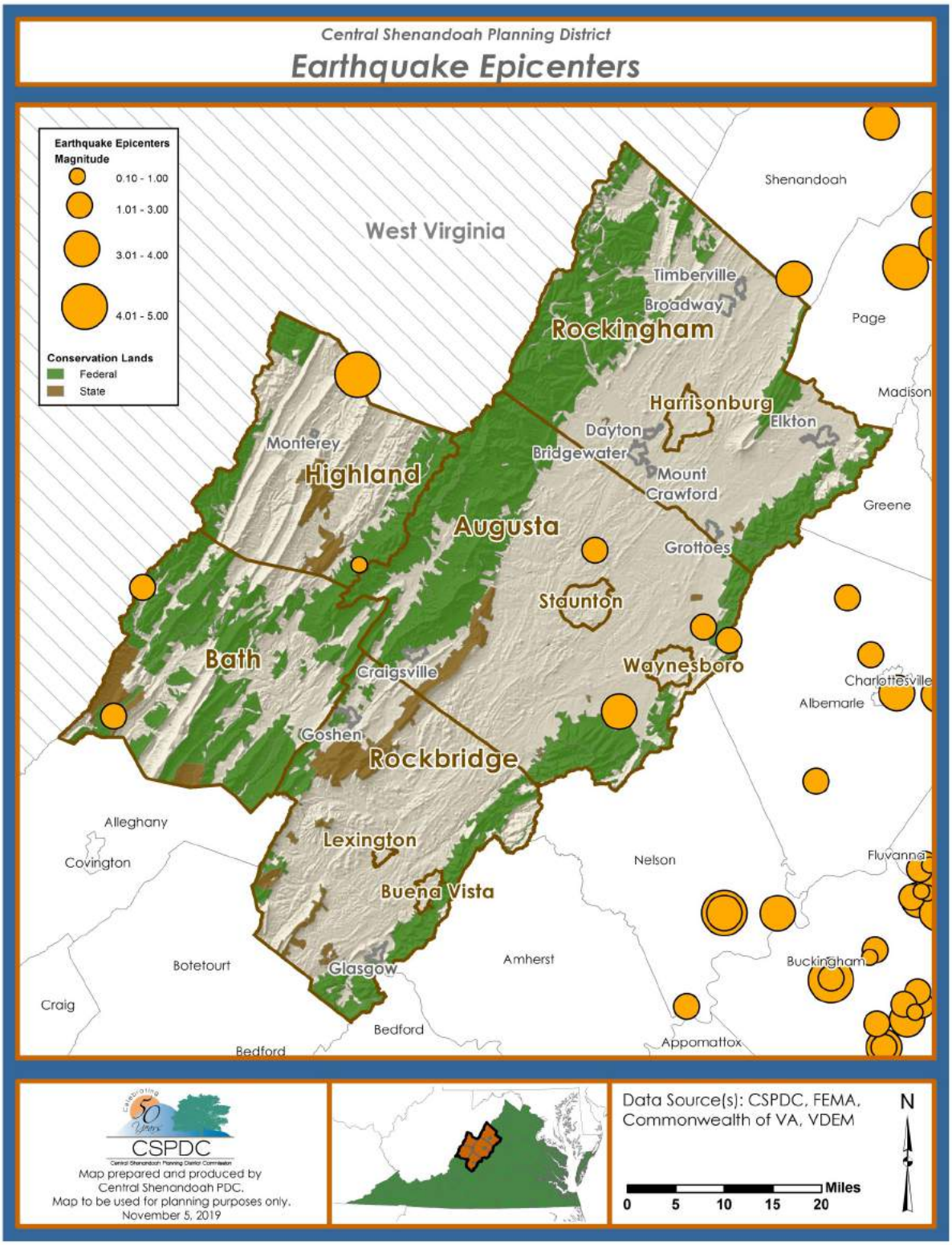
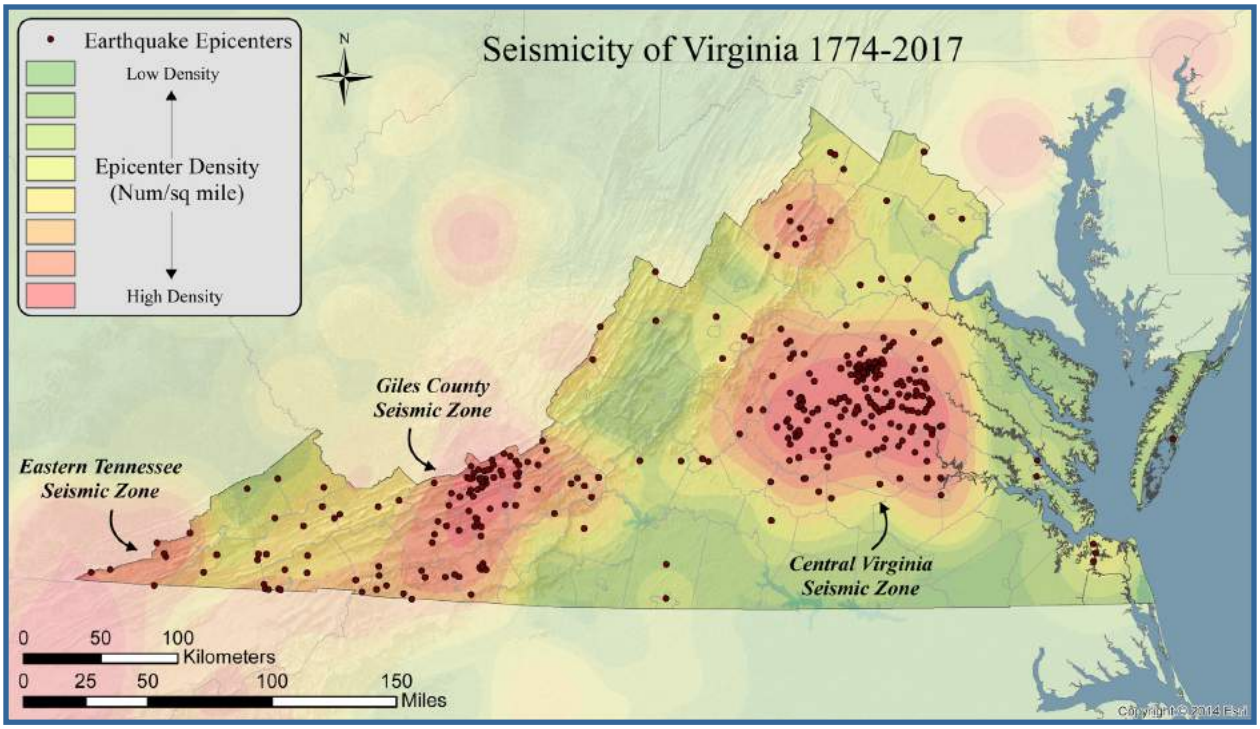


Figure IV-24: Seismicity of Virginia, 1744-2017



Source: Wendy S. Kelly, Anne C. Witt, Matthew J. Heller, and Martin C. Chapman, 2017, Virginia Department of Mines, Mineral and Energy, Division of Geology and Mineral Resources, Publication 185, "Seismic History of Virginia"

Hazard Profile

An earthquake is the result of a sudden release of energy in the Earth's crust.

Earthquakes are caused mostly by rupture of geologic faults, but also by volcanic activity, landslides, mine blasts, changes in groundwater storage, and nuclear tests. An earthquake is the result of a sudden release of energy in the Earth's crust that creates seismic waves. An earthquake's point of initial rupture is called its focus or hypocenter. The point at ground level directly above the hypocenter is the epicenter. The focal depth is the depth from the epicenter to the hypocenter. Once the seismic waves reach the surface, they become surface waves and travel away from the epicenter, causing shaking.

Earthquakes are measured both in magnitude and in intensity level.

Earthquakes are measured both in magnitude and intensity level. Magnitude is a measurement of the relative size of the earthquake compared to other standard earthquakes based on a logarithmic scale. Over time, magnitude has been measured on different scales, with moment magnitude (Mw) being used since 2000. Earthquake intensity is measured based upon the impacts on humans and man-man structures using the Modified Mercalli Intensity (MMI) Scale. It uses a scale of I to XII, with I being rarely felt and XII causing total damage. The intensity of the shaking lessens the further away from the epicenter location. Figure IV-25 depicts earthquake magnitude and the typical correlated intensity.

Earthquake hazards exist in both plate boundaries and intraplate settings. The largest percentage of earthquakes on Earth, 81 percent, occur in the "Ring of Fire" along the Circum-Pacific seismic belt. In this region, earthquakes are caused by the subduction of the ocean crust along the boundaries of the tectonic plats. The other two prominent areas include the Alpide earthquake belt and a belt that follows the Mid-Atlantic Ridge.

Virginia is located in an intraplate setting, within the North American tectonic plate where the tectonic strain is diffused. The state has thousands of geologic faults and three seismic zones– Central Virginia Seismic Zone, the Giles County Seismic Zone and the Eastern Tennessee Seismic Zone. Seismic zones are areas

Figure IV-25: Earthquake magnitude and typical correlated intensity

Magnitude		Intensity (Modified Mercalli)	
1.0 - 3.0		I	Rarely felt by humans
6.0 - 6.9	3.0 - 3.9	II	Felt by only a few people at rest, especially on upper floors of buildings
		III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor vehicles may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
	4.0 - 4.9	IV	Felt indoors by many, outdoors by few during the day. At night some people are awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking striking building. Standing motor vehicles rocked noticeably.
		V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
	5.0 - 5.9	VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
		VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
		VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
	7.0 and higher	IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
		X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
		XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
		XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Source: Wendy S. Kelly, Anne C. Witt, Matthew J. Heller, and Martin C. Chapman, 2017, Virginia Department of Mines, Mineral and Energy, Division of Geology and Mineral Resources, Publication 185, "Seismic History of Virginia"

with elevated seismic activity. The nearest seismic zone to the Region is the Central Virginia Seismic Zone, which extends into Albemarle County, adjacent to the Region. The largest earthquake to occur in Virginia's history is the August 23, 2011 earthquake which had an epicenter in Mineral, located within the Central Virginia Seismic Zone.

Although the Region is not located within a seismic zone, based upon historical records, nine earthquakes with epicenters in the Region have occurred since 1853. The majority of the earthquakes have had a magnitude below 3.0, which has a corresponding intensity level rarely felt by humans. The earthquake with the largest magnitude size was a May 2, 1853 earthquake near the Highland County/Pendleton County line. It had a magnitude of 4.6 Mb with an intensity level of VI on the Modified Mercalli Intensity Scale.

Hazard Areas

Following the August 23, 2011 earthquake in Louisa County, the Virginia Department of Mines, Minerals and Energy Division of Geology and Mineral Resources received Hazard Mitigation Grant funding from FEMA and the Virginia Department of Emergency Management (HGMP-4042-000-014). The purpose of the funding was to reduce the impact of future earthquakes in Virginia through:

- Creating a report with a map of prior documented events about past damaging earthquakes in the state.
- Compiling identified faults from existing geologic maps into an ArcGIS geodatabase.
- Conducting geological field studies to verify and classify identified faults.
- Studying the epicentral area of the 2011 earthquake using LiDaR data to identify faults.
- Identifying communities and infrastructure at greatest risk of future damage by conducting GIS analysis.
- Presenting the results in the affected communities to planning and emergency management agencies.

The analysis by the Division of Geology and Mineral Resources resulted in key findings including:

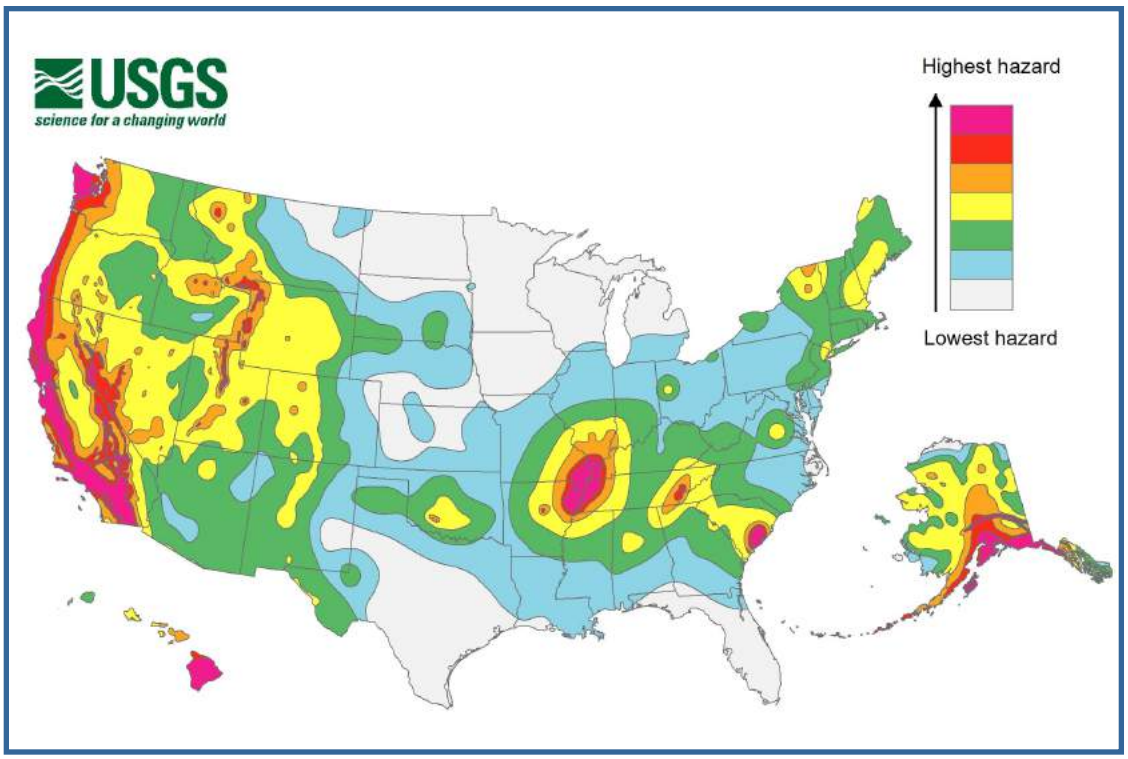
- "Earthquakes are common and widespread in Virginia. Since 1774, 476 earthquakes have been reported. 56 of 95 Virginia counties contain an earthquake epicenter. Earthquakes have occurred in 21 or 27 of Virginia's planning districts."
- "Earthquakes are more common in some parts of Virginia. Since 1774, approximately 90% of seismic events have been spatially associated with the Central Virginia Seismic Zone, the East Tennessee Seismic Zone or the Giles County Seismic Zone…"
- "Damaging earthquakes are rare in Virginia…"

- "Many thousands of faults exist in Virginia…"
- "Most of the faults in Virginia are geologically very old and are not active…"
- "Mapped fault locations at the surface of the Earth do not correlate well with historic epicenter locations in Virginia...in light of this information it is not appropriate to use the locations of mapped faults to assign seismic hazard or risk."

The report discussed that the three seismic zones in the state– the Central Virginia Seismic Zone, the Giles County Seismic Zone and the Eastern Tennessee Seismic Zone– are recognized as having a higher frequency of earthquakes based upon historical records. Over 90% of seismic events have been located in these zones. It was noted though that earthquakes do occur outside of those boundaries, and as a result the zones should not be used to assess seismic hazard. A recommended resource to assess seismic risk and hazard is Figure IV-26, a Seismic Hazard Map produced by the U.S. Geologic Survey. Based on the map, the Region is located in the second lowest hazard ranking.

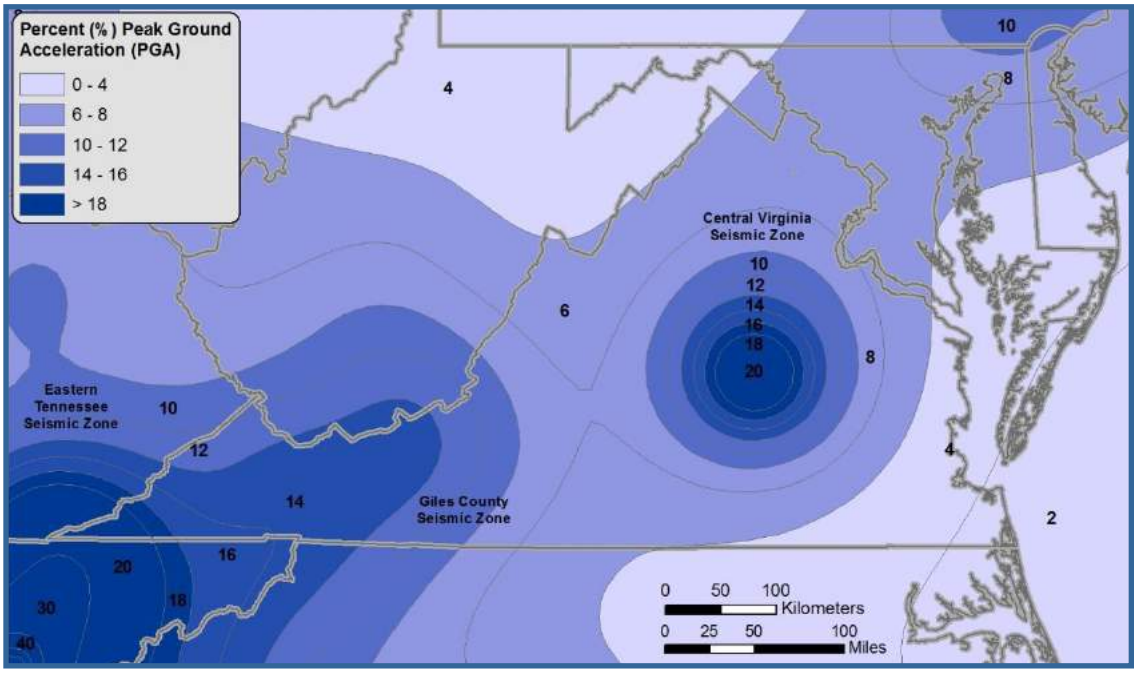
The Division of Geology and Mineral Resources also conducted a GIS analysis to identify those communities and infrastructure that were at greatest risk for future earthquakes based upon the peak ground acceleration for a two percent probability of exceedance in a 50 year period. The results of the analysis are shown in Figure IV-27. Areas of the Region are identified as having a 6% or a 4% probability. Those percentages are designated as being in either the very light damage category (6-8%) or the no damage category (0-4%). The very light damage category generally results in little to no reported damage other than broken dishes, broken windows, stopping of pendulum clocks, or overturning of unstable objects.

Figure IV-26: 2014 USGS National Seismic Hazard Map



Source: U.S. Geological Survey

Figure IV-27: Statewide map showing U.S. Geological Survey Percent Peak Ground Acceleration for a 2% probability of exceedance in a 50 year period.



Source: Anne C. Witt, Wendy S. Kelly,, Matthew J. Heller, and David B. Spears, 2017, Virginia Department of Mines, Mineral and Energy, Division of Geology and Mineral Resources, "GIS Fault Mapping of Virginia Seismic Zones"

In addition to reviewing the findings of the report completed by the Virginia Department of Mines, Mineral and Energy, Division of Geology and Mineral Resources, FEMA's HAZUS-MH software was also utilized to generate a Earthquake Global Assessment Report for the CSPDC region. For this report, the 100 year Probabilistic Earthquake, Magnitude 5 scenario was performed. It is noted in the report that HAZUS utilizes 2010 Census Data and result totals only reflect data for those census tracts/blocks included in the user's study region. The HAZUS report can be viewed in Appendix G and summarizes building inventory, and the estimated damage, social impact and economic losses for the Region as a whole.

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12. Hazardous Materials (Transportation and Industrial) (Medium Ranking)

Hazard History

There have not been any catastrophic Hazardous Materials Incidents in recent history. There have been minor to major incidents at manufacturing/industrial sites or during transportation of hazardous materials. A typical incident would involve an accident on either interstates I-64 or I-81, where a tractor trailer has been damaged causing the release of hazardous materials on the roadway or possibly to nearby soil or a body of water. These incidents while potentially harmful, stressful, and inconvenient are handled in a routine manner by first responders, who are trained and have the proper equipment. The Region has a vulnerability to Hazardous Materials Incidents based on its agriculture, industry and manufacturing, and transportation network. Because of this vulnerability, the Plan's Steering Committee has chosen to include Hazardous Materials in this update of the Hazard Mitigation Plan. The Steering Committee has given this hazard a medium ranking.

Hazard Profile

In 1986, Congress passed the Emergency Planning and Community Right-to-Know Act (EPCRA). As part of the requirements of this Act, local jurisdictions must form Local Emergency Planning Committees (LEPCs) that must meet regularly and maintain a current Emergency Response Plan. EPCRA also requires that facilities that transport hazardous materials or use them at their site, must comply with certain reporting requirements. Through the LEPCs, local Emergency Management, Fire, Medical, and Law Enforcement officials are aware of the hazardous materials in their jurisdiction and plan the response to incidents that potentially could occur. Response is the primary focus in dealing with Hazardous Materials. For local jurisdictions, mitigation for Hazardous Materials Incidents involves planning, training, and ensuring first responders have the proper equipment available prior to an incident. For facilities that use,

store, and/or transport hazardous materials, they can similarly mitigate the occurrence of an incident with the same advance steps of planning, training, and proper equipment to ensure these hazardous materials are handled properly.

Hazard Areas And Vulnerability

Throughout the Region, agricultural communities and manufacturing/industrial centers can be found. A broad transportation network that includes interstate highways, rail and air also covers the Region. Because of these factors, it is possible that a Hazardous Materials Incident could impact any of the 21 localities in the Region.

13. Terrorism (Low Ranking)

Hazard History

To date, there are no recorded terrorism incidents in recent history to include in this Plan. Due to several characteristics of the Region, the Steering Committee for the Hazard Mitigation Plan felt terrorism should be included but with a low ranking.

Hazard Profile

Currently there is no universal definition for terrorism. The Code of Federal Regulations defines terrorism as "the unlawful use of force and violence against persons or property to intimidate or coerce a government, civilian population, or any segment thereof, in furtherance of political or social objectives." (28 C.F.R. Section 0.85) Characteristics that make this Region vulnerable include:

- Proximity to several large urban centers, including Washington, D.C., Richmond, Virginia, and the Hampton-Roads area of Virginia;
- The regional transportation network that includes two major interstates (I-81 and I-64), the Shenandoah Valley Regional Airport and several smaller airports, and rail lines that carry both passenger and freight trainsl
- Manufacturing and industrial facilities that use a variety of hazardous chemicals;
- and several colleges, universities, and other residential institutions that house large numbers of people.

These characteristics possessed by the Region are similar to many communities in Virginia and across the United States. Like others, the communities in this Region have to evaluate the level of "acceptable risk" they have for terrorist events.

Hazard Areas

Unlike other hazards, specific vulnerable areas in the Region are not included in the scope of this Plan because of the security risk of terrorism.

Vulnerability Analysis

A regionwide vulnerability analysis has not been conducted. Due to security concerns, the local jurisdictions in the Region were not asked to share any vulnerability analyses or risk assessments of particular structures or locations within their communities. In terms of hazard mitigation for terrorism, protective measures involving buildings can be successful in reducing vulnerability and decreasing threat.

14. Power Outages (Medium Ranking)

A power outage is an unplanned loss of the electric power network's supply to an end user. Faults at power stations, damage to any part of the electric distribution system, short circuits, cascading failures, or problems with fuses or circuit breaker operations can cause a power outage. These damages to the electric power network may be caused by natural hazards, such as wind, fire, and severe weather; human-causes; the results of mechanical failure; or a variety of other factors.

Hazard History

There have been no catastrophic power outages in recent history. Two events where extended power outages occurred were the derecho in June 2012 and the ice storm in November 2018. Because a power outage can be its own disaster independent of another natural or man-made hazard, the Hazard Mitigation Plan's Steering Committee has chosen to include this hazard and has given it a medium ranking.

Hazard Profile

Power outages can be extremely disruptive and affect the whole community and the economy. Community impacts on communication, water and other utilities, vital services, transportation, and businesses are caused by power outages. Individuals can also be impacted by significant issues such as the inability to use power-dependent medical devices, food spoilage, water contamination, and sanitation issues.

For communities it is important to mitigate the effects of power outages through planning and providing back-up resources that can keep essential personal needs met and community services running. Communities can create Emergency Assurance Plans (EAPs). During the development of an EAP, a community will examine its local and regional energy infrastructure, review supply contracts, establish relationships with energy providers, identify back-up power sources, and ensure adequate emergency fuel supplies. Pre-established plans are not the only mitigation tool for communities. Installing equipment at critical locations to supply back-up power during an outage is a key strategic step in mitigating this hazard. Large-scale generators, generator quick connects, and Uninterruptible Power Supply/Sources (UPS) are valuable for keeping power running and protecting hardware such as computers, telecommunicators, and data centers.

Hazard Areas And Vulnerability

The Region receives its electricity from five service providers: BARC Electric Cooperative, Dominion Energy Virginia, Harrisonburg Electric Commission, Shenandoah Valley Electric Cooperative, and the Town of Elkton which supplies the electricity to its residents. As is common across the United States, the 21 jurisdictions in the Region are dependent on electricity for all manner of services. Each jurisdiction has the possibility of experiencing a power outage.

V. MITIGATION GOALS, STRATEGIES AND PROJECTS

We cannot always prevent the natural or manmade hazards that make us vulnerable, but through proactive planning and mitigation activities we can reduce their impact. The following section describes the four types of mitigation actions (local plans and regulations, structure and infrastructure projects, natural systems protection, and education and awareness programs) that are the focus of the Central Shenandoah Hazard Mitigation Plan's regional mitigation goals. These regional goals are included in this section as well. Following the mitigation goals, the local mitigation strategies are included. Each of the 21 jurisdictions in the Central Shenandoah Planning District has created a set of mitigation strategies for their local community.

1. Mitigation Actions

The four categories of mitigation actions are:

1. **Local Plans and Regulations:** These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built. Examples include: comprehensive plans, land use ordinances, building codes and enforcement, the National Flood Insurance Program's Community Rating System, and stormwater management regulations.

2. **Structure and Infrastructure Projects:** These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards. Examples include: Acquisitions, elevations, and mitigation reconstructions of structures in flood prone areas, utility undergrounding, structural retrofits, floodwalls and retaining walls, detention and retention structures, culverts, and safe rooms.

3. **Natural Systems Protection:** These are actions that minimize damage and losses and also preserve or restore the functions of natural systems. Examples include: sediment and erosion control, stream corridor restoration, forest management, conservation easements, and wetland restoration and preservation.

4. **Education and Awareness Programs:** These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These actions may also include participation in national programs, such as StormReady or Firewise Communities. Although this type of mitigation reduces risk less directly than structural projects or regulation, it is an important foundation. Examples include: websites with maps and information, media spots, real estate disclosure, presentations to school groups or neighborhood organizations, mailings to residents in hazard-prone areas.

Prioritization Methodology:

Regional goals and strategies have always been included in the CSHMP. For the 2020 HMP, the goals and strategies from the previous HMP were reviewed and discussed by the Steering Committee and relevant ones were revised to reflect the current situation. Additional goals and strategies were also added to address present gaps and vulnerabilities. While all mitigation actions move a community towards resilience, prioritization of goals and strategies in the Plan are based on those that will create the largest beneficial impacts. Mitigation Education and Awareness Program goals are the first priority because they can be conducted at a regional scale, require minimal resources, can be accomplished through existing partnerships, and encourage people to make safer initial choices that lessen the need for mitigation later. The second priority of goals include mitigation activities that impact a whole community. These goals fall into the Local Plans and Regulations, Natural Systems Protection, and Infrastructure Projects mitigation categories. The goals in the third category of priority are those that make a smaller scale impact at the neighborhood or even individual property level. These goals fall under the mitigation category of Structure and Infrastructure Projects.

2. Regional Mitigation Goals and Strategies

Goal 1: Improve local government operations, planning, zoning, land use regulations, and code enforcement to reduce the impact of natural and man-made hazards and disasters.

Strategies

1.1 For flood hazards, strengthen current floodplain, zoning and site development ordinances by adopting higher standards that provide additional protection and limit or restrict further development in the floodplain, i.e. additional freeboard, flood protection setbacks, limitation on fill, minimization of hydrostatic pressure, protection for mechanical and utility systems, etc. For drought hazards, utilize growth management tools like zoning and land use regulations to encourage low-impact development and forest preservation. For land subsidence hazards, strengthen enforcement of land use, zoning regulations and building ordinances that regulate construction in areas susceptible to landslides and sinkholes i.e. steep slopes, intermittent stream channels, and karst topography.

1.2 Encourage water supply planning and ground water protection projects. Seek and research alternative water supplies for communities. Improve forecasting and monitoring of drought conditions.

1.3 Ensure that floodplain ordinances and building codes are clearly understood by staff, property owners, developers, bankers and insurance companies.

1.4 Implement zoning tools that steer development away from hazardous areas or natural areas deserving preservation. Include Department of Forestry personnel in subdivision review for new development in woodland-urban interface areas.

1.5 Provide for tax incentives, donated easements, and other approaches that can assist in preserving land in the floodplain and other environmentally sensitive areas for agricultural, environmental, recreational or educational uses.

1.6 Rezone to open space or acquire undeveloped portions of floodplain to prohibit future residential building.

1.7 Limit government expenditures for public infrastructure such as roads and water and sewer service in hazard-prone areas.

1.8 Provide necessary staff and staff training to enforce floodplain regulations and building codes.

1.9 Provide training and appropriate equipment/tools for local fire fighters to respond to woodland fires.

1.10 Sponsor workshops for Building Officials that focus on floodplain ordinances and FEMA and NFIP regulations.

1.11 Develop a Continuity of Operations Plan for each locality.

Goal 2: Increase awareness of the National Flood Insurance Program (NFIP) and the Community Rating System (CRS) in local communities in the Region.

Strategies

2.1 Introduce local jurisdictions to the Community Rating System (CRS) and assist them in applying for CRS certification for their communities.

2.2 Encourage communities to remain active and compliant with the NFIP program.

2.3 Encourage citizens to purchase flood insurance. Partner with insurance companies, lenders, and real-estate agents to market the NFIP program.

2.4 Conduct NFIP training workshops for insurance providers.

Goal 3: Continue to improve stormwater management for the infrastructure throughout the Region.

Strategies

3.1 Consider conducting a Regional Storm Water Management Study which would guide the localities in developing the most cost-effective storm water management system, not only within the political boundaries of each locality, but within the locality's watershed.

3.2 Seek funding to prepare site-specific hydrologic and hydraulic studies that look at areas that have chronic and repetitive flooding problems.

3.3 Consider utilizing special utility assessment districts where property owners who directly benefit from a specific public improvement are charged a fee that is proportional to the benefits received.

3.4 Support projects that call for improved ditching, replacement of inadequate and undersized culverts, enlargements of bridge openings, and drainage piping needed to minimize flooding.

3.5 Develop regular maintenance programs and standard operation procedures and budget accordingly.

3.6 Encourage routine maintenance of stormwater management conveyances and culverts to allow more water to be carried with special emphasis placed on culverts where there are repeated problems.

3.7 Notify property owners living along stormwater conveyances to enhance riparian buffers and to be aware of large debris such as deadfall and trees.

Goal 4: Conduct planning and studies for the implementation of stormwater and flood mitigation projects at the watershed level when applicable.

Strategies

4.1 Develop a regional, broad-based watershed plan among localities within a watershed in order to achieve effective and long-term flood protection and a healthy riverine environment.

4.2 Develop a watershed partnership, i.e. watershed roundtable to coordinate planning and program activities among natural resource agencies and stakeholders.

4.3 Conduct a site analysis mapping study to determine and understand the karst topography in our region.

Goal 5: Conduct proactive planning focused on developing mitigation strategies and projects that focus on wildfire mitigation at the landscape scale in wildland areas across communities or at a regional level; to address vulnerabilities of the Wildland Urban Interface in the Region.

Strategies

5.1 Advocate the return of mitigation strategies back in the Wildland Urban Interface (WUI) International Code.

5.2 Encourage Building Codes and Zoning Regulations that support wildfire mitigation in the WUI and other woodland areas.

5.3 Implement public education programs that teach woodland homeowners their responsibilities for choosing to live in areas potentially vulnerable to wildfires.

5.4 Promote inter-agency coordination for wildfire response in the areas of daily communication, training, and especially pre-planning. Include this information in the Central Shenandoah Wildfire Protection Plan as well.

Goal 6: Reduce the impact of natural and man-made hazards and disasters on private residential structures and properties.

Strategies

6.1 Develop a program to elevate, relocate, floodproof, acquire flood-prone houses, or offer substantial reconstruction in order to provide protection to private residential structures and reduce future damages.

6.2 Continue residential buyout and elevation projects of identified structures most at risk of future flooding with priority given to houses that are repetitively flooded.

6.3 For properties where elevation, relocation or acquisition is not feasible, introduce retrofitting measures to protect existing structures from flood damage. Retrofitting is relatively inexpensive and can include dry floodproofing, wet floodproofing, installing sewer backflow valves, berms, and sump pumps.

6.4 Design and landscape structures with wildfire safety in mind by utilizing fire-resistant materials when building especially in the urban-wilderness interface areas. Create safety and defensible space around structures. Provide adequate water resources/dry hydrants nearby woodland communities. Improve access for fire trucks and equipment. Increase knowledge of controlled burns and use of fire-retardant vegetations.

6.5 Offer financial incentives such as tax abatements, conservation easements, and low-interest loans to encourage property owners to elevate, relocate or floodproof buildings.

6.6 Educate and provide guidance and technical assistance to citizens about measures they can take on their own to protect their properties.

6.7 For properties located in known karst and landslide areas, use corrective measures recommended by a professional site analysis (geotechnical or structural engineer) to protect homes.

6.8 Encourage developers to integrate mitigation techniques into new construction and renovation.

Goal 7: Assist with emergency planning, preparedness education, and hazard mitigation to individuals with access and functional needs and service providers. Access and functional needs include but are not limited to physical, sensory, cognitive, or emotional disabilities; medical issues; and communication barriers.

Strategies

7.1 Educate persons with access and functional needs on disaster preparedness and mitigation methods at community events and through public awareness campaigns.

7.2 Provide disaster preparedness and mitigation materials in alternate formats such as large print, digitally, and languages other than English to make materials accessible for a wider audience in the community. Also provide sign language interpreters at community events, workshops, and other educational programs.

7.3 Work with the first responder community to educate them about the access and functional needs that may impact people during a disaster.

7.4 Encourage persons with access and functional needs to contact their local emergency management office so their needs can be noted in the 911 system.

7.5 Offer emergency sheltering for all persons that can provide accommodations that consider access and functional needs including the use of medical equipment requiring electrical power, etc.

7.6 Provide training in emergency operations planning and preparedness to organizations that serve persons with access and functional needs to reduce down-time in service provision, to protect lives of staff and clients, and to reduce damage to facilities.

7.7 Work with emergency managers to make sure that weather alerts and warnings are in accessible formats for all citizens to receive essential information during a disaster.

7.8 Ensure that accessible transport vehicles for evacuations are available for persons with access and functional needs.

7.9 Educate pet owners and farmers so they will include their pets and livestock in their family's preparedness planning.

7.10 Work with local animal welfare organizations to provide emergency sheltering for pets and livestock.

Goal 8: Reduce the impact of natural and man-made hazards and disasters on commercial and industrial structures, properties, and businesses.

Strategies

8.1 Identify and seek funding to provide engineering and design services that would determine the most cost-effective mitigation option for each business.

8.2 Seek funding to floodproof and retrofit commercial buildings where acquisition and elevation are not feasible.

8.3 Sponsor workshops that educate local business and industry about mitigation measures they can install to protect their structures and inventory during a disaster.

8.4 Develop a program to assist local business and industry in developing emergency and business continuity plans.

Goal 9: Improve systems that are used for daily monitoring and that alert local emergency management officials of impending severe weather, emergencies, and disasters.

Strategies

9.1 Identify areas with recurring flood problems and request additional IFLOW stream/rain gauges to ensure that these areas are adequately covered and monitored.

9.2 Seek funding to purchase, install, and maintain public emergency notification systems, Integrated Flood Observing and Warning System (*IFLOWS*) gauges, and other state-of-the-art disaster response and recovery equipment.

Goal 10: Improve community warning systems in the region.

Strategies

10.1 Develop Emergency Action Plans for specific sites such as mobile home parks, apartment complexes, assisted living facilities, industrial facilities, and essential public facilities within disaster-prone areas and develop specific warning or notification plans for each identified site. These plans should include the designation of a point of contact or resident coordinator, with alternates, to receive warnings, the dispatch of police, sheriff, fire rescue units to these sites to issue warnings and pre-designation of routes. These specific warnings will supplement the general television or radio warnings, which most people receive.

10.2 Encourage businesses and public facilities located in high hazard areas to purchase NOAA Weather Radios. By receiving early notification of potential inclement weather, businesses and public facilities can benefit from additional time to prepare for natural disasters. Local governments may be eligible for grants to purchase equipment to be distributed in public facilities, businesses, and industries throughout their jurisdictions.

10.3 Utilize emergency preparedness and evacuation plans for people living in high-hazard areas, especially people with access and functional needs.

10.4 Work with the National Weather Service to expand transmission of Weather Radios or other notification systems.

Goal 11: Reduce the impact of natural and man-made hazards on public utilities, critical infrastructure, and public properties/lands.

Strategies

11.1 Evaluate and provide retrofit measures to prevent disruption of services. Measures can include elevating electrical controls and equipment and installing watertight doors where practicable at water and wastewater treatment plants.

11.2 Bury underground lines deeper and further away from waterways with stronger encasements in floodprone areas with erodible soils.

11.3 Increase the number of wind-secured critical facilities including schools, daycares, hospitals, and shelters.

11.4 Increase number of functional backup generators and generator quick connects at critical facilities.

11.5 Urge local utilities to implement a routine schedule for trimming trees/ limbs around power lines to prevent power outages during wind events and ice storms.

11.6 Limit the construction of new infrastructure in high hazard areas whenever feasible.

11.7 Conduct vulnerability assessments and develop security plans on public utility systems in accordance with the Bioterrorism Act of 2002.

Goal 12: Improve dam safety throughout the Region.

Strategies

12.1 Examine the risks posed by dams in watersheds that drain in the Region and consider adopting ordinances to restrict development around these dams because of the potential flooding danger in areas below and behind the dams.

12.2 Encourage maintenance and improvements to the dams in the Region. Require regular inspection and maintenance schedules.

Goal 13: Implement stream and natural systems protection actions that not only minimize damage and losses but also preserve and restore these systems.

Strategies

13.1 When implementing stream remediation projects consideration should be given when designing these structures and consider stream characteristics that influence the selection of these measures such as channel width, bank height, bend radii, storm event, channel velocities and flood depth, and floodplain configuration.

13.2 Obtain maintenance and access easements from property owners for annual maintenance work.

13.3 Coordinate with and support the U.S. Department of Agriculture's Emergency Watershed Protection Program that is activated during a Presidential Declaration or State Conservation Disaster.

Goal 14: Implement a disaster preparedness and mitigation education program.

Strategies

14.1 Develop comprehensive public information and education programs on disasters, including preparedness, recovery, mitigation and prevention. Other educational topics would also include transportation, the life-safety impact of disasters, and general maintenance of generators. This can be accomplished through presentations, workshops and marketing materials for citizens, business, schools, local staff and elected officials in the Region. Much of this has been and can be accomplished through Shenandoah Valley Project Impact.

14.2 Develop a public education program to educate citizens about water conservation, to use of water-conserving appliances, and irrigation practices in agricultural areas. Written materials could be developed to teach developers and homeowners about native and/or drought-tolerant grasses, shrubs, and trees to be planted around residential structures.

14.3 Increase public education and awareness regarding the dangers of winter storms including driving/traveling during a winter storm event. (Automobile accidents are the leading cause of death during a winter storm event.). Also, increase public awareness to health risks associated with winter storms including exposure, hypothermia, frostbite, overexertion, and accidents from falling/slipping.

14.4 Encourage communities to become involved with the Department of Forestry's Firewise program. Its goal is to encourage and acknowledge action that minimizes home loss to wildfire by preparing for a fire before it occurs.

14.5 Encourage communities to become involved in the National Weather Service program "Storm Ready". This program assists communities with local safety, planning, education, and communication programs needed to save lives and property before and during weather- related disasters.

14.6 Provide Community Emergency Response Team (CERT) training to citizens and maintain a CERT organization. Having an active CERT program will not only educate citizens about preparedness and mitigation measures, it will also provide a pool of trained volunteers that can assist during an emergency or disaster.

14.7 Develop a media campaign to educate the general public throughout the year about disasters when they may be likely to occur. For example a Spring campaign on tornado safety, winter storm preparedness in the Fall, and hurricane safety prior to the start of Hurricane Season. This holistic campaign would be designed to reach a multi-generational audience and would include mitigation and preparedness information.

14.8 Increase the number and use of NOAA weather radios or battery-powered radios or TVs. Improve the effectiveness of NOAA weather radios in the valley.

14.9 Utilize the services of amateur radio operators in the region.

14.10 Sponsor Hazard Mitigation Workshops designed to give information to contractors, property owners, and business owners on mitigation strategies such as acquisition, relocation, elevation, and floodproofing.

14.11 Develop Hazard Awareness programs with the local schools, youth programs, and libraries to disseminate information on natural hazards and mitigation actions. Utilize student environmental clubs to volunteer for projects.

14.12 Notify renters of homes, mobile homes, apartments that they are in an area that is subject to flooding and should consider purchasing flood insurance for their contents. Notification could be done via lease agreements.

14.13 Establish and maintain Hazard Resource Library/ Self Help Programs on natural hazards, mitigation and safety and related topics in a central location and available to or disseminated to property owners and businesses.

14.14 Strategically place flood elevation reference markers throughout the Region to educate and remind people of historical floods. The markers could show the elevation of the high water from previous floods as well as the 100-year flood levels.

14.15 Notify potential homebuyers of flood hazards and requirements for flood insurance. Programs should be developed with the cooperation of banks, real estate agents, and insurance agents as well as community development staff.

14.16 Implement programs to provide property owners with flood elevation certificates in order to alert them to the fact that they their property is in the floodplain.

14.17 Provide appropriate local government staff with technical expertise and training on flood protection measures, retrofitting, flood insurance, flood warning and response, etc. in order to help citizens meet and understand floodplain requirements and flood hazards.

Goal 15: **Improve hazard data collection and GIS for the Region.**

Strategies

15.1 Encourage communities to participate in FEMA's Cooperating Technical Partners (CTP) Program. This FEMA initiative establishes partners with local jurisdictions to develop and maintain up-to-date flood maps and other flood hazards. Mapping activities may include hydrologic and hydraulic analysis, floodplain mapping, preparation of digital FIRMs, and refinement of floodplain boundaries. Also take advantage of any training on FEMA's HAZUS mapping software that is offered in the Region.

15.2 Consider creating a consortium of communities to tackle the problem of outdated FIRM maps and how to update the FIRM maps on a regional basis.

15.3 Ensure that all localities have digitized FIRM maps and that they are current, and correct.

15.4 Acquire technology to assist in managing storm water, floodplain, and other land-based resources.

15.5 Utilize GIS technology to inventory at-risk infrastructure and public and private structures within at-risk areas.

15.6 Determine and map landslide/land subsidence, karst, and sinkhole vulnerable areas in the region. Archive events in a database to monitor trends and recurring sites. Coordinate with VDOT on sites impacting transportation infrastructure.

15.7 Identify and map assisted living centers, nursing homes, and facilities that serve people with special needs that require additional services during disasters.

Goal 16: Implement activities that promote resilience in the Region by enabling communities to better prepare, adapt to changing conditions, and become stronger to withstand and recover rapidly from stresses, shocks, and adverse situations.

Strategies

16.1 Develop local and regional Resilience Plans.

Goal 17: Review Mitigation and Community Improvement Plans in the aftermath of an event in order to encourage the implementation of mitigation projects during the recovery process.

Strategies

17.1 Encourage learning opportunities of best practices and challenges across the Region.

17.2 Conduct After Action Reviews in the aftermath of a disaster.

17.3 Share Community Improvement Plans with other localities in the Region.

3. Local Mitigation Strategies

Each of the 21 jurisdictions in the Central Shenandoah Planning District has created a set of mitigation strategies for their local community. Mitigation strategies were also created by James Madison University, a public university in the City of Harrisonburg. The strategies for each community are listed in the tables that follow in the order below:

- Augusta County
- Bath County
- Highland County
- Rockbridge County
- Rockingham County
- City of Buena Vista
- City of Harrisonburg
- City of Lexington
- City of Staunton
- City of Waynesboro
- Town of Bridgewater
- Town of Broadway
- Town of Craigsville
- Town of Dayton
- Town of Elkton
- Town of Glasgow
- Town of Goshen
- Town of Grottoes
- Town of Monterey
- Town of Mt. Crawford
- Town of Timberville
- James Madison University

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Augusta County**
NFIP Community Number: **510013**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi- Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi- Hazards	High	On-going	N/A	County	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi- Hazards	High	On-going	N/A	County	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	County	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	High	On-going	N/A	County	On-going
12.1 – 12.2	Continue study of dam risk assessment. Seek funding to inspect, maintain, and upgrade older dams. * Note: The December 2009 Floodplain Ordinance revision added floodpool areas to the Special Flood Hazard Area. The County continues to work with the HWSWCD, Staunton, and Waynesboro to map inundation zones for all publicly owned, regulated dams in Augusta County.	Flood	Medium	Robinson Hollow Dam 310 – A has been upgraded with reinforced spillways	Completed	County	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
				and concrete retaining wall. Inch Branch Dam has been upgraded with increased spillway capacity and a new riser structure.* Currently work is being done on the Hearth Stone dam on Tillman Road.	Completed On-going		
1.3	Floodplain Ordinance – Update and revise ordinance; include floodplain overlay district to zoning ordinance. *Note 2009 revision includes a general prohibition on development on new lots in the floodplain and institutes compensatory storage for any fill in the floodplain.	Flood	Medium	Completed Floodplain Ordinance revised in December 2009*.	N/A	County	N/A

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
15.3	Update FEMA's flood maps for the following areas in the County that have repetitive flooding problems: North Mountain Estates on East Dry Branch, Deerfield on Hamilton Branch, Crawford Manor at East Dry Branch, Jolliet Springs on South River, near Crimora, Stuarts Draft, and Augusta Springs on Little Calfpasture River.	Flood	Medium	Completed FEMA finished up a Physical Map Revision that has the effective date of **08/3/15.** Other revisions remain on the list for future updates.	N/A	FEMA and County	N/A
14.1	Continue to provide citizens with in-school programs, communication classes, tours, and emergency management seminars.	Multi- Hazards	High	On-going	N/A	County	On-going
10	Increase emergency communications capability including Reverse 9-1-1, Ind. Map, Emergency Action Plans (EAPs), Dam Protocols, Mass E-mails, and "Child Is Missing" Hotline.	Multi- Hazards	High	On-going	N/A	County	On-going
9.1	Maintain IFLOWS Rain-Stream Gauge. Install new gauges in Verona and Swoope.	Flood	High	On-going	N/A	County	On-going
12	Restoration of Dams in Robinson Hollow, Tom Branch, and Mills Creek.	Flood	High	Completed	N/A	County	On-going
13.1 –13.2	County has been an active participant in stream remediation projects through the Emergency Watershed	Flood	High	On-going	N/A	County	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
	Protection Program. Maintenance work has been and will continue to be performed when required on a large-scale project on the Saint Mary's River.						
16	Create and keep updated a regional Emergency Operations Plan (EOP) with the cities of Staunton and Waynesboro to more effectively and efficiently utilize the resources of the three localities.	Multi- Hazards	High	Completed On-going	N/A	County and Cities	On-going
5	Complete a wildfire protection plan to assess vulnerable woodland areas and propose mitigation techniques and projects to reduce wildfire risk in the County.	Wildfire	High	Completed	N/A	County	Complete d in 2013
7.9 –7.10	Continue development and implementation of planning, preparedness, and response strategies for pets, livestock, and other animals in the County. Maintain regional animal sheltering trailer to assist with animal needs during a disaster.	Multi- Hazards	High	On-going	N/A	County	On-going
16	Continue to partner with the Shenandoah Valley Regional Airport in training and implementation of their Airport Emergency Response Plan.	Multi- Hazards	High	On-going	N/A	County and Airport	On-going
14.6	Maintain the Staunton-Augusta-Waynesboro Community Emergency Response Team (S-A-W CERT).	Multi- Hazards	High	On-going	N/A	County and Cities	On-going
12	Yearly, participate in a Regional Dam Exercise that also includes private dam owners.	Flooding	Medium	On-going	N/A	County	On-going
11	Work with the Virginia Department of Transportation (VDOT) to keep roadways and stormwater drainage free from debris particularly when severe weather is anticipated.	Multi- Hazards	High	On-going	N/A	County VDOT	On-going
10	Implement a smoke installation program for mobile home and residential structures in the County.	Fire	High	Completed	N/A	County	2018-19

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Bath County**
NFIP Community Number: **51096**

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi- Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi- Hazards	High	On-going	N/A	County	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi- Hazards	High	On-going	N/A	County	On-going

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	County	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	High	On-going	N/A	County	On-going
6.1	Develop a program to elevate, relocate, floodproof or acquire floodprone structures in order to reduce or eliminate future damages with priority given to structures that are repetitively flooded. Areas of concern where flooding is repetitive include Hot Springs, Jackson River, Mill Creek, Millboro, Millboro Springs, Mountain Grove, and Pads Creek.	Flood	High	Pending – County continues to seek NFWF or other funding.	No funding	County State Federal	Unknown

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
15.3	Explore the possibility of revising the County 's Flood Insurance Rate Maps (FIRMS) through the Physical Map Revision Process to address changes in the current floodplain delineation.	Flood	High	Pending	No funding	County	Unknown
9.1	Maintain current IFLOWS rain/stream gauges and consider installing additional gauges in areas of concern if funding is available.	Flood	High	On-going	N/A	County	On-going
10	Implement the Code Red Emergency Notification system throughout the County. This system allows for telephone notification for the entire County or targeted areas during emergency situations that require immediate action.	Multi- Hazards	High	Completed	N/A	County	On-going
10	Construct new E-911 Center which will contain an enhanced 911 hardware and software program that will allow dispatches to receive telephone calls from land lines as well as cell phones and create location maps.	Multi- Hazards	High			County	
11.4	Continue to implement and expand Emergency Sheltering Program in the County by partnering with the Red Cross and applying for grant funding for emergency generators for shelters.	Multi- Hazards	High	On-going	N/A	County	On-going
16	Continue participation in the Bath County Local Emergency Planning Committee (LEPC).	Multi- Hazards	High	On-going	N/A	County	On-going
13	Consider flood mitigation actions in the County focused on natural systems protection.	Flood	High				On-going

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Highland County**
NFIP Community Number: **510311**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi- Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi- Hazards	High	On-going	N/A	County	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi- Hazards	High	On-going	N/A	County	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	County	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	High	On-going	N/A	County	On-going
13	Consider mitigation actions in the County that are focused on natural systems protection.	Flood	High				On-going

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Rockbridge County**
NFIP Community Number: **510205**

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi- Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi- Hazards	High	On-going	N/A	County	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi- Hazards	High	On-going	N/A	County	On-going

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	County	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	High	On-going	N/A	County	On-going
6.1	Complete the South River Flood Mitigation Project which calls for the acquisition of up to 35 properties that were destroyed or damaged in Hurricane Isabel.	Flood	High	Completed	N/A	County State Federal	N/A
3.2	Develop a St. Mary's/South River Watershed feasibility study – a joint project with Augusta County and the Army Corps of Engineers to study the flooding along the St. Mary's and South River watersheds.	Flood	Medium	On-hold	N/A	County Federal	N/A

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
13.1	Continue the stream remediation and bank stabilization work by NRCS on the South River that was affected by Hurricane Isabel and prior flooding events.	Flood	Medium	Complete	N/A	County Federal	N/A

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Rockingham County**
NFIP Community Number: **510133**

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi- Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi- Hazards	High	On-going	N/A	County	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire	Multi- Hazards	High	On-going	N/A	County	On-going

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
	mitigation projects.						
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	County	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	High	On-going	N/A	County	On-going
13.1	Begin the stream remediation projects sponsored by NRCS on Germany River, Naked Creek, and Dry Run River that call for streambank restoration, removal of watershed impairments and installation of debris basins to repair damage caused by Hurricane Isabel.	Flood	High	Complete	N/A	Federal County	NA

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.4	Continue participation in Department of Forestry's Firewise Program, a community awareness and education program that encourages and acknowledges woodland communities to take action that minimizes home loss to wildfires by preparing for a fire before it occurs	Wildfire	High	On-going	N/A	State County	N/A
6.1	Seek funding to continue county-wide residential flood mitigation project that calls for acquisition, elevation, floodproofing of properties identified as at-risk of future flooding. Most of these houses are located in the Naked Creek, Rawley Springs, and Bergton/Criders area of the County.	Flood	High	Delayed	These properties are now mitigated as a result of the Germany River Project.	N/A	N/a
9.1	Rockingham and Page Counties to install an I-Flow gauge on Naked Creek as well as complete stream remediation.	Flood	N/A	Completed	N.A	County	N/A
16	Continue support of the Harrisonburg-Rockingham Disaster Recovery Committee, a volunteer group made up of representatives of local churches, the Red Cross, Salvation Army, United Way, VOAD, Social Services, Rockingham County and others that work with residents affected by disasters in providing assistance not covered by federal and state recovery programs.	Multi-Hazards	High	On-going	N/A	County	N/A
7.10	Continue support of the Harrisonburg and Rockingham SPCA emergency shelter for pets and livestock during a disaster. Volunteers trained to work with animals during disaster situations staff the shelter. Fire Chief also serves on the State Animal Response Committee as well. Completed a grant-funded project that provided a pet emergency supply trailer including supplies and training.	Multi-Hazards	Medium	On-going	N/A	County	On-going

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
6.1	Acquire houses located in the floodplain along Naked Creek and have land deeded in Open Space.	Flood	High	Delayed	Property owners not willing to sell.	Federal State County	N/A
9.1	Install and maintain I-FLOW gauges in two dams: Dry River and Hone Quarry in the middle of each dam.	Flood	High	Completed	N/A	County and Shenandoah	N/A
3.4 – 3.6	Implement mitigation strategies within the Lake Shenandoah watershed to address recurrent urban flooding. Continue work to select suitable mitigation strategies, including increased detention capacity and increased conveyance capacity. Once suitable options are determined, move forward with implementation when resources are available.	Flood	High	On-going	N/A	Lake Shenandoah Stormwater Control Authority and County	N/A

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **City of Buena Vista**
NFIP Community Number: **510027**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi- Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi- Hazards	High	On-going	N/A	City	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi- Hazards	High	On-going	N/A	City	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	City	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	City	On-going
8	Continue study of acquiring and demolishing the Reeves Brothers plant, a major industrial site that was closed in 1985 after Hurricane Juan severely damaged the plant.	Flood	Low	Cancelled, Reeves Brothers Plan has been sold.	N/A	N/A	N/A
3.4	Continue the Buena Vista Watershed Project to prevent flooding from four of the interior streams that flow through Buena Vista. The project funded by the USDA	Flood	High	On-going	Funding has been cut.	Federal City	N/A

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
	would protect 240 residences, 70 commercial structures, and utilities by constructing debris basins, replacing culverts and bridges, and improving stream channels.						
6.1	Seek funding to continue city-wide residential flood mitigation project that calls for the acquisition, elevation, floodproofing of properties identified as at-risk of future flooding.	Flood	High	On-going	Lack of funding.	N/A	N/A

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **City of Harrisonburg**
NFIP Community Number: **510076**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi- Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi- Hazards	High	On-going	N/A	City	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi- Hazards	High	On-going	N/A	City	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	City	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	City	On-going
15.1	Continue participation in FEMA's Cooperating Technical Program (CTP), a technical assistance program sponsored by FEMA that will assist the City in re-mapping the entire floodplain boundary in the City.	Flood	Medium	Complete	N/A	Federal City	N/A
16	Continue support of the Harrisonburg-Rockingham Disaster Recovery Committee, a volunteer group made up of representatives of local churches, the Red Cross, Salvation Army, United Way, VOAD, Social Services,	Multi- Hazards	High	On-going	N/A	City	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
	Rockingham County and others that work with residents affected by disasters in providing assistance not covered by federal and state recovery programs.						
12.2	Decommission the dam at James Madison University* ** Note: Over-topping protection was constructed in 2014-15 to protect impoundment failure.*	Flood	High	Alternate construction completed.	N/A	JMU	N/A
3.4	Replace a deteriorating culvert bridge on Madison Street with upsized culverts which will trap less debris during storm events.	Flood	High	Completed	N/A	City	N/A
3.2, 3.4	Identify and implement drainage improvement projects to mitigate flooding throughout the City. Projects may be identified through the Drainage Improvement Program, the Stormwater Improvement Plan, or other methods.	Flood	High	On-going	N/A	City	On-going
13	Consider mitigation actions in the City that are focused on natural systems protection.	Flood	High				On-going

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **City of Lexington**
NFIP Community Number: **510089**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi- Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi- Hazards	High	On-going	N/A	City	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi- Hazards	High	On-going	N/A	City	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	City	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	City	On-going
13.1	Complete the Woods Creek Restoration Project to address water quality/quantity problems along Woods Creek, which runs through the City. The project includes establishing riparian buffers, control storm runoff, modify existing stormwater retention facilities and educate property owners about water quality/quantity issues.	Flood	Medium	On-going	N/A	N/A	N/A

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **City of Staunton**
NFIP Community Number: **510155**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi- Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi- Hazards	High	On-going	N/A	City	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi- Hazards	High	On-going	N/A	City	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2. 4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	City	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	City	On-going
3.4	Complete construction of the Churchville Avenue storm sewer project that is vital to reducing and alleviating downstream flooding in the central business district.	Flood	High	Completed	N/A	City	N/A
3.2	Seek funding to prepare site-specific hydrologic and hydraulic studies that look at the downtown commercial/historic areas that have chronic and repetitive flooding problems. After study is completed, implement recommended mitigation strategies.	Flood	High	Delayed	Lack of funding	N/A	N/A

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
9, 16	Increase expenditures for state-of the-art equipment, communication systems, and heavy equipment to respond to natural disasters in an effective and efficient manner.	Multi- Hazards	Low	Delayed	Lack of funding	N/A	N/A
8.2	Provide floodproofing measures to approximately 12 commercial structures in the downtown area that have been identified as at-risk of flooding. Six additional commercial structures needing floodproofing remain.	Flood	High	Completed	N/A	City State Federal	N/A
3.4	Demolish structures in floodplain on Central Avenue and complete process of "daylighting" a tributary of Lewis Creek.	Flood	High	Completed	N/A	City and Pvt. Citizen	N/A
10	Install emergency notification system with "Reverse 911" capability and notification by text. *City now has the "Staunton Alert Message" system.*	Multi- Hazards	High	Completed	N/A	N/A	N/A
6.3	Implement a floodproofing project throughout the City that will strap down above ground storage tanks in the floodplain.	Flood	High	Delayed	Lack of Funding	N/A	N/A
11.4	Install generators at all the designated emergency shelters in the City.	Multi- Hazards	High	Completed	N/A	N/A	N/A
7.10	Maintain an animal supply trailer and all the supplies needed to stock the mandated animal shelter which will be located at Augusta Expo.	Multi-Hazards	High	Completed	N/A	N/A	N/A
13	Create a retention pond in the western portion of the City and install other stormwater facilities throughout the City as needed to address stormwater issues.	Flood	High	Delayed	Lack of Funding	N/A	N/A
16	City departments will undergo an annual review of the planning process to evaluate their preparedness.	Multi- Hazards	High	On-going	N/A	City	N/A

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
16	Create a regional Emergency Operations Plan (EOP) with the City of Waynesboro and Augusta County to more effectively and efficiently utilize the resources of the three localities.	Multi-Hazards	High	Completed	N/A	County and Cities	N/A
14.6	Maintain the Staunton-Augusta-Waynesboro Community Emergency Response Team (S-A-W CERT).	Multi-Hazards	High	On-going	N/A	County and Cities	On-going
11.1	Move the fire station located at 500 N. Augusta Street out of the floodplain.	Flood	High	Delayed	Lack of Funding	City	N/A
13	Consider mitigation actions in the City that are focused on natural systems protection.	Flood	High				On-going

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **City of Waynesboro**
NFIP Community Number: **515532**

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi-Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi- Hazards	High	On-going	N/A	City	On-going
6.1 – 6.8 8.1,8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi- Hazards	High	On-going	N/A	City	On-going

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	City	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	City	On-going
6.1	Complete the acquisition and relocation of tenants of the Race Ave. Trailer Park, a 33-unit trailer park that has been repetitively and seriously damaged in numerous flood events.	Flood	High	Completed	N/A	N/A	N/A
6.2	Continue city-wide residential flood mitigation project that calls for the acquisition, elevation, or floodproofing of more than 50 properties identified as at-risk for future flooding. Most of the houses are in the River Shores/Club	Flood	High	On-going	Lack of Funding	N/A	On-going

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
	Court and adjacent to downtown areas of the City. Sixteen properties have been purchased and kept in "open space".						
6.1	Complete a project to elevate houses, floodproof utilities, and install flood vents for 12 properties located on residential areas adjacent to downtown area in the floodplain	Flood	High	On-going	Lack of Funding	State and Local	On-going
13	Implement greenways project along South River to keep floodplain in "Open Space".	Flood	High	Completed	N/A	N/A	N/A
3.4	Implement stormwater project for Wayne Hills Field in front of the Public Works Building by creating retention pond and connecting drop inlets with piping to travel to retention pond.	Flood	High	On-going	N/A	City	N/A
6.2	Seek funding to implement a flood mitigation project to provide floodproofing and retrofitting measures to Waynesboro's downtown commercial area.	Flood	Medium	On-going	Lack of Funding	N/A	N/A
3.1	Update a master stormwater study that identifies, analyzes, and prioritizes flooding in areas throughout the City. Hire a stormwater manager for the City.	Flood	Medium	On-going	N/A	Local	N/A
12	Install a flood control dam in Jones Hollow to address problem of ingress and egress of property owners near the mountain whose houses don't flood but people get trapped.	Flood	High	Completed	N/A	N/A	N/A
16	Create a regional Emergency Operations Plan (EOP) with the City of Staunton and Augusta County to more effectively and efficiently utilize the resources of the three localities.	Multi-Hazards	High	On-going	N/A	County and Cities	N/A

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.6	Maintain the Staunton-Augusta-Waynesboro Community Emergency Response Team (S-A-W CERT)	Multi-Hazards	High	On-going	N/A	County and Cities	N/A

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Town of Bridgewater**
NFIP Community Number: **510134**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi - Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi - Hazards	High	On-going	N/A	Town	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi - Hazards	High	On-going	N/A	Town	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	Town	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	Town	On-going
6.2	Seek funding to complete the Bridgewater Flood Mitigation Project where structures have been identified at-risk of flooding and mitigation options such as acquisition, elevation, and/or floodproofing is recommended.	Flood	High	Completed	N/A	Federal State Local	N/A
3.4-3.5	Aggressively improve the Town's levee system. Maintain levee annually.	Flood	High	On-going	N/A	Federal Local	N/A

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
3	Implement plans and regulations at the local level to meet revised storm water management regulations.	Flood	High	On-going	N/A	Local	N/A
13	Consider mitigation actions in the Town that are focused on natural systems protection.	Flood	High				On-going

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Town of Broadway**
NFIP Community Number: **510135**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi - Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi - Hazards	High	On-going	N/A	Town	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi - Hazards	High	On-going	N/A	Town	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	Town	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	Town	On-going
1.3	Complete a stream bank restoration project on the full length of Linville Creek to repair erosion that has already occurred and lessen future erosion. Linville Creek is the back-up water supply for the Town. The purpose of this project is to protect water and sewer lines, floodplain management, protect the water intake.	Multi-hazards		Delayed	Lack of Funding		N/A
6.1	Acquire structures in the floodplain in Town.	Flood		Delayed	Lack of Funding		N/A

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
3.4	Remove a sewer line that is above grade	Multi-hazards		Delayed	Lack of Funding		N/A

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Town of Craigsville**
NFIP Community Number: **510014**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi- Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi- Hazards	High	On-going	N/A	Town	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi- Hazards	High	On-going	N/A	Town	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	Town	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	Town	On-going
3.4	Seek funding to replace and improve infrastructure in key locations throughout the town to reduce flood damage caused by the interior streams, as well as inadequate culverts and infrastructure. Coordinate project with VDOT.	Flood	High	Delayed	Lack of Funding	N/A	N/A
13	Consider mitigation actions in the Town that are focused on natural systems protection.	Flood	High				On-going

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Town of Dayton**
NFIP Community Number: **510136**

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi- Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi- Hazards	High	On-going	N/A	Town	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi- Hazards	High	On-going	N/A	Town	On-going

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	Town	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	Town	On-going
11	Put fencing around water treatment plant with locked gates and surveillance equipment and alarms for water levels getting too low.	Multi-Hazards	N/A	Completed	N/A	N/A	N/A
14	Implement a fire education program to educate citizens on the fire code and burning permits.	Wildfire	N/A	Delayed	Lack of Funding and Staff	N/A	N/A

Regional Strategy ID#	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
3.2	Conduct a hydrologic study and floodplain analysis to determine vulnerable areas in the Town that receive flooding from Cook's Creek. Implement mitigation measures where needed.	Flood	N/A	Completed in part – Mill Street project	Priority area completed	N/A	N/A
3.4	Implement a stormwater drainage project to address the stormwater issues on Main Street and College Street.	Flood	N/A	Ongoing – to be completed in 2020	In progress	N/A	N/A
11	Add lightning protection to the Town's Water Plant.	Severe Storms	High	Completed	N/A	Town	N/A
13	Consider mitigation actions in the Town that are focused on natural systems protection.	Flood	High				On-going

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Town of Elkton**
NFIP Community Number: **510137**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi - Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi - Hazards	High	On-going	N/A	Town	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi - Hazards	High	On-going	N/A	Town	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	Town	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	Town	On-going
13	Consider mitigation actions in the Town that are focused on natural systems protection.	Flood	High				On-going

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Town of Glasgow**
NFIP Community Number: **515526**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi- Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi- Hazards	High	On-going	N/A	Town	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi-Hazards	High	On-going	N/A	Town	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	Town	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	Town	On-going
6.2	Seek funding to complete the Glasgow Residential Flood Mitigation Project that calls for the acquisition, relocation, and elevation of approximately 10 residential properties that have been severely damaged in the past flood events.	Flood	High	Delayed	Lack of Funding	N/A	N/A
3.4, 13.1	Seek funding to complete the Glasgow Interior Stream Drainage Project to prevent or reduce flooding along Sallings Mountain and Miller Mountain. The project calls for the construction of a debris basin, flood diversion wall,	Flood	High	Delayed	Lack of Funding	N/A	N/A

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
	improved channelization, and replacement of several culverts throughout Town. To date ditches have been cleaned out but that is all.						
3.2	Complete a hydrologic, floodplain, and stormwater study to access new and continued vulnerable areas in the Town and to provide recommendations for improvements to be made to the Town's stormwater system.	Flood	High	Delayed	Lack of Funding	N/A	N/A
3.4	Create a stormwater retention pond in north Glasgow. i.e. 1st Street and Pocahontas.	Flood	High	Delayed	Lack of Funding	N/A	N/A
11	Implement a project to safeguard the Town's water system and 2 municipal wells through a wellhead protection project that includes proper abandonment of unused wells, fencing, and other security measures, routine inspections of utility lines, and education for property owners, business, industry, and railroad. Also create another well.	Multi-hazards	Medium	On-going	Lack of Funding	N/A	N/A
3.4	Implement check-valve system or other floodproofing option to prevent culverts from backing up as they enter the Maury River when rainwater inundates the stormwater drainage system as the river water simultaneously rises.	Flood	High	Delayed	Lack of Funding	N/A	N/A
11	Remove the Glasgow Fire Department from the location of its current building in the floodplain to a less vulnerable location.	Flood	High	Delayed	Lack of Funding	N/A	N/A
6.1	Implement a flood mitigation project to acquire, relocate, or elevate structures on 53 properties located in the floodplain in the Town.	Flood	High	Completed	N/A	Federal, State, and Local	N/A

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Town of Goshen**
NFIP Community Number: **510217**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi-Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi- Hazards	High	On-going	N/A	Town	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi- Hazards	High	On-going	N/A	Town	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	Town	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	Town	On-going
11	Seek funding to relocate the Goshen Town Hall out of the floodplain. This critical facility is located on Main Street in close proximity to Mill Creek in a low-lying area that receives repeated flooding and affects the operation of the Town. The Town has purchased 40 acres out of the floodplain that could be used as an alternative site.	Flood	Medium	Delayed	Lack of Funding	N/A	N/A
13	Consider mitigation actions in the Town that are focused on natural systems protection.	Flood	High				On-going

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Town of Grottoes**
NFIP Community Number: **510138**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi - Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi - Hazards	High	On-going	N/A	Town	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi - Hazards	High	On-going	N/A	Town	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	Town	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	Town	On-going
3.4	Complete the Grottoes Stormwater Drainage Improvement Project to address flooding caused by ponding and poor drainage along Miller Run and Dry Run. Project Improvements such as ditching, replacement of undersized culverts, and drainage piping will protect between 30 and 50 structures and eliminate water on roads, yards, and crawl spaces. Clean-up of Miller Run takes place every year.	Flood	High	Initial project completed and maintenance is on-going.	N/A	Local	N/A

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
11	Extend earthen berm in Grottoes Town Park to provide protection to the park which periodically receives flooding from the South River.	Flood	High	Complete	N/A	N/A	N/A
11	Implement bank stabilization project at Grand Caverns to protect area from erosion and flooding.	Flood	High	On - going	N/A	State	N/A
13	Consider mitigation actions in the Town that are focused on natural systems protection.	Flood	High				On-going

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Town of Monterey**
NFIP Community Number: **510379**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi- Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi- Hazards	High	On-going	N/A	Town	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi- Hazards	High	On-going	N/A	Town	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	Town	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	Town	On-going
13	Consider mitigation actions in the Town that are focused on natural systems protection.	Flood	High				On-going

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Town of Mt. Crawford**
NFIP Community Number: **510224**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi-Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi-Hazards	High	On-going	N/A	Town	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi-Hazards	High	On-going	N/A	Town	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	Town	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	Town	On-going
11	Make improvements to the Town Hall property to include, but not limited to: 1. Public Park; 2. Public river access and landing This is to include floodplain management and environmental conservation and preservation.	Multi-Hazards	High	On-going	N/A	Town	On-going
13	Consider mitigation actions in the Town that are focused on natural systems protection.						

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community: **Town of Timberville**
NFIP Community Number: **510139**

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi-Hazards	High	On-going	N/A	CSPDC	On-going
14.1	Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	Multi - Hazards	High	On-going	N/A	Town	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi - Hazards	High	On-going	N/A	Town	On-going

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
2.1 – 2.4	Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	Town	On-going
5.1 – 5.4	Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	Medium	On-going	N/A	Town	On-going
3.1, 3.2	Conduct a stormwater management study to determine the effectiveness of the Town's stormwater system, highlight vulnerable areas to flooding, and provide recommendations for ways to improve the system.	Flood		Delayed	Lack of Funding	N/A	N/A
16	Complete a detailed Emergency Operations Plan written specifically for the Town.	Multi- hazards		Delayed	Lack of Funding	N/A	N/A

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
11	Explore options with the Army Corps of Engineers for the feasibility of dredging the river.	Flooding	High	Delayed	Lack of Funding	Federal Local	N/A
11	Implement security measures to protect the Town's water source.	Multi- hazards	High	Delayed	Lack of Funding	Town	N/A

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Organization: James Madison University
Location (Town, City, or County): City of Harrisonburg

Regional Strategy ID #	Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
14.1	Participate in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	Multi- Hazards	High	On-going	N/A	CSPDC	On-going
6.1 – 6.8 8.1, 8.2 10.1 – 10.4 12.1	Support implementation of structural and non-structural mitigation activities on our property, if needed to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	Multi - Hazards	High	On-going	N/A	Organization	On-going
13	Consider mitigation actions at the University that are focused on natural systems protection.	Flood	High				On-going

VI. CAPABILITIES ASSESSMENT

1. Capabilities Assessment

This portion of the Plan assesses the current capacity of the communities of the Central Shenandoah Valley Region to mitigate the effects of the natural hazards mentioned in Section IV, Hazard Identification Risk Assessment. Determining the ability of local governments to implement mitigation strategies and where potential opportunities to increase these abilities exist is the purpose of the Capabilities Assessment.

This Capabilities Assessment has two primary components: an inventory of the plans and programs that the local governments in the Central Shenandoah Valley Region possess, and an analysis of the government's abilities to implement mitigation strategies and measures based on this inventory. Table VI-1 provides an inventory of local plans for the Counties, Cities and Towns. Table VI-2 provides an inventory of the administrative and technical capabilities of local government staff for the Counties and Cities. Since Towns are considered part of the Counties where they are located and have access to County resources, Towns are not listed separately for this review.

**** Table VI-1: Local Plans (Augusta County) Please note: In 2013, Augusta County completed its own Community Wildfire Protection Plan (CWPP) that was adopted by the Board of Supervisors through a resolution. As part of the regional planning process, this plan was updated and included in the 2020 Central Shenandoah Wildfire Protection Plan (CSWPP). The CSWPP when completed will be included as Appendix H in the Central Shenandoah Hazard Mitigation Plan (CSHMP). The Wildfire Protection Plan will be adopted by the 5 Counties, 5 Cities, and 11 Towns of the Central Shenandoah Planning District through the local jurisdictions as part of the CSHMP.**

Table VI-1: Local Plans

Local Plans	Hazard Mitigation Plan	Comprehensive Land Use Plan	Wildfire Protection Plan	Emergency Operations Plan	SARA Title III Hazardous Materials Emergency Response Plan	Capital Improvement Plan
Augusta County**	Y	Y	Y	Y	Y	Y
Bath County	Y	Y	Y	Y	Y	Y
Highland County	Y	Y	Y	Y	U	U
Rockbridge County	Y	Y	Y	Y	N	Y
Rockingham County	Y	Y	Y	Y	Y	Y
City of Buena Vista	Y	Y	Y	Y	N	Y
City of Harrisonburg*	Y	Y	Y	Y	Y	Y
* Also has Stormwater Improvement Plan and Chesapeake Bay TMDL Action Plan						
City of Lexington	Y	Y	Y	Y	Y	Y
City of Staunton	Y	Y	Y	Y	Y	Y
City of Waynesboro	Y	Y	Y	Y	Y	Y
Town of Bridgewater	Y	Y	Y	Y	Y	Y
Town of Broadway	Y	Y	Y	Y	Y	Y
Town of Craigsville	Y	Y	Y	Y	Y	U
Town of Dayton	Y	Y	Y	Y	Y	U
Town of Elkton	Y	Y	Y	Y	Y	Y
Town of Glasgow	Y	Y	Y	Y	N	U
Town of Goshen	Y	Y	Y	Y	N	U
Town of Grottoes	Y	Y	Y	Y	Y	U
Town of Monterey	Y	Y	Y	Y	U	U
Town of Mount Crawford	Y	Y	Y	Y	Y	U
Town of Timberville	Y	Y	Y	Y	Y	N

Table Legend: Y = Yes; N = No; U = Unknown

Note: Towns are included in the County's Emergency Operations Plan and Hazardous Materials Emergency Response Plan where they are located.

Table VI-2: Administrative and Technical Capabilities of Local Government Staff

Administrative and Technical Capabilities of Local Government Staff	Augusta County	Bath County	Highland County	Rockbridge County	Rockingham County	City of Buena Vista	City of Harrisonburg	City of Lexington	City of Staunton	City of Waynesboro
Land use planners or planners with knowledge of land development and land management practices	Y	Y	U	Y	Y	Y	Y	Y	Y	Y
Engineers or professionals trained in construction practices related to buildings or infrastructure	Y	Y	U	Y	Y	Y	Y	Y	Y	Y
Staff with an understanding of natural or human caused hazards	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Emergency Manager	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Floodplain Manager	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Staff with the education and/or expertise to assess the community's vulnerability to hazards	Y	Y	Y	Y	Y	N	Y	N	Y	Y
Resource development and grant writing staff	N	N	N	N	Y	Y	Y	N	Y	N
Internet Access	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Fire and Rescue Paid or Volunteer Staff	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
The 11 towns in the Central Shenandoah Region: Bridgewater, Broadway, Craigsville, Dayton, Elkton, Glasgow, Goshen, Grottoes, Monterey, Mount Crawford, and Timberville use the resources of the County where they are located.										

Table Legend: Y = Yes; N = No; U = Unknown

2. Capabilities Assessment Findings

Existing Local Plans

Planning capability is based on the creation and implementation of plans that demonstrate a jurisdiction's commitment to guiding and managing growth in a responsible manner; encouraging public safety; preserving the local economy; protecting environmental, historic, and cultural resources; and maintaining the general welfare of the community. Planning initiatives present significant opportunity to integrate hazard mitigation principles and practices into the community. The jurisdictions of the Central Shenandoah Region have many planning mechanisms in place that include mitigation information and techniques including:

Hazard Mitigation Plan: A hazard mitigation plan represents a community's blue print for how it intends to reduce the impact of natural and human-caused hazards on people and the built environment. All twenty-one jurisdictions in the Region have adopted the 2013 update of the Central Shenandoah Hazard Mitigation Plan.

Comprehensive Land Use Plan: A comprehensive land use plan establishes the overall vision for what a community wants to be and serves as a guide to future governmental decision making. A comprehensive plan contains sections on demographic conditions, land use, natural resources, economic development, transportation, and community facilities. Community strategies included in these plans can encourage the achievement of risk reduction goals. The five Counties and Cities in the Region have Comprehensive Land Use Plans.

Community Wildfire Protection Plan (CWPP): The Healthy Forests Restoration Act (HFRA) of 2003 created the opportunities for local governments to prioritize goals and needs for the wildland areas in their communities through community wildfire protection plans. A CWPP addresses issues in a community such as wildfire response, hazard mitigation, community preparedness, and structure protection. Augusta County has adopted a Community Wildfire Protection Plan.

Emergency Operations Plan (EOP): An emergency operations plan outlines responsibilities and the means by which resources are deployed during and following an emergency or disaster. A section that specifically deals with mitigation is included in these plans. The five counties and five cities in the Region either have their own EOP or participate in regional EOPs.

SARA Title III Emergency Response Plan (ERP): Required by federal law under Title III of the Superfund Amendments and Re-authorization Act (SARA), these plans outline the procedures to be followed in the event of a chemical emergency such as the accidental release of toxic substances. The five counties and cities in the Region either have their own individual ERP or participate in regional ERPs.

Based on the types of planning initiatives by all of the jurisdictions in the Region, the opportunities to incorporate mitigation concepts into local planning processes is very possible for the Central Shenandoah Region. After the 2020 Central Shenandoah Hazard Mitigation Plan has been approved by FEMA and adopted by the 21 jurisdictions in the Region, CSPDC staff will contact the planning staff of each local jurisdiction to notify them of the updated HMP and discuss plan integration. CSPDC staff will prepare a fact sheet to give to local planning staff pertinent information about the useful elements of the HMP that could be included in local planning efforts such as for the Comprehensive Plan. During the annual review of the HMP, CSPDC staff will reach out to local planning and emergency management staff to discuss the community and emergency planning that will be done in the upcoming year and how integration of information from the HMP might occur.

Expertise of Local Planning Staff

As described previously, the Central Shenandoah Region consists of 21 jurisdictions (5 counties, 5 cities, and 11 towns). The Counties in the Region are led by an elected Board of Supervisors who appoints a County Administrator to manage the day to day operations of the government. In the Cities, a City Council are the elected officials and a City Manager, appointed by Council, manages the day to day operations.

Mitigation cuts across many disciplines. For a successful mitigation program, it is necessary to have a broad range of people involved with diverse backgrounds. Across the jurisdictions in the Central Shenandoah Valley Region, this expertise can be found in local government staff in the following areas or departments:

- Community Development and Building Inspection Departments have the ability to conduct land use planning based on knowledge of land development and land management practices. They may also possess expertise in resource development and grant writing. These departments may also house a community's floodplain manager and other staff with the ability to assess the natural hazards vulnerability of the community. As all of the communities are in good standing in the National Flood Insurance Program (NFIP), these departments may also enforce NFIP requirements.

- Engineering and Public Works Departments have the training in construction practices related to buildings and infrastructure. The Engineering Department may oversee the design and construction of infrastructure including roadways and stormwater facilities. The Public Works Department oversees the maintenance of the community's infrastructure, water treatment and sewer facilities.

- Emergency Management, Fire and Rescue Staff are involved with natural and man-made hazards and disasters and are closely involved with mitigation as it is one of the four cornerstones of the emergency management cycle. Fire and Rescue departments provide fire suppression and medical aid at the scene of disasters and may be involved with hazardous materials incidents.

This Capability Assessment illustrates the variety of staff and departments in local governments in the Central Shenandoah Region that possess the expertise to identify and implement mitigation activities.

The other resource that the 21 jurisdictions of the Region have is partnerships with private organizations, non-governmental organizations (NGOs), and neighboring jurisdictions. The Counties and Cities have Memorandums of Understanding and Mutual Aid agreements with these organizations and jurisdictions surrounding our Region for assistance in the event of emergencies and disasters for supplies, equipment, and manpower.

More informal partnerships also exist in non-disaster times between local government staff from all departments to their counterparts in neighboring jurisdictions for technical assistance and the sharing of resources. When applicable, these partners are often included in the mitigation planning process and other hazard mitigation activities to share their expertise. These partnerships only further the depth of capabilities that the local jurisdictions of the Central Shenandoah Region possess.

3. Local National Flood Insurance Program Surveys

All twenty-one jurisdictions in the Region participate in the National Flood Insurance Program (NFIP). As part of the Hazard Mitigation planning process, the Counties and Cities were asked to complete surveys providing information on floodplain identification and mapping, Floodplain Management, and Flood Insurance. Because much of the floodplain management for the Towns is done through the County where they are located, the information provided by the each County was relevant for the Towns in that County as well. The surveys are included in Appendix I.

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VII: PLAN MAINTENANCE

According to the Disaster Mitigation Act of 2000 (DMA2K), local plans are required to include a method and schedule of monitoring, evaluating, and updating the hazard mitigation plan within a five-year cycle as well as a description of continued public involvement in the hazard mitigation planning process.

The Central Shenandoah Valley Region will use its Hazard Mitigation Plan Steering Committee as the body responsible for the review, monitoring, and update of the Central Shenandoah Hazard Mitigation Plan. This group includes representatives from local government and other relevant organizations throughout the Region. The Steering Committee is staffed by the Central Shenandoah Planning District Commission. In the event that the Steering Committee shall dissolve, then each local jurisdiction will be responsible for the maintenance and update of the Plan.

Through the Hazard Mitigation Plan Steering Committee, the Central Shenandoah Hazard Mitigation Plan will be reviewed on an annual basis and updated when and where needed. Each local jurisdiction will be asked to review the Plan and submit a report when necessary that outlines any revisions, projects, or activities that impact the Plan. These annual reports will be reviewed by the Hazard Mitigation Plan Steering Committee, when necessary, and revisions will be made to the Plan by CSPDC staff. In addition, any local, state, or federal regulations that change or impact the Plan will be incorporated. Local governments will be apprised of any substantial changes to the Plan. An annual report will be developed and submitted as needed.

In addition to an annual review, local governments will asked to reference the Central Shenandoah Hazard Mitigation Plan in their Emergency Operations Plan (EOP). The Virginia Emergency Management and Disaster Law of 2000 requires that the State, and each County and City within the State develop and maintain a current Emergency Operations Plan (EOP) which addresses their planned response to extraordinary emergency situations. As part of the basic EOP, an appendix that addressees hazard mitigation activities is required. CSPDC staff will request that each of the Cities and Counties refer to the Central Shenandoah Hazard Mitigation Plan as a resource document as part of their EOP's Hazard Mitigation Annex and request local government review of the Hazard Mitigation Plan as part of their annual EOP review. In addition, a request will be made to each local jurisdiction to include the Hazard Mitigation Plan in other planning documents such as comprehensive plans and capital improvement plans.

The Plan will undergo a comprehensive review every 5 years. The Hazard Mitigation Plan Steering Committee will be the entity responsible for the review, evaluation, and update of the Plan. The criteria used to evaluate the Plan will be developed in accordance with the requirements of the Federal Emergency Management Agency (FEMA) as well as additional guidance documents provided by FEMA and Virginia Department of Emergency Management. The method used to update the Plan will include a request from each jurisdiction for a report that describe the progress of mitigation strategies identified in the Plan and any activities or projects that has been implemented. Other factors that could necessitate a revision to the Plan may include any new local, state, or federal regulations or requirements that impact the Plan; any Presidentially-declared disasters that have impacted the Region, or an increase or decrease in a community's vulnerability to a natural disaster. The 5-year update will be submitted to each of the local governments, the Virginia Department of Emergency Management, and FEMA as required. Significant changes to the Plan will include public input.

Public participation was an integral part of the development of this Plan and will continue through the course of its existence. Activities to involve the public in the maintenance, evaluation and revision of the Plan may include a yearly "Disaster Resistance Forum" meeting where the general public is invited, utilizing the websites of the Central Shenandoah Planning District Commission to notify the public of meetings, agendas, and revisions of the Plan, and employing the media to notify the public of any upcoming activities or public input sessions regarding the Plan and the Plan update.

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VIII. ADOPTION PROCESS AND DOCUMENTATION

The Central Shenandoah Hazard Mitigation Plan was developed as a multi-jurisdictional plan. Therefore, to meet the requirements of the Disaster Mitigation Act of 2000 (DMA2K), the Federal Emergency Management Agency (FEMA) Section 322 local hazard mitigation planning regulations, and Title 44 Code of Federal Regulations (CFR) §201.6, the 2020 update of the Plan will be adopted by each of the 21 municipalities in our Region. Resolutions from this adoption process for each of the jurisdictions in the Central Shenandoah Planning District will be included in Appendix J.

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Augusta Angus	2/14/1899	pg. 3
Augusta Angus	6/8/1897	pg. 4
Buena Vista News	3/27/1936	pg. 1
Buena Vista News	6/30/1972	Special Flood Section pg 1-12
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Harrisonburg Daily News Record	8/13/1955	pg. 2
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Harrisonburg Daily News Record	1/15/2010	Cover
Harrisonburg Daily News Record	11/25/1938	Cover
Harrisonburg Daily News Record	3/6/1962	Cover, pg. 2, 7
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Lexington News-Gazette	5/7/1929	Cover
Lexington News-Gazette	1/17/1912	pg. 5
Lexington News-Gazette	3/7/1962	Cover
Lexington News-Gazette	3/29/1978	pg. 13
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News Virginian	6/29/2006	
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News Virginian	12/20/2009	Cover, A2, A5
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NOAA Event Records	2/14-2/18/2003	Storm
NOAA Event Records	12/19/2009	Storm
NOAA Event Records	1/16/1996	Storm
NOAA Event Records	12/18-12/19/2009	Winter Storm
NOAA Event Records	2/5-2/10/2010	Winter Storm
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Staunton Daily News Leader	6/29/1995	Cover, A2
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Newspaper	Date	Pages
Staunton Daily News Leader	8/14/1955	pg. 4
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Staunton Daily News Leader	4/27/1937	Cover
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Staunton Daily News Leader	2/8/2010	Cover, A4, A5
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Staunton Daily News Leader	12/21/2009	Cover, A8
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Staunton Daily News Leader	6/7/1911	Cover, pg. 3
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Staunton Daily News Leader	3/6/1962	Cover
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Staunton Spectator	9/30/1896	Cover
Staunton Spectator	8/10/1896	
Staunton Vindicator	9/23/1870	Cover
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The Recorder	11/?/1985	Cover, pg. 3
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Washington Post	12/24/2009	Cover, A8
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Staunton News Leader	2/13/2014	A1, A5, A6
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Staunton News Leader	1/27/2016	A3
Staunton News Leader	1/25/2016	A1, A6
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Daily News Record	2/13/2014	A1, A6
Daily News Record	2/14/2014	A1, A2, A5, A6
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Appendix A – Planning Process and Public Engagement

Steering Committee Meetings

Attendance and Agenda Packets

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
April 3, 2019
Sign-In Sheet

Name	Locality or Organization	Email Address	Phone
KEITH TAYLOR	HOLTZMAN OIL CORP	KTAYLOR@HOLTZMANCORP.COM	540-477-3131
Calvin LoKey	Holtzman Oil Corp	calvinl@holtzmancorp.com	540-477-3131
Kevin Moore	Rockbridge County	kmoore@rockbridgecounty.va.gov	540-319-9878
Kevin Moore	Town of Glasgow	kmoore@rockbridgecountyva.gov	540-319-9878
Carl Williams	Highland County	cwilliams@highlandrescue.net	540-632-7331
Anthony Foretich	JMU	foretiae@dukes.jmu.edu	703-638-5972
Alex Cherney	JMU	cherneax@dukes.jmu.edu	703-785-9798
Joe Ziegler	JMU	ziegljm@dukes.jmu.edu	443-766-9485
Megan Deel	Town of Goshen	townofgoshen_va@yahoo.com	540-997-5515
Steven Craig	Dixie Gas and Oil Corp.	craigs@dixiegas.com	540-248-6273
Harley Gardner	Highland Co	hgardner@yahoo	540 2920456

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
April 3, 2019
Sign-In Sheet

Name	Locality or Organization	Email Address	Phone
Scott Mosinkup	Sentara RMH Medical Ctr	BXMASINC@sentara.com	540-292-3762
Gary Crawn	SHD Airport	gwcrawn@flyshd.com	540-607-4000
Robbie Symons	JMU	symonsrx@jmu.edu	540-476-1192
Pat Cherfund	JMU	cherfndlc@jmu.edu	540 568 7606
Jennifer Welch	DEQ	jennifer.welch@deq.virginia.gov	540-574-7854
Dr. Richard Robinson	Monterey	DOT Robin1@gmail	540-290-5842
Paul Helmuth	Harrisonburg	paul.helmuth@harrisonburg.va.gov	540-476-0860
Trent Roberts	Lexington	TRoberts@lexingtonva.gov	463 3240
Tom Roberts	Buena Vista	troberts@bvcity.org	540 319 8004
Waylon Miller	Buena Vista	bv25@bvcity.org	540 917 1442
Colter Lotts	Staunton	lottscre@ci.staunton.va.us	540-332-3868

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
April 3, 2019
Sign-In Sheet

Name	Locality or Organization	Email Address	Phone
Jon Ellestad	Glasgow	jellestad@glasgowvirginia.org	540-258-2246
Corey Wood	Craigsville	woodca.craigsvillepd@outlook.com	540-987-5814
David Williams	VMI	williamsdp@vmi.edu	(540) 464-7095
Milton Franklin	Bridgewater College	mfranklin@bridgewater.edu	540 830 5807
Austin Garber	Town of Timberville	townmanager@townoftimberville.com	540-896-7058
Keith Hartman	Buena Vista PD	KHartman@BUCity.org	540-261-6174
Paul Burns	Washington & Lee Univ	pburns@wlu.edu	540-460-6207
Roger Ramsey	Valley Community Services	RRamsey@vesb.org 540 480-0667	
Donna Good	Augusta ECC	dgood@co.augusta.va.us	540 245-5503
Anthony Ramsey	Augusta ECC	abramsey@co.augusta.va.us	946-245-5508
Laura Dwyer	Blue Ridge CC	dwyerl@brcc.edu	540-453-2533

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
April 3, 2019
Sign-In Sheet

Name	Locality or Organization	Email Address	Phone
William Wilkerson	Blue Ridge Community College	wilkersonw@brcc.edu	804 939-8909
Brett Sinclar	ACSA	bsinclar@co.augusta.va.us	540-430-3437
Deane Dozier	Cherry Orchard Homeowner	deanedozier@gmail.com	540-949-8853
Philip Davis	USDA-NRCS	philip.davis@va.usda.gov	540-433-2653 x:117
Amy Carter	Waynesboro DEM/EMS	carterg@ci.waynesboro.va.us	540 942 6698
Penny Weller	Staunton Fire-Rescue	wellerpw@ci.staunton.va.us	540-332-3720
Beky Putney	Town of Bridgewater	bputney@bridgewater.town	540-908-3397
Patrick Wilcox	"	pwilcox@ "	"
Chris Bruce	VDEM	chris.bruce@vdem.virginia.gov	804-516-5796
Karen Clark	Augusta Health	kclark@augustahealth.com	5403324540
Jeremy Holloway	Rockingham County	JHolloway@rockinghamcountyva.gov	540-564-3175

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
April 3, 2019
Sign-In Sheet

Name	Locality or Organization	Email Address	Phone
Jeff Michael	Rockingham County F/R	jmichael@rockinghamcountyva.gov	540-476-3242
Sharon Foley	Harrisonburg-Rockingham RSA	sfoley@hrrsa.org	540-820-0498
Anita Riggleman	HRRSA	ariggleman@hrrsa.org	540-434-1053
David Mawyer	Western State	mawyerd@gmail.com	540.569-0479
Patrick Robertson	WSH	patrick.robertson@dbhds.virginia.com	540-332-7368
Dan Jenkins	HRCSB	djenkins@hrcsb.org	540-434-1441
Ross Clem	Town of Broadway	rclem@town.broadway	540-578-0486
Sherry Ryder	Bath Co.	bathbpz@tds.net	540-839-7236
Hilary Crowin	Central Shenandoah Health District - VDH	Hilary.Crowin@vdh.virginia.gov	540-290-4100
Brendan Perry	Washington and Lee Univ	bperry@wlu.edu	540-958-4467
Nathan Garrison	Town of Grottoes	ngarrison@ci.grottoes.va.us	540-249-5896

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
April 3, 2019
Sign-In Sheet

Name	Locality or Organization	Email Address	Phone
Daniel Hanlon	Dayton PD	dhanlon@daytonva.us	540-879-2161 ext 317
Chris Ellis	Harrisonburg Chambe	christopher.ellis@BBandT.com	540/292-3940
Patti Nylander	Va. Dept. of Forestry	patricia.nylander@dof.virginia.gov	434-962-8172
Doug Wolfe	County of Augusta	dwolfe@co.augusta.va.us	540 245 5700
Tracy Hibbitts	CSPDC		
Rebecca Joyce	CSPDC		
Hunter Moore	CSPDC		

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
BRITE Transit Facility Meeting Room, Fishersville
Wednesday, April 3, 2019
10 a.m. – 12 p.m.

Agenda

10:00 a.m. **Welcome and Introductions**

- Ms. Rebecca Joyce, Community Program Manager, CSPDC

10:15 a.m. **Regional Hazard Identification**

- Ms. Hunter Moore, Regional Planner/GIS Coordinator, CSPDC
- Ms. Tracy Hibbitts, Regional Planner, CSPDC

11:00 a.m. **Break**

11:10 a.m. **Regional/Local Mitigation Goals and Strategies**

- Ms. Rebecca Joyce, Community Program Manager, CSPDC

11:40 a.m. **Public Outreach**

- Ms. Rebecca Joyce, Community Program Manager, CSPDC
- Ms. Tracy Hibbitts, Regional Planner, CSPDC
- Ms. Hunter Moore, Regional Planner/GIS Coordinator, CSPDC

11:55 a.m. **Closing and Adjournment**

- Ms. Tracy Hibbitts, Regional Planner, CSPDC

Central Shenandoah Valley Hazard Mitigation Plan
2019 Steering Committee Members

Administrative

Central Shenandoah Planning District Commission
Virginia Department of Emergency Management

Local Government

City of Buena Vista
City of Harrisonburg
City of Lexington
City of Staunton
City of Waynesboro
County of Augusta
County of Bath
County of Highland
County of Rockbridge
County of Rockingham
Town of Bridgewater
Town of Broadway
Town of Craigsville
Town of Dayton
Town of Elkton
Town of Glasgow
Town of Goshen
Town of Grottoes
Town of Monterey
Town of Mount Crawford
Town of Timberville

Other Organizations or Government Agencies

Augusta County Service Authority
Augusta Health
Blue Ridge Community College
Bridgewater College
Central Shenandoah Health District, Virginia Department of Health
Cherry Orchard Homeowners Association
Dixie Gas and Oil Corporation
Greater Augusta Regional Chamber of Commerce
Harrisonburg-Rockingham Chamber of Commerce
Harrisonburg-Rockingham Community Services Board
Harrisonburg-Rockingham Regional Sewer Authority
Holtzman Oil Corp.
James Madison University
Sentara Rockingham Memorial Hospital
Shenandoah National Park, National Park Service
Shenandoah Valley Project Impact
Shenandoah Valley Regional Airport
USDA- Natural Resources Conservation Service
Valley Community Services Board
Virginia Department of Environmental Quality
Virginia Department of Forestry
Virginia Military Institute
Washington and Lee University
Western State Hospital

FEMA

Fact Sheet

Federal Insurance and Mitigation Administration

LOCAL HAZARD MITIGATION PLANNING

Hazard Mitigation Planning for Resilient Communities

Disasters can cause loss of life; damage buildings and infrastructure; and have devastating consequences for a community's economic, social, and environmental well-being. Hazard mitigation is the effort to reduce loss of life and property by lessening the impact of disasters. In other words, hazard mitigation keeps natural hazards from becoming natural disasters.

Hazard mitigation is best accomplished when based on a comprehensive, long-term plan developed before a disaster strikes. Mitigation planning is the process used by state, tribal, and local leaders to understand risks from natural hazards and develop long-term strategies that will reduce the impacts of future events on people, property, and the environment.

The Local Mitigation Planning Process

The mitigation plan is a community-driven, living document. The planning process itself is as important as the resulting plan because it encourages communities to integrate mitigation with day-to-day decision making regarding land use planning, floodplain management, site design, and other functions. Mitigation planning includes the following elements:

Public Involvement – Planning creates a way to solicit and consider input from diverse interests, and promotes discussion about creating a safer, more disaster-resilient community. Involving stakeholders is essential to building community-wide support for the plan. In addition to emergency managers, the planning process involves other government agencies, businesses, civic groups, environmental groups, and schools.

Risk Assessment – Mitigation plans identify the natural hazards and risks that can impact a community based on historical experience, estimate the potential frequency and magnitude of disasters, and assess potential losses to life and property. The risk assessment process provides a factual basis for the activities proposed in the mitigation strategy.

Mitigation Strategy – Based on public input, identified risks, and available capabilities, communities develop mitigation goals and objectives as part of a strategy for mitigating hazard-related losses. The strategy is a community's approach for implementing mitigation activities that are cost-effective, technically feasible, and environmentally sound as well as allowing strategic investment of limited resources.

Disaster Mitigation Act of 2000

The Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended by the Disaster Mitigation Act of 2000, is intended to "reduce the loss of life and property, human suffering, economic disruption, and disaster assistance costs resulting from natural disasters."

Under this legislation, state, tribal, and local governments must develop a hazard mitigation plan as a condition for receiving certain types of non-emergency disaster assistance through the Hazard Mitigation Assistance Programs. The regulatory requirements for local hazard mitigation plans can be found at Title 44 Code of Federal Regulations §201.6.

For more information about FEMA's Hazard Mitigation Assistance Grants, visit: www.fema.gov/hazard-mitigation-assistance.

"FEMA's mission is to support our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all hazards."

Benefits of Hazard Mitigation

Mitigation is an investment in your community's future safety and sustainability. Mitigation planning helps you take action now, before a disaster, to reduce impacts when a disaster occurs. Hazard mitigation planning helps you think through how you choose to plan, design, and build your community and builds partnerships for risk reduction throughout the community. Consider the critical importance of mitigation to:

- Protect public safety and prevent loss of life and injury.
- Reduce harm to existing and future development.
- Maintain community continuity and strengthen the social connections that are essential for recovery.
- Prevent damage to your community's unique economic, cultural, and environmental assets.
- Minimize operational downtime and accelerate recovery of government and business after disasters.
- Reduce the costs of disaster response and recovery and the exposure to risk for first responders.
- Help accomplish other community objectives, such as capital improvements, infrastructure protection, open space preservation, and economic resiliency.

Having a hazard mitigation plan will increase awareness of hazards, risk, and vulnerabilities; identify actions for risk reduction; focus resources on the greatest risks; communicate priorities to state and federal officials; and increase overall awareness of hazards and risks.

Mitigation Activities for Risk Reduction

Possible mitigation activities may include:

Adoption and enforcement of regulatory tools, including ordinances, regulations, and building codes, to guide and inform land use, development, and redevelopment decisions in areas affected by hazards.

Acquisition or elevation of flood-damaged homes or businesses retrofit public buildings, schools, and critical facilities to withstand extreme wind events or ground shaking from earthquakes.

Creating a buffer area by protecting natural resources, such as floodplains, wetlands, or sensitive habitats. Additional benefits to the community may include improved water quality and recreational opportunities.

Implement outreach programs to educate property owners and the public about risk and about mitigation measures to protect homes and businesses.

Mitigation Plan Implementation & Monitoring

History shows that hazard mitigation planning and the implementation of risk reduction activities can significantly reduce the physical, financial, and emotional losses caused by disasters. Putting the plan into action will be an ongoing process that may include initiating and completing mitigation projects and integrating mitigation strategies into other community plans and programs. Monitoring the plan's implementation helps to ensure it remains relevant as community priorities and development patterns change.

Planning Guidance, Tools, and Resources

FEMA provides a variety of guidance, tools, and resources to help communities develop hazard mitigation plans. These resources and more can be found online at: www.fema.gov/hazard-mitigation-planning-resources.

- Hazard mitigation planning laws, regulations, and policies guide development of state, local, and tribal FEMA-approved hazard mitigation plans.
- The Local Mitigation Planning Handbook is the official guide for governments to develop, update, and implement local plans. The Handbook includes guidance, tools, and examples communities can use to develop their plans.
- Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards provides ideas for mitigation actions.
- Visit www.fema.gov/hazard-mitigation-planning-training for more information on available online and in-person mitigation planning training.

"FEMA's mission is to support our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all hazards."

Central Shenandoah Valley Hazard Mitigation Plan
2019 Hazard Identification Ranking

Name: _____

Locality/Organization: _____

Please select one ranking category below for each identified hazard. Please rank the hazards based upon what impact you feel they have on your community. An other category is provided if you have additional identified hazards you would like included.

	Significant	High	Medium	Low	None
Flooding					
Drought					
Hurricane					
Severe Winter Weather					
Land Subsidence/Karst					
Tornado					
Wildfire					
Landslide					
Terrorism					
Earthquake					
Other: _____					

Please select all dates that you might be available to attend a Steering Committee meeting. One meeting will be held in June and one meeting will be held in October. The meeting dates will be announced soon.

June:

Wednesday, June 5, 10 a.m. - 12 p.m. _____

Wednesday, June 12, 10 a.m. - 12 p.m. _____

Thursday, June 13, 10 a.m. - 12 p.m. _____

October:

Wednesday, October 2, 10 a.m. - 12 p.m. _____

Monday, October 7, 10 a.m. - 12 p.m. _____

Thursday, October 10, 10 a.m. - 12 p.m. _____

Goal 1: Improve local government planning, zoning, land use regulations and code enforcement to reduce impact of natural disasters.

Hazard: All Hazards
Location: Region-wide
Category: Prevention

Goal Statement: Perhaps the most cost-effective way to reduce damages due to natural hazards is to incorporate mitigation measures into planning, zoning ordinances, land use regulations, and code enforcement as described in the strategies below. Most of the hazards that impact our region can be reduced by addressing them upfront in planning and prevention and through code enforcement and regulatory activities.

Strategies

1.1 For flood hazards, strengthen current floodplain, zoning and site development ordinances by adopting higher standards that provide additional protection and limit or restrict further development in the floodplain, i.e. additional freeboard, flood protection setbacks, limitation on fill, minimization of hydrostatic pressure, protection for mechanical and utility systems, etc. For drought hazards, utilize growth management tools like zoning and land use regulations to encourage low-impact development and forest preservation. For land subsidence hazards, strengthen enforcement of land use, zoning regulations and building ordinances that regulate construction in areas susceptible to landslides and sinkholes i.e. steep slopes, intermittent stream channels, and karst topography.

1.2 Provide funds for water supply planning and ground water protection projects and seek and research alternative water supplies for communities. Improve forecasting and monitoring of drought conditions.

1.3 Ensure that floodplain ordinances and building codes are clearly understood by staff, property owners, developers, bankers and insurance companies.

1.4 Implement zoning tools that steer development away from hazardous areas or natural areas deserving preservation. Include Department of Forestry personnel in subdivision review for new development in woodland-urban interface areas.

1.5 Provide for tax incentives, donated easements, and other approaches that can assist in preserving land in the floodplain and other environmentally sensitive areas for agricultural, environmental, recreational or educational uses.

1.6 Rezone to open space or acquire undeveloped portions of floodplain to prohibit future residential building.

1.7 Limit government expenditures for public infrastructure such as roads and water and sewer service in hazard-prone areas.

1.8 Provide necessary staff and staff training to enforce floodplain regulations and building codes.

1.9 Provide training and appropriate equipment/tools for local fire fighters to respond to woodland fires.

1.10 Sponsor workshops for Building Officials that focus on floodplain ordinances and FEMA regulations.

Goal 2: Promote the Community Rating System (CRS).

Hazard: Flood/Hurricane
Location: Region-wide
Category: Prevention

Goal Statement: The National Flood Insurance Program (NFIP) administers a program called the Community Rating System (CRS) whereby the cost of flood insurance is reduced in those jurisdictions which carry out floodplain management activities which are more protective than the minimum requirements of the NFIP. Examples include public outreach, mapping and regulations, damage reduction, and preparedness activities. The benefit of CRS participation, other than the reduced cost of flood insurance premiums to policyholders, is the increased overall awareness of flood hazards in the community and decreased flood damages in the future.

Strategy

2.1 Introduce local jurisdictions to the Community Rating System (CRS) and assist them in applying for CRS certification for their communities.

Goal 3: Improve storm water management throughout the region.

Hazard: Flood/Hurricane
Location: Region-wide
Category: Prevention

Goal Statement: Development, whether in or out of the floodplain, has the potential to increase flooding throughout the watershed. Without due consideration of storm water management, development can increase runoff, causing areas previous unaffected by flooding to become flooded and flood depths to increase in other areas.

Strategies

3.1 Consider conducting a Regional Storm Water Management Study which would guide the localities in developing the most cost-effective storm water management system, not only within the political boundaries of each locality, but within the locality's watershed.

3.2 All communities benefiting from a regional storm water management plan could share in the cost of preparing the plan.

3.3 Seek funding to prepare site-specific hydrologic and hydraulic studies that look at areas that have chronic and repetitive flooding problems.

3.4 Consider utilizing special utility assessment districts where property owners who directly benefit from a specific public improvement are charged a fee that is proportional to the benefits received.

Goal 4: Implement watershed planning programs and conduct watershed analysis studies.

Hazard: Flood/Hurricane, Karst/Sinkholes
Location: Region-wide
Category: Prevention

Goal Statement: While it is important for communities to plan and take responsibility for the land uses that occur in their own floodplains, it must be recognized that flooding and water quality can be affected by land use activities that occur elsewhere. In order to address the wide range of water quality, water quantity, and stream stability problems that exist in our Region an integrated approach is needed. Watershed planning allows localities to look holistically at water resource problems beyond jurisdictional lines.

Strategies

4.1 Develop a regional, broad-based watershed plan among localities within a watershed in order to achieve effective and long-term flood protection and a healthy riverine environment.

4.2 Develop a watershed partnership, i.e. watershed roundtable to coordinate planning and program activities among natural resource agencies and stakeholders.

4.3 Conduct a site analysis mapping study to determine and understand the karst topography in our region.

Goal 5: Increase awareness of flood insurance and the National Flood Insurance Program (NFIP).

Hazard: Flood/Hurricane
Location: Region-wide
Category: Prevention

Goal Statement: Insurance does not prevent disaster damage, but it provides financial protection to support recovery, repairs, and reconstruction. All 21 localities in the Region participate and are in good standing with the National Flood Insurance Program (NFIP). This program is designed to provide flood insurance at affordable rates to policyholders. In return, the local jurisdictions agree to adopt and administer local floodplain management measures directed at protecting lives, existing property, and future construction from future flooding. Only about 25% of the structures in our region that are in the floodplain are covered by flood insurance.

Strategies

5.1 Encourage communities to remain active and compliant with the NFIP program.

5.2 Encourage citizens to purchase flood insurance. Partner with insurance companies, lenders, and real-estate agents to market the NFIP program.

5.3 Conduct NFIP training workshops for insurance providers.

Goal 6: Reduce the impact of natural disasters on private residential properties.

Hazard: Flood/Hurricane, Wildfires, Tornado/Wind, Winterstorms
Location: Region-wide
Category: Property Protection

Goal Statement: There are hundreds of residential structures located in hazardous areas, particularly the floodplain, throughout our region. Most of these structures were built in the floodplain or other vulnerable areas before the enactment of zoning ordinances and other regulations that prohibited building in these areas. For these existing as well as new structures, there are numerous measures that can be taken to reduce the impact of disasters.

Strategies

6.1 Develop a program to elevate, relocate, floodproof or acquire flood-prone houses in order to provide protection to these homes and reduce future damages.

6.2 Continue residential buyout and elevation projects of identified structures most at risk of future flooding with priority given to houses that are repetitively flooded.

6.3 For properties where elevation, relocation or acquisition is not feasible, introduce retrofitting measures to protect existing structures from flood damage. Retrofitting is relatively inexpensive and can include dry floodproofing, wet floodproofing, installing sewer backflow valves, berms, and sump pumps.

6.4 Design and landscape structures with wildfire safety in mind by utilizing fire-resistant materials when building especially in the urban-wilderness interface areas. Create safety and defensible space around structures. Provide adequate water resources/dry hydrants nearby woodland communities. Improve access for fire trucks and equipment. Increase knowledge of controlled burns and use of fire-retardant vegetations.

6.5 Include in local building codes a requirement for manufactured home tie downs and hurricane straps in high wind hazard and flood prone areas.

6.6 Offer financial incentives such as tax abatements, conservation easements, and low-interest loans to encourage property owners to elevate, relocate or floodproof buildings.

6.7 Encourage property owners to take advantage of NFIP's Increased Cost of Compliance (ICC). ICC helps pay for the cost of mitigation, including demolition and relocation, up to $15,000 for a flood- insured structure that sustains a flood loss and is declared to be substantially or repetitively damaged.

6.8 Provide guidance and technical assistance to citizens about measures they can take on their own to protect their properties.

6.9 For properties located in known karst and landslide areas, use corrective measures recommended by a professional site analysis (geotechnical or structural engineer) to protect homes.

6.10 Encourage developers to integrate mitigation techniques into new construction and renovation.

Goal 7: Improve disaster education and planning services for persons with special needs.

Hazard: All Hazards
Location: Region-wide
Category: Public Education and Awareness

Goal Statement: Our region is home to many persons with special needs. A number of state-run facilities, assisted living facilities, group homes, retirement communities, nursing homes, and other agencies that serve persons with special needs are also in our region. Persons with special needs are dramatically affected by disasters and include persons with medical issues, physical and mental disabilities, visual and hearing impairments, and the elderly. Non-English speaking citizens and pet owners are also considered to have special needs as well. Education programs and planning are essential to helping persons with special needs minimize the effects of disasters on their lives and homes.

Strategies

7.1 Educate persons with special needs on disaster preparedness and mitigation methods at community events and through public awareness campaigns.

7.2 Provide disaster preparedness and mitigation materials in alternate formats such as large print, audio-cassette, and languages other than English to make materials accessible for a wider audience in the community. Also provide sign language interpreters at community events, workshops, and other educational programs.

7.3 Work with the first responder community to educate them about the special needs that people may have during a disaster.

7.4 Encourage persons with special needs to contact their local emergency management office so their needs can be noted in the 911 system.

7.5 Offer emergency sheltering for persons with disabilities that can provide accommodations that take into account their special needs including the use of medical equipment requiring electrical power, etc.

7.6 Provide training in emergency operations planning and preparedness to organizations that serve persons with special needs to reduce down-time in service provision, to protect lives of staff and clients, and to reduce damage to facilities.

7.7 Work with emergency managers to make sure that weather alerts and warnings are in accessible formats for all citizens to receive essential information during a disaster.

7.8 Ensure that emergency vehicles are accessible for persons with special needs and available to assist in evacuation if needed.

7.9 Educate pet owners and farmers so they will include their pets and livestock in their family's preparedness planning.

7.10 Work with local animal welfare organizations to provide emergency sheltering for pets and livestock.

Goal 8: Reduce the impact of natural disasters on commercial property and businesses.

Hazard: Flood/Hurricane
Location: Region-wide
Category: Property Protection

Goal Statement: Many of the Region's older commercial districts, downtowns, and factories were built near the water. In particular are the Cities of Waynesboro and Buena Vista, in which businesses and industry have been flooded many times costing millions of dollars in property damage, lost revenue, and jobs. Projects that provide funds to floodproof and retrofit commercial buildings would not only provide protection from future flooding but could also preserve the downtown commercial districts.

Strategies

8.1 Identify and seek funding to provide engineering and design services that would determine the most cost-effective mitigation option for each business.

8.2 Seek funding to floodproof and retrofit commercial buildings where acquisition and elevation are not feasible.

8.3 Sponsor workshops that educate local business and industry about mitigation measures they can install to protect their structures and inventory during a disaster.

8.4 Develop a program to assist local business and industry in developing emergency and business continuity plans.

Goal 9: Improve community warning systems in the region.

Hazard: Flood/Hurricane, Wildfire, Winter Storms Tornadoes/Wind
Location: Region-wide
Category: Emergency Services

Goal Statement: Many of localities participate in a flood warning system developed by the National Weather Service called the Integrated Flood Observing and Warning System (IFLOWS). There are numerous IFLOW stream and rain gauges located throughout our Region. Two of our jurisdictions (Rockingham County and the City of Waynesboro) have "Reverse 911" systems installed. This system allows the locality to alert property owners, businesses, and industry of impending emergencies such as a chemical leak, tornado, flood, etc. through a recorded telephone message. Both the IFLOW and Reverse 911 systems are excellent and effective means to warn citizens of impending disasters. However, not all areas of our Region are covered sufficiently and effectively by this technology.

Strategies

9.1 Identify areas with recurring flood problems and request additional IFLOW stream/rain gauges to ensure that these areas are adequately covered and monitored. Areas that would benefit from an early warning system include the Greenlee Bridge on the James River near Natural Bridge Station in Rockbridge County.

9.2 Develop Emergency Action Plans for specific sites such as mobile home parks, apartment complexes, assisted living facilities, industrial facilities, and essential public facilities within disaster-prone areas and develop specific warning or notification plans for each identified site. These plans should include the designation of a point of contact or resident coordinator, with alternates, to receive warnings, the dispatch of police, sheriff, fire rescue units to these sites to issue warnings and pre-designation of routes. These specific warnings will supplement the general television or radio warnings, which most people receive.

9.3 Seek funding to purchase, install, and maintain Reverse 911 emergency warning systems and other state-of-the-art disaster response and recovery equipment.

9.4 Encourage businesses and public facilities located in high hazard areas to purchase NOAA Weather Radios. By receiving early notification of potential inclement weather, businesses and public facilities can benefit from additional time to prepare for natural disasters. Local governments may be eligible for grants to purchase equipment to be distributed in public facilities, businesses, and industries through out their jurisdictions.

9.5 Utilize emergency preparedness and evacuation plans for people living in high-hazard areas, especially people with special needs and mobility impairments.

Goal 10: Increase protection of public utilities and critical facilities.

Hazard: Flood/Hurricane, Wildfire, Winter Storms, Tornados/Wind
Location: Region-wide
Category: Structural Protection

Goal Statement: Most communities provide some public utility service such as water, sewer, and stormwater systems. Most of these facilities have been upgraded to meet environmental protection design criteria and to remain operational during a disaster. However, in some instances these facilities have failed or services have been disrupted.

Strategies

10.1 Evaluate and provide retrofit measures to prevent disruption of services. Measures can include elevating electrical controls and equipment and installing watertight doors where practicable at water and wastewater treatment plants.

10.2 Bury underground lines deeper and further away from waterways with stronger encasements in floodprone areas with erodible soils.

10.3 Increase the number of wind-secured critical facilities including schools, daycares, hospitals, and shelters.

10.4 Increase number of functional backup generators at critical facilities.

10.5 Establishing routine schedule for trimming trees/limbs around power lines to prevent power outages during wind events and ice storms.

10.6 Limit government spending on infrastructure in high hazard areas.

10.7 Conduct vulnerability assessments and develop security plans on public utility systems in accordance with the Bioterrorism Act of 2002.

Goal 11: Improve dam safety throughout the region.

Hazard: Flood/Hurricane, Land Subsidence
Location: Region-wide
Category: Structural Protection

Goal Statement: There are 28 flood control dams in the Region built between 1954 and 1980. Many are at or near the end of their planned design life and may pose a threat to public safety. The Soil and Water Conservation Districts have the responsibility for the operation and maintenance of most of these dams. Many of the dams in our Region require significant and costly rehabilitation and maintenance.

Strategies

11.1 Examine the risks posed by dams in watersheds that drain in the Region and consider adopting ordinances to restrict development around these dams because of the potential flooding danger in areas below and behind the dams.

11.2 Consider local government funding to maintain and upgrade these dams. Require regular inspection and maintenance schedules.

Goal 12: Improve storm drainage systems in the region.

Hazard: Flood/Hurricane
Location: Region-wide
Category: Structural Protection

Goal Statement: Much of the flooding problems in our Region are a result of poor drainage and inadequate infrastructure. Drainage systems are designed to provide a certain level of protection when maintained in proper condition. Systems that are not maintained on a regular basis may become clogged with debris caused by either natural events or dumping of lawn debris, appliances, and other materials. To minimize the amount of debris accumulation in the drainage system, a combination of public education, regulation, and maintenance programs are needed.

Strategies

12.1 Support projects that call for improved ditching, replacement of inadequate and undersized culverts, enlargements of bridge openings, and drainage piping needed to minimize flooding.

12.2 Develop regular maintenance programs and standard operation procedures and budget accordingly.

12.3 Encourage routine maintenance of creek beds and culverts to allow more water to be carried with special emphasis placed on culverts where there are repeated problems.

12.4 Notify property owners living along interior streams to keep the creek beds clear of debris, weeds, and high grass.

Goal 13: Implement stream remediation projects where needed.

Hazard: Flood/Hurricane
Location: Region-wide
Category: Structural Protection

Goal Statement: Local communities in the Region recognize the importance of protecting existing bank lines and bridge substructures. This can be accomplished with rip rap or gabion revetments, flood retarding structures, bulkheads and berms, and riparian buffers that have been properly designed or constructed.

Strategies

13.1 When implementing stream remediation projects consideration should be given when designing these structures and take into account stream characteristics that influence the selection of these measures such as channel width, bank height, bend radii, storm event, channel velocities and flood depth, and floodplain configuration.

13.2 Obtain maintenance and access easements from property owners for annual maintenance work.

13.3 Coordinate with and support the Region's Soil and Water Conservation Districts' Emergency Watershed Protection Programs.

Goal 14: Implement a disaster preparedness and mitigation education program.

Hazard: All Hazards
Location: Region-wide
Category: Public Education and Awareness

Goal Statement: There are many ways that citizens and business owners can protect themselves and reduce their losses caused by natural disasters. However, many citizens, even recent victims are unaware of these measures. Listed below are a number of activities that can be implemented in the Region to increase public awareness to the hazard and mitigation actions that can be taken to reduce future damage, injury, and death caused by the natural disasters.

Strategies

14.1 Develop comprehensive public information and education programs on disasters, including preparedness, recovery, mitigation and prevention. This can be accomplished through presentations, workshops and marketing materials for citizens, business, schools, local staff and elected officials in the Region. Much of this has been and can be accomplished through Shenandoah Valley Project Impact.

14.2 Develop a public education program to educate citizens about water conservation, to use of water-conserving appliances, and irrigation practices in agricultural areas. Written materials could be developed to teach developers and home owners about native and/or drought-tolerant grasses, shrubs, and trees to be planted around residential structures.

14.3 Increase public education and awareness regarding the dangers of winter storms including driving/traveling during a winter storm event. (Automobile accidents are the leading cause of death during a winter storm event.). Also, increase public awareness to health risks associated with winter storms including exposure, hypothermia, frostbite, overexertion, and accidents from falling/slipping.

14.4 Encourage communities to become involved with the Department of Forestry's Firewise program. Its goal is to encourage and acknowledge action that minimizes home loss to wildfire by preparing for a fire before it occurs.

14.5 Encourage communities to become involved in the National Weather Service program "Storm Ready". This program assists communities with local safety, planning, education, and communication programs needed to save lives and property before and during weather- related disasters.

14.6 Provide Community Emergency Response Team (CERT) training to citizens and maintain a CERT organization. Having an active CERT program will not only educate citizens about preparedness and mitigation measures, it will also provide a pool of trained volunteers that can assist during an emergency or disaster.

14.7 Develop a media campaign to educate the general public throughout the year about disasters when they may be likely to occur. For example a Spring campaign on tornado safety, winter storm preparedness in the Fall, and hurricane safety prior to the start of Hurricane Season. This holistic campaign would be designed to reach a multi-generational audience and would include mitigation and preparedness information.

14.8 Increase the number and use of NOAA weather radios or battery-powered radios or TVs. Improve the effectiveness of NOAA weather radios in the valley.

14.9 Utilize the services of amateur radio operators in the region.

14.10 Sponsor Hazard Mitigation Workshops designed to give information to contractors, property owners, and business owners on mitigation strategies such as acquisition, relocation, elevation, and floodproofing.

14.11 Develop Hazard Awareness programs with the local schools, youth programs, and libraries to disseminate information on natural hazards and mitigation actions. Utilize student environmental clubs to volunteer for projects.

14.12 Notify renters of homes, mobile homes, and apartments that they are located in an area that is subject to flooding and should consider purchasing flood insurance for their contents. Notification could be done via lease agreements.

14.13 Establish and maintain Hazard Resource Library/ Self Help Programs on natural hazards, mitigation and safety and related topics in a central location and available to or disseminated to property owners and businesses.

14.14 Strategically place flood elevation reference markers throughout the Region in an effort to educate and remind people of historical floods. The markers could show the elevation of the high water from previous floods as well as the 100-year flood levels in a particular area.

14.15 Notify potential homebuyers of flood hazards and requirements for flood insurance. Programs should be developed with the cooperation of banks, real estate agents, and insurance agents as well as community development staff.

14.16 Implement programs to provide property owners with flood elevation certificates in order to alert them to the fact that they their property is in the floodplain.

14.17 Provide appropriate local government staff with technical expertise and training on flood protection measures, retrofitting, flood insurance, flood warning and response, etc. in order to help citizens meet and understand floodplain requirements and flood hazards.

Goal 15: Improve hazard data collection and GIS for region.

Hazard: All Hazards
Location: Region-wide
Category: Public Information

Goal Statement: Many of the Flood Insurance Rate Maps (FIRM) produced by FEMA are outdated - most over 15 years old - and unreliable. These maps do not always reflect man-made alterations to floodplains caused by development that can change drainage patterns and increase flood hazards. Accurate and dependable maps are critical in helping the Region develop floodplain management strategies aimed at limiting the devastation caused by floods to area businesses and residents. Improved mapping, along with GIS, a computerized mapping and analysis tool, aids in the administration of building codes, land use plans, and efforts to identify risk areas and develop mitigation actions.

Strategies

15.1 Encourage communities to participate in FEMA's Cooperating Technical Partners (CTP) Program. This FEMA initiative establishes partners with local jurisdictions to develop and maintain up-to-date flood maps and other flood hazards. Mapping activities may include hydrologic and hydraulic analysis, floodplain mapping, preparation of digital FIRMs, and refinement of floodplain boundaries.

15.2 Consider creating a consortium of communities to tackle the problem of outdated FIRM maps and how to update the FIRM maps on a regional basis.

15.3 Ensure that all localities have digitized FIRM maps.

15.4 Acquire technology to assist in managing storm water, floodplain, and other land-based resources.

15.5 Utilize GIS technology to inventory at-risk infrastructure and public and private structures within at-risk areas.

15.6 Determine and map landslide/land subsidence, karst, and sinkhole vulnerable areas in the region. Archive events in a database to monitor trends and recurring sites. Coordinate with VDOT on sites impacting transportation infrastructure.

15.7 Identify and map assisted living centers, nursing homes, and facilities that serve people with special needs that require additional services during disasters.

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
June 5, 2019
Sign-In Sheet

Name	Locality or Organization	Email Address	Phone
Kevin Moore	Rockbridge County	kmoore@rockbridgecountyva.gov	540-319-9878
Harley Gardner	Highland Co	hgrdnr@yahoo	5402920456
Keith Taylor	Mt. Jackson, VA.	KTAYLOR@HOLTZMANCORP.COM	540-477-3131
Chris Bruce	VDEM	Chris.Bruce@vdem.virginia.gov	804-516-5796
Steven Craig	Dixie Gas and Oil Corporation	craigs@dixiegas.com	540-248-6273
Andy Stabout	Bath County	bathcodeofficial@tds.net	540-839-7236
Richard Robinson	Monterey	DOTRobin1@GM	540-290-5842
Steve Strawderman	SVPI	strawderman@juno.com	540-209-5919
Patti Nylander	Va. Dept. of Forestry	patricia.nylander@dof.virginia.gov	434-962-8172
Sharon Angle	City of Staunton	—	—
Dan Hanlon	Town of Dayton		

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
June 5, 2019
Sign-In Sheet

Name	Locality or Organization	Email Address	Phone
Ross E. Clem	Town of Broadway	reclem@town.broadway.va.us	540-578-0486
Penni Walker	City of Waynesboro	walkerPI@ci.waynesboro.va.us	540-221-1035
Deane Dozier	CHERRY ORCHARD HOMEOWNERS ASSOC.	deanedozier@gmail.com	540-949-8853
Betsy Putney	Town of Bridgewater	bputney@bridgewater.town	540-908-3397
Patrick Wilcox	Town of Bridgewater	pwilcox@ " "	" " 4205
Perry Weller	City of Staunton	wellerpw@ci.staunton.va.us	540-332-3720
Doug Wolfe	County of Augusta	dwolfe@co.augusta.va.us	540 245 5700
JAY WILLIAMS	VMI	WILLIAMSJL@VMI.EDU	540 464 7119
Paul Helmuth	Harrisonburg	paul.helmuth@harrisonburgva.gov	540-476-0860
COREY WOOD	CRAIGSVILLE	WOODCA.CRAIGSVILLE@OUTLOOK.COM	540 997-5935
Dave Robinson	NPS-Shenandoah NP	david_robinson@nps.gov	928-606-2694

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
June 5, 2019
Sign-In Sheet

Name	Locality or Organization	Email Address	Phone
ANITA RIGGLEMAN	HRRSA	ariggleman@hrrsa.org	(540)434-1052
Donna Good	Augusta Co.	dgood@co.Augusta.VA.US	540 245-5503
Gaither Hurt	TOWN OF ELKTON	ghurt@townofelkton.com	540 528-0563
Nancy Sorrells	Alliance for Shenandoah Valley	Lotswife@comcast.net	540-292-4170
Megan Deel	town of Goshen	townofgoshen_va@yahoo.com	540-997-5545
Jeff Micha	Rockingham County	JMichael@rockinghamcountyva.gov	540-426-3242
ARLÉ GLAESER	CITY OF LEXINGTON	AGLAESER@LEXINGTONVA.GOV	540 462 3730
KEITH HARTMAN	BUENA VISTA	KHARTMAN@BUENAVISTA.ORG	540-817-0029
ERIC POLLITT	GLASGOW	EPOLLITT@GLASGOWVIRGINIA.ORG	540 258 2248
ROGER RAMSEY	VCSB	RRAMSEY@VCSB.ORG	540 480 0667
HILARY CRONIN	CENTRAL SHENANDOAH HEALTH DISTRICT - VDH	HILARY.CRONIN@VDH.VIRGINIA.GOV	540-290-4100

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
June 5, 2019
Sign-In Sheet

Name	Locality or Organization	Email Address	Phone
Tom Roberts	City of Buena Vista	troberts@bvcity.org	

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
Augusta Health, Augusta Community Care Building
Conference Room 3
Wednesday, June 5, 2019
10 a.m. – 12 p.m.

Agenda

I. **Welcome** - Rebecca Joyce, Community Program Manager

II. **Regional Hazard Identification 2019 Ranking Results**

   a. **Ranking of Prior Hazards** - Tracy Hibbitts, Regional Planner

   b. **Consideration of Other Hazards** - Hunter Moore, Regional Planner/GIS Coordinator

III. **Break**

IV. **Regional/Local Mitigation Goals and Strategies** - Rebecca Joyce, Community Program Manager

V. **Public Input and Outreach** - Rebecca Joyce, Community Program Manager

VI. **Closing and Adjournment** - Tracy Hibbitts, Regional Planner

   a. **Next Meeting: Monday, October 7, 10 a.m. – 12 p.m. – Augusta Health, Augusta Community Care Building, Conference Rooms 1 & 2**

Central Shenandoah Valley Hazard Mitigation Plan

2019 Steering Committee Members

Administrative

Central Shenandoah Planning District Commission

Virginia Department of Emergency Management

Local Government

City of Buena Vista
City of Harrisonburg
City of Lexington
City of Staunton
City of Waynesboro
County of Augusta
County of Bath
County of Highland
County of Rockbridge
County of Rockingham
Town of Bridgewater
Town of Broadway
Town of Craigsville
Town of Dayton
Town of Elkton
Town of Glasgow
Town of Goshen
Town of Grottoes
Town of Monterey
Town of Mount Crawford
Town of Timberville

Other Organizations or Government Agencies

Augusta County Service Authority
Augusta Health
Blue Ridge Community College
Bridgewater College
Central Shenandoah Health District, Virginia Department of Health
Cherry Orchard Homeowners Association
Dixie Gas and Oil Corporation
Greater Augusta Regional Chamber of Commerce
Harrisonburg-Rockingham Chamber of Commerce
Harrisonburg-Rockingham Community Services Board
Harrisonburg-Rockingham Regional Sewer Authority
Holtzman Oil Corp.
Lexington-Rockbridge Chamber of Commerce
James Madison University
Sentara Rockingham Memorial Hospital
Shenandoah National Park, National Park Service
Shenandoah Valley Project Impact
Shenandoah Valley Regional Airport
USDA- Natural Resources Conservation Service
Valley Community Services Board
Virginia Department of Environmental Quality
Virginia Department of Forestry
Virginia Military Institute
Washington and Lee University
Western State Hospital

Hazard Identification Results		
Hazard Type	**2013 Rank**	**2019 Rank**
Flooding	Significant	Significant
Drought	High	High
Hurricane	High	High
Severe Winter Weather	High	High
Land Subsidence/Karst	Medium	Medium
Tornado	Medium	Medium
Wildfire	Medium	Medium
Landslide	Low	Low
Earthquake	Low	Low
Terrorism	Low	Low

Central Shenandoah Valley Hazard Mitigation Plan

2019 Other Hazard Identification Ranking

Name: _____

Locality/Organization: _____

Please select one ranking category below for each identified hazard. Please rank the hazards based upon what impact you feel they have on your community.

	Significant	High	Medium	Low	None
Transportation of Hazardous Materials / Industrial Event					
Dam Failure					
Livestock / Poultry Disease					
Derecho					
Opioids/Drugs					
Civil Unrest					
Infectious Disease / Pandemic Emergency					
Criminal Behavior					
Power Outages					
Environmental/ Water Quality					

Central Shenandoah Hazard Mitigation Plan - Mitigation Goals

2020 Mitigation Goals
2013 Mitigation Goals

Goal 1: Improve local government planning, zoning, land use regulations, and code enforcement to reduce the impact of natural and man-made hazards and disasters.

Goal 1: Improve local government planning, zoning, land use regulations, and code enforcement to reduce the impact of natural disasters.

Goal 2: Increase awareness of the National Flood Insurance Program (NFIP) and the Community Rating System (CRS) in local communities in the Region.

Goal 2: Promote the Community Rating System (CRS).
Goal 5: Increase awareness of flood insurance and the National Flood Insurance Program (NFIP).

Goal 3: Continue to improve stormwater management and infrastructure throughout the Region.

Goal 3: Improve stormwater management throughout the region.
Goal 12: Improve storm drainage systems in the region.

Goal 4: Conduct planning and studies and implementation of stormwater and flood mitigation projects at the watershed level when applicable.

Goal 4: Implement watershed planning programs and conduct watershed analysis studies.

Goal 5: Conduct planning and studies and implementation of wildfire mitigation projects in wildland areas, across communities, or at a regional level to address vulnerabilities of the Wildland Urban Interface in the Region.

Goal 6: Reduce the impact of natural and man-made hazards and disasters on private residential structures and properties.

Goal 6: Reduce the impact of natural disasters on private residential properties.

Goal 7: Assist with emergency planning, preparedness education, and hazard mitigation to individuals with special needs and service providers.

Goal 7: Improve disaster education and planning services for persons with special needs.

Goal 8: Reduce the impact of natural and man-made hazards and disasters on commercial structures and properties and businesses.

Goal 8: Reduce the impact of natural disasters on commercial property and businesses.

Goal 9: Improve access to systems that alert local emergency management officials of impending disasters from natural hazards such as rain and river gauges that alert to impending flooding that then allow for more advanced and informed warning to the public in the Region.

Goal 9: Improve community warning systems in the region.

Goal 10: Increase protection of public utilities, infrastructure, and critical facilities.

Goal 10: Increase protection of public utilities and critical facilities.

Goal 11: Improve dam safety throughout the Region.

Goal 11: Improve dam safety throughout the region.

Goal 12: Implement natural systems protection actions that not only minimize damage and losses but also preserve and restore these systems.

Goal 13: Implement natural stream remediation projects where needed.

Goal 13: Implement a disaster preparedness and mitigation and education program.

Goal 14: Implement a disaster preparedness and mitigation and education program.

Remove this goal.

~~*Goal 15: Improve hazard data collection and GIS for the region.*~~

Goal 14: Implement activities that promote resilience in the Region by enabling communities to better prepare, adapt to changing conditions, and become stronger to withstand and recover rapidly from stresses, shocks, and adverse situations.

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
October 3, 2019
Sign-In Sheet

Name	Locality or Organization	Email Address	Phone
Corey Wood	Craigsville	woodca.craigvillepd@outlook.com	540-292-9133
Jennifer Welcher	VDEQ	jennifer.welcher@deq.virginia.gov	540-574-7854
Sharon Angle	CSPDC	ladystaunton@verizon.net	540-480-4566
Steven Craig	Dixie Gas and Oil Corporation	Craigs@dixiegas.com	(540) 294-1328
Gary Cintora	City of Waynesboro	Cintorag@ci.waynesboro.va.us	540 241 2298
Scott Masincup	Sentara RMH	BXMASINC@Sentara	540-292-3762
TB Roberts	City of Lexington	tbroberts@lexingtonva.gov	540 463 3210
Dennis Driver	Mt. Crawford	doubledfour@comcast.net	540-421-2349
Paul Helmuth	Harrisonburg	paul.helmuth@harrisonburgva.gov	540-476-0860
Steve Strawderman	VDOT	strawdermans@vdot.com	540.209-5919
Carl Williams	Highland County	cwilliams@highlandrescue.net	540-632-7331

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
October 3, 2019
Sign-In Sheet

Name	Locality or Organization	Email Address	Phone
Harley Gardner	Highland	hgardner@yahoo	540 292 0452
Brittney Hurt	TOWN OF ELKTON	ghurt@townofelkton.com	540-578-0563
Dale Chestnut	JMU	chestndl@jmu.edu	540 568 7606
Kathy Hilm	USDA-NRCS	kathy.hilm@usda.gov	
Chris Bruce	VDEM	Chris.Bruce@vdem.virginia.gov	804-516-5796
Jonathan T. Simmons	VDEM RG	jonathan.simmons@vdem.virginia.gov	804-314-1053
Ross E. Clem	Town of Broadway	rclem@Town.broadway.va.us	540-578-0486
JAMES L WILLIAMS	VMI	WILLIAMSJL@VMI.EDU	540-464-7109
Richard Robinson	Monterey	DOTRobinrl at Gmail	540-468-3923
Michael Keirns	VDH	michael.keirns@vdh.virginia.gov	540 280 2473
Keith Hartman	Buena Vista	KHartman@buenavista.org	540-817-0009

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
October 3, 2019
Sign-In Sheet

Name	Locality or Organization	Email Address	Phone
Chris Cary	Shenandoah Valley Airport	ccary@flyshd.com	540-414-4056
Jeff Michael	Rockingham County	jmichael@rockinghamcountyva.gov	540-476-3241
Chrissy Snyder	Augusta Health	jsnyder@augustahealth.com	540-245-7337
Donna Good	Augusta ECC	dgood@co.augusta.va.us	540 245-5503
Anthony Ramsey	Augusta EMS	abramsey@co.augusta.va.us	540-245-5508
Perry Weller	City of Staunton	wellerpw@ci.staunton.va.us	540-332-3720
Cory Smith	City of Staunton	smithcs@ci.staunton.va.us	540 3323720
Betsy Putney	Town of Bridgewater	bputney@bridgewater.town	540-908-4212
Patricia Wilcox	" " "	pwilcox@ " . "	" " "
Kevin Moore	Rockbridge County	Kmoore@rockbridgecountyva.gov	540-319-9878
Andy Sorrells	Bath County	bathcodeofficial@tds.net	540-839-7236

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
October 3, 2019
Sign-In Sheet

Name	Locality or Organization	Email Address	Phone
Brett Sinclair	ACSA	bsinclair@co.augusta.va.us	540-430-3437
Dewy Wolfe	Augusta Co	dwolfe@co.augusta.va.us	245-5700
Keith Taylor	Holtzman Oil	KTAYLOR@HOLTZMANOILCORP.COM	477-3131
Nathan Garrison	Town of Grottoes	ngarrison@ci.grottoes.va.us	271-4584
Anita Riggleman	HRRSA	ariggleman@hrrsa.org	540-434-1053
Frances Cancelo	Augusta Health	fcancelo@augustahealth	540-332-4788
Laura Dwyer	Blue Ridge Community College	dwyerl@brcc.edu	540-453-2533
Chief William Wilkerson	BRCC	wilkersonw@brcc.edu	540-453-2310
Deane Dozier	CHERRY ORCHARD HOMEOWNERS	deanedozier@gmail.com	540-949-8853
Tracy Hibbitts	CSPDC		
Rebecca Joyce	CSPDC		
Hunter Moore	CSPDC		

Central Shenandoah Valley Hazard Mitigation Plan
Steering Committee Meeting
Augusta Health, Augusta Community Care Building
Conference Rooms 1 & 2
Monday, October 7, 2019
10 a.m.

Agenda

I. **Welcome** - Sharon Angle, Chair, Shenandoah Valley Project Impact

II. **Project Status Update and Timeline -** Rebecca Joyce, Community Program Manager

III. **Update on HIRA and Critical Facilities Maps** – Hunter Moore, Regional Planner/GIS Coordinator

IV. **Damage Assessments** – Tracy Hibbitts, Regional Planner

V. **Regional Strategies** - Rebecca Joyce, Community Program Manager and Tracy Hibbitts, Regional Planner

VI. **Local Strategies** - Rebecca Joyce, Community Program Manager

VII. **VDEM and FEMA Review Process** - Tracy Hibbitts, Regional Planner

VIII. **Locality Adoption Process** - Rebecca Joyce, Community Program Manager

IX. **Closing**- Sharon Angle, Chair, Shenandoah Valley Project Impact

Central Shenandoah Valley Hazard Mitigation Plan

2019 Steering Committee Members

Administrative

Central Shenandoah Planning District Commission

Virginia Department of Emergency Management

Local Government

City of Buena Vista
City of Harrisonburg
City of Lexington
City of Staunton
City of Waynesboro
County of Augusta
County of Bath
County of Highland
County of Rockbridge
County of Rockingham
Town of Bridgewater
Town of Broadway
Town of Craigsville
Town of Dayton
Town of Elkton
Town of Glasgow
Town of Goshen
Town of Grottoes
Town of Monterey
Town of Mount Crawford
Town of Timberville

Other Organizations or Government Agencies

Augusta County Service Authority
Augusta Health
Blue Ridge Community College
Bridgewater College
Central Shenandoah Health District, Virginia Department of Health
Cherry Orchard Homeowners Association
Dixie Gas and Oil Corporation
Greater Augusta Regional Chamber of Commerce
Harrisonburg-Rockingham Chamber of Commerce
Harrisonburg-Rockingham Community Services Board
Harrisonburg-Rockingham Regional Sewer Authority
Holtzman Oil Corp.
Lexington-Rockbridge Chamber of Commerce
James Madison University
Sentara Rockingham Memorial Hospital
Shenandoah National Park, National Park Service
Shenandoah Valley Project Impact
Shenandoah Valley Regional Airport
USDA- Natural Resources Conservation Service
Valley Community Services Board
Virginia Department of Environmental Quality
Virginia Department of Forestry
Virginia Military Institute
Washington and Lee University
Western State Hospital

Goal 1: Improve local government operations, planning, zoning, land use regulations, and code enforcement to reduce the impact of natural and man-made hazards and disasters.

Strategies

1.1 For flood hazards, strengthen current floodplain, zoning and site development ordinances by adopting higher standards that provide additional protection and limit or restrict further development in the floodplain, i.e. additional freeboard, flood protection setbacks, limitation on fill, minimization of hydrostatic pressure, protection for mechanical and utility systems, etc. For drought hazards, utilize growth management tools like zoning and land use regulations to encourage low-impact development and forest preservation. For land subsidence hazards, strengthen enforcement of land use, zoning regulations and building ordinances that regulate construction in areas susceptible to landslides and sinkholes i.e. steep slopes, intermittent stream channels, and karst topography.

1.2 Encourage water supply planning and ground water protection projects. Seek and research alternative water supplies for communities. Improve forecasting and monitoring of drought conditions.

1.3 Ensure that floodplain ordinances and building codes are clearly understood by staff, property owners, developers, bankers and insurance companies.

1.4 Implement zoning tools that steer development away from hazardous areas or natural areas deserving preservation. Include Department of Forestry personnel in subdivision review for new development in woodland-urban interface areas.

1.5 Provide for tax incentives, donated easements, and other approaches that can assist in preserving land in the floodplain and other environmentally sensitive areas for agricultural, environmental, recreational or educational uses.

1.6 Rezone to open space or acquire undeveloped portions of floodplain to prohibit future residential building.

1.7 Limit government expenditures for public infrastructure such as roads and water and sewer service in hazard-prone areas.

1.8 Provide necessary staff and staff training to enforce floodplain regulations and building codes.

1.9 Provide training and appropriate equipment/tools for local fire fighters to respond to woodland fires.

1.10 Sponsor workshops for Building Officials that focus on floodplain ordinances and FEMA regulations.

Goal 2: Increase awareness of the National Flood Insurance Program (NFIP) and the Community Rating System (CRS) in local communities in the Region.

Strategies

2.1 Introduce local jurisdictions to the Community Rating System (CRS) and assist them in applying for CRS certification for their communities.

2.2 Encourage communities to remain active and compliant with the NFIP program.

2.3 Encourage citizens to purchase flood insurance. Partner with insurance companies, lenders, and real-estate agents to market the NFIP program.

2.4 Conduct NFIP training workshops for insurance providers.

Goal 3: Continue to improve stormwater management for the infrastructure throughout the Region.

Strategies

3.1 Consider conducting a Regional Storm Water Management Study which would guide the localities in developing the most cost-effective storm water management system, not only within the political boundaries of each locality, but within the locality's watershed.

3.2 Seek funding to prepare site-specific hydrologic and hydraulic studies that look at areas that have chronic and repetitive flooding problems.

3.3 Consider utilizing special utility assessment districts where property owners who directly benefit from a specific public improvement are charged a fee that is proportional to the benefits received.

3.4 Support projects that call for improved ditching, replacement of inadequate and undersized culverts, enlargements of bridge openings, and drainage piping needed to minimize flooding.

3.5 Develop regular maintenance programs and standard operation procedures and budget accordingly.

3.6 Encourage routine maintenance of creek beds and culverts to allow more water to be carried with special emphasis placed on culverts where there are repeated problems.

3.7 Notify property owners living along interior streams to keep the creek beds clear of debris, weeds, and high grass.

Goal 4: Conduct planning and studies for the implementation of stormwater and flood mitigation projects at the watershed level when applicable.

Strategies

4.1 Develop a regional, broad-based watershed plan among localities within a watershed in order to achieve effective and long-term flood protection and a healthy riverine environment.

4.2 Develop a watershed partnership, i.e. watershed roundtable to coordinate planning and program activities among natural resource agencies and stakeholders.

4.3 Conduct a site analysis mapping study to determine and understand the karst topography in our region.

Goal 5: Conduct proactive planning focused on developing mitigation strategies and projects that focus on wildfire mitigation at the landscape scale in wildland areas across communities or at a regional level; to address vulnerabilities of the Wildland Urban Interface in the Region.

Goal 6: Reduce the impact of natural and man-made hazards and disasters on private residential structures and properties.

Strategies

6.1 Develop a program to elevate, relocate, floodproof or acquire flood-prone houses in order to provide protection to these homes and reduce future damages.

6.2 Continue residential buyout and elevation projects of identified structures most at risk of future flooding with priority given to houses that are repetitively flooded.

6.3 For properties where elevation, relocation or acquisition is not feasible, introduce retrofitting measures to protect existing structures from flood damage. Retrofitting is relatively inexpensive and can include dry floodproofing, wet floodproofing, installing sewer backflow valves, berms, and sump pumps.

6.4 Design and landscape structures with wildfire safety in mind by utilizing fire-resistant materials when building especially in the urban-wilderness interface areas. Create safety and defensible space around structures. Provide adequate water resources/dry hydrants nearby woodland communities. Improve access for fire trucks and equipment. Increase knowledge of controlled burns and use of fire-retardant vegetations.

6.5 Include in local building codes a requirement for manufactured home tie downs and hurricane straps in high wind hazard and flood prone areas.

6.6 Offer financial incentives such as tax abatements, conservation easements, and low-interest loans to encourage property owners to elevate, relocate or floodproof buildings.

6.7 Provide guidance and technical assistance to citizens about measures they can take on their own to protect their properties.

6.8 For properties located in known karst and landslide areas, use corrective measures recommended by a professional site analysis (geotechnical or structural engineer) to protect homes.

6.9 Encourage developers to integrate mitigation techniques into new construction and renovation.

Goal 7: Assist with emergency planning, preparedness education, and hazard mitigation to individuals with special needs and service providers. Special needs include but are not limited to physical, sensory, cognitive, or emotional disabilities; medical issues, and communication barriers.

Strategies

7.1 Educate persons with special needs on disaster preparedness and mitigation methods at community events and through public awareness campaigns.

7.2 Provide disaster preparedness and mitigation materials in alternate formats such as large print, digitally, and languages other than English to make materials accessible for a wider audience in the community. Also provide sign language interpreters at community events, workshops, and other educational programs.

7.3 Work with the first responder community to educate them about the special needs that

people may have during a disaster.

7.4 Encourage persons with special needs to contact their local emergency management office so their needs can be noted in the 911 system.

7.5 Offer emergency sheltering for persons with disabilities that can provide accommodations that consider their special needs including the use of medical equipment requiring electrical power, etc.

7.6 Provide training in emergency operations planning and preparedness to organizations that serve persons with special needs to reduce down-time in service provision, to protect lives of staff and clients, and to reduce damage to facilities.

7.7 Work with emergency managers to make sure that weather alerts and warnings are in accessible formats for all citizens to receive essential information during a disaster.

7.8 Ensure that emergency vehicles are accessible for persons with special needs and available to assist in evacuation if needed.

7.9 Educate pet owners and farmers so they will include their pets and livestock in their family's preparedness planning.

7.10 Work with local animal welfare organizations to provide emergency sheltering for pets and livestock.

Goal 8: Reduce the impact of natural and man-made hazards and disasters on commercial and industrial structures, properties, and businesses.

8.1 Identify and seek funding to provide engineering and design services that would determine the most cost-effective mitigation option for each business.

8.2 Seek funding to floodproof and retrofit commercial buildings where acquisition and elevation are not feasible.

8.3 Sponsor workshops that educate local business and industry about mitigation measures they can install to protect their structures and inventory during a disaster.

8.4 Develop a program to assist local business and industry in developing emergency and business continuity plans.

Goal 9: Improve access to systems that alert local emergency management officials of impending severe weather, emergencies, and disasters.

Goal 10: Improve community warning systems in the region.

Strategies

10.1 Identify areas with recurring flood problems and request additional IFLOW stream/rain gauges to ensure that these areas are adequately covered and monitored. Areas that would benefit from an early warning system include the Greenlee Bridge on the James River near Natural Bridge Station in Rockbridge County.

10.2 Develop Emergency Action Plans for specific sites such as mobile home parks, apartment complexes, assisted living facilities, industrial facilities, and essential public facilities within disaster-prone areas and develop specific warning or notification plans for each identified site. These plans should include the designation of a point of contact or resident coordinator, with alternates, to receive warnings, the dispatch of police, sheriff, fire rescue units to these sites to issue warnings and pre-designation of routes. These specific warnings will supplement the general television or radio warnings, which most people receive.

10.3 Seek funding to purchase, install, and maintain Reverse 911 emergency warning systems and other state-of-the-art disaster response and recovery equipment.

10.4 Encourage businesses and public facilities located in high hazard areas to purchase NOAA Weather Radios. By receiving early notification of potential inclement weather, businesses and public facilities can benefit from additional time to prepare for natural disasters. Local governments may be eligible for grants to purchase equipment to be distributed in public facilities, businesses, and industries throughout their jurisdictions.

10.5 Utilize emergency preparedness and evacuation plans for people living in high-hazard areas, especially people with special needs and mobility impairments.

Goal 11: Reduce the impact of natural and man-made hazards on public utilities, critical infrastructure, and public properties/lands.

Strategies

11.1 Evaluate and provide retrofit measures to prevent disruption of services. Measures can include elevating electrical controls and equipment and installing watertight doors where practicable at water and wastewater treatment plants.

11.2 Bury underground lines deeper and further away from waterways with stronger encasements in floodprone areas with erodible soils.

11.3 Increase the number of wind-secured critical facilities including schools, daycares, hospitals, and shelters.

11.4 Increase number of functional backup generators at critical facilities.

11.5 Establishing routine schedule for trimming trees/limbs around power lines to prevent power outages during wind events and ice storms.

11.6 Limit government spending on infrastructure in high hazard areas.

11.7 Conduct vulnerability assessments and develop security plans on public utility systems in accordance with the Bioterrorism Act of 2002.

Goal 12: Improve dam safety throughout the Region.

Strategies

12.1 Examine the risks posed by dams in watersheds that drain in the Region and consider adopting ordinances to restrict development around these dams because of the potential flooding danger in areas below and behind the dams.

12.2 Consider local government funding to maintain and upgrade these dams. Require regular inspection and maintenance schedules.

Goal 13: Implement natural systems protection actions that not only minimize damage and losses but also preserve and restore these systems.

Strategies

13.1 When implementing stream remediation projects consideration should be given when designing these structures and consider stream characteristics that influence the selection of these measures such as channel width, bank height, bend radii, storm event, channel velocities and flood depth, and floodplain configuration.

13.2 Obtain maintenance and access easements from property owners for annual maintenance work.

13.3 Coordinate with and support the Region's Soil and Water Conservation Districts' Emergency Watershed Protection Programs.

Goal 14: Implement a disaster preparedness and mitigation education program.

Strategies

14.1 Develop comprehensive public information and education programs on disasters, including preparedness, recovery, mitigation and prevention. This can be accomplished through presentations, workshops and marketing materials for citizens, business, schools, local staff and elected officials in the Region. Much of this has been and can be accomplished through Shenandoah Valley Project Impact.

14.2 Develop a public education program to educate citizens about water conservation, to use of water-conserving appliances, and irrigation practices in agricultural areas. Written materials could be developed to teach developers and homeowners about native and/or drought-tolerant grasses, shrubs, and trees to be planted around residential structures.

14.3 Increase public education and awareness regarding the dangers of winter storms including driving/traveling during a winter storm event. (Automobile accidents are the leading cause of death during a winter storm event.). Also, increase public awareness to health risks associated with winter storms including exposure, hypothermia, frostbite, overexertion, and accidents from falling/slipping.

14.4 Encourage communities to become involved with the Department of Forestry's Firewise program. Its goal is to encourage and acknowledge action that minimizes home loss to wildfire by preparing for a fire before it occurs.

14.5 Encourage communities to become involved in the National Weather Service program "Storm Ready". This program assists communities with local safety, planning, education, and communication programs needed to save lives and property before and during weather- related disasters.

14.6 Provide Community Emergency Response Team (CERT) training to citizens and maintain a CERT organization. Having an active CERT program will not only educate citizens about preparedness and mitigation measures, it will also provide a pool of trained volunteers that can assist during an emergency or disaster.

14.7 Develop a media campaign to educate the general public throughout the year about disasters when they may be likely to occur. For example a Spring campaign on tornado safety, winter storm preparedness in the Fall, and hurricane safety prior to the start of Hurricane Season. This holistic campaign would be designed to reach a multi-generational audience and would include mitigation and preparedness information.

14.8 Increase the number and use of NOAA weather radios or battery-powered radios or TVs. Improve the effectiveness of NOAA weather radios in the valley.

14.9 Utilize the services of amateur radio operators in the region.

14.10 Sponsor Hazard Mitigation Workshops designed to give information to contractors, property owners, and business owners on mitigation strategies such as acquisition, relocation, elevation, and floodproofing.

14.11 Develop Hazard Awareness programs with the local schools, youth programs, and libraries to disseminate information on natural hazards and mitigation actions. Utilize student environmental clubs to volunteer for projects.

14.12 Notify renters of homes, mobile homes, apartments that they are in an area that is subject to flooding and should consider purchasing flood insurance for their contents. Notification could be done via lease agreements.

14.13 Establish and maintain Hazard Resource Library/ Self Help Programs on natural hazards, mitigation and safety and related topics in a central location and available to or disseminated to property owners and businesses.

14.14 Strategically place flood elevation reference markers throughout the Region to educate and remind people of historical floods. The markers could show the elevation of the high water from previous floods as well as the 100-year flood levels.

14.15 Notify potential homebuyers of flood hazards and requirements for flood insurance. Programs should be developed with the cooperation of banks, real estate agents, and insurance agents as well as community development staff.

14.16 Implement programs to provide property owners with flood elevation certificates in order to alert them to the fact that they their property is in the floodplain.

14.17 Provide appropriate local government staff with technical expertise and training on flood protection measures, retrofitting, flood insurance, flood warning and response, etc. in order to help citizens meet and understand floodplain requirements and flood hazards.

Goal 15: Improve hazard data collection and GIS for the region.

Strategies

15.1 Encourage communities to participate in FEMA's Cooperating Technical Partners (CTP) Program. This FEMA initiative establishes partners with local jurisdictions to develop and maintain up-to-date flood maps and other flood hazards. Mapping activities may include hydrologic and hydraulic analysis, floodplain mapping, preparation of digital FIRMs, and refinement of floodplain boundaries.

15.2 Consider creating a consortium of communities to tackle the problem of outdated FIRM maps and how to update the FIRM maps on a regional basis.

15.3 Ensure that all localities have digitized FIRM maps.

15.4 Acquire technology to assist in managing storm water, floodplain, and other land-based resources.

15.5 Utilize GIS technology to inventory at-risk infrastructure and public and private structures within at-risk areas.

15.6 Determine and map landslide/land subsidence, karst, and sinkhole vulnerable areas in the region. Archive events in a database to monitor trends and recurring sites. Coordinate with VDOT on sites impacting transportation infrastructure.

15.7 Identify and map assisted living centers, nursing homes, and facilities that serve people with special needs that require additional services during disasters.

Goal 16: Implement activities that promote resilience in the Region by enabling communities to better prepare, adapt to changing conditions, and become stronger to withstand and recover rapidly from stresses, shocks, and adverse situations.

Goal 17: Review Mitigation and Community Improvement Plans in the aftermath of an event in order to encourage the implementation of mitigation projects during the recovery process.

Central Shenandoah Hazard Mitigation Plan: Local Mitigation Strategies

Community:
NFIP Community Number:

Regional Goals FEMA/VDEM Goals Required To Be Included In Plan Regional Wildfire Mitigation Plan Goals

Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program that was started in September 2000. Shenandoah Valley Project Impact educates citizens in the region about disaster preparedness and mitigation through public awareness campaigns, workshops and trainings, and an extensive resource library.	All Hazards	High	On-going	N/A	CSPDC	On-going
Maintain a relationship with the Southern Shenandoah Chapter of Virginia Voluntary Organizations Active in Disaster (VOAD), to share knowledge and resources throughout the preparation, response, and recovery phases of a disaster.	All Hazards	High	On-going	N/A	County City Town	On-going
Support implementation of structural and non-structural mitigation activities on private or public property to reduce exposure to and provide protection from natural and man-made hazards. Eligible projects include but are not limited to acquisition, elevation, minor structural flood control projects, relocation of structures, retrofitting of existing structures, infrastructure protection measures, stormwater and wastewater management improvements, advanced warning systems, hazard gauging systems, hazard education, and wildfire mitigation projects.	All Hazards	High	On-going	N/A	County City Town	On-going

Mitigation Strategy	Hazard	Priority High Medium Low	Project Status Delayed On-going Completed	If Not Completed, Why?	Responsible Party	Time Frame
Maintain the community's compliance with the National Flood Insurance Program (NFIP) by engaging in various activities included in the three basic components of the NFIP program; 1. floodplain identification and mapping risk, 2. responsible floodplain management, and 3. flood insurance. Sample activities include but are not limited to: maintaining publicly accessible and accurate Flood Insurance Rate Maps (FIRMs), adopting and enforcing a compliant floodplain ordinance, and provide general assistance and education to community members regarding the flood insurance program.	Flood	High	On-going	N/A	County City Town	On-going
Encourage the lessening of potential wildfires in our community and the region by; 1. Education and outreach to residents, especially those that live in woodland areas and the Wildland Urban Interface (WUI). 2. Reduction of hazardous fuels throughout the community. 3. Reduction of structural ignitability to limit injury, loss of life, and property and structural damage. 4. Having trained first responders with proper tools and equipment that will serve as a frontline defense against a wildfire.	Wildfire	High Medium	On-going	N/A	County City Town	On-going

Public Survey and Survey Results

2019 Central Shenandoah Valley Natural Hazards Survey

The Central Shenandoah Planning District Commission is in the process of updating its Central Shenandoah Valley Hazard Mitigation Plan. Hazard mitigation is the effort to reduce loss of life and property by lessening the impact of disasters before it happens. Mitigation plans allow a community to assess its risks, vulnerabilities and create strategies to reduce damage to structures, infrastructure, and properties. These plans help communities to become more resilient. By completing this survey, you will help the hazard mitigation planning team gain a better understanding of the public's perceptions and opinions regarding natural hazards.
Thank you for your help!

* 1. **Have you or someone in your household experienced any of the natural disasters below?** *(Please check ALL that apply)*

- ☐ Coastal Erosion
- ☐ Drought
- ☐ Dust Storm
- ☐ Earthquake
- ☐ Flood
- ☐ Household Fire
- ☐ Hurricane/Tropical Storm
- ☐ Landslide/Debris Flow
- ☐ Tsunami
- ☐ Volcanic Eruption
- ☐ Wildfire
- ☐ Windstorm
- ☐ Winter Storm/Blizzard

* 2. **How concerned are you about the following natural hazards affecting our area?** *(Please check only ONE box for each hazard)*

	Extremely Concerned	Very Concerned	Concerned	Somewhat Concerned	Not Concerned
Drought	○	○	○	○	○
Earthquake	○	○	○	○	○
Flood	○	○	○	○	○
Household Fire	○	○	○	○	○
Hurricane	○	○	○	○	○
Ice Storm	○	○	○	○	○
Landslide/Debris Flow	○	○	○	○	○
Wildfire	○	○	○	○	○
Wind Storm/Derecho	○	○	○	○	○
Winter Storm/Blizzard	○	○	○	○	○
Tornado	○	○	○	○	○

Other (please specify)

* 3. For each activity below please select: what you have done, plan to do in the near future, have not done, or are unable to do, in your household. *(Please check ONE answer per activity)*

	Have Done	Plan To Do	Not Done	Unable To Do
Attend meetings or received written information on natural disasters or emergency preparedness?	○	○	○	○
Developed a plan for what everyone would do in the event of a household emergency?	○	○	○	○
Prepared a "Disaster Supply Kit" (Stored extra food, etc.)?	○	○	○	○
In the last year, has anyone in your household trained in first aid or CPR?	○	○	○	○
Purchased Flood Insurance?	○	○	○	○
Implemented fire-resistance or floodproofing techniques on your home or business?	○	○	○	○
Installed smoke detectors and fire extinguishers in your home or business?	○	○	○	○

* 4. How concerned are you of an occurrence of a natural hazard on your property?

- ○ Extremely Concerned
- ○ Very Concerned
- ○ Concerned
- ○ Somewhat Concerned
- ○ Not Concerned

* 5. How much money are you willing to spend to better protect your family and home from natural disasters? *(Please check only ONE)*

- ◯ $50- 99
- ◯ $100-$999
- ◯ $1,000-$4,999
- ◯ $5,000 and above
- ◯ None

* 6. What modifications have you made or would you consider making to protect your home from natural disasters? *(Please check ALL that apply)*

- ☐ Anchor bookcases, cabinets to wall
- ☐ Secure water heater to wall
- ☐ Install latches on drawers/cabinets
- ☐ Fit gas appliances with flexible connections
- ☐ Purchase flood insurance
- ☐ Keep culverts, ditches, and gutters free of debris
- ☐ Elevate utilities and move appliances out of basements
- ☐ Seal basement walls and windows with waterproofing compounds
- ☐ Install check valves to keep sewer lines from backing up
- ☐ Secure home to its foundation
- ☐ Brace un-reinforced masonry and concrete walls and foundations
- ☐ Find out if you live in a floodplain
- ☐ Avoid building in a floodplain
- ☐ Elevate your house at least one foot above the 100-year flood elevation
- ☐ Relocate your home outside of the floodplain
- ☐ Select fire-resistant materials to build your home such as flame-retardant roof shingles
- ☐ Landscape your yard with fire-resistant vegetation
- ☐ Keep gutters clean
- ☐ Dispose of stove, grill and fireplace ashes properly
- ☐ Stack firewood at least 30 feet away and uphill from your home and clear combustible materials around it
- ☐ Place metal screens over structure openings
- ☐ None

* 7. Which of the following incentives, if any, would motivate you to take additional steps to better protect your family and home from a natural disaster? *(Please check ALL that apply)*

- ☐ Insurance discount
- ☐ Free (brief) training on preparation and prevention of property disaster
- ☐ Low interest rate loan
- ☐ Lower new home construction costs
- ☐ Free wildfire mitigation home assessment
- ☐ Other (please specify)
- ☐ Mortgage discount
- ☐ Federal or state grant
- ☐ Tax break or incentive
- ☐ None

8. In what county, city, or town do you live?

9. Do you own or rent your dwelling?

- ◯ Own
- ◯ Rent

10. Additional Comments:

11. Thank you for your participation!

This survey may be submitted anonymously; however, if you would like to receive information regarding upcoming public meetings for the hazard mitigation plan update, please provide your name and contact information:

Name	
Address	
Address 2	
City/Town	
State/Province	
ZIP/Postal Code	
Email Address	

Thank you for your time and providing this information!

For more information about the survey, please contact:

Rebecca Joyce, Community Program Manager
Central Shenandoah Planning District Commission
112 MacTanly Place
Staunton, Virginia 24401

by phone: (540)885-5174
e-mail: rebecca@cspdc.org

Central Shenandoah Valley All Hazards Mitigation Plan – 2020 Update
Natural Hazards Survey Report

Summary

Beginning in April 2018 with the Central Shenandoah Regional Wildfire Protection Plan until October 2019, the CSPDC conducted a survey of the citizens of the twenty-one jurisdictions in the Region. The purpose of this survey was to receive public input regarding perceptions about natural hazards experienced by individuals in the Central Shenandoah Region, their knowledge regarding mitigation techniques, and their willingness to implement mitigation measures.

Distribution of the survey was purposely widespread throughout the Region. Individuals had the option to complete the survey on-line, as a paper copy, or by telephone interview. A press release explaining the survey and how citizens could obtain a copy was distributed in a mass e-mail to contacts throughout the Region and to various media outlets such as newspapers and local television stations.

Five hundred and fifty-seven (557) people completed the survey. The majority of completed surveys were from Augusta County, 156; the City of Staunton, 65; and Rockingham County, 54 based on the responses of the 478 people who answered the question regarding where they live.

Results

- The survey asked respondents which natural disasters they had experienced. The top four natural disasters were; winter storms (82%), windstorms (49%), hurricanes/tropical storms (48%), and floods (44%). With the survey done for the last update of the Plan, windstorms were not included as a top category. This change may be the result of the 2012 Derecho and several smaller, localized windstorms we have had since the last update.

- Respondents were asked to state their concerns about natural hazards affecting the Shenandoah Valley. The largest percentages for each disaster fell in the middle of the rating scale in the *Concerned* category: with the largest being household fire (35%), windstorm/derecho (32%), winter storm (32%), drought (31%), and hurricanes (30%). The *Very Concerned* or *Extremely Concerned* categories did not receive a majority for any hazard. In the survey for the 2013 update, respondents were *Very Concerned* about winter storms/ blizzards (35%) and ice storms (33%). Hurricanes (31%), drought (32%), and floods (30%) had respondents *Concerned* in their response to that survey.

- The survey listed several mitigation activities and asked respondents which of these they had completed. Answers for this survey are in **bold.** Answers from the previous survey are in *italics*. Completed activities included:

    - Installed smoke detectors. **(90%)** *(88%)*
    - Attended meetings or received information about natural disasters or emergency preparedness. **(67%)** *(54%)*
    - Trained in First Aid or CPR in the last year. **(49%)** *(53%)*
    - Prepared a disaster supply kit. **(46%)** *(37%)*
    - Developed a household emergency plan. **(50%)** *(34%)*
    - Implemented fire-resistance or floodproofing techniques. **(27%)** *(19%)*
    - Purchased flood insurance. **(7%)** *(8%)*

- Less than 20% of respondents are *Very Concerned* or *Extremely Concerned* about an occurrence of a natural hazard on their property.

- When asked how much money would respondents be willing to spend to better protect their family and homes from natural disasters; forty-seven percent (47%) said they would spend up to one thousand dollars ($1,000), twenty-five percent (25%) said they would spend up to five thousand dollars ($5,000), and seven percent (7%) would spend five thousand dollars ($5,000) or above.

- The survey listed several types of modifications people have made or would make to protect their home from natural disasters. The three most popular modifications were:

    - Eighty-seven percent (87%) of respondents would keep gutters clean.
    - Sixty-nine percent (69%) of respondents would keep culverts, ditches, and gutters free of debris to allow the free flow of potential floodwaters.
    - Sixty-six percent (66%) of respondents would dispose of stove, grill, and fireplace ashes properly.

- Respondents were asked what incentives would motivate them to take additional steps to better protect their family and homes from a natural disaster. The three incentives that received the most responses were:

    - Seventy-three percent (73%) of respondents said an insurance discount would be a motivating factor.

    - Fifty percent of respondents (50%) said a tax break or incentive would be a motivating factor.

    - Forty-seven percent (47%) of respondents said a federal or state grant would be a motivating factor.

Conclusions

What conclusions can be drawn by examining the responses of the five hundred and fifty-seven (557) individuals that completed the survey?

- The most common natural disasters that respondents have experienced are the ones that have happened most frequently. Windstorms/Derechos are new to this list.

- The disasters respondents expressed the most concern about are the ones that occur the most frequently. Windstorms/Derechos are new to this list. House fires are more of a concern than in the past.

- Mitigation and preparedness information is being distributed and received by citizens throughout the Central Shenandoah Region.

- Since the last HMP update more respondents are doing the three most essential tasks needed to prepare for emergencies and disasters; creating a family plan, assembling a disaster supply kit, and receiving information about hazards preparedness.

- Fire safety education in the Central Shenandoah Valley continues to be extremely effective as illustrated by 90% of respondents having installed smoke detectors. This has stayed consistent since the previous update of the HMP.

- Yard work and home maintenance activities that reduce combustible debris and assist with the proper drainage of stormwater are simple mitigation methods a majority of respondents are willing to undertake to prevent damage to their property.

- Not more than one thousand dollars ($1,000.00) is the amount of financial resources that the majority of respondents are willing to spend to protect their families and properties from natural hazards. This trend has not changed since the previous HMP.

- Financial incentives whether through insurance discounts, tax breaks, or grants are the most motivating factors to respondents in order to implement steps to protect their homes and families. The most motivating factor is now insurance discounts compared to the last HMP where tax breaks were the most popular incentive.

In conclusion, while the Central Shenandoah Valley continues to make strides in its progress towards disaster-resistance and resilience there is still much work to be done.

Appendix B -

James Madison University

Climate Adaptation Chapter

CLIMATE ADAPTATION

Submitted to the Central Shenandoah Planning District Commission

Raven Brubach, Macon Thompson, Alex Cherney, Anton Foretich, Jake Rehm, Joe Ziegler, Jesse Faas

James Madison University

April 29, 2019

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Introduction

The impacts of climate change have the potential to be hazardous to the communities and environment of the Central Shenandoah Valley. As the impacts from climate change increase, the region will face more frequent, severe storms and natural disasters. These threaten local commercial and agricultural industries and infrastructure, as well as the safety and well-being of residents within the Central Shenandoah Planning District Commission (CSPDC) region. As population continues to grow, the risk of supplementary physical damage and economic loss will rise, as well.

Population

The population of the individual cities and counties of the CSPDC region vary considerably (Table 1). Rockingham and Augusta counties have the highest populations as well as the highest median household income, median property value, and number employed (Data USA, 2019-h; Data USA, 2019-b). Each locality is expected to see an increase in population except for Bath County, Highland County and the City of Buena Vista, where the populations are slowly declining (Data USA, 2019-b; Data USA, 2019-d; Data USA, 2019-c). The city of Harrisonburg has a population growth rate of 2.09%, the fastest growing within the region; it also has the third highest median property value behind Rockingham and Augusta counties (Data USA, 2018-e; Data USA, 2019-h). Amongst the most common occupations within the localities are administrative, sales and management positions; however, there are comparatively high numbers of residents working within the farming, fishing, and forestry occupations as well as firefighting and prevention, and other protective service jobs. (Data USA, 2019-a-j). As people continue to move into the area, prompting further infrastructure and development, the risk of economic and social losses will increase unless additional hazard mitigation measures are taken to match the threat of increasingly destructive weather.

Land Use

The Central Shenandoah Valley region consists of 3,439 square miles located in western Virginia between the Blue Ridge and Allegany Mountains (Central Shenandoah Valley Region, 2015). According to each county's latest comprehensive plan, the majority of Central Shenandoah Valley land is dominated by forest and agriculture. The region's growing

Table 1. Population Data for Central Shenandoah Region (Data USA, 2019).

County/City	Population	Population Growth Rate (Between 2015-2016)	Median Household Income	Median Property Value	Number of Employees
Augusta	74,330	0.37%	$56,802	$199,700	34,486
Bath	4,558	-0.55%	$44,985	$146,400	2,209
Highland	2,230	-0.62%	$44,877	$160,800	982
Rockbridge	22,450	0.03%	$52,478	$193,300	10,184
Rockingham	78,427	0.83%	$55,029	$200,900	38,083
Buena Vista	6,495	-1.74%	$33.672	$111,700	2,806
Lexington	7,113	1.09%	$37,309	$252,500	2,257
Harrisonburg	53,064	2.09%	$43,009	$196,200	26,008
Staunton	24,273	0.161%	$46,435	$162,500	11,848
Waynesboro	21,620	1.19%	$42,112	$161,600	9,976

recreational and agricultural industries are supported by such land use. All five counties within the CSDPC region have over 10% of land use devoted to agriculture; however, the largest percentages are in Rockbridge and Rockingham counties that respectively utilize 73% and 46% of their land for agriculture. State and Federal lands such as Shenandoah National Park, George Washington National Forest, and Jefferson National Forest are located within the CSPDC bounds and are a significant attraction to the area (Figure 1). Within the region, efforts to increase lands dedicated to conservation and recreation purposes are being made with intent to preserve their intrinsic value.

Changes to Weather and Climate Patterns

"Climate" describes the long-term weather patterns in a specific region. Regions with the same climate are likely to have similar averages of precipitation, temperature, wind, insolation, and humidity. These averages are referred to as "climate normals" (NOAA, 2018). Earth's climate goes through periodic cycles that normally take place over a span of

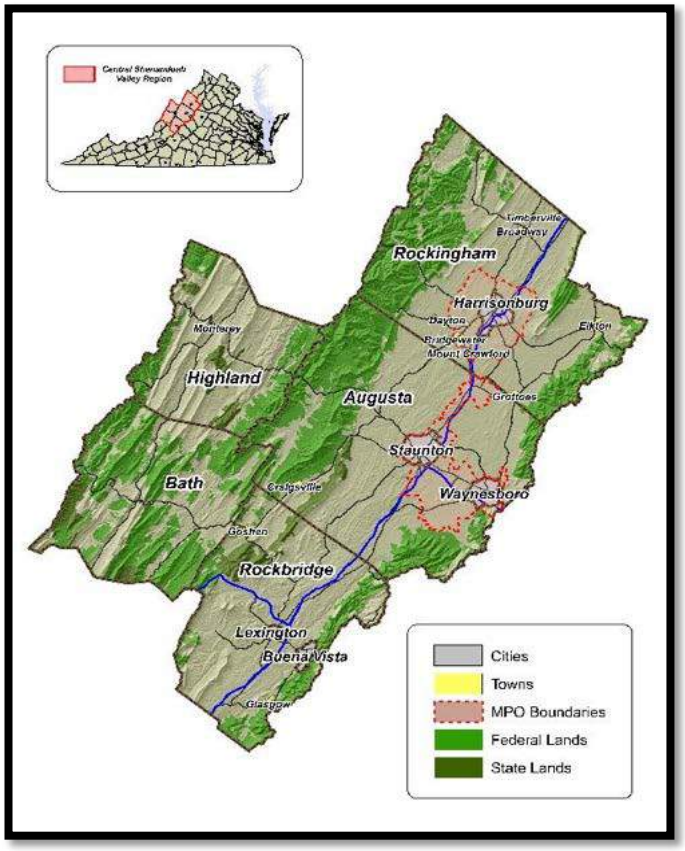

Figure 1. Map of Localities in Central Shenandoah Valley Region (CSDPC, 2019).

thousands of years (NASA, 2014). However, this process is accelerated due to anthropogenic causes (environmental pollution caused by humans), such as the increase of carbon dioxide and other greenhouse gases in the atmosphere. The rapid rate at which climate change is taking place is concerning and increasingly impacting world economies and human health. Within the past 100 years, Earth's average temperature has risen one-degree Fahrenheit and is expected to increase up to 10 degrees over the next 100 years (NASA, 2014). Climate change can increase the frequency and severity of hazardous weather events such as hurricanes, tornadoes, winter storms, droughts, wildfires, and floods. In the Central Shenandoah Valley, climate change will present hazards to the sustainability of the agricultural, commercial, residential, urban, and recreation sectors. It is important for local communities to be aware of these hazards in order to plan for resilience and adaptation.

The effects of climate change on local weather are seen throughout the Central Shenandoah Valley, which displays varied topography and elevation. Data compiled by the National Oceanic and Atmospheric Administration (NOAA) clearly demonstrates that local, regional and national trends in temperature, extreme climate variations, as well as natural disaster frequency have increased over the past century (NOAA, 2019-b; NOAA, 2019-c; NOAA, 2019-e). The southeast region of the United States has been experiencing a recent increase in climate extremes. NOAA (2019-e) quantifies extreme variations of climate cycles

using the Climate Extremes Index (CEI). The regional CEI consists of five indicators compiled to create an annual timeline from 1910 to 2018. The indicators, called steps, include: extremes in maximum temperature, minimum temperature, Palmer Drought Severity Index (PDSI), 1-day precipitation, as well as days with and without precipitation. In the Southeast (Figure 2), there is a sharp increase in the percentage of indicators per year within the past decade (NOAA 2019-e). The green trendline, or 9-point binomial filter, reached past 40% for the first time in 1990, doubling the overall average of 19.7%. This occurs in five other instances within a 20-year span from 1998-2018. Extreme changes have taken place in a short time period, increasing in frequency as the graph approaches present day. It is likely that this trend will continue and the southeast, including Virginia, will experience more drastic weather patterns and potentially more dangerous and destructive hazards as a result (National Climate Assessment, 2014; States at Risk-Virginia, 2019; United States Environmental Protection Agency, 2016).

NOAA's graph (2019-b) of billion-dollar weather climate disasters for Virginia reveals a trend similar to that of seen in the Southeast's extreme climate variations. Within the past 20 years, the number of natural disasters that caused a billion or more dollars in damage has increased drastically within Virginia (Figure 3). The brightly colored trendlines, representing years with the highest costs for disaster events, are all located above the black trendline, representing the average number of events from 1980-2018. The most expensive year for Virginia took place in 2018, where all 12 months exceeded the average, and some months tripled the average cost of disasters per month.

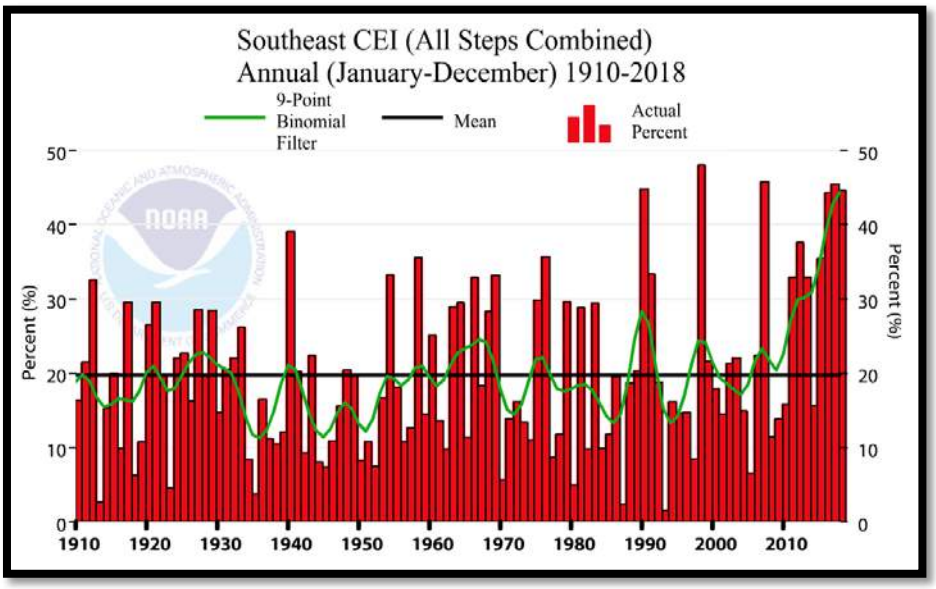

Figure 2. Graph of Climate Extremes Index for southeast (NOAA, 2019-e).

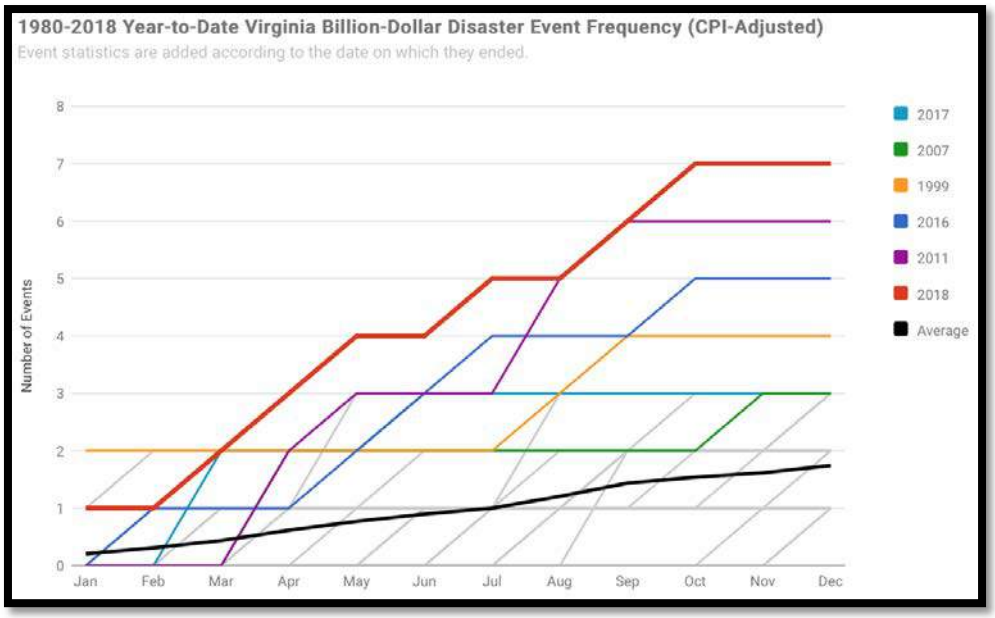

Figure 3. 1980-2018 Year-to-Date Billion-Dollar Disaster Event Frequency (CPI-Adjusted), (NOAA, 2019-b).

The Central Shenandoah Valley has witnessed an increase in precipitation and temperature throughout the last century. According to NASA's (2019) description of the patterns expected as climate change continues, dry areas will become drier, wet areas are expected to face an increase in precipitation brought on by higher average temperatures, and storms are expected to become more intense. Rockingham and Rockbridge counties have experienced an overall increase in the annual average temperature since 1896 (Figures 4, 5) (NOAA, 2019-c; NOAA, 2019-d). This tendency is observed throughout the remaining counties within CSPDC, as well.

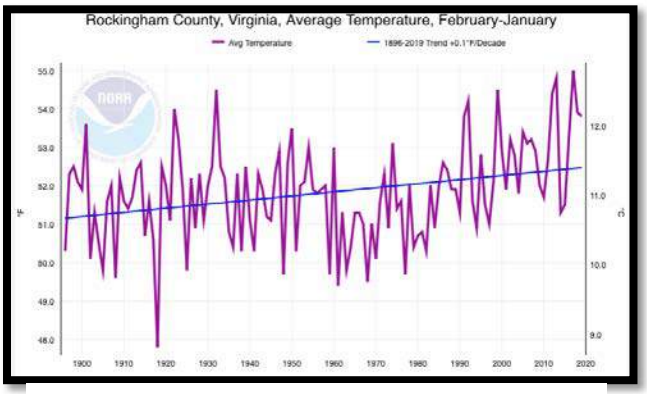

Figure 4. Rockingham County's annual average temperature from 1896-2019 (NOAA, 2019-d).

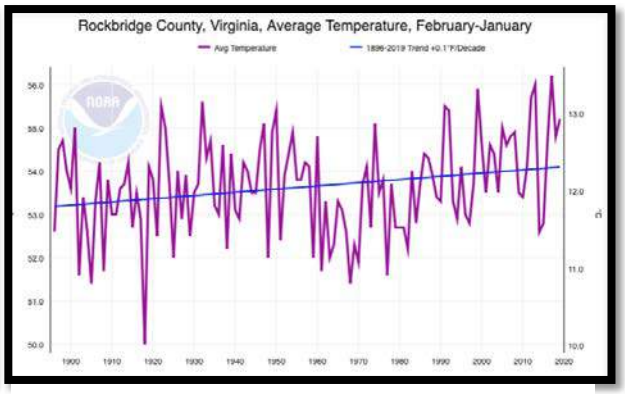

Figure 5. Rockbridge County's annual average temperature from 1896-2019 (NOAA, 2019-c).

As of February 2019, the entirety of Virginia has experienced higher amounts of precipitation than normal (Figure 6). While Rockingham, Highland, and Augusta counties have had above

average precipitation, both Bath and Rockbridge counties have had well above average precipitation, according to NOAA (2019-c; 2019-d).

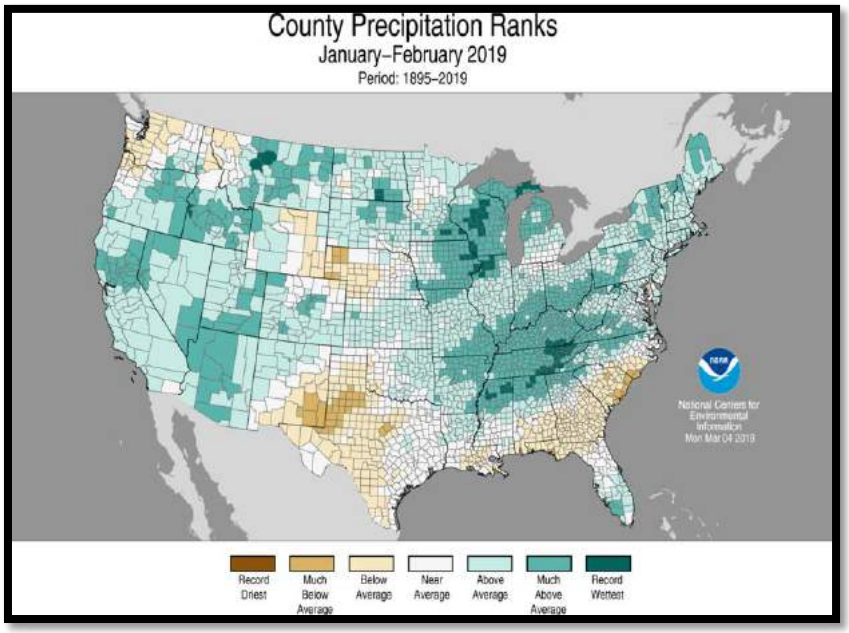

Figure 6. United States County Precipitation Ranks as of January-February 2019 (NOAA, 2019-f)

While the region is experiencing higher amounts of rain than normal and increased probability of flooding, there is still the possibility of severe drought due to the Central Shenandoah's geographic location. Bath and Highland counties sit within the Allegheny Mountains, with Rockingham, Rockbridge, and Augusta counties bordering on the Allegheny Mountains to the west and the Blue Ridge Mountains to the east. (Central Shenandoah Valley Region, 2015). Even with more frequent storms, if the Central Shenandoah Valley becomes drought stricken, rain will not alleviate the symptoms. Once soil moisture evaporates the ground becomes hard and dense, making it difficult for it to absorb any water. When it does rain, the water ends up running off into rivers and streams instead of infiltrating into the soil (Climate Reality Project, 2016).

Hazard Profile

Agriculture: Livestock

The agriculture industry is among the most important sectors of the economies of the five counties (data not available on the cities) within Central Shenandoah. With a large economic output of $959,013,000 collectively amongst the counties, the importance of mitigating the hazards to the industry into the future of climate change is apparent (U.S. Agricultural Census, 2012). In all five counties, livestock production provides far greater economic output than that of crop production. Therefore, livestock production must be a priority in terms of allocating resources to hazard mitigation programs. Data on the agricultural industry within the five counties for analysis of the hazards particular to it is provided in (Table 2).

Table 2. ***Data on the number of farms, their average acreage, economic output for livestock and crop production, the types of livestock with top economic output, and the quantity of the top livestock within the county presented. The data was retrieved from the Virginia Community Profile websites for each of the respective counties within the jurisdiction of the CSPDC. The websites are maintained by the Virginia Employment Commission (Virginia Employment Commission, 2019) (U.S. Agricultural Census, 2012).***

Variable	Rockingham	Rockbridge	Bath	Augusta	Highland	Total
Number of Farms	1902	833	116	1,706	261	4,818
Land in Farms (acres)	222,049	168,376	41,332	360,137	93,080	884,974
Average Size of Farm	117	202	356	152	357	1,184
Crop Sales (dollars)	47,606,000	6,974,000	1,340,000	27,685,000	1,362,000	84,967,000
Livestock Sales (dollars)	611,389,000	24,804,000	4,717,000	204,432,000	28,705,000	874,047,000
Total Value of Agricultural Products Sold	658,995,000	31,778,000	6,057,000	232,117,000	30,067,000	959,014,000
Top Livestock Inventory Item	Broilers/meat-type Chickens	Turkeys	Cattle/calves	Broilers/meat-type Chickens	Turkeys	N/A
Quantity of Top Livestock Item Within County	12,879,488	49,376	5,707	3,496,853	152,165	16,583,589
Ratio of Men to Women within Agricultural Industry	7.05	6.57	7.92	7	7.41	AVG= 7

Temperature increases related to climate change increasingly threaten the livestock sector by decreasing feeding efficiency, water availability, milk production, egg production, and livestock reproduction. It also simultaneously degrades the industry by increasing industry water demands, pest related illnesses, lignin (a complex organic polymer which makes the cell walls of many plants rigid and difficult to digest) in plants, and pathogen

contact (Harrigan, 2017). Every hazard represents threats to the economic viability of the livestock industry within the Central Shenandoah Valley region. Nationwide, heat stress (which is the hazard of most concern to the livestock industry here) is already responsible for annual economic losses between 1.69 and 2.36 billion dollars, of which 50% occurs in the dairy industry supported by livestock (Harrigan, 2017).

Livestock have a "thermal neutral zone," the range of temperatures to which the animals can be subjected before physiologically responding negatively (Harrigan, 2017). Each species of livestock has a different thermal neutral zone; however, lighter fur color and smaller size favor higher temperature thresholds (Renaudeau, 2012). When livestock are subjected to temperatures above this thermal neutral zone, the response to heat stress includes reductions to feed intake, increases to water intake, and changes in respiration rate (Johnson, 2018). The reduced feed intake means a reduction in weight, making livestock less valuable. Additionally, heat stresses also cause a reduction in milk production, egg production, and the efficiency of feed conversion, all of which reduce the economic output of the livestock (Harrigan, 2017). Heat stress can also reduce reproductive rates in livestock (Johnson, 2018). With the general increases in temperatures (Figures 4, 5), it is projected that heat stress will increasingly threaten the economy of the Central Shenandoah and its agricultural industries.

A reduction in nutrient intake rate (the amount of nutrients livestock intake from eating in a given time) will be a critical climate change hazard to the livestock industry. The relationship between increased temperatures and average nutrient intake for growing pigs along with daily bodyweight gain (Figure 7) reveals a steep drop off in energy intake and body weight gain as temperatures exceeded 22 degrees Celsius.

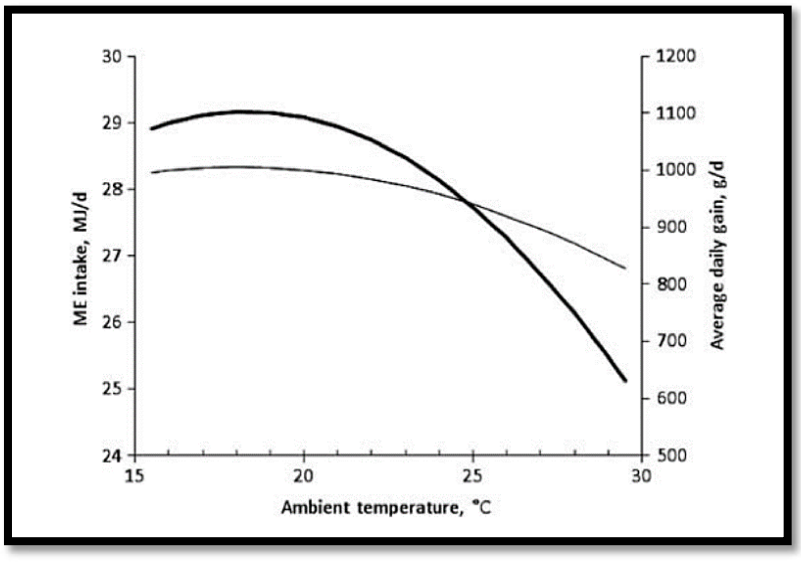

Figure 7: The increasing effect of ambient temperatures between 15-30 degrees Celsius on growing pigs and their daily nutrient intake (Renaudeau, 2012).

The poultry industry in Rockingham County, which includes almost thirteen million broilers, will be more vulnerable to the hazards associated with climate change (U.S. Agricultural Census, 2012). In Rockingham County alone (where agricultural economic output is greatest), $611,389,000 of the $658,995,000 total agricultural economic output comes from livestock production, and most of that from broilers/meat-type chickens. Temperatures higher than 30 degrees Celsius (86ºF) can subject the poultry to heat stress (Harrigan, 2017), which means reduced weight gain, feed intake, carcass weight, and protein/muscle calorie content. Egg production from poultry can also be compromised with increased temperatures, as ovulation can be interrupted. Heat stress can reduce egg numbers, total weight, shell weight, and shell thickness (Harrigan, 2017). Feed intake has been shown to be reduced in chickens by 1-1.5% per degree of ambient temperature rise from 20-30 degrees Celsius (68 ºF-86ºF) and by 5% per degree from 32-38 degrees Celsius (89.6 ºF-100.4ºF) (Renaudeau, 2012). Egg production is decreased heavily at temperatures higher than 30 degrees Celsius. From 15-30 degrees Celsius, there are steep reductions in egg laying rate and egg weight (Figure 8).

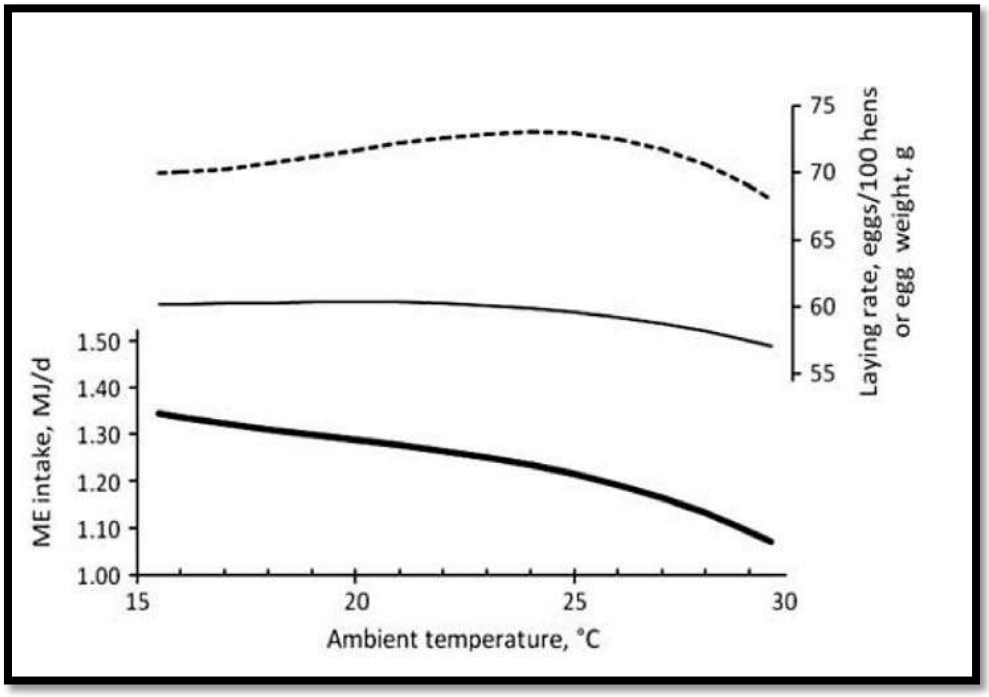

Figure 8: The effect of increasing temperature on hen egg laying rate and average egg weight (Renaudeau, 2012).

The dairy industry will also be threatened by climate change. Rockingham County is the largest milk producing county in the Central Shenandoah, with an annual economic

output of more than $53 million (U.S. Agricultural Census, 2012). The economic output of milk production within the five counties in the Central Shenandoah is quantified in Table 3.

Table 3. Provides data on the economic output from milk production in each county (U.S. Agricultural Census, 2012). Bath county data on countywide milk production not available.

County	Rockingham	Rockbridge	Bath	Augusta	Highland	Total
Annual (Dollars)	53,563,000	6,792,000	N/A	27,640,000	12,518,000	100,513,000

The reduction in nutrient intake caused by heat stress has been linked in cattle to reduced milk production (Renaudeau, 2012). For every one-degree Celsius increase past the thermal neutral zone, an 0.85 kg reduction in cattle feed intake occurs, resulting in a ~36% reduction in milk production (Pragna, 2017).

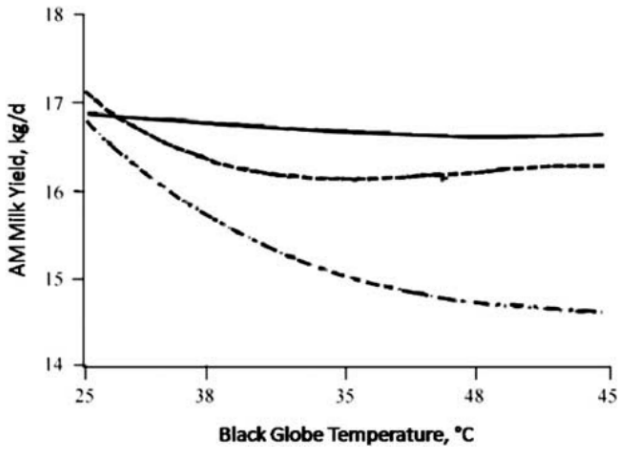

Figure 9. The effect of ambient temperature on dairy cow performance during lactation. Milk yield in units of kg/d was plotted against increasing temperatures from 25-45 degrees Celsius. The effect of cows subjected to heat stress, both two days prior (—**—), and 1 day prior to (— —), and the day of (—) is shown for milk production. (Renaudeau, 2012).

Reproductive rates of livestock are known to be reduced when temperatures exceed the thermal neutral zone. When the temperature humidity index exceeds 72.9 for beef cows in pasture, a reduction in pregnancy rates can be witnessed (Bernabucci, 2010). In summertime, conception rate already drops by 24% due to the higher temperatures (Renaudeau, 2012). As climate change and global temperatures increase, breeders of cattle in the Central Shenandoah must be aware of these threats to their reproducing livestock.

In the last few decades as the global climate has changed, rates of pest related diseases have increased greatly in the US (CDC, 2019). Nine new germs spread by mosquitoes were discovered during the last 13 years. In addition to these, Zika, West Nile, Lyme, and chikungunya are among the diseases increasingly being spread by pests (CDC, 2019). These diseases pose hazards to both humans and livestock alike. The US as a whole is witnessing a large increase in pest populations and related illnesses, and Virginia happens to be in among the states most heavily impacted. The nationwide increase in pest related illnesses is described (Figure 10). These nationwide phenomena are of special concern to Virginia as the state ranks in the top 20% in the US for the sheer number of reported disease cases from ticks and other pests at 16,454 between 2004-2016 (CDC, 2019).

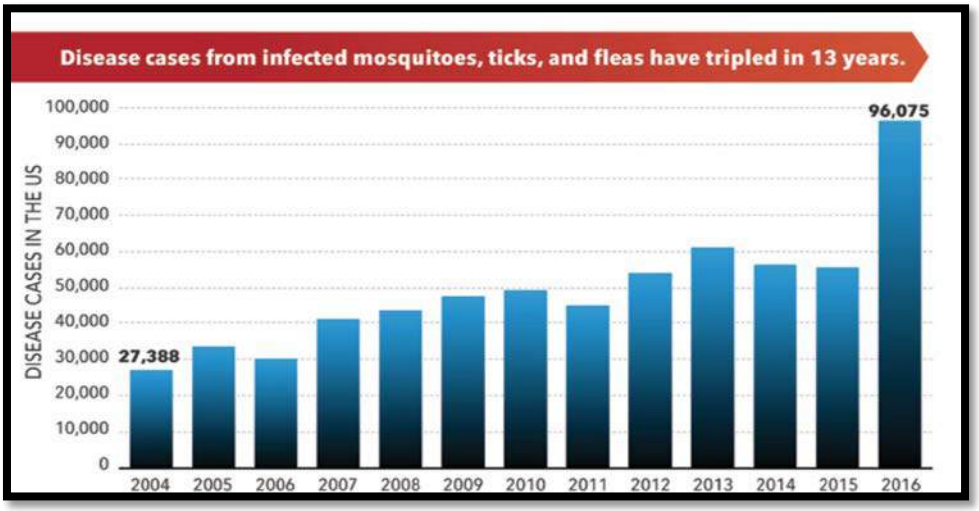

Figure 10: The number of reported mosquito, tick, and flea bite related illnesses (CDC, 2019).

Livestock Recommendations

Farmers should be familiar with the thermal neutral zones for all their livestock breeds. When temperatures exceed those thermal neutral zones, farmers should take measures to cool livestock. Creating a dependable water infrastructure for livestock to utilize as they acclimate to warmer temperatures is perhaps one of the most obvious and important adaptations for the industry into the future of climate change (Korthaus, 2015). Providing shade for livestock is also critically important, as it keeps them out of the sun's hottest rays. Planting trees is a cost-effective method for providing such shade and also serves to help with flooding and water infrastructure (Korthaus, 2015).

On hot days, working cattle should only be working in the early morning or later in the day in order to mitigate the chances of subjecting the cattle to heat stress. Other methods

include selecting livestock for purchase that are adapted to warmer climates. Having a lighter hide color and thickness are advantageous traits in warmer conditions. As calves are the most susceptible to heat stress, it is recommended that calving be started around May as to not have them born in the hottest part of the year (Korthaus, 2015).

Feeding livestock and specifically broiler high fat diets can help to reduce the hazard of heat stress (Renaudeau, 2012). Under heat-stress conditions of 35-36 degrees Celsius, broilers that receive a high-fat diet of 5 to 10 percent fat were able to gain more body weight than those with low fat diets. Such a switch can, in hens, increase the thermal neutral zone upper range from 22-24 degrees Celsius to 25-29 degrees Celsius (Renaudeau, 2012). Additionally, reducing the stocking density of hens can help to reduce the temperature in their facilities as radiant from the animals would be reduced. Increasing ventilation within the facilities can also help to reduce temperature (Renaudeau, 2012).

The typical systematic approach to pest control must also be revolutionized, as increased temperatures are likely to increase pest abundance (EPA, 2016). Increasing the amount of pesticides used to deal with the increased pests will result in increased bio-magnification (the increasing concentration of a substance within higher levels of the food chain) and our food will become more toxic (EPA, 2016). The CDC advises that adapting to the increased hazards of pest diseases involves “Reducing the spread of these diseases and responding to outbreaks effectively will require additional capacity at the state and local level for tracking, diagnosing, and reporting cases; controlling mosquitoes and ticks; and preventing new infections; and for the public and private sector to develop new diagnostic and vector control tools” (CDC, 2019). Additional recommendations for mitigating pest related hazards include improving coordination between federal, state, and local officials for pest control programs and to use modeling to predict and pinpoint the likelihoods of pest-related disease outbreaks. (Renaudeau, 2012). Managers of livestock can also find and remove ticks from their livestock daily to further reduce pest-related hazards.

Agriculture: Crops

Climate change has the potential to impact the economy and the health of the people in the Central Shenandoah Valley by affecting crop agriculture through plant dehydration from longer and more severe droughts, physical damage from extreme storms, damage to soil health from increased carbon dioxide and temperatures, and increased insecticide use on crops (U.S. EPA, 2019).

A major concern of the impact of climate change on crop production is the degradation of cropland soil (Islam, 2017). Elevated levels of carbon dioxide cause an increase in the weathering of rocks and minerals, which disrupts carbon biotic cycles in the soil and reduces the productivity of plants (Islam, 2017). Increased frequencies of extreme weather patterns such as droughts, floods, and heat waves can also have negative effects on agricultural soils by changing the drying and rewetting cycles of the soil (Islam, 2017). This disturbance of the drying and rewetting cycles reduces nutrient uptake by plants and increases nutrient competition, resulting in a decline in productivity and yield (Islam, 2017).

Droughts will be an increasing threat to crop production in the Central Shenandoah Valley. It is predicted that drought frequency will increase by 100% by the mid-21st century and by 200% at the end of the 21st century for most regions (Sheffield, 2008). Agriculture accounts for 80% of the total water use in the United States; therefore, the agricultural industry is most affected by drought (Chou, 2016). Droughts cause significant yield reductions for rain-fed and irrigated crops and can cause complete loss of crops (Ray, 2018). Water helps move nutrients from the soil throughout the plant and is critical to the production of plant food through photosynthesis (UCSB, 2012).

Central Shenandoah Valley farmers will increasingly encounter extreme storms and flooding. Heavy downpours from storms are increasing in the amount of precipitation and frequency by more than 30% of the average from 1901-1960 (Figure 11). This correlates to an increase in floods because these areas are getting a large amount of water in a short amount of time (National Climate Assessment, 2014). The greatest danger to crops from flooding is oxygen deprivation. Roots in plants do not photosynthesize, unlike the rest of the plant, requiring the roots to consume oxygen and respire (UCSB, 2004). Water contains less oxygen than the air pockets in the soil, so when flooded, the crops do not receive enough oxygen. This reduces yield production and can cause plant death through deprivation of oxygen (U. Missouri, 2015). Another consequence of a low-oxygen environment is the performance of anaerobic respiration (similar to fermentation) by crops. Anaerobic respiration has a byproduct of lactic acid, which can be harmful to plants as it changes the pH of the cells, resulting in tissue damage and reduced productivity (U. Missouri, 2015).

An increasing impact of climate change on agricultural crops is an increase in pests such as harmful insects and funguses, all associated with longer growing seasons from increased temperatures and a warmer climate (Conrow, 2018). To combat this issue, farmers are likely to use more pesticides, which will not only add to the costs of farming but may

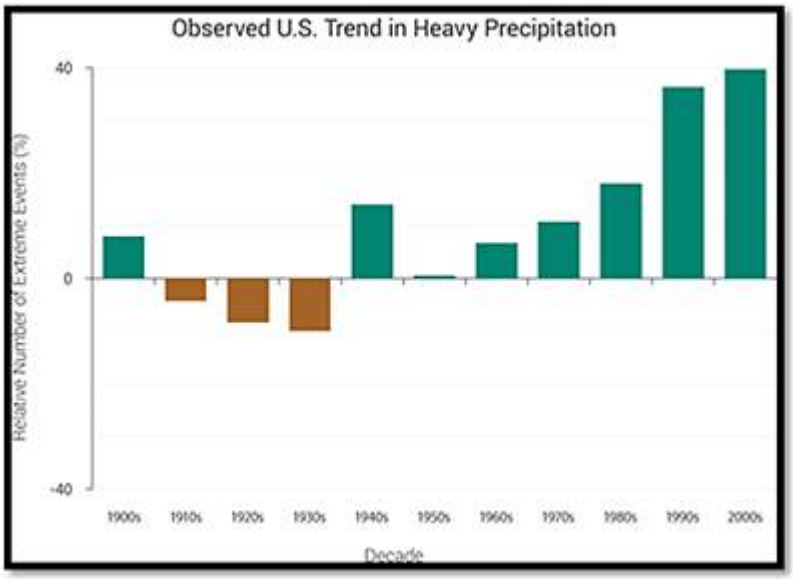

Figure 11. Heavy precipitation trends in the U.S. (National Climate Assessment, 2014).

also pose a danger to the farmers and consumers. Negative effects generally present themselves over a long period of exposure from the bioaccumulation of these chemicals (Miller, 2005).

The total net income of all the farms in the CSPDC was $959 million in 2012. (U.S. Census of Agriculture, 2012) (Table 2). Approximately $85 million of this was associated with crop production, and this is a significant amount of income that has the potential to negatively affect the economy if profits drop (U.S. Census of Agriculture, 2012). Even though the number of farms in the CSPDC region remained relatively stable from 2007 to 2012, the income from farms is still increasing (Table 2), underscoring the potential for loss.

Despite the potential for climate change to reduce yields due to extreme weather events, overall yields are still increasing as a result of new technologies and better farming techniques that raise the production of farms (EPA, 2016). Even with the increased yield trend, though, climate change has already set production back by almost 30% in some years due to droughts and extreme weather events (EPA, 2016; Figure 12).

The most common crops in the CSPD are corn, soybeans, and barley (U.S. Census of Agriculture, 2012). All of these crops are sensitive to environmental stresses such as droughts and floods because they were chosen for high yield capacity, not resiliency (Mustroph, 2018). In a Stanford study (Lobell 2016), it was determined that corn and soybean crops are especially sensitive to drought. At the current rate of sensitivity increase, it is predicted that crop yields could decline by 15% over the next 50 years, even though yields are increasing because of better farm practices (Lobell, 2016).

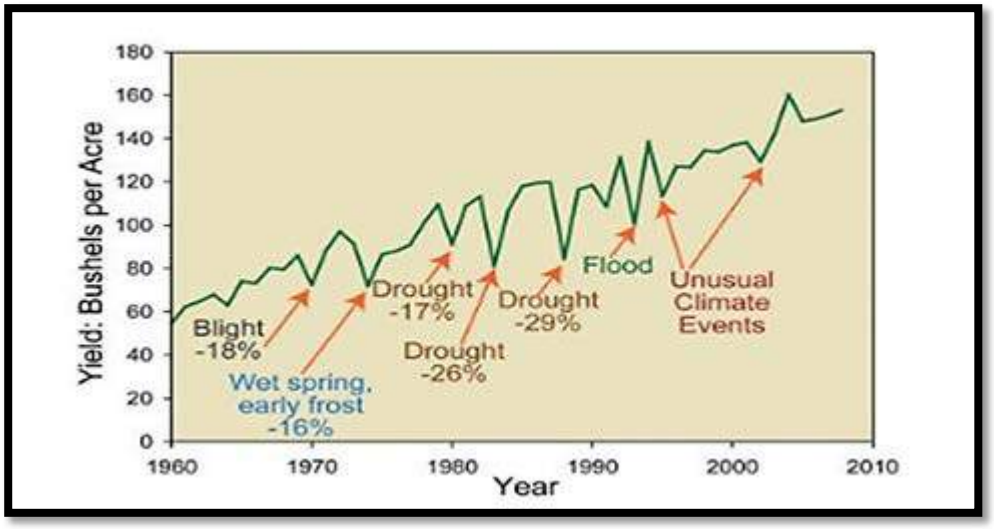

Figure 12. Crop yield fluctuations from extreme weather events 1960-2009 (EPA, 2016).

Yield reduction of crops has economic impacts on farmers and the people who buy crops from them, as food prices will increase if the farmers experience a decline in yield (Sherony et al, 1991).

The CSPDC region has already seen effects of crop loss in recent years. In 2017, the USDA's Farm Service Agency (FSA) had corn indemnity payment rates of $45.83 to $63.60 per acre in Rockingham, Augusta, and Rockbridge counties. These payments were distributed to farmers as compensation for corn losses that reduced their revenue below the guaranteed crop revenue set by the FSA (USDA, 2019). In the same year, the FSA distributed even more indemnity payments in the range of $23.71 to $33.85 per acre for wheat losses in the same counties and including Highland County (USDA, 2019). In 2015, the FSA's soybean indemnity payment rates to Augusta County reached the maximum range of $51.71 to $76.10 per acre (USDA, 2019). Indemnity payments to farmers have been increasing over the past decade and are expected to further increase into the future (USDA, 2018). As a result, farm insurance payments are likely to rise, which can negatively affect the economic status of farmers in the Central Shenandoah Valley (USDA, 2018).

Crops Recommendations

There are many strategies for adaptation to climate-related impacts on the Central Shenandoah Valley, including regulation, planning, information/education, tax incentives, ecosystem management, and community engagement tools (City of Lewes, 2011). The main strategies for the adaptation to agricultural crop impacts revolve around the events that influence production the most, such as droughts, floods, and increased pests from higher temperatures. Although droughts cannot be prevented, local governments can regulate the

water consumption during periods of drought to reduce the impacts on farmers. To discourage large quantities of water usage during droughts the government can also tax excess water use heavily, which will make more water available to farmers (City of Lewes, 2011). To adapt for more frequent flooding, farmers should consider identifying areas on the farm that are prone to flooding and possibly create runoff ponds on their farm to limit the damage. This strategy can also be used along with rain gardens on areas near impervious surfaces that could potentially be adding more runoff to farms. Farmers might also consider loosening soil to allow more water to seep through the ground to prevent high levels of flooding. To manage increased pests on the farm, investment by farmers and local governments into genetically modified crops that are resistant to damages from pests are a promising way to reduce health effects from pesticides. They can also invest in safer and cheaper pesticides to decrease the effect of pests on crop production and human health.

Built Environment: Commercial Areas

The commercial sector of the Central Shenandoah Valley will be affected by climate change. The history of flooding in the region is well-documented (CSPDC 2013), but with the predicted increase in precipitation and severe weather, property damage will increase. Many of the region's commercial districts, downtowns, and factories can be found near water in vulnerable flooding areas. The cities of Waynesboro and Buena Vista have already experienced millions of dollars in flood losses by property damage, lost revenue and jobs (Figure 13; FEMA, 2017). These losses are due to combination of vulnerabilities found in building structures, in addition to their proximity to a hazard prone area. The monetary value of the built environment exposure throughout the CSPDC (Table 4) is an indication of potential losses.

If a business or residence is in a FEMA-designated flood area, it is important to take precautions to avoid unnecessary additional damages. For example, without flood insurance, any flood damage costs will likely come out of pocket and be catastrophic to local businesses and their employees. Insurance can be expected to cost more in areas that are vulnerable to flooding. In many cases, relocation out of a flood zone is the most fiscally responsible long-term option. Another line of defense is retrofitting and flood-proofing existing buildings to be more flood resistant (FEMA, 2017). In the coming years, businesses and residences not previously located in an established flood zone must take precautions. Even structures located in a low or moderate flood risk area, are five times more likely to experience a

.

Table 4. Monetary vulnerability of structures within the CSPDC, organized by building occupancy (CSPDC, 2013)

Community	Residential	Commercial	Industrial	Agri.	Religion	Gov't	Ed.	Total
Augusta County	$3,217,697	$326,175	$194,572	$20,448	$35,973	$3,908	$8,845	$3,807,618
* Craigsville, Town of	$48,009	$4,867	$2,903	$305	$537	$58	$132	$56,811
Bath County	$452,878	$21,892	$7,852	$907	$4,392	$2,607	$3,971	$494,499
Buena Vista City	$332,182	$25,453	$9,893	$0	$5,015	$1,265	$724	$374,532
Harrisonburg City	$1,820,119	$527,791	$135,296	$14,926	$39,652	$3,703	$116,243	$2,657,730
Highland County	$206,296	$12,188	$2,437	$1,790	$1,335	$1,099	$213	$225,358
* Monterey, Town of	$12,853	$759	$152	$112	$83	$68	$13	$14,040
Lexington City	$384,287	$88,390	$1,165	$259	$8,293	$3,875	$25,032	$511,301
Rockbridge County	$1,098,775	$76,022	$54,564	$7,212	$15,469	$4,433	$3,267	$1,259,742
* Glasgow, Town of	$55,234	$3,822	$2,743	$363	$778	$223	$164	$63,326
* Goshen, Town of	$21,439	$1,483	$1,065	$141	$302	$86	$64	$24,580
Rockingham County	$3,308,546	$242,667	$106,619	$52,367	$47,450	$5,857	$9,211	$3,772,717
* Bridgewater, Town of	$254,180	$18,643	$8,191	$4,023	$3,645	$450	$708	$289,840
* Broadway, Town of	$107,085	$7,854	$3,451	$1,695	$1,536	$190	$298	$122,108
* Dayton, Town of	$65,658	$4,816	$2,116	$1,039	$942	$116	$183	$74,869
* Elkton, Town of	$99,757	$7,317	$3,215	$1,579	$1,431	$177	$278	$113,753
* Grottoes, Town of	$103,275	$7,575	$3,328	$1,635	$1,481	$183	$288	$117,763
* Mt. Crawford, Town of	$12,409	$910	$400	$196	$178	$22	$35	$14,149
* Timberville, Town of	$84,955	$6,231	$2,738	$1,345	$1,218	$150	$237	$96,873
Staunton City	$1,348,576	$213,605	$16,783	$1,884	$22,150	$8,174	$15,886	$1,627,058
Waynesboro City	$1,039,554	$153,293	$23,731	$5,156	$13,249	$57	$1,198	$1,236,238
TOTAL	$14,073,764	$1,751,752	$583,213	$117,381	$205,108	$36,702	$186,988	$16,954,907
								All values are in thousands of dollars

*Denotes town values that are also included in totals for the perspective County.

flood than a fire over the next 30 years (FEMA, 2017). It is also important to note that properties not in a designated flood zone may also purchase flood insurance for their protection and often at a much lower rate. As the severity and frequency of storms increase, flooding is possible outside of designated flood zones as well.

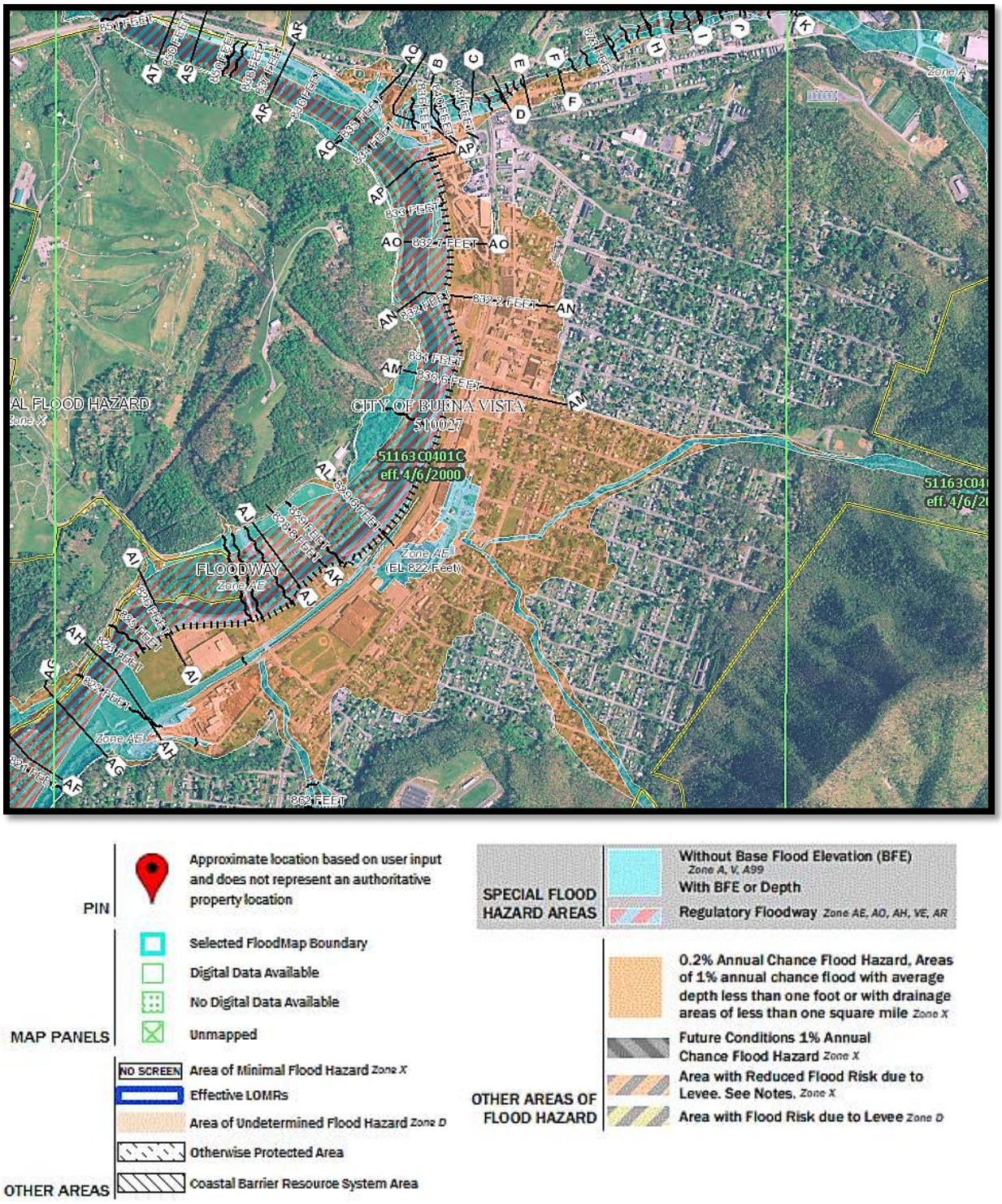

Figure 13. Flood prone areas in the City of Buena Vista. (FEMA, 2017).

Commercial Areas Recommendations

Strategies for the commercial sector adaptations to climate change-related events include discouraging new construction in flood-prone areas; as flooding worsens, damage and higher insurance rates will follow. An effort should be made to inform businesses about

FEMA's flood map tool, as flood zones will continue to increase. Businesses should be encouraged to invest in flood insurance to protect assets, and to avoid paying for damages out of pocket. The National Flood Insurance Program can cost less than $400 a year (FEMA, 2017). Businesses in flood-prone areas should be encouraged to invest in retrofitting and flood proofing buildings to limit damages. Businesses in areas that are shown to be extremely vulnerable by FEMA's flood map tool should consider moving to an area less prone to flooding. New buildings being constructed should be built to be both wind and flood resistant, as the frequency of hurricanes and high wind storms in the area is expected to increase.

Built Environment: Residential Areas

The most likely climate change impacts to residential areas in the Central Shenandoah Valley are the increased frequencies of natural hazards such as flooding, hurricanes, and wildfires (CSPDC, 2013). Homeowners whose properties that have been damaged in a severe weather event have the option to claim recovery compensation. As outlined the 2005 CSPDC Hazard Mitigation plan, "recovery activities include rebuilding homes, businesses and public facilitates; clearing debris; repairing roads and bridges; and restoring water, sewer and other essential services" (Central Shenandoah Valley All Hazards Mitigation Plan, 2005). In 2003, when the Hurricane Isabel recovery option was widely used, homeowners in the Central Shenandoah Valley had $12,114,793 worth of repair/building claims compared to $36,434,940 worth of total building value. $7,600,258 of those fees were devoted to building repair payments, while $4,514,535 were devoted to contents compensation payments (Central Shenandoah Valley All Hazards Mitigation Plan, 2005). A strong mitigation plan for dealing with natural hazards can help to reduce the need of such recovery plans. At least 10% of the housing units in the CSPDC's member counties are at risk from flooding (CSPDC, 2013). Increased precipitation that comes with climate change will most likely increase that number. The structural vulnerability value estimates and total loss estimates per the localities within the Central Shenandoah (Table 5, 6) are indicators of these impacts.

Augusta and Rockingham counties could see $2.5 million in structural losses to flooding (CSPDC, 2013), while Bath, Highland, and Rockbridge counties combined could see less than 300 thousand. These numbers have the possibility to increase or decrease depending on both the variability in weather conditions and the manner in which the counties address flooding problems. Even though there is some investment in flood insurance,

Table 5. Structures at Risk due to Flooding 2013 (CSPDC, 2013).

Community	Houses at Risk	Housing Units	% of Housing Units
Augusta County	2,608	24,818	10.51%
Bath County	250	2,053	12.18%
*Bridgewater, Town of	*70*	*1,850*	*3.78%*
*Broadway, Town of	*100*	*976*	*10.25%*
*Glasgow, Town of	*138*	*494*	*28%*
*Goshen, Town of	*64*	*214*	*30%*
*Grottoes, Town of	*40*	*894*	*4.47%*
Rockbridge County	703	8,486	8.28%
Rockingham County	5,017	25,355	19.79%
Staunton City	200	9,676	2.07%
Waynesboro City	958	8,332	11.50%
Total	**9,736**	**78,720**	**12.37%**

Table 6. Structure vulnerability and losses due to flooding (CSPDC, 2013).

Community	Flood Policies	Total Housing Units	Medium Home Value	Total Structure Value Vulnerability	Total Loss Estimate
Augusta County	261	24,818	$110,900	$289,227,200	$926,612
*Craigsville, Town of	*28*	*474*	*$64,800*	*$2,495,117*	*$7,994*
Bath County	32	2,053	$79,700	$19,925,000	$63,835
Buena Vista City	91	2,547	$72,900	$22,817,700	$73,159
Harrisonburg City	88	13,133	$122,700	$87,239,700	$279,525
Highland County	12	1,131	$83,700	$1,841,400	$5,899
*Monterey, Town of	*5*	*141*	*$84,200*	*$2,105,000*	*$6,744*
Lexington City	8	2,232	$131,900	$19,785,000	$63,571
Rockbridge County	273	8,486	$92,400	$64,957,200	$208,107
*Glasgow, Town of	*40*	*494*	*$66,400*	*$9,163,200*	*$29,357*
*Goshen, Town of	*13*	*214*	*$59,100*	*$3,782,400*	*$12,118*
Rockingham County	489	25,355	$107,700	$540,330,900	$1,731,085
*Bridgewater, Town of	*57*	*1,850*	*$126,300*	*$8,841,000*	*$28,324*
*Broadway, Town of	*19*	*976*	*$101,100*	*$10,110,000*	*$32,390*
*Dayton, Town of	*10*	*565*	*$120,600*	*$10,502,628*	*$33,648*
*Elkton, Town of	*25*	*919*	*$94,800*	*$14,362,028*	*$46,012*
*Grottoes, Town of	*29*	*894*	*$90,500*	*$3,620,000*	*$11,598*
*Mt. Crawford, Town of	*2*	*109*	*$96,700*	*$1,741,441*	*$5,579*
*Timberville, Town of	*8*	*770*	*$82,300*	*$7,966,640*	*$25,523*
Staunton City	114	9,676	$87,500	$17,500,000	$56,066
Waynesboro City	185	8,332	$89,300	$85,549,400	$274,079
Total	**1,789**	**97,763**		**$1,149,173,500**	**$3,681,938**

*Denotes town values that are also included in totals for the perspective County.

vulnerable areas can still suffer great losses in the case of a severe storm. Residential areas impacted by climate hazards are in need of adaptation programs. The CSPDC hosted a Floodplain Management Workshop to provide updated training on floodplain management requirements for localities (CSPDC, 2018). As identified in the workshop, the main issue in residential areas is flood risk.

Table 7. Building Stock Loss by General Occupancy (From HAZUS-MH) Hurricane Model (CSPDC, 2013).

Community	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Augusta County	$219.57	$11.76	$9.75	$0.89	$0.99	$0.16	$0.27	$243.39
*Craigsville, Town of	$3.28	$0.18	$0.15	$0.01	$0.01	$0.00	$0.00	$3.63
Bath County	$18.66	$0.39	$0.14	$0.03	$0.07	$0.05	$0.06	$19.41
Buena Vista City	$28.27	$1.22	$0.84	$0.00	$0.20	$0.06	$0.03	$30.62
Harrisonburg City	$121.09	$20.34	$8.56	$0.81	$1.26	$0.19	$4.66	$156.91
Highland County	$10.19	$0.25	$0.05	$0.05	$0.02	$0.03	$0.00	$10.60
*Monterey, Town of	$0.63	$0.02	$0.00	$0.00	$0.00	$0.00	$0.00	$0.66
Lexington City	$34.69	$5.31	$0.06	$0.02	$0.39	$0.24	$1.47	$42.17
Rockbridge County	$76.78	$2.79	$3.00	$0.34	$0.47	$0.24	$0.11	$83.73
* Glasgow, Town of	$3.86	$0.14	$0.15	$0.02	$0.02	$0.01	$0.01	$4.21
* Goshen, Town of	$1.50	$0.05	$0.06	$0.01	$0.01	$0.00	$0.00	$1.63
Rockingham County	$210.67	$7.35	$3.57	$2.31	$1.27	$0.25	$0.31	$225.72
* Bridgewater, Town of	$16.18	$0.56	$0.27	$0.18	$0.10	$0.02	$0.02	$17.34
* Broadway, Town of	$6.82	$0.24	$0.12	$0.07	$0.04	$0.01	$0.01	$7.31
* Dayton, Town of	$4.18	$0.15	$0.07	$0.05	$0.03	$0.00	$0.01	$4.48
* Elkton, Town of	$6.35	$0.22	$0.11	$0.07	$0.04	$0.01	$0.01	$6.81
* Grottoes, Town of	$6.58	$0.23	$0.11	$0.07	$0.04	$0.01	$0.01	$7.05
* Mt. Crawford, Town of	$0.79	$0.03	$0.01	$0.01	$0.00	$0.00	$0.00	$0.85
* Timberville, Town of	$5.41	$0.19	$0.09	$0.06	$0.03	$0.01	$0.01	$5.80
Staunton City	$105.78	$8.84	$0.82	$0.10	$0.80	$0.46	$0.67	$117.48
Waynesboro City	$95.88	$7.95	$1.45	$0.29	$0.56	$0.00	$0.07	$106.21
Total	$977.16	$68.20	$29.38	$5.39	$6.36	$1.76	$7.73	$1,095.99
All values are in thousands of dollars								

The metric of stock loss (how much value each area's buildings have declined since bought value) is an indication of the impacts of severe weather on valuation. Predicted stock loss (per $1000) associated with hurricanes (Table 7) is significant for the Central Shenandoah Valley.

Wildfire is also a concern for the region. Most of the high potential wildfire risk to communities and homes are in Rockbridge, Augusta and Rockingham counties because they

have higher populations and have more communities closer to forested lands. 71% of woodland homes are considered to have high potential for a wildfire, while 63% of woodland communities in the Central Shenandoah Valley are considered at high risk for wildfire (Tables 8, 9; CSPDC, 2013). This could increase as cycles of prolonged drought become common in this region.

Table 8. Woodland Communities Wildfire Risk (CSPDC, 2013).

County	Low Potential	Medium Potential	High Potential	Total	% High Risk
Augusta	0	21	19	**40**	**48%**
Bath	0	4	4	**8**	**50%**
Highland	N/A	N/A	N/A	**N/A**	**N/A**
Rockbridge	1	6	9	**16**	**56%**
Rockingham		1	25	**26**	**96%**
Total	**1**	**32**	**57**	**90**	**63%**

Table 9. Woodland Homes Wildfire Risk (CSPDC, 2013)

County	Low Potential	Medium Potential	High Potential	Total	% High Risk
Augusta	0	493	580	**1,073**	**54%**
Bath	0	120	65	**185**	**35%**
Highland	0	20	10	**30**	**33%**
Rockbridge	300	82	458	**840**	**55%**
Rockingham	0	25	1,523	**1,548**	**98%**
Total	**300**	**761**	**2,636**	**3,697**	**71%**

Residential Recommendations

The well-being of communities should be a major priority in catastrophic situations. At issue is the lack of knowledge pertaining to important response procedures for each hazard. To address this, residential areas within each locality should have meetings that address past impacts and plan for hazards. The hazard most impactful to residential areas within all localities within the CSPDC region is flooding. What is needed is an up-to-date

response unit in case of floods and other hazards. An example is the Community Emergency Response Team (CERT), a national program offered through FEMA. "The goal of CERT is for emergency personnel to train members of neighborhoods, community organizations or workplaces in basic response skills like disaster preparedness, fire safety, emergency first aid and crime prevention" (CSPDC, 2013). CSPDC began offering CERT classes to the Staunton, Augusta and Waynesboro communities in September 2003. Since then, there have been 25 courses held resulting in a total of 423 trained volunteers (CSPDC, 2013). This program should be encouraged in all localities within the Central Shenandoah Valley with the goal of training as many people as possible

Built Environment: Urban Areas

The CSPDC works with the cities of Buena Vista, Harrisonburg, Lexington, Staunton, and Waynesboro. Urban areas are at high risk for climate-induced hazards because of their dense populations and high levels of activity. There is a parallel between high populations with high levels of energy usage and climate hazard potential (U.S. EPA, 2014). Cities experience increased temperatures due to the amount of heat and emissions produced in a given day, creating urban heat islands. Energy is needed for heating/cooling buildings, electricity, and transportation. Along with the high levels of energy use comes a high level of waste heat which is released from sources such as buildings and cars. It is important for cities to monitor their energy usage and make economically and environmentally suitable decisions.

Table 10. **Expected Increase in Population (Virginia Population Projections, 2019)**

Geography Name	2010 Census	Projected Population		
		2025	2035	2045
Buena Vista	6,650	7,089	7,298	7,455
Harrisonburg	48,914	62,920	70,837	78,204
Lexington	7,042	7,898	8,145	8,333
Staunton	23,746	25,378	25,480	25,403
Waynesboro	21,006	23,167	24,339	25,332

According to the U.S. Census Bureau (2017), all the urban areas in the CSPDC's jurisdiction except Buena Vista are expected to continue increasing in population (Table 10). As population increases, more heat will be produced through the movement of people and goods. And, as the temperatures outside rise, so does the need for cooler temperatures inside.

This means the energy to heat buildings is in high demand: about 1.5-2% more for every 1°F increase in air temperatures (U.S. EPA, 2014). This not only leads to high energy bills but can also bring with it climate hazards that can have impacts on the community. Extreme heat can cause health related illnesses in the population, higher levels of pollution and harmful chemicals, poor water quality from heated storm water runoff and in some cases can even cause death (U.S. EPA, 2014). According to the Centers for Disease Control and Prevention, more than 600 people in the U.S. alone are killed by extreme heat in cities every year (CDC, 2019). With proper adaptation and changes made to the infrastructure of the city, the increase of temperatures in cities can be slowed to improve the general health and wellness of its people.

High temperatures not only increase the likelihood of heat waves, but they can even cause more rain, which can lead to flooding. The heat causes pockets of air to rise and change the normal wind patterns, while the humidity pulls moisture into the air, forming rain clouds (NASA/Goddard Space Flight Center, 2002). Excess rain, especially in a city, can lead to flooding and put the urban area at greater risk. In turn, this can lead to power outages, destruction of buildings, sickness/disease from flooded sewage, injury, and potentially even death (U.S. EPA, 2014). Fortunately, these outcomes can be avoided with the correct precautions and preparations.

Low-lying areas that are prone to flooding under normal conditions will see an increased threat as precipitation rates increase with climate change. In the Central Shenandoah Valley, urban areas that have grown up around prolific springs and streams are especially at risk. For example, the City of Staunton's West End community, with its low base flood elevation, is the focus of a flood probability study for the Lewis Creek floodplain (Fair, 2018). A flood insurance study of Augusta County (FEMA, 2014) identified runoff from impervious surfaces and inadequate drainage structures as sources of flooding in the City of Staunton, a problem that will be exacerbated by climate change-related precipitation. The same study identified the downtown area of the City of Waynesboro as vulnerable, due to the development of the large floodplains of the South River. In promoting flood protection measures, the Natural Resources Conservation Service (NRCS, 2005) described the impacts of four streams that flow through the City of Buena Vista, including ponding problems and overland flooding. At that time, NRCS predicted that a 100-year storm would flood 245 residences, 70 commercial properties, and infrastructure, resulting in $9.5 million in urban damages. Urban areas within the CSPDC region will be affected by flooding, making the

availability of online mapping tool especially important for residents who must make decision about flood protection.

It is easy to overlook the slight increase in temperature in the Central Shenandoah Valley and its impacts on urban areas because the effects have not yet become detrimental to residents. However, as the temperature rises and populations continue to rise, so too will hazardous conditions (McCarthy, 2010).

There are many options for an urban area to change the way it combats and prepares for the increasing hazards, including green rooftops, LED lighting, insulation, and changing the color of the city's surfaces so that they reflect (and not absorb) the sun's rays (Hawken, 2018). These adaptations not only influence the environment of the cities, but also have potential to be economically beneficial to the urban development (Hawken, 2018).

Urban Recommendations

One practice that can help to lower temperatures in the atmosphere of urban areas and help to absorb some of the rainfall is planting vegetation on the roofs of buildings. The foliage helps to protect the roof from the sun's rays, while at the same time sequestering carbon and filtering the air. Plants also need a lot of water to survive, so instead of the rain water going down a storm water system, it can be absorbed by the plants. Not only are green roofs helpful to the environment of the urban area, but they can also have economic benefits. It is estimated that if 30% of the roofs in cities around the world were vegetated, the cities would not only reduce the temperature of rooftops and cool buildings, but also produce $988.5 billion dollars in net savings (Hawken, 2018). Green roofs are just one of the many measures that can be taken to help a city lower its risk of hazards induced by high temperatures, all the while saving money by reducing the amount of energy needed to heat the inside of buildings.

Insulation is another important development that can help an urban area reduce the amount of waste heat it produces as well as save money in the long run. Pockets of temperature move from warm to cold and vice versa depending on the time of year and the temperature inside and outside (McCarthy, 2010). Without enough insulation, heat will escape the building in the winter and the cool air will leave through the cracks of the building in the summer, causing the heaters and air conditioners to work harder and expend more energy. It is easy to determine whether a building is insulated properly. If it is not, insulation can be added to structures under construction or standing buildings. Insulating a building is

relatively cheap and can save money on utility bills, help to keep moisture out of the air, and improve overall air quality (Hawken, 2018).

The final measure that can be taken to not only help the cities in the Shenandoah Valley reduce the amount of waste heat, but also save money in the long run is painting the rooftops of buildings or the pavement white. Cities are typically black and grey in color, absorbing heat from the sun and increasing temperatures within these buildings. By painting the surfaces of the pavement and rooftops white, the sun's rays are reflected into the atmosphere, keeping the building cooler than if the surface were black. One of the biggest reasons that cities have higher temperatures than the surrounding suburbs is that the buildings trap the heat in overnight (Hawken, 2018). Night time temperatures in cities have been recorded to be as high as 22°F warmer than the surrounding suburban neighborhoods (U.S. EPA, 2014). Painting the rooftops or city walkways white will help to lower the temperature of that individual buildings and the city overall.

Recreation

People travel from all over the country to visit Shenandoah National Park (SNP) each year and in return stimulate the economy. The counties within the CSPDC region that have lands included in SNP, Augusta and Rockingham, especially benefit from its visitation. The National Park Service (NPS) reported that in 2017 over 1.45 million patrons

Figure 14. Entrance to George Washington National Forest (USDA Forest Service)

visited Shenandoah National Park, which contributed over $125 billion to the local economy (Comer, 2018). This economic boost has been felt across widely the Valley. The NPS claims that within 60 miles of SNP, economic effects include over $18 billion in spending across the local community, over $35 billion to the national economy, and the creation of hundreds of thousands of jobs nationally (Comer, 2018). Tourism is an essential economic sector for the Central Shenandoah region, which means that the impacts of climate change on these natural and cultural settings will reverberate through communities. In areas where recreation spending is a large share of the economy, as in rural communities, climate-induced changes in economic impacts will be significant (Askew & Bowker, 2018). Impacts to the tourism industry will be detrimental to the economy of the area because so many families are financially dependent on business generated from tourists and recreation-centered activities.

National Parks are an important source of revenue for the areas surrounding park boundaries. In the United States in 2018, more than 318 million people visited parks across the nation. One of the top grossing US National Parks falls within the CSPDC region: The Blue Ridge Parkway, which competes with parks like Grand Canyon National Park, Yosemite National Park, and Yellowstone. The Blue Ridge Parkway, which extends through portions of Augusta and Rockbridge counties, was surpassed by the Golden Gate Bridge and was ranked number two in 2018 (NPS, 2019). George Washington and Jefferson National Forests are important recreation areas for the Central Shenandoah Valley (Figure 14). Within the four Ranger Districts included in the CSPDC region (Glenwood-Pedlar Ranger District that serves Augusta and Rockbridge counties; Lee Ranger District serving Rockingham County; North River Ranger District serving Augusta, Highland, and Rockingham counties; and Warm Springs Ranger District serving Bath and Highland counties), both developed and undeveloped campsites are spread through the forest. There are opportunities for four-wheeling and off-roading, horseback riding, hiking, fishing, hunting, and more (USDA, 2019). The U.S. Forest Service has 6 recreation areas around Lake Moomaw that are enjoyed by the general public. Lake Moomaw is stocked with over 14 types of fish which has grown to make the lake and surrounding recreation areas a draw for sport fishing (DGIF, 2019). Changes to the local climate will impact fish populations in Lake Moomaw, among other lakes, rivers, and streams across the region, because of the sensitivity of cold water fish species to warmer waters and changes in water pH (CSPDC, 2015).

As this region gets warmer and wetter, winter recreation activities like skiing, snowboarding, and snow tubing will suffer from shorter seasons, a rise in artificial snow use, and higher costs to the tourism industry because of more measures being taken to provide for

a cold, snow-filled season (U. of Arizona, 2019). At Massanutten Ski Resort, located in Rockingham County, the natural snow season is estimated to be only a day or two in length because of a warming climate, and the Resort relies on a "snow gun" to provide enough snow for all the ski and tubing slopes for the rest of the winter recreation season (Jenner, 2018). According to the State Climatology Office, every 10 years the number of cold winter days has dropped by more than 7 days which reveals that this region of the state is seeing fewer freezing days and nights and a rising average temperature (Jenner, 2018). Resorts like the Homestead Ski Area in Bath County are becoming proactive in the climate change discussion as one of several hundred organizations supporting the "We Are Still In" coalition and taking measures to limit carbon dioxide and greenhouse gas emissions (CTA, 2013; Ceres Policy Network, 2019).

The unique conditions of the Shenandoah Valley such as its topography, highly variable precipitation across short distances, and a wide variety of soil types all contribute toward variation in climate-related impacts, both in intensity and frequency (Nash, 2019). As this region becomes more vulnerable to climate change, more financial strains will be placed on the region, its workers, and public lands resources. The impacts most likely to affect Shenandoah National Park, the Blue Ridge Parkway, George Washington and Jefferson National Forests, or neighboring public lands include heavy precipitation and flood events, wildfire, extreme winds, and debris flows (Nash 2019). Also, shifts in seasonal patterns associated with climate change will impact tourism tied to the well-known four-season climate of the Virginia uplands (Nash, 2019). A comparison of the Blue Ridge Parkway to other well-known parks in the U.S., in terms of income from human labor, number of jobs created, the economic output stimulated by the parks, the amount of spending by visitors to the park, and total value added to the economy (Table 11) shows that the Central Shenandoah Valley benefits from these resources.

Unfortunately, severe weather events can cause closures of recreation areas, loss of tourism, loss of public lands, and alterations to public spaces many Virginians use for recreational purposes year-round (U. of Arizona, 2019). As the climate shifts and temperatures continue to rise, changes in available land use and shifting population centers will begin to impact the Valley. Targeting specific recreation locations helps officials focus adaptation strategies on public lands and natural resources that are most vulnerable.

Table 11. Comparison of popular sites from ranking of The Top 15 US National Parks by economic contributions across different categories (Visitor Spending Effects NPS, 2019).

Park Name	Labor Income (USD)	Jobs	Economic Output (USD)	Visitor Spending (USD)	Value Added (USD)
Blue Ridge Parkway	$459 million	15.4 k	$1.4 billion	$1 billion	$786 million
Grand Canyon	$329 million	9,420	$938 million	$667 million	$582 million
Yosemite	$205 million	6,670	$589 million	$452 million	$336 million

Recreation Recommendations

Conservation efforts that focus on protecting lands for future generations should be at the forefront of any climate adaptation strategy applied to recreational areas. Conservation of public lands and forested areas are essential when planning for the future of Virginia in terms of climate adaptation. The management of resources, specifically the creation of long-term plans for all different land use areas, will result in long-term benefits to the Central Shenandoah region. Programs that combine efforts from government, non-governmental organizations, academic institutions, and the general public will result in more thorough plans, increased outreach and education among local citizens which will result in better, more informed policy as an outcome (NWF, 2018).

Additionally, there are technical solutions that can be implemented to at risk areas to prevent future devastation, including storm water treatment, the addition of Green Infrastructure to urban and rural areas, raising roads, and flood buffer technology. Specifically, employing a technique like Green Infrastructure can guide floodplain management strategies and reduce the stress on local water supplies by integrating rain gardens or “green streets” (Green Infrastructure, 2016). Benefits to implementing Green Infrastructure techniques include reduced incidents of flooding, increased preparedness for times of drought, lessened heat island effect in cities, reductions in energy demands and indoor air temperature from adding shading to buildings, and reductions in water pumping/treatment that will lessen spending on water management (Green Infrastructure, 2016).

Climatic variations caused by increasing global temperatures are already impacting the Shenandoah Valley and will have a widespread impact on recreational and economic activity across the region. The Shenandoah Valley is rich in natural beauty, outdoor attractions, millions of acres of public land, and outdoor recreation including hunting, fishing, and boating. Historically, this region has been vulnerable to flooding, drought, and severe weather events that can have a lasting impact on outdoor recreation spaces and increase financial resources required to manage impacts from these events (CSPDC, 2013). Droughts impact communities directly by straining crop production, lowering the viability of livestock, and stressing local water supplies. Droughts also have secondary effects, such as fewer opportunities to participate in water recreation activities which will have a lasting negative impact on tourism as well as the local economy and livelihoods of local residents (U. of Arizona, 2019). Another hazard relevant to the region is flooding which could result in property loss or heavily polluted storm water. Secondary impacts from higher-than-average water levels allow for more opportunities for warm weather water recreation but with fewer opportunities for winter recreational activities, like skiing and snowboarding, because of less below-freezing days as well as a shorter winter season (U. of Arizona, 2019).

Forestry

Forests are highly productive ecosystems that can be used for raw materials and ecosystem services such as filtering air pollutants, sequestering carbon, and protecting water, (Paul, 2011). Over half (62%) of Virginia's lands are forestland and most of that forested land is owned privately, with only a small percentage owned by forestry related companies. If impacts of a changing climate force people from their homes and more humans migrate to the CSPDC region there will be changes for the forests and land use across the region. Rising populations have a negative effect on land availability because more residents must have more space to support the population growth. Farmland, forested lands, and rural spaces are the undergo development to meet the need for more housing complexes, businesses, and infrastructure. Over 1 million acres of undeveloped land in Virginia has been developed since 1987 (Paul, 2011). While this number is expected to continue to rise, conservation efforts have been increasing to protect ecosystem services, resources, as well as public, forested, and other lands that could be degraded or destroyed by construction projects and development.

Wildfires are another hazard that poses a significant risk to this region. Each year from 2008 to 2017, The Virginia Department of Forestry (VDOF), put out hundreds of fires

that resulted in approximately 12,000 acres of burned lands annually. Most of these fires are set by humans and cause loss of life, resources, and land (NPS, 2015). Within the Central Shenandoah Valley, the Ranger Districts are responsible for National Forest management, projects, and planning. Much of the area under the jurisdiction of the Ranger Districts is remote, which has made it a popular recreation destination having over 3 million visitors come to George Washington and Jefferson National Forests every year (USDA, 2019). As climate change hazards intensify over the coming years, the 1.8 million acres of public forest land will be at a higher risk (USDA(b), 2019). Additionally, the most vulnerable species and habitats are Appalachian (hemlock)/northern hardwood forests, large stream floodplain, riparian forests, small stream riparian forests, and spruce/fir forests (Butler, 2015). Whether future population growth will result in land clearing and development, or tree species will off from climate-induced hazards, the region's forests are at risk.

Forestry Recommendations

Forestland conservation efforts are driven because the forestry industry is credited with providing $21.5 billion in revenue for Virginia (DOF, 2018). Educating landowners about the value of passing their land down to the next generation of foresters, through programs like Generation NEXT, is one way to improve conservation efforts statewide (VDOF, 2018). Educating residents about the environmental and economic benefits forestlands provide will help grow additional efforts of conservation.

Water Availability

As a result of warmer days, warmer water temperatures will be measured in streams and rivers of the region, and less vegetation will shade river areas, which will lead to declines in local populations of freshwater fish native to the region, including brook trout, which is a staple to the Blue Ridge Mountains and Shenandoah Valley (CSPDC, 2015). In addition to threats posed to wildlife, rising temperatures will also put more stress on how Virginians access and allocate available fresh water. Virginia's Department of Environmental Quality (DEQ) has several measures in place that protect water across the state and aims to provide clean water for years into the future for residents. Specifically, the Water Supply Planning Program plans for water availability, the use of alternate sources of water, and protection of water across Virginia (DEQ, 2019). In the natural environment, the presence of wetlands, forested lands, and reservoirs are ecosystem resources that are highly undervalue. It is estimated that reservoirs in Virginia are valued at over $200 million in ecosystem services.

These reservoirs play a crucial role in regulating the water supply and storing water naturally that can be used for human consumption and industrial operations, among other sectors (Paul, 2011).

Water Availability Recommendations

As water resources become more strained across the Central Shenandoah Valley region, alternate sources of water must be identified to help ease planning efforts. Incentives will be applied to limit/decrease water use in the area, and innovative solutions will need to be promoted to guarantee that every locality has a nearby water supply equipped for a growing population. Plans for the future of that supply must consider projected population values so each locality can plan accordingly for necessary changes (DEQ, 2019). A Virginia State University College of Agriculture research project predicted that as climate change impacts intensify, they will bring more precipitation and more extreme temperatures. As a result, the availability of good quality, clean water supplies for the region may be compromised (Logan, 2019).

Social Impacts

Environmental Justice

"Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. This goal will be achieved when everyone enjoys: the same degree of protection from environmental and health hazards, and equal access to the decision-making process to have a healthy environment in which to live, learn, and work" (US EPA, 2019).

As more frequent and severe weather events occur in the Shenandoah Valley, it will become necessary to consider the ways in which these impacts differentially affect communities. Citizens of the respective localities will be impacted differently because of variations in geography (e.g., low-lying, flood-prone areas) and in the ability to respond. The evaluation of issues of environmental justice requires an understanding of differences in economic well-being, resource allocation, and education, especially during the aftermath of an environmental disaster or severe weather event. Statistically, low income communities take longer to recover from environmental catastrophes than economically prosperous areas,

(Jones, 2011). Rural communities are often geographically isolated and suffer a greater impact of environmental hazards than other communities in more heavily populated and industrialized areas. Rural communities in Virginia are not guaranteed the same protections, access to federal aid, and are controlled frequently by outside corporations that drive the local economy from which they profit (Jones, 2011). The added vulnerability to environmental degradation is sometimes attributed to the residents' choice to live in a rural community, instead of long-term inequities that are magnified by environmentally hazardous conditions (Jones, 2011). These areas can be identified using data on about poverty rates, income, and percentage risk of suffering from local hazards. With this information, planners can suggest changes to policies and budgets to close gaps and protect more citizens' lives and livelihoods.

United Way of Northern Shenandoah Valley, the local program of the national organization, created an acronym, A.L.I.C.E. or "Asset Limited, Income Constrained, Employed," which serves residents in the Central Shenandoah region who fall just above the poverty line but are not considered financially stable. An interactive ALICE Map has compiled research from across Virginia and enumerates at the county and city level the specific areas that have fallen below the ALICE threshold. Specifically, this tool can map the "Geographic Distribution of Vulnerable Populations" and pinpoint the exact locations of increased vulnerability within every county and city in the Commonwealth of Virginia (ALICE, 2019). Specific "Places" within each county and city that fall below the ALICE Threshold are shown for the CSPDC region (Table 12).

Regionally, one of the most important issues to address is equality of opportunity, meaning that all citizens in these localities, regardless of race, income, and location are entitled to the same coverage under any regulations and policies and are treated fairly when enduring physical and economic losses (EPA, 2019). In New Orleans, Louisiana after Hurricane Katrina in 2005, low income communities suffered for over 10 years after the storm hit. More recently, Hurricane Harvey in 2017 caused millions of dollars of devastation to poor communities because of insufficient federal aid, under-preparedness by local entities, and lack of infrastructure. These disadvantaged groups were systematically stunted and recovery efforts slowed or stopped altogether because many homeowners did not have flood insurance to protect them from damages incurred from hurricane destruction or the financial stability to afford the costs of natural disasters. Additionally, low-income groups tend to be pushed toward the floodplain and other damage prone areas because of exceedingly high property costs in more advantageous and better prepared areas because of their

Table 12. ALICE Map Data for CSPDC Region (ALICE, 2019).

	Augusta	Bath	Highland	Rockbridge	Rockingham	Staunton City	Lexington	Buena Vista City	Harrison-burg City	Waynes-boro City
Total House-holds	29,664	2,104	1,121	9,277	31,186	10,383	1,856	2,709	16,626	9,044
% Poverty	9	11	12	12	10	14%	19%	26%	26%	14%
% ALICE	29	25	27	31	29	34%	25%	38%	38%	31%
% above ALICE Thresh-old	62	64	61	57	61	52%	56%	36%	36%	55%

affordability (Krause, 2017).

Since the Central Shenandoah region is agriculturally-centered and rural in nature, it poses its own unique issues of environmental justice. Understanding how environmental justice shapes community planning, legislation, funding, and recovery is crucial because it will help these counties improve their adaptation strategies to benefit the greatest number of citizens when climate occurrences disturb daily life.

Environmental Justice Recommendations

When addressing issues of environmental justice, it is important that planning efforts are at the forefront. More detailed comprehensive plan hazard mitigation and adaptation strategies, planning for possible situations, and covering all necessary bases are the best way to be adequately prepared for the pending impacts of climate change. Since many citizens may not understand their associated risks of living in the Central Shenandoah Valley region, they also may not know how to prepare themselves, their homes, businesses, and communities for disaster. As a result, increasing outreach and education across the community will ensure that citizens do more on their own to protect themselves as well as become more informed.

Food Deserts

Food Deserts are defined by the U.S. Department of Agriculture as “areas where people cannot access affordable and nutritious food” (Virginia Tech, 2014). Food deserts are

an issue of environmental justice because they are usually located in rural regions that have higher rates of poverty and low-income residents (Virginia Tech, 2014; CDC, 2019). Within CSPDC's service area, there are several pockets within the counties and most of the cities where residents do not have equal access to healthy food that meets all nutritional requirements (Dutko, 2012; Virginia Tech, 2014). Factors that contribute the most to the prevalence of food deserts are the lack of public transportation (or transportation, in general), lack of available retail food locations within a 10-mile vicinity in rural communities, and low incomes of resident in those communities (Dutko, 2012; Virginia Tech, 2014).

Food Desert Recommendations

Food deserts formed because inequalities across space, lacking grocery infrastructure, and little/no access to adequate transportation. Recommendations for reducing food deserts include: creating shared resources like a community garden, hosting local farmer's markets where residents can buy affordable, fresh produce and meat, establishing food banks/food pantries for in-need community members, starting a garden, and growing your own food. (CDC, 2019, Virginia Tech, 2014). Additionally, a program could be implemented to grant money to areas designated as food deserts to decrease the amount of Virginian's who are considered food insecure. Addressing food deserts could provide healthy food to community members across the CSPDC's jurisdiction who are suffering adverse health effects (including increased rates of obesity) from inadequate food availability (Hall & Berti, 2019; Virginia Tech, 2014).

Coastal Migration and Future Population

Sea level rise will impact many urban areas across the globe. For example, in the United States, nearly 40% of citizens live in "high population-density coastal areas" (Lindsey, 2018). Around the world there are large numbers of people who will be at risk of displacement over the coming years due to sea level rise. People displaced by sea level rise are known as environmental refugees, a term coined in the 1970s for people who could no longer inhabit their land due to dangerous environmental conditions (Doran, 2015). However, environmental refugees do not fall into the traditional definition of refugee, which has allowed for debate around the legitimacy of climate refugees (Doran, 2015). For this reason, there is not an international infrastructure set in place for this type of refugee to find a place

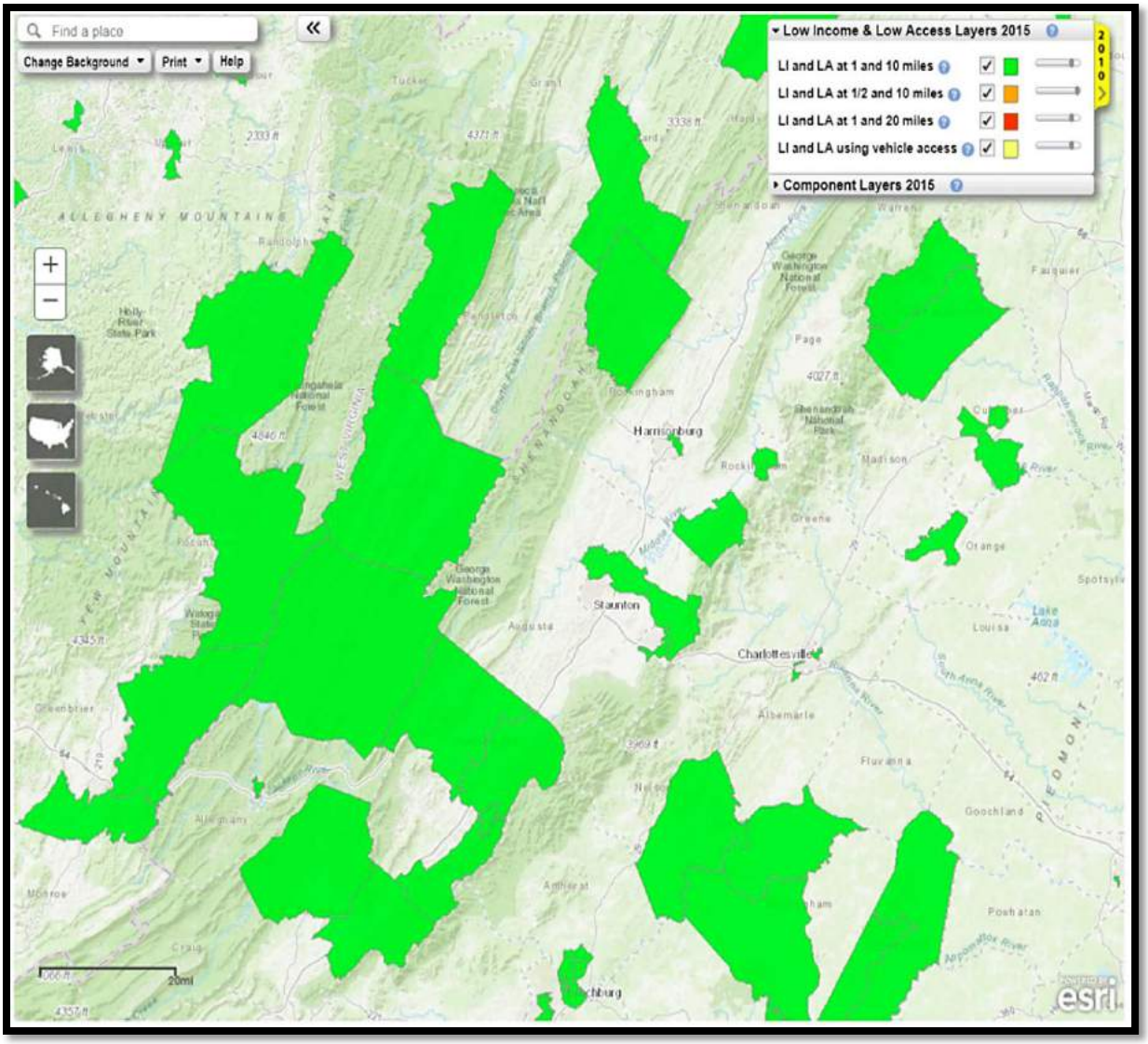

Figure 15. Food Deserts showing Low Income & Low Access Areas in the CSPDC region (Ploeg, 2017).

of asylum. Nevertheless, 25 million climate refugees currently exist, and this number is expected to increase to 200 million by 2065 (Doran, 2015).

The largest city in Virginia is Virginia Beach. This coastal city has 35 miles of shoreline (City of Virginia Beach, 2017) and an estimated 450,435 citizens within the 248-square mile radius (U.S. Census Bureau, 2018). Here, sea level rise has the potential to displace thousands of people within this city alone. Other coastal or tidewater cities within Virginia will face an important question in the coming years: where will environmental refugees go?

Climate change will also exacerbate the frequency and intensity of natural disasters, including floods and hurricanes. Along with other natural disasters, the number of environmental refugees is expected to spike in coming years causing a global crisis. The

CSPDC has population projections for the next 25 years (Table 13). However, the uncertainty that comes with this issue makes it hard to predict just how much population in the area may grow due to environmental refugees. Current projections place the growth in climate migrants for Augusta, Bath, and Rockingham, anywhere between 1 and 50,000 new residents, while in Rockbridge and Highland there is no significant expected increase (Hauer, 2017).

Table 13. Projected populations in the Central Shenandoah Planning District (CSPDC, 2013).

Geography Name	2010 Census	Projected Population		
		2025	2035	2045
Virginia	8,001,024	9,145,616	9,874,244	10,528,817
CSPDC	286,781	319,248	340,290	358,808
Augusta County	73,750	78,582	83,570	87,939
Bath County	4,731	4,592	4,318	4,016
Highland County	2,321	2,140	1,941	1,730
Rockbridge County	22,307	22,365	22,944	23,359
Rockingham County	76,314	85,116	91,418	97,037
Buena Vista city	6,650	7,089	7,298	7,455
Harrisonburg city	48,914	62,920	70,837	78,204
Lexington city	7,042	7,898	8,145	8,333
Staunton city	23,746	25,378	25,480	25,403
Waynesboro city	21,006	23,167	24,339	25,332

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Appendix C –

Flood History and
Dam Risk Assessment and Inventory

C-I. FLOOD HISTORY

Flood	Description and Damages*
July 13, 1842	• Occurred in Rockbridge County and also affected Covington, Buchanan, Lynchburg. • Floods in Rockbridge affected Irish Creek, Mill Creek, Jackson Run, North River (now known as the Maury River), and James River. • Furnaces, forges, mills, and bridges washed away. • Caused by a week of heavy rains. • Destroyed crops: corn, wheat, oats, and hay. • Fences along rivers washed away. • Flooding along James River did not reach Scottsville. • Canal seriously damaged in Lynchburg. *"The heavy rains of last week were succeeded by the most disastrous freshet with which our county has ever been visited."* *- Lexington Gazette July 21, 1842*
1846	*"… a stranger walking thru the business portion of Staunton, would not imagine that the place was liable to be devastated by floods, there being no water force visible to the eye. Yet the town had several times suffered severely from the cause. "* - Annals of Augusta County, Virginia from 1726 to 1871 by Jos. A. Waddel
January 1854	• Heavy rains caused the James River to flood Balcony Falls and Glasgow in Rockbridge County. • On January 21, 1854, the canal boat Clinton and its passengers became stranded in the raging waters. Frank Padget, a skilled boatman and an enslaved person, led four other men to rescue them. As Padget was trying to save the last passenger, he drowned in the rushing current. Capt. Edward Echol's, who witnessed the rescue, was so moved he commissioned the construction of a granite monument which now stands in Glasgow's Centennial Park.
August 4, 1860	• Flashflood in City of Staunton caused by a severe thunderstorm. • Sidewalks were pulled up along Augusta Street. • Many stores in downtown Staunton received thousands of dollars of damages. • A chimney at St. Francis church was blown down. • A stable was lifted off it's foundation and destroyed. "*It is sufficient to arouse our citizens to the absolute necessity of arming themselves against a recurrence of the disastrous results which have followed this freshet."* - Staunton Spectator, August 10, 1896

Description and Damages*: Please note that in this section where stated, dollar amounts were calculated for inflation and shown in 2019 dollars in most instances. Some amounts were kept in dollars for the year they occurred either due to how long ago the event occurred or that the large size of the number didn't make an inflation calculation easy to report.

Flood	Description and Damages
September 28 - 30, 1870	The flood of September 28-30, 1870 was one of the earliest floods in the history of the Shenandoah Valley where written accounts are widely available. The flood event occurred throughout the central Valley from the north in Rockingham County and to the south in Rockbridge. The rain was first welcomed after a period of drought and a summer where rivers had been running below normal. As the rain continued, rivers rose to swirling torrents. The Shenandoah River with its expanded and rapid course carried away houses, trees, and bridges in Rockingham County and northward. The Village of Port Republic was reportedly under 15 feet of water at one time during the event. An example of destruction caused by this flood could be seen in Harper's Ferry, West Virginia, the confluence of the Shenandoah and Potomac Rivers where 47 people died. In Augusta and Rockbridge Counties, extensive damage occurred. Some reports measured nine inches of rain with this storm. In Staunton, flooding along Lewis Creek caused damage to its downtown and washed away a railroad bridge and wood and brick houses. The C & O railroad was damaged, including another bridge that washed away in Waynesboro. In Rockbridge County, Lexington was particularly hard hit in The Point area where several houses were swept away. Also in Rockbridge County, farms, crops, and fences, were destroyed by the flood event. Throughout the Shenandoah Valley, communication lines and transportation routes were blocked. With images of the Civil War still fresh in the minds of people, rebuilding from the flood of September 1870, became another challenge in the recovery they were already experiencing. *"… some idea may be obtained of the immense destruction which has spread over many portions of our beloved old State, greater, by far, than the devastations of four years war. Our people however, have exhibited in the past a wonderful recuperative power. They will not be downcast now, but will bow with humble resignation to the will of Heaven, and will still hope and strive for the best."* – Staunton Vindicator, October 7, 1870
August 28, 1893	• Flood caused by heavy rainfall affected Rockbridge County. • Rain started at around 9 a.m. in the morning and continued until midnight. • The North River (now known as the Maury River) before the rainfall had been so low there wasn't enough electricity to run the electric plant. As a result of the storm, water was 3 feet over the roadway at The Point.

Flood	Description and Damages
September 29, 1896	On the twenty-sixth anniversary to the day of the flood of 1870, the Shenandoah Valley was hit by another significant flood event. This flood most likely occurred as a result of a tropical storm that was tracking through Virginia during this time. The rain, which fell steadily all day on September 30, 1896, increased in volume through the evening and culminated in torrential flooding that night. *"The gentle, soaking rain which gladdened the hearts of Rockingham farmers Tuesday morning, continuing its steady downpour all day long, at night became a raging equinoctial storm which carried death and destruction in its wake."* *– Rockingham Register, October 2, 1896* The City of Staunton was the hardest hit locality in the region. Lewis Creek and its tributaries overflowed their banks, devastating Staunton's downtown. Houses, sheds, and stables were swept away. Thirty - forty horses drowned. This flood caused significant damage to the downtown business district. The archway under Augusta Street and the arch bridge over Middlebrook Road survived but nearby buildings in the vicinity of both were severely undermined and many homes were washed off their foundations. The dam at the Fair Grounds broke. Six lives were lost in Staunton. While the Flood of 1896 was the most dramatic flood in Staunton's history, flooding also occurred in other parts of the region, though not at such a level. In Rockingham County, three lives were lost, crops destroyed, and railroad and telegraph lines were damaged. In Rockingham, flooding hit Bridgewater, Elkton, and Keezletown. It was estimated that damages to public roads and bridges reached $600,000 (2019 dollars) in Rockingham County. In Harrisonburg, houses along Black's Run were flooded. Damage estimates for Harrisonburg were a few thousand dollars (2019 dollars). At the weather station at Dale Enterprise, six and a half inches of rain reportedly fell over an 18-hour period in Rockingham County. The Flood of 1896, believed to be part of a tropical system, was short lived but during its brief period was able to drop much rain in the northern part of the Central Shenandoah Region during its visit. The heavy, localized flooding was swift and its damage was difficult to grasp. The Flood of 1896 is the flood of record for the City of Staunton.

City of Staunton, September 1896

Farm Land In Highland County

Flood	Description and Damages
August 15, 1906	August 1906 was a wet month in the Central Shenandoah Valley. For a period of three to four weeks, rain fell daily in the northwestern part of the Region. The steady rainfall combined with a storm system that stalled against the mountains, caused heavy flooding in Highland County on August 15, 1906. *"The damage to growing crops, public roads, farmland, etc. cannot be given nor even intelligently estimated, but the loss of one human life, reported from, Forks of Water, seven miles north of town, is the saddest feature of the storm" - The Recorder, August 17, 1906.* The storm started with a sustained cloudburst that caused small, mountain streams to rage and overflow their banks. Throughout the Valley, residents coped with the dampness brought on by the repetitive rainfall that month. Farmers, building contractors, and other businesses faced losses because of the long period of rainy weather. In Highland County, and in particular the Town of Monterey, they also faced flood damages including a foot and a half of water in the Monterey Hotel Stables. The Flood of 1906 is an excellent example of a flash flood, where intense rainfall from a stalled storm system causes tremendous damage over a geographically concentrated area. A flash flood event, like other types of flooding, may cause just as much damage and can be just as deadly.
November-December 1934	• Flooding in Rockbridge County, including Long Hollow Road where damage was estimated at over $28,000 (2019 dollars). • A week later, water still surrounded many homes and flooded basements.
March 16 - 17, 1936 "The Great Spring Flood" "The Great St. Patrick's Day Flood"	The winter of 1935-1936 was a brutal one in Virginia. Across the State that winter, low temperatures and heavy snowfalls were common. March began with milder temperatures, but in mid-March, storms tracked across the eastern parts of the United States, dumping heavy snowfalls and torrential rains in its path. Up to 200 deaths nationwide were attributed to this storm. Damage estimates for the United States reached millions of dollars. In Virginia, the James, Potomac, Rappahannock, Shenandoah, and York River watersheds were flooded. Much of the Central Shenandoah Valley suffered the effects of this storm. In Rockingham County, 3.10 – 6.25 inches of rain fell over a two-day period. In the Shenandoah Watershed, streams and creeks reached record depths in Bridgewater, Brock's Gap, Rawley Springs, Lynwood, Keezletown, and Port Republic. The Town of Elkton was cut off as roads were blocked and bridges washed out. The City of Harrisonburg lost power as Black's Run flooded areas surrounding Main Street. Much of the Central Shenandoah Valley suffered the effects of this storm. In Rockingham County, 3.10 – 6.25 inches of rain fell over a two-day period. In the Shenandoah Watershed, streams and creeks reached record depths in Bridgewater, Brock's Gap, Rawley Springs, Lynwood, Keezletown, and Port Republic. The Town of Elkton was cut off as roads were blocked and bridges washed out. The City of Harrisonburg lost power as Black's Run flooded areas surrounding Main Street. *(Continued On Next Page)*

Flood	Description and Damages
(Continued From Previous Page) March 16 - 17, 1936 "The Great Spring Flood" "The Great St. Patrick's Day Flood"	In Augusta County, Waynesboro's DuPont Plant was forced to close due to flooding by the South River. Torrential rains along with the melting of 18 inches of snow quickly filled Back Creek and the South River beyond their banks. In Waynesboro, many homes were flooded and cars washed away. Staunton reported heavy rainfall, at one point recording 2.5 inches of rain in a twelve-hour period. Craigsville reported flooding six feet in depth at an underpass on the Craigsville Fordwick Highway. Flooding along the James River watershed, hit Rockbridge County, Lexington, Buena Vista, and Glasgow. Lexington escaped heavy damage, but several residents were forced to evacuate their homes and oil company storage plants were flooded. Buena Vista suffered significant damage. In Buena Vista several industries were damaged by the flood including the Columbia Paper Company, the Majestic Silk Mills, the Buena Vista Throwing Company, and the W.V. Darling Manufacturing Company. *"Buena Vista was the scene of a bad flood causing one death and costing the factories, townspeople, it is estimated, about three million dollars [$55.5 million in 2019 dollars] in goods and property."* *– Lexington Gazette, March 20, 1936* In Glasgow, its major manufacturer, the Blue Ridge Company, rug makers, remained dry while Locher and Company, brick manufacturers, did get some water but had little damage. The residential area of Glasgow wasn't as lucky; many people had to be rescued by boat from their homes. It was reported that water reached between eight and ten feet on the main road through Town. In March of 1936, flooding, thunderstorms, landslides, and deep snows caused devastation up and down the East Coast of the United States. A harsh winter that was followed by an equally challenging spring wreaked havoc over many states. The Central Shenandoah Region was not exempt from the storms of 1936 that caused what would come to be known as "The Great Spring Flood".

Flood	Description and Damages
April 1937	• Flooding in six states caused numerous rivers to overflow their banks. • There were reports of high water on all roads leading into Staunton. Drainage systems were taxed with the large amounts of rainfall.
October 1942	• Prolonged rainfall over several days caused flooding. • The rain gauge just below Afton mountain recorded 11.27" of rainfall. • City of Waynesboro was hardest hit in the Central Shenandoah Valley. The amount of water was 3.5 inches higher at the Chestnut Avenue gauge that it had ever been recorded, and up to two feet higher in the Rife-Loth Plant and 17 inches higher at the Main Street service than ever before. • Damages across Augusta County, including the Cities of Staunton and Waynesboro, were estimated at over $30,000,000 (2019 dollars).
June 18, 1949	In the Summer of 1949, when the rest of the Central Shenandoah Valley was experiencing the post-World War II economic boom, the Town of Bridgewater was forced to focus its energy and resources on re-building itself after flash flooding ravaged the Town. Parts of Rockingham and Augusta Counties were also struck hard by this storm. On June 17th, rain fell steadily throughout the day and into the night. Rising waters turned into floodwaters in the early hours of June 18th. Rising floodwaters filled Mossy Creek, Dry River, and Briery Branch. These rivers passed along their floodwaters to the already swollen North River. The Town of Bridgewater faced the worst flood event in its history. Floodwaters reached the second story in many houses. "A News-Record Reporter covering the story, reported that the roar of the raging river could be heard in the extreme northern end of Bridgewater. 'It sounds like the roar of Niagara Falls,' he said." – Harrisonburg Daily News Record, June 18, 1949. In Bridgewater, three lives were lost, one home was completely washed away, approximately 100 homes and many businesses damaged, and between 25-30 cars were smashed or washed away. Damage estimates were reported to range from $1,076,000 to $11 million (2019 dollars). (Continued On Next Page)

1949 Flood - Stokesville - Alan Cramer Collection

1949 Flood - Stokesville - Alan Cramer Collection

Flood	Description and Damages
(continued from previous page) June 18, 1949	One of the saddest events of the Flood of 1949, was the three deaths that occurred in Bridgewater, including Mrs. C.R. Bowman, Margaret Bricker, and her nine-year-old daughter, Frances. The Bricker's were killed when their house was washed off its foundation in a fifteen-foot wave of water. Mrs. Bricker's twelve-year-old daughter, Betty, who had also been in the house, was rescued from a submerged tree. *"This two-story frame house was hit by the flood at midnight, and, at 1:30 Saturday morning, was lifted from its foundations, carried a quarter of a mile, and smashed to bits, it's tin roof being all that [was left] of it against a tree on College Street."* *- Harrisonburg Daily News Record, June 20, 1949.* Ironically, the day the house washed away was also Frances' ninth birthday. It took a week for Frances Bricker's body to be recovered. The lengthy search to recover her body and the senseless death of "little" Frances Bricker, as she was known, personified the loss that the whole Town felt in the aftermath of this horrific flood. To the west, along the North River, parts of Rockingham and Augusta Counties were also hard hit by severe flooding. Up to 15 bridges were removed by flooding. Small roads covering the area were washed out leaving residents stranded. Aerial views of fields revealed that tons of topsoil had been washed away, leaving only red clay to be exposed. Damage to the George Washington National Forest was estimated at $1.6 million (2019 dollars). In Augusta County, Stokesville experienced a great deal of flood damage. Fortunately, there was no loss of life in Stokesville but more than 12 homes were completely demolished as a result of the flood and many others were heavily damaged. Because of the loss of topsoil, many small farmers were unable to replant crops. Poultry in the thousands and heads of livestock in the hundreds were destroyed in the Stokesville area. In the immediate aftermath of the flood, Stokesville was unable to rebound as quickly as Bridgewater because they faced a tremendous shortage of resources and an inability to get tools and materials needed to clean and make repairs. The flash flood of June 1949 left the Town of Bridgewater, the community of Stokesville, and parts of Rockingham and Augusta Counties forever changed.

Flood	Description and Damages
September 10, 1950	• Flash flood after 24 hour period of rainfall. • 3.8" of rain at Dale Enterprise and 3.86" of rain at Timberville in Rockingham County. • 5.81" of rainfall near Balcony Falls in Rockbridge County. • 3.9" of rainfall in Augusta Springs in Augusta County. • Black's Run overflowed in Harrisonburg on Main Street. • In Rockbridge County two people drowned; the Town of Glasgow was completely cut off; Buena Vista flooded; Buffalo Creek and Whistle Creek left their banks. Many homes and hundreds of cars were washed away. 35 bridges and 50 bridge approaches were washed away. • Rockbridge County damages were estimated at $21 million (2019 dollars) with $369,000 of that in damage to secondary roads and over $421,000 of that in damage to primary roads. "At Whistle Creek Carl H. 'Doc' Collett… got up at 4:45 a.m. to close a window against the rain and saw his refrigerator float by downstairs. Within 10 minutes water rose downstairs from two feet to five feet downstairs and the Colletts were trapped upstairs." - Lexington News-Gazette May 16, 2001 Page A12
October 15, 1954 "Hurricane Hazel"	• Hazel struck land as a Category 4 hurricane on October 15, 1954. • The storm caused a national total of 95 deaths and $2.6 billion in damages (2019 dollars) and was considered the worst storm of the 1954 hurricane season. • Observers in Washington, D.C. reported 78mph wind gusts. • Twelve people were killed in Virginia, including four crewmembers of the tugboat Indian, which sank in the James River as a result of the turbulent wind and water. • Turkey growers in the Shenandoah Valley lost between 150,000 and 250,000 turkeys when poultry sheds were wrecked. • The Staunton/Augusta area received five to six inches of rain, and roofs, roadways, and bridges throughout the area sustained significant damage.

Flood	Description and Damages
August 1955 "Hurricanes Connie and Diane"	Hurricanes Connie and Diane teamed up to spin a relentless one-two punch on the eastern portion of the United States, causing widespread flooding in numerous states. Hurricane Connie struck South Carolina as a Category 1 hurricane on August 12, 1955, inflicting flooding and high winds that killed 41 people and resulted in $144 million in damages (2019 dollars). Connie caused extensive damage to Virginia tobacco and corn crops, and flooded low-lying areas throughout the state, but caused little to no damage locally. Hurricane Diane, also a Category 1 storm, made landfall in North Carolina on August 17, 1955. With the ground already saturated from Connie's rain, Diane caused intense flooding, resulting in 184 to 200 deaths and $31.2 billion (2019 dollars) in damages, making it the sixth most costly U.S. hurricane of the 20th century. Virginia received about three inches of rain from Diane. The storm also caused widespread flooding throughout Augusta County, an automobile accident, a backup of Harrisonburg's flood and sewer systems into homes and businesses, and a 4 by 200 foot chunk of concrete to be swept away from the Harrisonburg hydroelectric dam.

Flood	Description and Damages
August 19, 1969 "Hurricane Camille"	**Camille.** In the western part of Virginia this name is synonymous with unequalled destruction. The remnants of Hurricane Camille caused flooding during the evening hours of August 19, 1969 and the morning hours of August 20, 1969 that broke all flooding records in modern history along the James and Maury Rivers. On August 17, 1969, Hurricane Camille made landfall on the gulf coast of Mississippi as a Category Five Hurricane – the deadliest type of hurricane. Gusts of up to two hundred miles an hour were reported. The storm surge was the highest ever recorded in the United States. One hundred and forty-three people died as a result of this hurricane on the gulf coast of the United States. Hurricane Camille had weakened to a tropical depression by the time it had reached the Mississippi/Tennessee border. Rain was forecast for the western part of Virginia but it was the combination of three factors that caused the rain to turn into torrential downpours of unparalleled amounts. *"As Camille reached Virginia, it ran into three influences—a westerly flow of cold air, an 'orthographic lifting' of air over the mountains, and a stationary cold front over the northern part of the state. The counter clockwise flow of air created by the storm drew moisture, apparently in great amounts, from the Atlantic Ocean into the center of the storm. The 'orthographic lifting' or updrafts of air created by the mountains, forced the moisture up to the westerly flow of cold air, where it was cooled to a 'release point' and then came down in torrents of rain. The cold front acted as a blocking force, causing the storm to move eastward over the mountains where the updrafts of air continued to force the moisture upward."* *– excerpt from the Richmond Times-Dispatch in Hurricane Camille: A Review.* Nelson County was the hardest hit in all of Virginia receiving from between 27 to 31 inches of rain, most of which fell in a five-hour period during the middle of the night while people were sleeping. Homes in Massie's Mill and Lovingston were washed off their foundations and completely destroyed. Whole families died either in their homes or as they tried to escape the floodwaters. As the land became saturated, tons of topsoil streamed down the mountainsides, toppling trees and creating mammoth landslides. An example of this devastation could be seen after the flood where for a five-mile stretch of Davis Creek, logs were piled 30 feet high. One hundred and seventeen people died in Virginia and a majority of those people were in Nelson County. In the Central Shenandoah Region, three localities– Augusta, Bath and Rockbridge Counties were included in the federal major disaster declaration (DR-274). Rockbridge County was severely impacted by Hurricane Camille. For the City of Buena Vista and the Town of Glasgow, Camille would become their flood of record. Up to eight inches of rain fell in the southeastern part of Rockbridge County. Twenty-three people died in Rockbridge County including three members of the Rion family of Glasgow, and eight members of the Clark family in Cornwall. In Buena Vista, 69 year-old Hansford Odell Allen died in Camille also. *(Continued On Next Page)*

Nelson County in the aftermath of Hurricane Camille.

Flood	Description and Damages
(*continued from previous page)* August 19, 1969 "Hurricane Camille"	Both Buena Vista and Glasgow's business districts were flooded with six feet and fourteen feet of water respectively. At least 75 homes were damaged in Buena Vista, and in Glasgow a quarter of the residences were damaged by the floodwaters. In Goshen, the Stillwater plant was inundated with water. Not only were lives lost, homes destroyed, and businesses devastated, but agriculture in Rockbridge County was also affected. One hundred and fifty head of cattle were lost, crops were ravished, and fertile topsoil washed away. Damages in Rockbridge County exceeded $208 million (2019 dollars). Hurricane Camille affected both Mississippi and Virginia. Two hundred and sixty lives were lost as the result of the hurricane and the flash flooding it created. Camille caused over 3 billion dollars (2019 dollars) in damages throughout Virginia. The year following Hurricane Camille was full of loss and a struggle to recover for thousands of residents in western Virginia. This struggle is best illustrated through the words on a plaque given by the Lion's Club to the citizens of the City of Buena Vista, "To the citizens of Buena Vista and their good friends from far and near, in grateful recognition of their collective efforts and achievements in the rebuilding of Buena Vista following the flood which came in the wake of Hurricane Camille on August 20, 1969. This plaque expresses appreciation for the labors, moneys, services, supplies, equipment, leadership, and the spirit of cooperation which were extended by individuals, organizations, agencies, and companies; both local and throughout the nation; to relieve the flood devastation and to restore order to our city. In unity lies our strength." Camille, its colossal rainfall, and the total destruction it left in its wake have yet to be surpassed and will be imprinted in the memories of many for a lifetime. The stories of Camille will be passed on for generations.

Glasgow's business district flooded by Hurricane Camille. Photo by Ralph Ogden

Rising water in Waynesboro from Hurricane Camille.

Flood	Description and Damages
June 19, 1972 "Hurricane Agnes"	On June 19, 1972 Hurricane Agnes, a weak disorganized hurricane, made landfall in Florida. Barely able to reach hurricane status, it quickly disintegrated to a tropical storm, and quickly a depression. Although it was a weak hurricane, it was a large storm with a diameter of 1,000 miles. It made its way up the Appalachians and exited back out to sea off the coast of North Carolina. Sponging up moisture from the Atlantic Ocean, it regained strength. On June 21, 1972, Agnes now back to tropical storm status reached the Virginia coast and made its way up the Eastern seaboard. Several states received record flooding. From Virginia to New York, several places received rainfall totaling 15 inches or more. An example of the devastation was witnessed in Wilkes-Barre, Pennsylvania where they had built a dike, 37 feet high, to protect them from floods similar to the Flood of 1936, their flood of record, where the Susquehanna River crested at 33 feet above its normal levels. As a result of Agnes, the river crested at 40 feet, pouring water over the dike and flooding the Town. In Kingston, Pennsylvania, only 20 of its 6,600 homes were above water." 'Agnes re-wrote the book on inland flooding and the impact a tropical storm can have hundreds of miles from the coast.' – Sol Summer, National Weather Service, from Storms of the Century, www.weather.com". Damage from Hurricane Agnes in the United States was over $19 billion (2019 dollars), the second costliest hurricane in U.S. history and caused 120 deaths. In Virginia, 13 lives were lost and damages equaled over $1 billion (2019 dollars). Rivers surpassed their banks throughout the State including the Appomattox, Dan, James, Potomac, and Roanoke Rivers. Like other parts of the State, the Central Shenandoah Region received flooding but not to the levels that had occurred three years earlier with Hurricane Camille. Eight localities (Bath, Buena Vista, Harrisonburg, Lexington, Rockbridge, Rockingham, Staunton and Waynesboro) were included in the federal major disaster declaration (DR-339) following the storm. Waynesboro was one of the hardest areas hit in the Region. Waynesboro's downtown and Club Court areas were evacuated. At the time, damages to homes and businesses were estimated to be in the hundreds of thousands of dollars. In Rockbridge County, both Buena Vista and Glasgow received flooding. Glasgow, at the confluence of the James and Maury Rivers, received the greatest amount of flooding in Rockbridge County. In Glasgow, damages reached approximately $925,500 (2019 dollars) and 50 families were evacuated in the small town. In Buena Vista, many homeowners and businesses were evacuated. Hurricane Agnes was one of the costliest and damaging tropical storms to hit the Eastern United States. In the Central Shenandoah Region, because of the recent memories of Camille, many residents took steps early to evacuate and remove property from homes and businesses. While Agnes did bring along floodwaters, Valley residents were prepared.

Hurricane Agnes in the Town of Glasgow

Flood	Description and Damages
October 7, 1972	Severe storms resulted in flooding. Buena Vista was included in a federal major disaster declaration (DR-358).
October 10, 1972	Severe storms resulted in flooding. Augusta, Buena Vista, Rockbridge and Rockingham were included in a federal major disaster declaration (DR-359).
November 4 - 7, 1985 "Hurricane Juan" "Election Day Flood"	The Flood of November 1985 will be remembered in Virginia for its flash flooding. Flooding was caused when a slow-moving low pressure system, possibly containing remnants of Hurricane Juan, moved northeasterly through West Virginia and Virginia dumping torrential rains over a four-day period. Known as the "Election Day Flood", because it occurred during election day, the storm caused 22 deaths. Damages across the state reached nearly $1.8 billion (2019 dollars). This flood was the worst flood for the City of Roanoke, where the Roanoke River rose seven feet in one hour and eighteen feet in six hours. Areas all across the Central Shenandoah Region were affected by the flooding. Nine localities– Augusta, Bath, Buena Vista, Harrisonburg, Highland, Lexington, Rockbridge and Rockingham- were included in the federal major disaster declaration (DR-755). In Rockingham County, the western part of the County was hardest hit. A railroad bridge built in 1896 was washed out in Elkton. The Town of Bridgewater experienced limited damage because of a levy built after the disastrous flood of 1949. Bridgewater did receive damage to roads, their hydroelectric plant, and the athletic field at Bridgewater College. In Highland County, at least 50 homes and 300 farms received damages from the flooding. In Highland County, road damage was estimated at a little over $4.7 million (2019 dollars). In Bath County, bridges were washed out, and property damage was estimated in the thousands of dollars. Communities in Augusta County were inundated by floodwater. The swollen Middle River damaged homes, property, and roads in areas like Frank's Mill, Fort Defiance, and Verona. Buffalo Creek washed away bridges and roads in the Buffalo Gap area. Damages to roads in Augusta County were estimated at $18 million (2019 dollars) and homes, businesses, and public facilities at $16.5 million (2019 dollars). The rains had minimal affects on the City of Staunton except for the water treatment plant that was damaged and the evacuation of residents of the Beverly Hotel where the flooded basement caused concerns. The City of Waynesboro, on the other hand, experienced significant damages. Waynesboro's South River created record flood levels and caused damages to 140 homes, 32 mobile homes, and 41 businesses. The City's sewage treatment plant was also severely damaged. Damage estimated for the City of Waynesboro directly after the flood exceeded $7 million (2019 dollars). *(Continued On Next Page)*

Flood	Description and Damages
(*continued from previous page)* November 4 - 7, 1985 "Hurricane Juan" "Election Day Flood"	In Rockbridge County, Goshen, Glasgow, and Buena Vista were the areas most affected by the flooding. Goshen experienced the heaviest damage due to the swiftness of the floodwaters. Damages in Buena Vista and Glasgow equaled or surpassed what they had experienced during Hurricane Camille in 1969. In Buena Vista, three to six feet of water flooded homes and businesses. In Glasgow, almost half of the homes and two-thirds of the businesses were hit by floodwaters. In Lexington, the waste water treatment plant was covered by the waters of the Maury River. Damages in Rockbridge County were estimated at $236 million (2019 dollars), well exceeding the cost of Hurricane Camille. In the 1985 Flood, 584 homes and 32 businesses were damaged in Rockbridge County. The November 1985 Flood reached its watery fingers throughout the Central Shenandoah Region, grasping homes, public facilities, and businesses. The three-day period of sustained rains caused flash flooding all over the Region. It is no doubt that the Election Day Flood created one of the lowest poll turnouts in history.
May 19, 1992	Severe storms resulted in flooding. Six localities- Augusta, Bath, Buena Vista, Lexington, Rockbridge and Rockingham- were included in a federal major disaster declaration.
April 1993	· Flooding in Bath and Highland Counties caused by heavy, localized rainfall. Between 1 and 6 inches of rain fell. · A corridor running north-south from Pendleton County, WVA into Bath County, between the east side of Lantz Mountain and the west sides of Jack and Warm Springs Mountains, sustained the most damage. · Streams were inundated along U.S. 220 and Rt. 642 and culverts, small bridges, and fences washed out. · Livestock had to escape floodwaters on many farms. · Some areas experienced more damage then they did in 1985. · Gardens including all their topsoil were washed away.
March 10, 1994	Severe ice storms resulted in flooding. Bath, Buena Vista and Rockbridge were included in a federal major disaster declaration.

Flood	Description and Damages
June 22 - 28, 1995	A week-long period of ground saturating rains fell over the western part of Virginia, causing flash floods and landslides. Madison and Greene Counties were the most devastated in the State, when an intense rainfall stalled over the mountains. On June 27, 1995, in a fifty mile area of Madison County, 30 inches of rain fell in a 16-hour period, with as much as 25 inches falling in a five-hour period in some areas. This caused debris flows and mudslides that uprooted trees, removed topsoil, and caused extensive altercations in the landscape. Rainfall had not been seen there in such a concentrated level over such a short duration since pre-historic times. In the Central Shenandoah Region, six localities– Augusta, Bath, Buena Vista, Lexington, Rockbridge and Staunton were included in a federal major disaster declaration (DR-1059). The week of rains caused flash flooding in Augusta and Rockbridge Counties. In Augusta County, the Town of Craigsville was flooded when 12 inches of rain fell over an 11-hour period. Trees were uprooted in yards, basements caved it, and 40 people were forced to evacuate their homes. Damage estimates exceeded $843,000 (2019 dollars) for the Town. *"Craigsville Mayor Herbert Campbell called Thursday's flood much worse than the 1985 flood which caused damage that some residents believed would never be equaled." – Staunton Daily News Leader, June 24, 1995.* In the Town of Glasgow, flooding from interior mountain streams became more of a problem than river flooding with this event. At least 42 homes in Glasgow experienced flooding on the first floor of their homes and 64 homes had flooded basements or crawl spaces. In the City of Staunton, Gypsy Hill Park was flooded when Lewis Creek overflowed its banks. The Park's duck pond also overflowed causing sinkholes and creating other problems.
January 13, 1996	Severe winter weather resulted in a blizzard, followed by two additional snowstorms bringing over a foot of snow. Snowpack was on the ground for an extended period of time. It was thawed by higher temperatures and heavy rain, resulting in severe flooding. Ten localities- Augusta, Bath, Buena Vista, Harrisonburg, Highland, Lexington, Rockbridge, Rockingham, Staunton and Waynesboro- were included in a federal major disaster declaration (DR-1086).
January 27, 1996	Flooding was caused by melting snow. Eight localities- Augusta, Bath, Buena Vista, Harrisonburg, Highland, Rockbridge, Rockingham and Waynesboro- were included in a federal major disaster declaration (DR- 1098).

Town of Goshen Flood of June 1995

Flood	Description and Damages
September 6, 1996 "Hurricane Fran"	Hurricane Fran made landfall in North Carolina as a Category Three hurricane on September 6, 1996. In the Central Shenandoah Region, ten localities– Augusta, Bath, Buena Vista, Harrisonburg, Highland, Lexington, Rockbridge, Rockingham, Staunton and Waynesboro were included in the federal major disaster declaration (DR-1135). The Counties of Augusta and Rockingham were most affected by Fran. Fran dropped eight inches of rain in parts of the Valley and up to thirteen inches of rain in the Big Meadows area of the Shenandoah National Park. Hurricane Fran broke almost all flood records along the Shenandoah River and its tributaries, including those set in 1972 with Hurricane Agnes and in 1985. Damages in the Shenandoah Valley were estimated at over $97 million (2019 dollars). The Naked Creek area in Rockingham County, north of Elkton, sustained severe damage by the flood. The flood carved new channels and filled yards and homes with debris. Areas in the Town of Bridgewater were flooded when the North River overflowed its banks. Broadway, Mount Crawford, and Dayton were among the other communities in Rockingham County that experienced flooding. The City of Harrisonburg received flooding along Blacks Run but damage was minimal in comparison to other areas in Rockingham. More than 125 roads were closed in Rockingham as a result of the floods. In the County, 16 homes and 18 mobile homes were completely destroyed by Fran, and 334 additional structures received damage. In Augusta County, National Guard troops evacuated people in the Mount Solon and Churchville areas. Buffalo Gap, Augusta Springs, and Sherando were also vulnerable to the high waters caused by the heavy tropical rains. Twenty-nine roads were closed in Augusta County. Two deaths resulted in Augusta County when people tried to cross the flood-swollen Middle River in two separate incidents. In the City of Staunton, much of downtown was closed due to flooding in the Wharf parking lot area and damage was done to roads at the Frontier Culture Museum. The City of Waynesboro also experienced flooding in their downtown business area when the South River reached flood stage. Waynesboro streets became clogged with debris and tree limbs as the storm progressed. In Virginia, damage from Hurricane Fran was estimated at $466 million (2019 dollars) and caused eight deaths. Two hundred and thirty-three homes were destroyed and over seven thousand homes were damaged in Virginia.

Hurricane Fran in Rockingham County

Flood	Description and Damages
July 8-August 21, 2001	Severe Storms caused flooding. Bath County was included in a federal major disaster declaration (DR-1386).
February 15 – February 28, 2003	A severe winter storms brought snowfall, heavy rain, flooding and mudslides. Highland County was included in a federal major disaster declaration (DR-1458).
August 8, 2003	Flooding occurred in the City of Staunton after a thunderstorm cell stalled out over Staunton's downtown area, dropping between 4-6 inches of rain in an hour. This heavy rainfall caused structures downtown to fill with 2 - 7 feet of water. Floodwaters receded within several hours leaving $1.8 million (2019 dollars) in damages to 55 businesses and up to 70 homes. Gypsy Hill Park and the City's Johnson Street parking garage also sustained damage. In Augusta County, countywide impacts occurred from the storm.
September 18, 2003 "Hurricane Isabel"	Hurricane Isabel made landfall on September 18, 2003, along the Outer Banks of North Carolina. Isabel made landfall as a Category 2 Hurricane. It moved northwestward through Virginia and Maryland, finally dissipating near Erie, Pennsylvania. In Virginia, as Isabel passed through, some areas had sustained winds of 100 mph. Also, for twenty-nine hours tropical storm winds lasted throughout Virginia. Communities located along either the Chesapeake Bay or the Atlantic Coast felt the effects of a storm surge of 5-8 feet. In the Central Shenandoah Region, seven localities– Augusta, Buena Vista, Harrisonburg, Highland, Rockbridge, Rockingham, Staunton and Waynesboro- were included in a federal major disaster declaration (DR-1491). Augusta County received the most rainfall and Rockbridge County received the most damage due to severe flooding along the South River. In Augusta County, the heaviest rain occurred in the Sherando area, which is located at the foothills of the Blue Ridge Mountains. The Upper Sherando monitoring station recorded a rainfall total of 20.6 inches. In Augusta County, damage estimates equaled $2.2 million (2019 dollars). For the City of Waynesboro, damages equaled $1.39 million (2019 dollars). The South River at Waynesboro crested at 13.46 feet, above flood stage of 9.5 feet. In Staunton, damages were minimal but one death occurred as a result of carbon monoxide poisoning from the improper use of a generator. In Rockingham County, damage was mainly confined to roads, downed trees, and agricultural lands. Two deaths were caused a few days after the storm, when a man and his daughter tried to cross a swollen stream in a horse and buggy. In Harrisonburg, downed trees were the major problem as a result of rain soaked soil. A JMU student drowned when his canoe overturned in Black's Run the morning after the storm. *(Continued On Next Page)*

The Wharf District in Staunton's downtown

Flood	Description and Damages
(*continued from previous page)* September 18, 2003 "Hurricane Isabel"	The northeastern part of Rockbridge County sustained the most damage when the South River flooded along Rt. 608. The South River is fed by the St. Mary's, Big Mary's, and Little Mary's Creeks which flow down the west side of the Blue Ridge Mountains. During Isabel, the South River began rising by 9 p.m. and the River jumped its bank by 11 p.m. Significant damage to property and infrastructure occurred from the northern Rockbridge County border down stream to the South River's confluence with the Maury River. Rt. 608, which parallels the South River was washed out or undermined in several places. Three permanent bridges over the South River were destroyed. An abandoned C&O railroad bridge, that was part of the Chessie trail system, was washed off its supports as well. In Rockbridge County, property damages were estimated at $9.3 million (2019 dollars), damage to South River Road was estimated at $5.5 million (2019 dollars), and agricultural losses were estimated at $6.9 million (2019 dollars) (which included the loss of 25-30 head of livestock). Amazingly, there were no serious injuries or fatalities in Rockbridge County as a result of this flood event. In the U.S., forty deaths were attributed to Hurricane Isabel and damages were estimated at over $4.17 billion (2019 dollars). It was one of the top thirty most expensive storms in U.S. history.

Hurricane Isabel - South River in Rockbridge County

Flood	Description and Damages
August 9-August 15, 2004 Hurricane Charley	Impacts from Hurricane Charley were felt countywide in Augusta County.
August 24—September 10, 2004 Hurricane Frances	Hurricane Frances resulted in flooding in Augusta County.
September 2—September 25, 2004 Hurricane Ivan	Hurricane Ivan brought flooding to Augusta County and resulted in road closures in the Staunton area.
September 13-September 26, 2004 Hurricane Jeanne	Hurricane Jeanne resulted in flooding countywide in Augusta.
July 3-July 12, 2005 Hurricane Cindy	Hurricane Cindy brought countywide flooding to Augusta County and resulted in road closures in Western Augusta.
November 29, 2005	Flooding occurred in the Sherando area.

Flood	Description and Damages
June 23 - July 6, 2006 "Mid-Atlantic United States Flood"	The Mid-Atlantic United States Flood of 2006 affected much of the Mid-Atlantic region of the eastern U.S. It is widely considered the worst flooding in the region since Hurricane David in 1979. At least 16 deaths in the U.S. were caused by this flood event. The flooding occurred because of a stalling of the jet stream just west of the Appalachian Mountains, a "Bermuda high" over the Atlantic Ocean, and the influence of a tropical low off the coast of North Carolina. The National Weather Service stated that rain events of this size take place in the region only once every 200 years. In Virginia, flooding occurred in the northern regions and mudslides were also witnessed in the mountainous regions. In the Central Shenandoah Valley, flooding occurred countywide in Augusta County. In the Brand Flats area along U.S. 250 when Christians Creek spilled over its banks. Residents of 50 trailers in Knox Mobile City were cut off by the flooding. The American Red Cross assisted 1,600 citizens during the week, providing food, clothing, and shelter.
August 28-September 12, 2008 Hurricane Hanna	Hurricane Hanna resulted in flooding impacts countywide in Augusta County.
January 25, 2010	Storms brought flash flooding to Augusta County, resulting in impacts county wide with evacuations and water rescues. Flooding impacted the Pastures District, bringing streams out of their banks and washing out roads. The South River at Waynesboro crested at 10.01 feet, above flood stage of 9.5 feet, resulting in minor flooding.
April 11—April 12, 2011	Heavy rains caused mud and rock slides in Bath County, downing trees and blocking roads. The Cowpasture River crossed Rt 42, and flooding, rock slides and mudslides occurred in areas near Burnsville, Williamsville, Bacova and Bolar. No homes were damaged, but several road washouts occurred. Flooding occurred in northern Augusta County.

Flood	Description and Damages
April 16 , 2011	An EF1 tornado reached wind speeds in excess of 95 mph traveling 4.1 miles in Augusta County. The tornado damaged 37 structures and downed numerous trees and powerlines. Preliminary damage estimates from Augusta County listed storm damage to 12 residences, 3 businesses, 15 outbuildings, 2 mobile structures and 5 barns. Preliminary damage cost is estimated at over 2.5 million (2019 dollars). An EF0 tornado touched down near Vesuvius in Rockbridge County causing minor damage to a barn and a house, and slightly moving another barn off its foundation. The twister left a path about 100 yards wide and 1.3 miles in length. Wind speeds were estimated at 80 mph. Rockbridge also experienced 3.5 inches of rain and reports of quarter size hail. Numerous trees were reported downed in Lexington and countywide in Rockbridge. In Glasgow, the Maury River reached near flood stage at 18 feet. As many as 33 roads were closed due to high waters and fallen trees, the worse being Rt. 631, Furrs Mill Road. A swift water rescue was required to retrieve two women and two small children stranded in a van. 350 Dominion Power customers lost power. In Bath County, downtown Hot Springs flooded. Flooding, mud and rock slides also occurred in other areas of Bath County damaging roads, driveways, homes and the Warm Springs Pools at the Homestead. Highland County experienced power outages, downed trees and flooded roadways. Highland County Supervisors declared the County a disaster area.
April 27-April 28, 2011	Four tornados touched down in Augusta County and Rockingham County. The strongest was an EF-2 that started in Fulks Run and traveled 33.3 miles into Shenandoah County, damaging homes and farm buildings; downing trees and causing 2 injuries. An EF-1 Tornado occurred in Churchville in Augusta County, and traveled for 4 miles damaging homes, downing trees and destroying outbuildings. Two EF-1 tornados occurred in Rockingham. A tornado in Keezletown was on the ground for 2.7 miles causing tree damage and damage to two homes, farms buildings and outbuildings. A tornado in Linville traveled for 0.9 miles causing tree damage. Other reported storm damage from the region included reports of downed trees in Bath County, Rockbridge County, Augusta County and Rockingham County. A tree fell on a trailer in the Colen Hollow area of Rockbridge and damage was reported to houses in Rockingham. The storm brought heavy rains and flooding in Bath County, causing downed trees and powerlines, washing debris into the roads, and damaging roads in Burnsville and Williamsville. Rt. 614 Muddy Run Road in front of the Burnsville Volunteer Fire Department and Rescue Squad was washed out. Flooding damaged a home in Williamsville.
October 22-November 2, 2012 Hurricane Sandy	Hurricane Sandy brought rain to the Central Shenandoah Valley region, resulting in flooding. Governor McDonnell declared a State of Emergency for Virginia. A transmission line serving the Monterey substation failed due to high winds, resulting in a widespread, extended power outage to 90% of Highland County. County officials declared a state of emergency. Following the storm, Highland County was deemed eligible for FEMA public assistance funding in DR-4092 due to damage to public infrastructure. The countywide per capita impact for Highland County was $7.26 (2012 dollars)
May 9, 2013	A slow moving low pressure system caused rain to fall over saturated ground from previous rainfall. The storm resulted in flash flooding, closing roads, delaying schools systems and causing accidents. More than 40 sections of roadways were flooded in Augusta County.

Flood	Description and Damages
June 17, 2013	Rain and thunderstorms brought flooding to the Dooms area in eastern Augusta County. Route 340 was closed in several locations, and several cars were swept away. No injuries were reported.
April 15-16, 2018	A severe storm moved through the region with moderate to heavy rain, strong winds and hail, causing flooding. The South River crested at 11.38 feet, above flood stage of 9.5 feet. A tornado warning was issued for southeastern Augusta County. While the Central Shenandoah Valley was spared and a tornado touchdown did not occur in the region, the same storm system produced an EF3 tornado which touched down in neighboring Amherst County earlier in the evening. Rockingham County, Augusta County and Harrisonburg were included in a agricultural disaster declaration (S4493).
May 14, 2018	A series of thunderstorms with high winds, heavy rain and hail caused flash flooding in the central Shenandoah Valley, resulting in downed trees and power outages. Several homes or businesses in the region were damaged. In Verona, a family was displaced when flooding caused their basement wall to collapse leading to the condemnation of their home. Homeowners insurance denied the claim since the property was not covered by flood insurance. Strong winds struck a local bank branch during business hours, damaging the building, while employees and customers took shelter in the bank vault. A tree fell damaging a home in Waynesboro. Hail was reported in Verona, and half dollar size hail was reported in Rockbridge County. Trees were reported downed in other areas of Augusta County, Rockingham County and the City of Staunton. 21,000 Dominion Power customers were without power in the region.
May 21, 2018	Five inches of rain were estimated to have fallen in less than 2 hours causing flooding in Bath County. Flooding closed roads on Jackson River Turnpike, Douthat Park State Park and Route 687. Damages were reported to three homes, an auto shop, roads, private driveways and a vehicle. One structure (a garage) had significant damage. Flash flooding in Rockingham County occurred, washing out or temporarily closing roads in Fulks Run, Harrisonburg and other areas of the County. Flooding in Fulks Run damaged houses, farm buildings and roads. Augusta County also experienced county-wide flooding impacts.
May 28-June 3, 2018	A line of thunderstorms brought heavy rains and flash flooding to western and central Virginia. In Rockingham County, including the areas of Harrisonburg, Dayton, and Bridgewater, 2 inches of rain fell in a short amount of time. During the heaviest deluge, rain fell at a rate of 6 inches per hour. The storm stranded vehicles and resulted in several swift water rescues of stranded drivers. Flooding closed several roadways in Augusta County and Rockingham County, including Route 11 in Harrisonburg and Route 42 in Dayton. Route 33 near Swift Run Gap was closed due to a series of mudslides. Businesses in downtown Harrisonburg, as well as City parks flooded. In Dayton, the Cargill Poultry Plant suspended operations when it flooded. A daycare center in Broadway flooded, impacting 95 families, when the center temporarily closed to clean up. Augusta, Highland and Rockingham were included in an agricultural disaster declaration (4378).

Flood	Description and Damages
June 21-22, 2018	A stalled out front caused flooding and damage in Rockingham County and the City of Staunton. In Staunton, a flash flood damaged two homes, four businesses, two vehicles and park amenities at Gypsy Hill Park. The Bergton area of Rockingham County was hit the hardest leading to flooding in low-lying areas. Flooding and downed trees caused road closures in Augusta County and Rockingham County.
June 27-28, 2018	Flooding occurred in the Augusta County area.
August 30, 2018	Severe thunderstorms caused flooding and damages including downed trees, power outages and closed roads in Augusta and Rockingham Counties. The storms included wind gusts of at least 60 mph. Over three inches of rain fell in the area, with the Mount Solon area in northwestern Augusta County being the hardest hit and receiving over four inches. Damaging winds and pea-sized hail were reported.
September 9-September 28, 2018 Hurricane Florence	Hurricane Florence, a category 4 hurricane which downgraded to a tropical depression, widespread flooding in Staunton, Waynesboro and Augusta County closing roads and causing property damage. In Grottoes, the Middle River exceeded the 12 foot flood stage, cresting at 17 feet. The Jennings Branch area and Churchville area experienced flooding, including at Churchville Community Park. Basements and a vehicle flooded in Waynesboro. Staunton declared a local emergency. Augusta and Waynesboro provided sandbags to residents and businesses, and opened emergency shelters. In the Bridgewater area of Rockingham County, Wildwood Park flooded. Rockbridge County was included in an agricultural disaster declaration (4401).
June 29-June 30, 2019	Severe storms resulted in flooding, landslides and mudslides. Augusta, Highland, Rockingham, Harrisonburg, Staunton and Waynesboro were included in an agricultural disaster declaration (4455).

C-II. DAM RISK ASSESSMENT AND INVENTORY

Information in the Dam Risk Assessment and Inventory is taken from the Commonwealth of Virginia Hazard Mitigation Plan, Chapter 3 - HIRA, Section 3.11 Flooding.

Dam Failure

Flooding following a dam failure may occur due to any one or a combination of the following causes:

- *Prolonged periods of rainfall and flooding;*
- *Inadequate spillway capacity;*
- *Internal erosion caused by embankment or foundation leakage or piping;*
- *Improper maintenance, including failure to remove trees and/or woody vegetation, repair internal seepage problems, replace lost material from the cross section of the dam and abutments, failure to clean and remove debris or obstructions, or maintain gates, valves, or other operational components;*
- *Improper design, including the use of improper construction materials and incorrect construction practices or methods;*
- *Improper operation, including failure to remove or open gates or valves during high flow periods;*
- *Failure of upstream dams on the same waterway (dams in serious condition);*
- *High winds, which can cause significant wave action and result in substantial erosion; or Intentional terrorism or criminal acts*

Historic Occurrence

There are no comprehensive databases of historical dam failures, breaches, or dam related flooding in Virginia. Most dam related failures occur due to lack of maintenance, overtopping events, seismic situations, seepage or internal erosion issues, major precipitation events such as hurricanes and thunderstorms, or a combination of any of these factors.

There are not any known historic, catastrophic dam failures in the Central Shenandoah Region to include in this plan.

Risk Assessment

Virginia uses its hazard classification system to determine the level of risk a regulated impounding structure may pose to life and property. According to Virginia law and regulations adopted by the Virginia Soil and Water Conservation Board, hazard classification is based on the potential for loss of life and damage to downstream structures, including but not limited to residences, businesses, occupied structures or roadways. Under this regulatory structures, dams are given a classification in the following manner: High Hazard – "probable loss of life or serous economic damage"; Significant Hazard - "may cause loss of life or appreciable economic damage"; Low Hazard – "no expected loss of life and cause no more than minimal economic damage." As a result, when determining the "risk" of any particular dam, Virginia relies on the determined hazard classification.

Virginia Impounding Structure Regulations require predictive modeling related to dam failure risk under specified conditions. In addition, as part of determining the hazard classification, engineering analyses that result in inundation zone maps include detailed information about potential downstream impacts. These analyses offer predictions of the downstream consequences if a dam were to fail during a storm event or on a "sunny day." These analyses also include maps which aid emergency personnel in warnings and evacuations of downstream homes, schools, or businesses.

The Code of Virginia and the Impounding Structure Regulations can also, on a case by case basis, determine which structures, by virtue of their condition have some greater risk than others. For example, a "Conditional Operation and Maintenance Certificate" defines those elements of the impounding structure that are not in compliance with the regulations and may identify situations where risk factors are increased. Deficiencies can be expressed in inspection reports that follow incidents or other activities on or around the structure. Further, the Department can unilaterally take action under authority granted in §10.1 -608 and §10.1 – 609 for unsafe dams presenting imminent or non-imminent failure. Although in all cases, the hazard classification of the dam is the foundation for any analysis by the Department.

To aid in the implementation of mitigation actions and activities for state regulated dams, especially high hazard dams that pose an unacceptable risk to the public, the Commonwealth of Virginia has available the Virginia Dam Safety, Flood Prevention and Protection Assistance Fund to local governments and private entities for specified dam safety and floodplain management issues. The fund was established to provide matching grants to local governments, including local Soil and Water Conservation Districts, and to private entities owning regulated dams to improve dam safety. This

includes matching grants to local governments for orphan-type dams that are within their jurisdiction. State-owned and federally-owned dams, or dams not regulated pursuant to the Virginia Dam Safety Act are ineligible. The fund also provides matching grants to any local government for the purposes of assisting the local government with improvements to flood prevention or protection. Grants are awarded through a competitive application process, as spelled out in a yearly issued Grant Manual and awards are approved by the Virginia Soil and Water Conservation Board. Scoring criteria for dam safety projects, as outlined in Appendix C of the Grant Manual provides for higher point value assignments for high hazard potential classification dams with unacceptable risks to the public. This includes but is not limited to those high hazard potential classified dams with confirmed spillway deficiencies, large dams with no hazard classification determinations, dams with high numbers of residential units within the dam's probable dam break/inundation zone, and proposed grant projects which focus on critical dam safety program elements such as hazard potential classification analysis, (PMP) impact analysis and certification, and emergency plan (EAP-emergency action plan or EPP-emergency preparedness plan) development.

The Virginia DSFPM also consistently seeks opportunities for assistance from established federal and industry association dam safety grant opportunities that implement mitigation actions and measures for high hazard potential classification dams. Such examples include the Notice of Funding Opportunity (NOFO), Department of Homeland Security (DHS), Rehabilitation of High Hazard Potential Dams (HHPD) and initiatives by the Association of State Dam Safety Officials (ASDSO).

Probability

Predicting the probability of flooding due to dam failure requires a detailed, site-specific engineering analysis for each dam in question. Failure may result from hydrologic and hydraulic design limitations, from geotechnical or operational factors, or from force majeure weather events. The data and time necessary to perform a probabilistic failure analysis for each dam in Virginia is beyond the scope of this plan and regulatory capabilities of Virginia DSFPM. The probability of dam failure due to hydrologic and hydraulic design limitations is related to the regulatory standards for dam spillway design in Virginia. Dams are required to safely pass a spillway design flood (SDF) without failure based on their assigned hazard potential classification, as indicated below in Table 3.11-2.

Table 3.11-2: Performance Standards for Dams

Hazard Potential	Spillway Design Flood (SDF)	Spillway Design Flood (SDF) for Existing Impounding Structures	Minimum Threshold for Incremental Damage Analysis (IDA)
High	PMF	0.9 PMP	100-YR
Significant	0.50 PMF	0.50 PMF	100-YR
Low	100-YR	100-YR	50-YR

PMF = Probable Maximum Flood; PMP = Probable Maximum Precipitation; YR = Year

Note that a dam may be designed to a slightly lower standard than the spillway design flood based on a detailed incremental damage analysis showing that designing the dam to a higher spillway design flood does not further protect the public downstream of the impoundment (i.e. infrastructure downstream already under water / destroyed before any danger from a dam failure were to develop). Low hazard dams expected to result in no loss of human life and no economic damage to any property, except the dam owners, may qualify for a Special Low Hazard rating lowering the required spillway design flood to the 50-year event as well as possibly being exempt from other standards required by the regulations.

Impact and Vulnerability

Failure of dams may result in catastrophic localized damages at both the dam location and downstream areas. Vulnerability to dam failure is dependent on dam operations planning and the nature of downstream development. Depending on the elevation and storage volume of the impoundment, the impact of flooding due to dam failure may include loss of human life, economic losses such as property damage and infrastructure disruption, and environmental impacts such as destruction of habitat. Evaluation of vulnerability and impact is highly dependent on site-specific conditions; no broad-brush approach can be applied at a statewide level.

Owners of impounding structures are required to have dam break inundation zone maps that meet the standards of the Virginia Impounding Structure Regulations. The properties that are identified within the dam break inundation zone are recorded in the dam safety Emergency Plan (EAP – Emergency Action plan or EPP - Emergency Preparedness Plan) for that impoundment. Please note that due to the overall limitations of this Report, the impact and vulnerability to downstream state facilities and critical facilities due to dam failure was not estimated.

Dams with known deficiencies continue to create an ever-growing public safety issue for downstream residents, communities, and overall infrastructure. Virginia DSFPM's main goals are to protect public safety and ensure regulated dams within the Commonwealth of Virginia adhere to the current Impounding Structure Regulations. Virginia DSFPM's yearly Grant Program provides potential financial

aid through a 50% match to dam owners looking to work on their regulated dams to keep them in compliance. In addition, Virginia DSFPM provides dam focused educational trainings to the public to help dam owners understand their dam related regulatory / maintenance responsibilities and to ensure private engineers understand dam related requirements.

As dam related infrastructure continues to age, Virginia DSFPM continues to look into ways to keep dams safe, continues to work to bring newly located dams into compliance, and continues to offer the yearly Grant Program to dam owners. Avenues are being considered to help increase the Virginia DSFPM staff to better manage existing workloads and staff are looking into creative ways to institute online video based training centered around dam related information / dam ownership.

Virginia DSFPM has implemented a new online database called DSIS which continues to be populated with dam related data for dams. By continuing to maintain and populate DSIS with important data such as inundation studies and Emergency Plans, Virginia DSFPM has real-time access to critical dam information which is invaluable during emergencies and helpful in planning situations (development downstream). Access to a system like DSIS helps to reduce long term dam related vulnerabilities within the Commonwealth and decrease the ever-growing unacceptable risk to the general public.

Risk

As of May 2019, Virginia DSFPM is aware of approximately 3,590 dams within the Commonwealth based on information provided in DSIS (see previous discussions within this section regarding DSIS (Dam Safety Inventory System)) and the 2018 National Inventory of Dams data from the US Army Corps of Engineers. Out of those 3,590 known dams, Virginia DSFPM is known to regulate approximately 2,034 dams (57%). When evaluating the 2,034 dams; it is know that there are approximately 313 high hazard (15%), 166 significant hazard (8%), 262 low hazard (13%), and 1,293 unknown hazard (64%) dams regulated by Virginia DSFPM. At this time Virginia DSFPM has decided to utilize the label "unknown hazard potential classification" for dams where an inundation study is required to be performed by the dam owner's engineer and submitted, reviewed, and approved (confirmed) by Virginia DSFPM prior to assignment of a final hazard potential classification.

Dam related data including geographically based information is constantly being revised and updated within the Commonwealth of Virginia as better data / technology becomes available. As a result, latitude / longitude coordinates were provided for all included high hazard dams (see above) for the use by the public to locate high hazard dams rather than pre-made geographic maps. Please contact either the Virginia Department of Emergency Management (VDEM) GIS section or Virginia DSFPM if geographically based maps are required. This approach regarding geographic based maps will ensure that the most up-to-date dam related information is being provided at the time of the mapping request.

Please note that it is recommended by Virginia DSFPM that the dam related information presented in Section 3.11 of the Virginia Hazard Mitigation Plan be reviewed annually and updated as necessary to ensure accurate information is provided for planning, public safety, and emergency management purposes.

Future Conditions Considerations

As precipitation amounts fluctuate and extreme weather events become more common, the flood control and impoundment infrastructure in Virginia becomes more of a concern. Like most of the country, the infrastructure in Virginia is overwhelmingly privately owned and maintained, and it is aging – in many cases, to the end of its design life. The occurrence of more frequent high intensity rainfall events may create conditions that exceed the original design criteria of these aging facilities.

During the 20-year period of January 1, 1996 to December 31, 2016, the NCEI (National Centers for Environmental Information) recorded 1,154 heavy rain events in Virginia. This equates to an average of 57.7 heavy rain events per year. A review of the individual records suggests that this type of event is increasing in both frequency and intensity over time. While a 20-year data set is too limited to establish a long-term outlook, it does indicate a trend. If this trend continues, it could be detrimental to flood control and impoundment infrastructure throughout Virginia. More frequent and/or more intense rain events may increase the risk of potential failure, which increases the risk to downstream properties and residents.

Table C-1: Known High Hazard Potential Classification Dams Regulated by Virginia Dam Safety and Floodplain Management

VDEM Region	VA ID #	Dam Name	Regulatory	Owners	Hazard	City/County	Latitude	Longitude
3	165001	Lower North River #80	VA DSFPM	Shenandoah Valley SWCD	High	Rockingham County	38.4717	-79.0613
3	165002	Lower North River #78	VA DSFPM	Shenandoah Valley SWCD	High	Rockingham County	38.45	-79.1598
3	165003	Lower North River #83	VA DSFPM	Shenandoah Valley SWCD	High	Rockingham County	38.4707	-79.1428
3	165004	Lower North River #22B	VA DSFPM	Shenandoah Valley SWCD	High	Rockingham County	38.562	-79.0904
3	165005	Lake Shenandoah Dam	VA DSFPM	VA DGIF	High	Rockingham County	38.3789	-78.8326
3	165006	Lower North River #81C	VA DSFPM	City of Harrisonburg	High	Rockingham County	38.5718	-79.1377
3	165007	Lower North River #82	VA DSFPM	Shenandoah Valley SWCD	High	Rockingham County	38.5885	-79.1219
3	165009	Shoemaker River #1A	VA DSFPM	Shenandoah Valley SWCD	High	Rockingham County	38.5589	-78.9696
3	165010	Shoemaker River #4C	VA DSFPM	Shenandoah Valley SWCD	High	Rockingham County	38.6108	-78.9711
3	165011	Shoemaker River #3B	VA DSFPM	Shenandoah Valley SWCD	High	Rockingham County	38.592	-78.9738
3	660001	Newman Lake Dam	VA DSFPM	James Madison	High	City of Harrisonburg	38.4314	-78.8748

Table C-1: Known High Hazard Potential Classification Dams Regulated by Virginia Dam Safety and Floodplain Management

VDEM Region	VA ID #	Dam Name	Regulatory Agency	Owners	Hazard Class	City/County	Latitude	Longitude
3	015001	South River Dam #26	VA DSFPM	Headwaters SWCD	High	Augusta County	38.0144	-78.9241
3	015002	South River Dam #25	VA DSFPM	Headwaters SWCD	High	Augusta County	37.9641	-78.9479
3	015004	South River Dam #10A	VA DSFPM	Augusta County	High	Augusta County	37.9532	-79.0006
3	015005	Upper North River Dam #10	VA DSFPM	Headwaters SWCD	High	Augusta County	38.3639	-79.2058
3	015006	Upper North River Dam #76	VA DSFPM	City of Staunton	High	Augusta County	38.3266	-79.2234
3	015007	Upper North River Dam #77	VA DSFPM	Headwaters SWCD	High	Augusta County	38.3938	-79.1602
3	015008	South River Dam #23	VA DSFPM	Headwaters SWCD	High	Augusta County	38.0046	-78.9202
3	015009	South River Dam #6	VA DSFPM	Headwaters SWCD	High	Augusta County	37.9911	-79.1221
3	015011	South River Dam #4	VA DSFPM	Headwaters SWCD	High	Augusta County	37.9627	-79.1502
3	015012	South River Dam #11	VA DSFPM	Headwaters SWCD	High	Augusta County	37.9925	-78.9905
3	015014	South River Dam #19	VA DSFPM	Headwaters SWCD	High	Augusta County	38.0133	-78.9695

Table C-1 : Known High Hazard Potential Classification Dams Regulated by Virginia Dam Safety and Floodplain Management

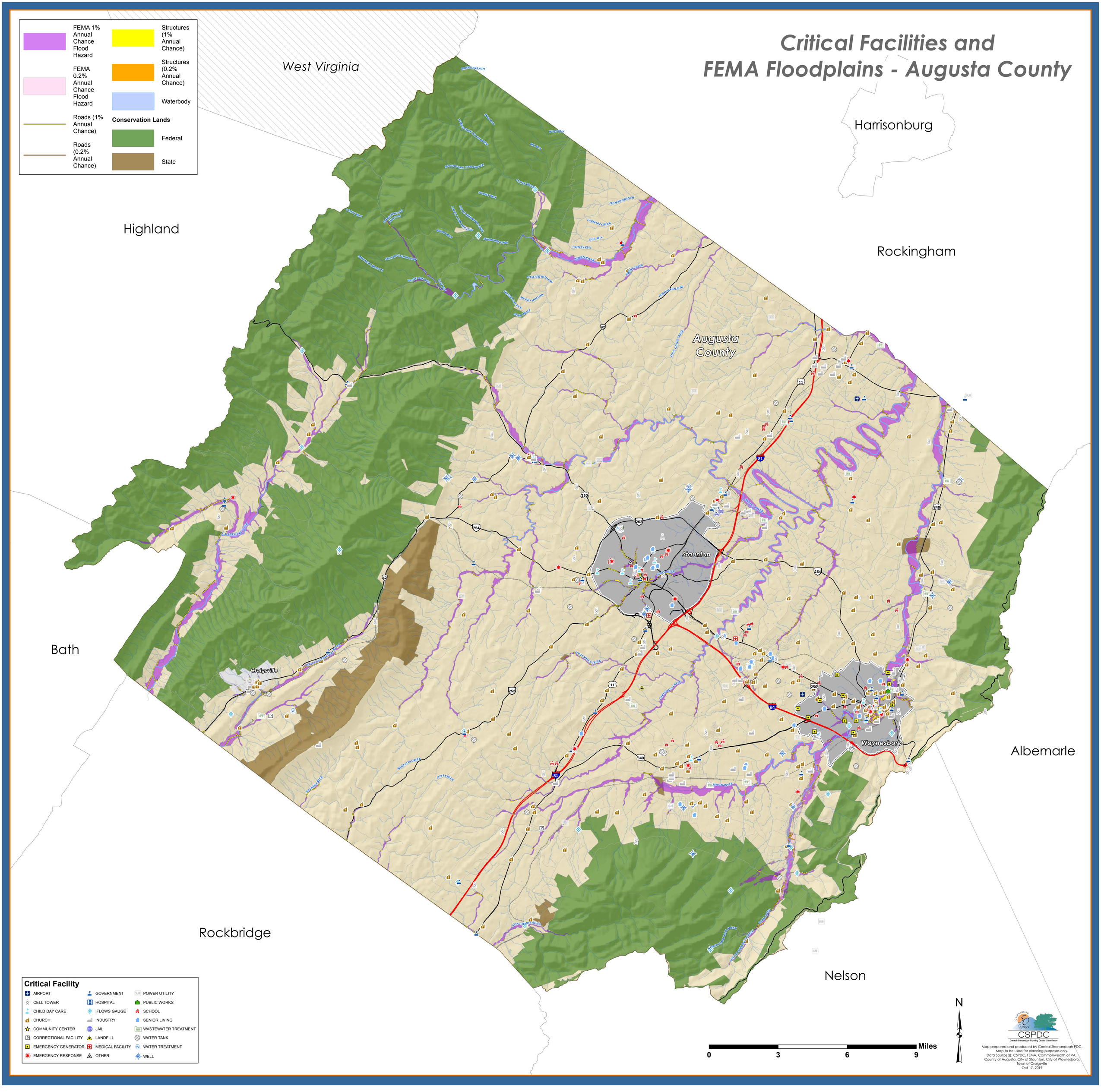
VDEM Region	VA ID #	Dam Name	Regulatory	Owners	Hazard	City/County	Latitude	Longitude
3	015018	Staunton Dam	VA DSFPM	City of Staunton	High	Augusta County	38.3333	-79.2065
3	015019	Coles Run Dam	VA DSFPM	Augusta County	High	Augusta County	37.9761	-79.0303
3	015022	South River Dam #7	VA DSFPM	Headwaters SWCD	High	Augusta County	38.0175	-79.0962
3	820001	South River Dam #8A	VA DSFPM	City of Waynesboro	High	City of Waynesboro	38.0526	-78.8732
6	163001	Goshen Dam	VA DSFPM	B.S.A., National	High	Rockbridge County	37.9597	-79.4592
6	163002	Robertson Dam	VA DSFPM	VA DGIF	High	Rockbridge County	37.8015	-79.6053
6	163003	Moore's Creek Dam	VA DSFPM	City of Lexington	High	Rockbridge County	37.7473	-79.6462
6	163007	Turner Pond Dam	VA DSFPM	VCLF Land Trust & DCR State Parks	High	Rockbridge County	37.6416	-79.5413
6	163013	Natural Bridge Dam #5	VA DSFPM	VCLF Land Trust & DCR State Parks	High	Rockbridge County	37.624	-79.543
6	017001	Douthat Lake Dam	VA DSFPM	Virginia DCR - State Parks	High	Bath County	37.9037	-79.8039

Table C-2: Known High Hazard Potential Classification Dams NOT Regulated by Virginia Dam Safety and Floodplain Management

VDEM Region	VA ID #	Dam Name	Regulatory Agency	Owners	Hazard Class	City/County	Latitude	Longitude
6	017006	Bath County Pumped Storage - Upper Dam	FERC	Dominion Energy, Bath County LLC, and Allegheny Power	High	Bath County	38.2266	-79.823
6	017007	Bath County Pumped Storage - Lower Dam	FERC	Dominion Energy, Bath County LLC, and Allegheny Power	High	Bath County	38.1973	-79.8065

Appendix D - Critical Facilities Maps

Critical Facilities and FEMA Floodplains - Augusta County



CSPDC
Central Shenandoah Planning District Commission

Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA,
County of Augusta, City of Staunton, City of Waynesboro,
Town of Craigsville
Oct 17, 2019

Critical Facilities and FEMA Floodplains - Bath County

- FEMA 1% Annual Chance Flood Hazard
- Structures (1% Annual Chance)
- Roads (1% Annual Chance)
- Waterbody

Conservation Lands

- Federal
- State

Highland

West Virginia

Augusta

Bath County

Rockbridge

Alleghany

Covington

Critical Facility

AIRPORT	GOVERNMENT	POWER UTILITY
CHILD DAY CARE	HOSPITAL	SCHOOL
CHURCH	INDUSTRY	SENIOR LIVING
COURTHOUSE	JAIL	UTILITY
EMERGENCY RESPONSE	LANDFILL	WASTEWATER TREATMENT

N

0 2.5 5 7.5 Miles

CSPDC
Central Shenandoah Planning District Commission

Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, Bath County
October 18, 2019

Critical Facilities and FEMA Floodplains - Highland County

FEMA 1% Annual Chance Flood Hazard

Roads (1% Annual Chance)

Structures (1% Annual Chance)

Waterbody

Conservation Lands

Federal

State

West Virginia

West Virginia

Highland County

Monterey

Augusta

Bath

Critical Facility

CHURCH | EMERGENCY RESPONSE | SCHOOL

COURTHOUSE | GOVERNMENT | WASTEWATER TREATMENT

0 2 4 6 Miles

N

CSPDC

Central Shenandoah Planning District Commission

Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, Highland County, Town of Monterey
Sept. 25, 2019

Critical Facilities and FEMA Floodplains - Rockbridge County

FEMA 1% Annual Chance Flood Hazard

FEMA 0.2% Annual Chance Flood Hazard

Roads (1% Annual Chance)

Roads (0.2% Annual Chance)

Structures (1% Annual Chance)

Structures (0.2% Annual Chance)

Waterbody

Conservation Lands

Federal

State

Augusta

Bath

Alleghany

Nelson

Amherst

Botetourt

Bedford

Rockbridge County

Goshen

Lexington

Buena Vista

Glasgow

Critical Facility

- CHILD DAY CARE
- CHURCH
- COMMUNITY CENTER
- CORRECTIONAL FACILITY
- COURTHOUSE
- EMERGENCY RESPONSE
- EOC AND COMMUNICATION
- GOVERNMENT
- HOSPITAL
- INDUSTRY
- JAIL
- LANDFILL
- MEDICAL FACILITY
- POWER UTILITY
- SCHOOL
- SENIOR LIVING
- SUBSIDIZED HOUSING
- TRAVEL CENTER
- VISITOR'S CENTER
- WASTEWATER TREATMENT
- WATER TANK
- WATER TREATMENT
- WELL

0 2.5 5 7.5 Miles

N

CSPDC
Central Shenandoah Planning District Commission

Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, Rockbridge County, City of Buena Vista, City of Lexington, Town of Glasgow, Town of Goshen
Sept. 24, 2019

Critical Facilities and FEMA Floodplains - Rockingham County

- FEMA 1% Annual Chance Flood Hazard
- FEMA 0.2% Annual Chance Flood Hazard
- FEMA Area with reduced flood risk due to levee
- Roads (1% Annual Chance)
- Roads (0.2% Annual Chance)
- Structures (1% Annual Chance)
- Structures (0.2% Annual Chance)
- Water Body

Conservation Lands

- Federal
- State

Warren

Shenandoah

West Virginia

Page

Rockingham County

Madison

Harrisonburg

Timberville

Broadway

Dayton

Bridgewater

Mt. Crawford

Elkton

Grottoes

Greene

Augusta

Albemarle

Critical Facility

CHILD DAY CARE	INDUSTRY	POWER UTILITY	TOWN HALL
CHURCH	JAIL	PUBLIC WORKS	WASTEWATER PUMP STATION
COMMUNITY CENTER	LANDFILL	RETAIL	WASTEWATER TREATMENT
EMERGENCY RESPONSE	MEDICAL FACILITY	SCHOOL	WATER TANK
GOVERNMENT	OTHER	SENIOR LIVING	WATER TREATMENT
HOSPITAL	POLICE DEPT	SPRING	WELL

N

0 3 6 9 Miles

CSPDC
Central Shenandoah Planning District Commission

Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, County of Rockingham, City of Harrisonburg, Towns of Broadway, Bridgewater, Timberville, Grattoes, Mt. Crawford, Elkton and Dayton.
Sept. 20, 2019

Critical Facilities and FEMA Floodplains - City of Buena Vista

FEMA 1% Annual Chance Flood Hazard
FEMA 0.2% Annual Chance Flood Hazard
Structures (1% Annual Chance)
Structures (0.2% Annual Chance)
Roads (1% Annual Chance)
Roads (0.2% Annual Chance)

Rockbridge County

City of Buena Vista

JORDAN RD
DUCK PONL
LONGHOLLOW RD
REIDS HILL RD
BRAE HAVEN L
SBURG RD
HILLSIDE DR
LONG HOLLOW RD
CATALPA AVE
34TH ST
60
28TH ST
RIDGE AVE
FORGE RD
PAXTON HOUSE DR
VISTA LINKS DR
GLEN MAURY PARK RD
WALNUT AVE
24TH ST
23RD ST
22ND ST
21ST ST
South Fork Chalk Run
19TH ST
MAPLE AVE
BIRCH AVE
Indian Gap Run
18TH ST
ROCKSPRING LN
10TH ST
FOREST AVE
CEDAR AVE
WHEATLAN DR
KEYES MILL RD
Maury River
OAK AVE
HAWTHORN AVE
PINE AVE
13TH ST
4TH ST
WOODLAND AVE
DICKINSON LN
HAZEL AVE
Noels Run
ROBINSON GAP RD
BEVERLY HOLLOW LN

Critical Facility

CHILD DAY CARE
CHURCH
EMERGENCY RESPONSE
EOC AND COMMUNICATION
GOVERNMENT
INDUSTRY
SCHOOL
SENIOR LIVING
VISITOR'S CENTER
WASTEWATER TREATMENT
WELL

N

0 0.3 0.6 Miles

Celebrating 50 Years
CSPDC
Central Shenandoah Planning District Commission

Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, City of Buena Vista
Sept. 20, 2019

Critical Facilities and FEMA Floodplains - City of Harrisonburg

FEMA 1% Annual Chance Flood Hazard
FEMA 0.2% Annual Chance Flood Hazard
Roads (1% Annual Chance)
Roads (0.2% Annual Chance)
Structures (1% Annual Chance)
Structures (0.2% Annual Chance)

City of Harrisonburg

Rockingham County

Critical Facility
EMERGENCY RESPONSE
HOSPITAL
JAIL
SENIOR LIVING
GOVERNMENT
INDUSTRY
LANDFILL
WATER TANK
SCHOOL

N

0 0.5 1 Miles

Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, City of Harrisonburg
Sept. 18, 2019

Celebrating 50 Years
CSPDC
Central Shenandoah Planning District Commission

Critical Facilities and FEMA Floodplains - City of Lexington

FEMA 1% Annual Chance Flood Hazard
FEMA 0.2% Annual Chance Flood Hazard
Structures (1% Annual Chance)
Structures (0.2% Annual Chance)
Roads (1% Annual Chance)
Roads (0.2% Annual Chance)

Rockbridge County
City of Lexington

ALPHIN LN
GREENHOUSE RD
64
FURRS MILL RD
HUNTER HILL RD
11
60
DENNY CIR
Woods Creek
Maury River
OLD BUENA VISTA RD
Mill Creek
BORDEN RD
LIME KILN RD
ENFIELD RD
PRESTON ST
LEWIS ST
MCCORKLE DR
SCOTLAND DR
RIVERBEND DR
JACKSON AVE
ROSS RD
HOUSTON ST
MCCORKLE EXT DR
FLOWER LN
251
SHENANDOAH RD
OLD FARM RD
MEMORIAL LN
JACOBS LDR
Gordons Run
POPLAR HILL RD

Critical Facility

- CHILD DAY CARE
- CHURCH
- COMMUNITY CENTER
- COURTHOUSE
- EMERGENCY RESPONSE
- GOVERNMENT
- HOSPITAL
- INDUSTRY
- JAIL
- MEDICAL FACILITY
- SCHOOL
- SENIOR LIVING
- SUBSIDIZED HOUSING
- WASTEWATER TREATMENT
- WATER TANK
- WATER TREATMENT

N

0 0.25 0.5 Miles

Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, City of Lexington
October 17, 2019

Celebrating 50 Years
CSPDC
Central Shenandoah Planning District Commission

Critical Facilities and FEMA Floodplains - City of Staunton

FEMA 1% Annual Chance Flood Hazard
FEMA 0.2% Annual Chance Flood Hazard
Structures (1% Annual Chance)
Structures (0.2% Annual Chance)
Roads (1% Annual Chance)
Roads (0.2% Annual Chance)

Augusta County

City of Staunton

SHUTTERLEE MILL RD
ANDERSON SCHOOL LN
SPRING HILL RD
BERRY LN
LIMESTONE RD
QUICKS MILL RD
MAURY MILL RD
RIVER VIEW DR
MIDDLE RIVER
PLEASANT VIEW RD
BERRY FARM RD
GALENA RD
FARMINGTON DR
EDGEFIELD LN
BALDWIN LN
SHADY HOLLOW LN
BON LEA DR
CEDAR LN
TECHNOLOGY DR
FROG POND RD
250
262
11
RAINBOW DR
BALDWIN DR
COLLEGE CIR
WOODLEE RD
WOODLAND DR
SPRINGHILL RD
COUNTRY CLUB RD
BELLS LN
MORRIS MILL RD
GRUBERT AVE
THIRD ST
SELMA BLVD
THORNROSE AVE
COALTER ST
BEVERLEY ST
LEWIS CREEK
254
BUTTERMILK SPRING RD
MONTGOMERY AVE
STUART ST
JOHNSON ST
NATIONAL AVE
81
64
STATE ROUTE 1426
BALSLEY RD
SANGERS LN
RITCHIE BLVD
FRONTIER DR
BARTERBROOK RD
LARIAT CIR
EQUESTRIAN DR
HEATHER LN
OLD GREENVILLE RD
SR 218
MAINE CIR
CHRISTIANS CREEK
OLD GOOSE CREEK RD
HAMMOND
TISDALE FARM LN

Critical Facility

- CELL TOWER
- CHILD DAY CARE
- CHURCH
- EMERGENCY RESPONSE
- GOVERNMENT
- IFLOWS GAUGE
- INDUSTRY
- JAIL
- MEDICAL FACILITY
- OTHER
- POWER UTILITY
- PUBLIC WORKS
- SCHOOL
- SENIOR LIVING
- WATER TANK
- WATER TREATMENT
- WELL

N

0 0.5 1 Miles

Celebrating 50 Years
CSPDC
Central Shenandoah Planning District Commission

Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, City of Staunton
Sept. 19, 2019

Critical Facilities and FEMA Floodplains - City of Waynesboro

FEMA 1% Annual Chance Flood Hazard
FEMA 0.2% Annual Chance Flood Hazard
Structures (1% Annual Chance)
Structures (0.2% Annual Chance)
Roads (1% Annual Chance)
Roads (0.2% Annual Chance)

Conservation Lands

Federal
State

Augusta County

City of Waynesboro

Nelson

Critical Facility

AIRPORT
CELL TOWER
CHILD DAY CARE
CHURCH
EMERGENCY GENERATOR
EMERGENCY RESPONSE
GOVERNMENT
IFLOWS GAUGE
INDUSTRY
POWER UTILITY
PUBLIC WORKS
SCHOOL
SENIOR LIVING
WASTEWATER TREATMENT
WATER TANK
WATER TREATMENT
WELL

N

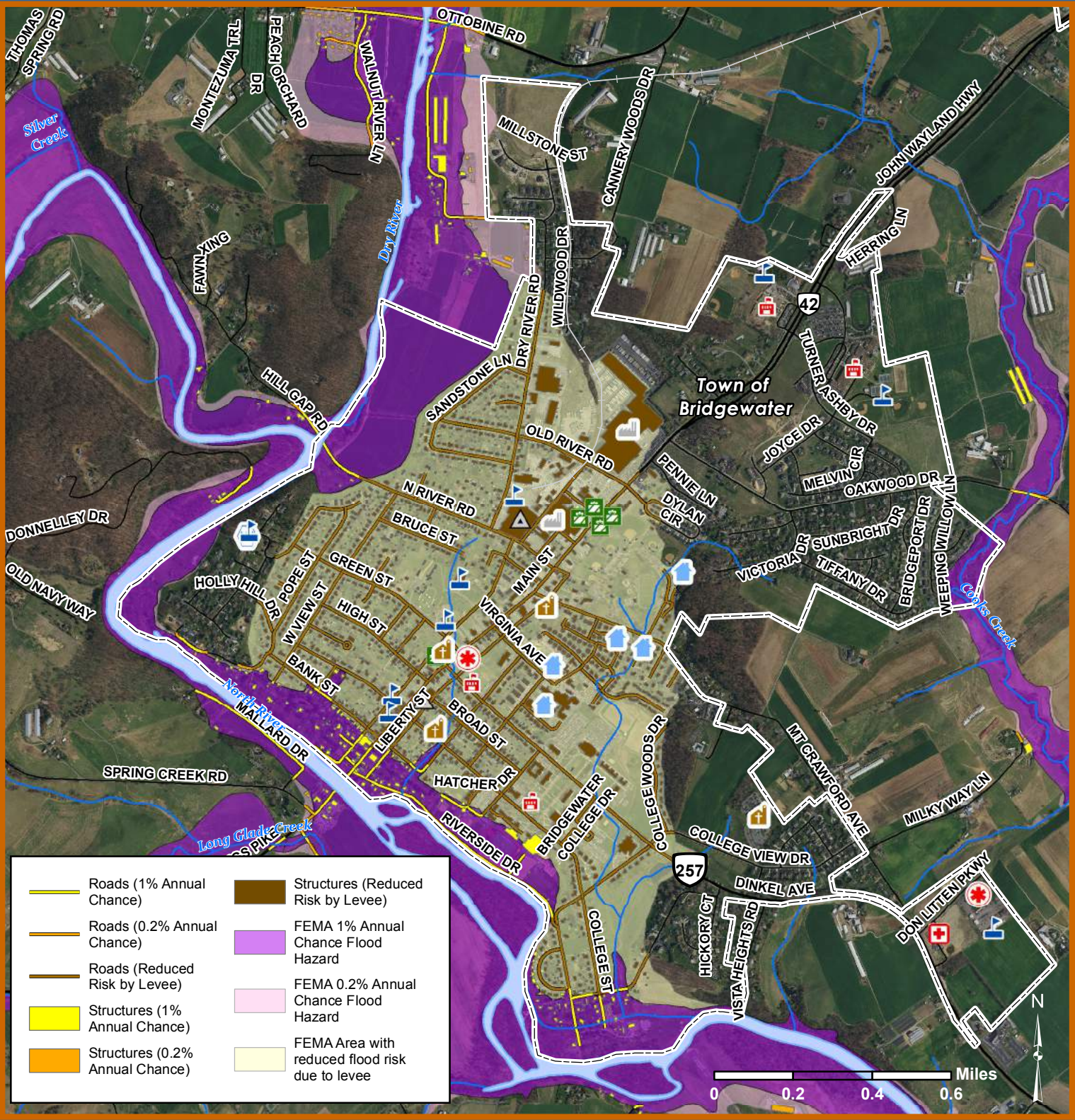
0 0.5 1 Miles

CSPDC
Central Shenandoah Planning District Commission

Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, City of Waynesboro
Sept. 19, 2019

Central Shenandoah Planning District

Critical Facilities and FEMA Floodplains - Town of Bridgewater



CSPDC

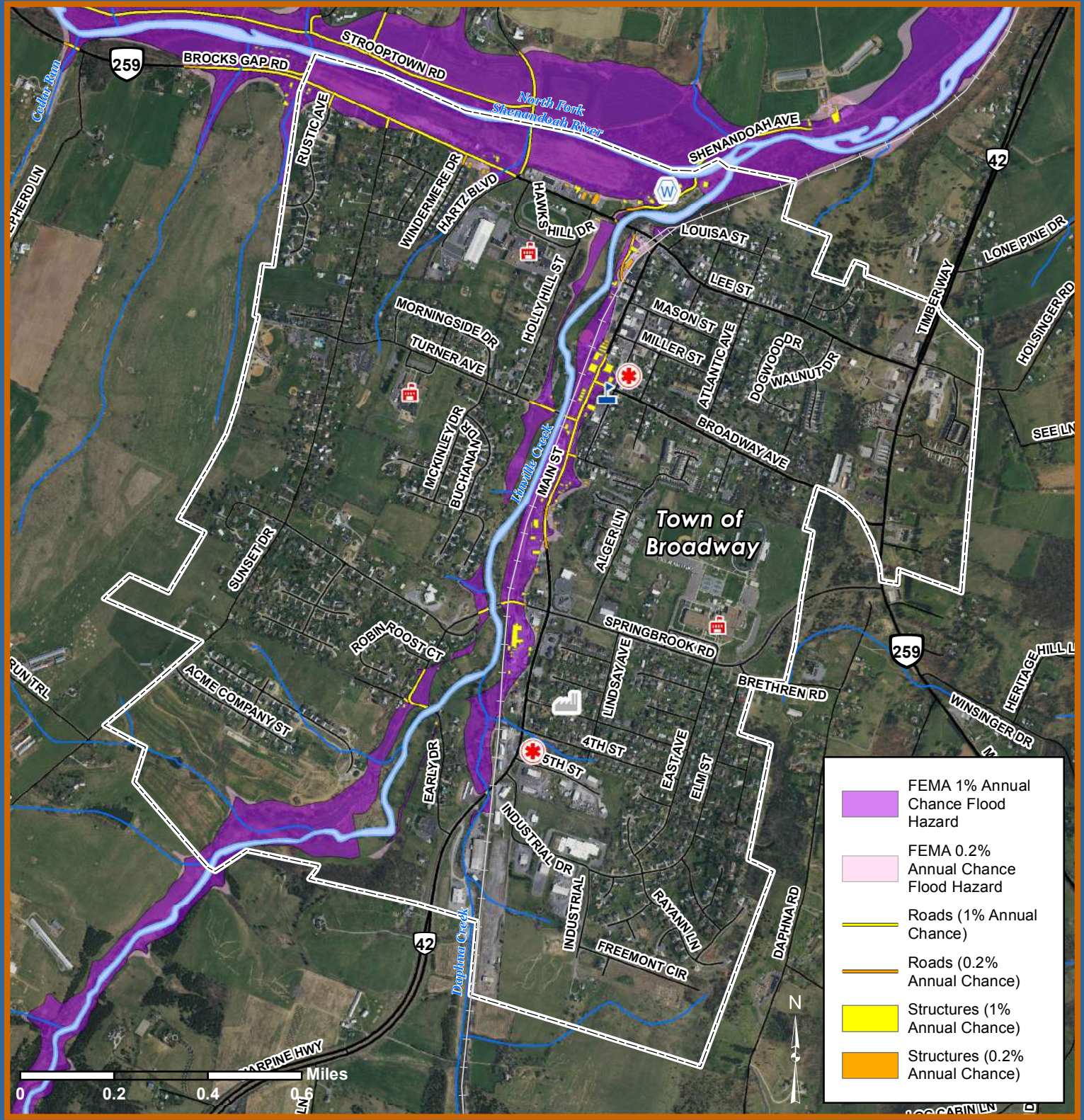
Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, Town of Bridgewater
Sept. 16, 2019

Critical Facility

- CHURCH
- EMERGENCY RESPONSE
- GOVERNMENT
- INDUSTRY
- MEDICAL FACILITY
- OTHER
- RETAIL
- SCHOOL
- SENIOR LIVING
- WATER TREATMENT

Central Shenandoah Planning District

Critical Facilities and FEMA Floodplains - Town of Broadway



CSPDC

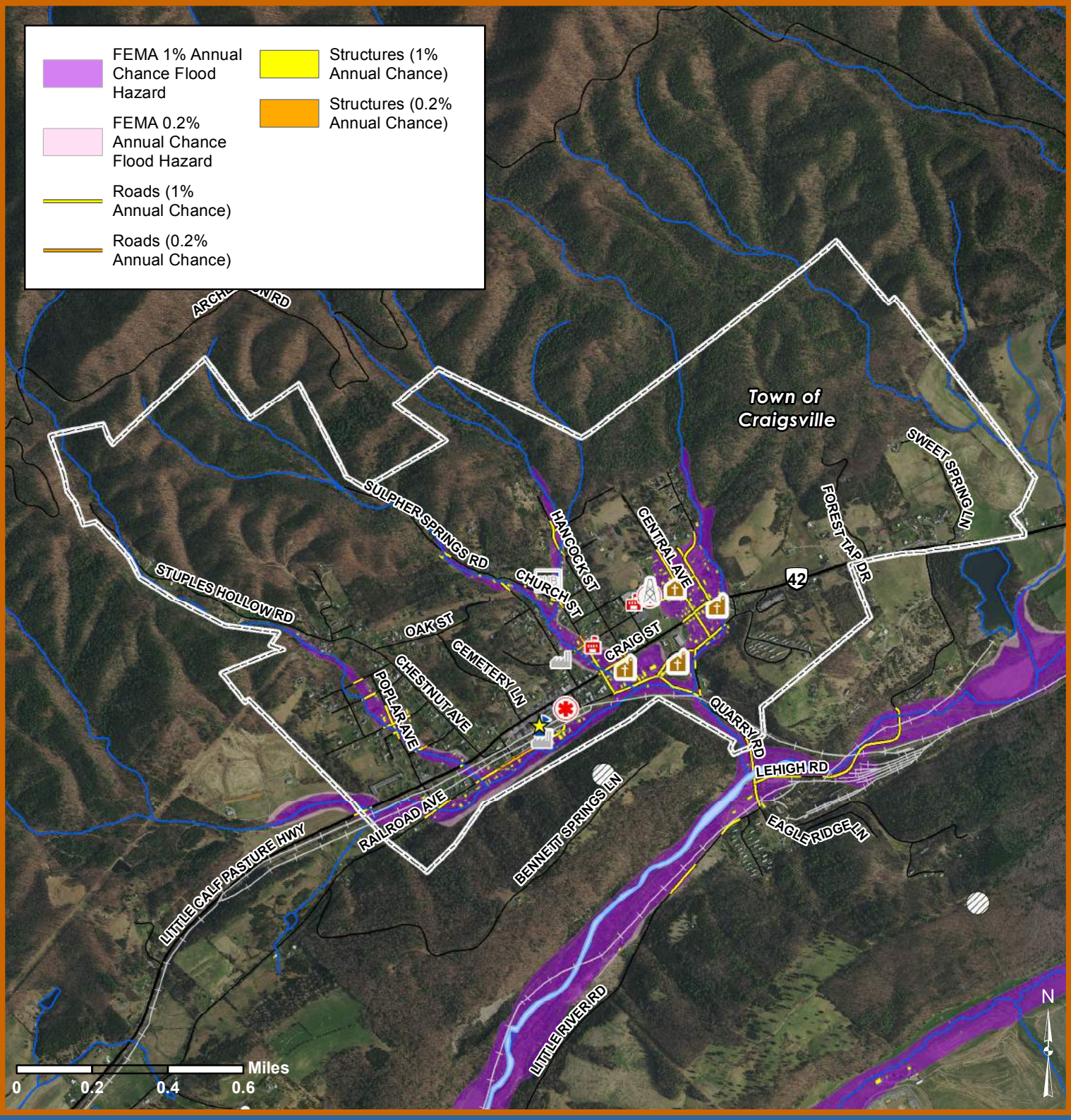
Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, Town of Broadway
Sept. 17, 2019

Critical Facility

- EMERGENCY RESPONSE
- INDUSTRY
- GOVERNMENT
- SCHOOL
- WATER TREATMENT

Central Shenandoah Planning District

Critical Facilities and FEMA Floodplains - Town of Craigsville



CSPDC

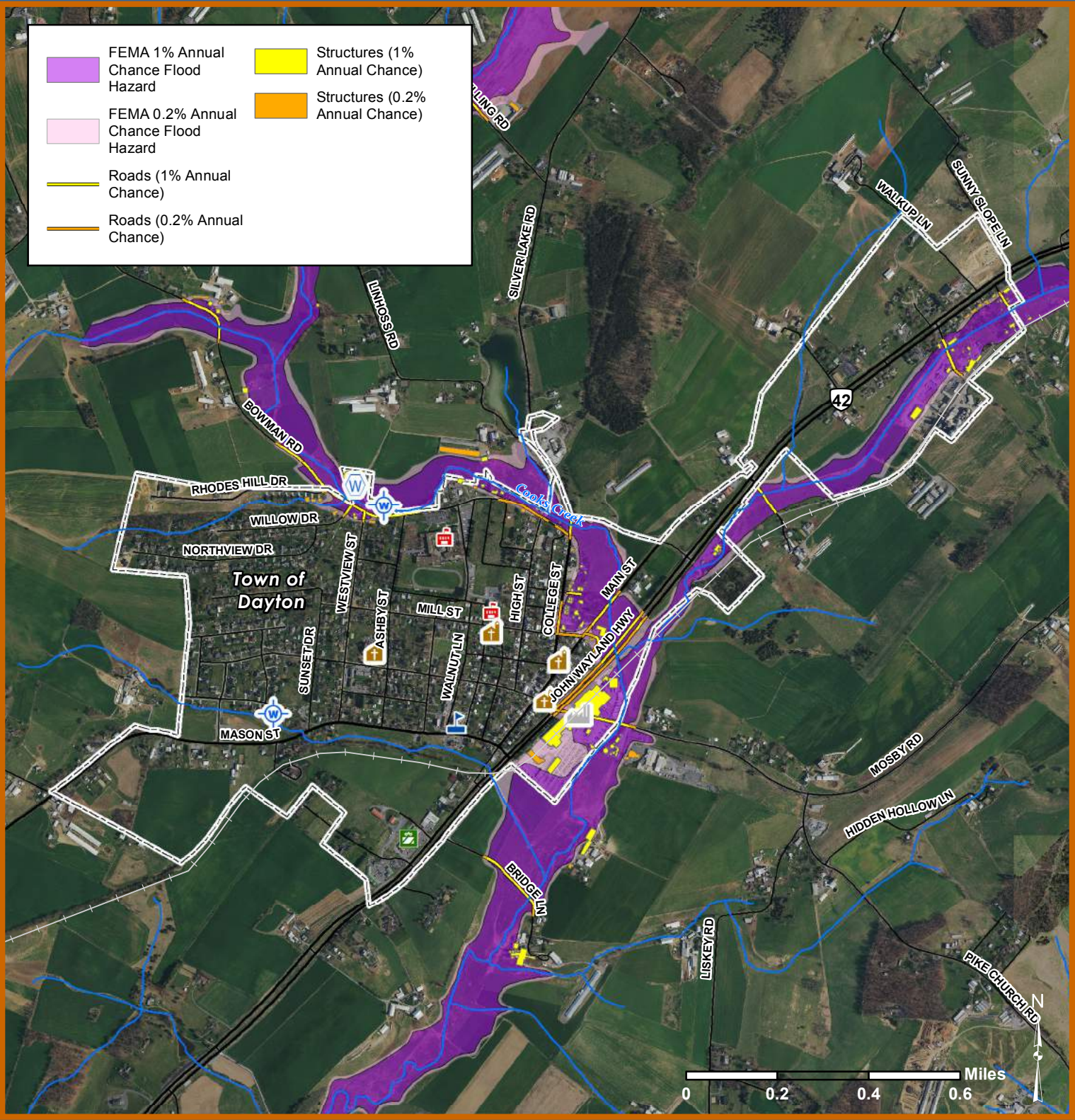
Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, Town of Craigsville
October 17, 2019

Critical Facility

- CELL TOWER
- CHURCH
- COMMUNITY CENTER
- EMERGENCY RESPONSE
- GOVERNMENT
- IFLOWS GAUGE
- INDUSTRY
- POWER UTILITY
- SCHOOL
- WATER TANK

Central Shenandoah Planning District

Critical Facilities and FEMA Floodplains - Town of Dayton



CSPDC

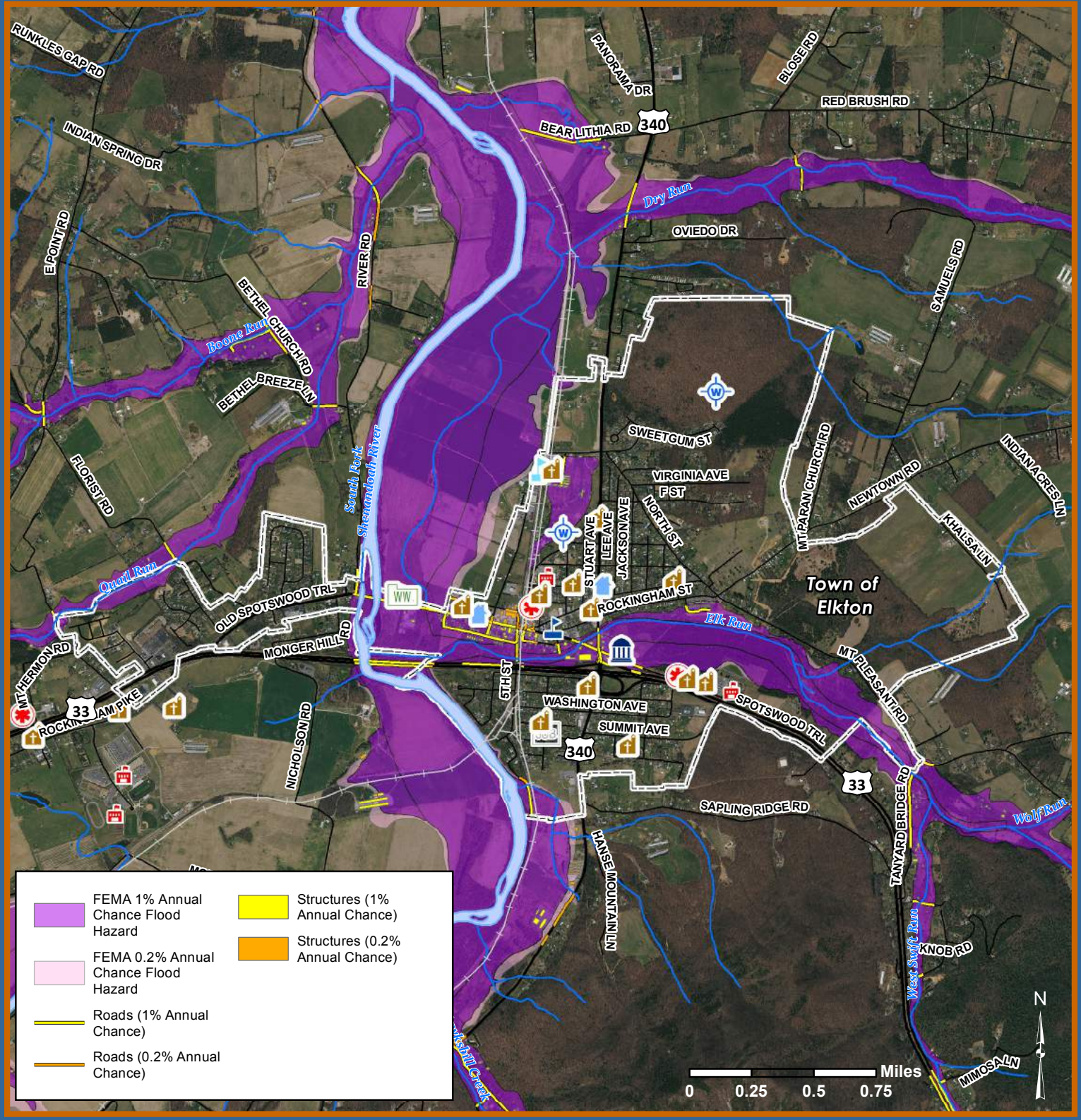
Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, Town of Dayton
Sept. 18, 2019

Critical Facility

- CHURCH
- GOVERNMENT
- INDUSTRY
- RETAIL
- SCHOOL
- WATER TREATMENT
- WELL

Central Shenandoah Planning District

Critical Facilities and FEMA Floodplains - Town of Elkton



CSPDC

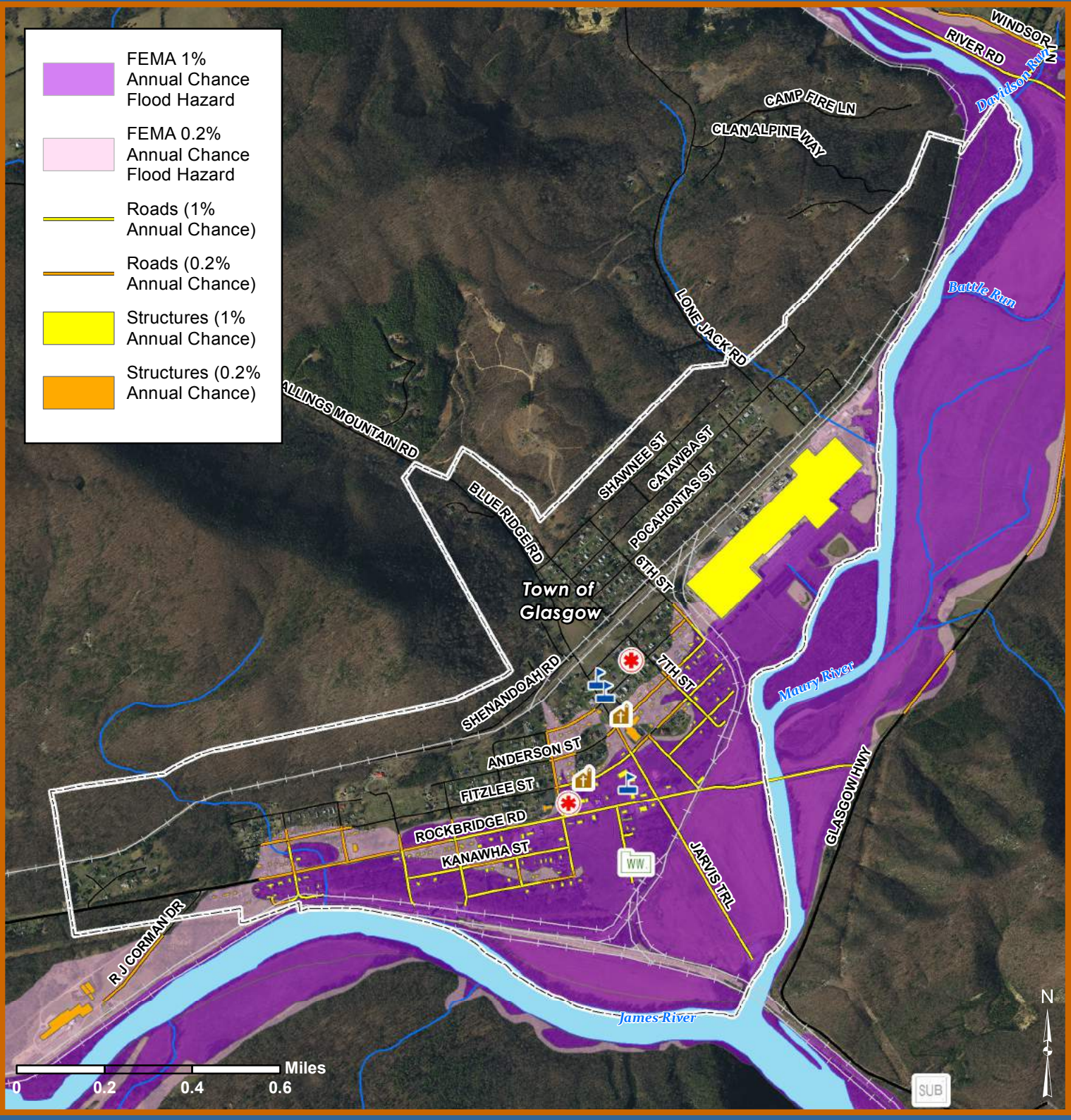
Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, Town of Elkton
October 17, 2019

Critical Facility

- CHILD DAY CARE
- CHURCH
- EMERGENCY RESPONSE
- GOVERNMENT
- POWER UTILITY (SUB)
- SCHOOL
- SENIOR LIVING
- TOWN HALL
- WASTEWATER TREATMENT (WW)
- WELL

Central Shenandoah Planning District

Critical Facilities and FEMA Floodplains - Town of Glasgow



CSPDC

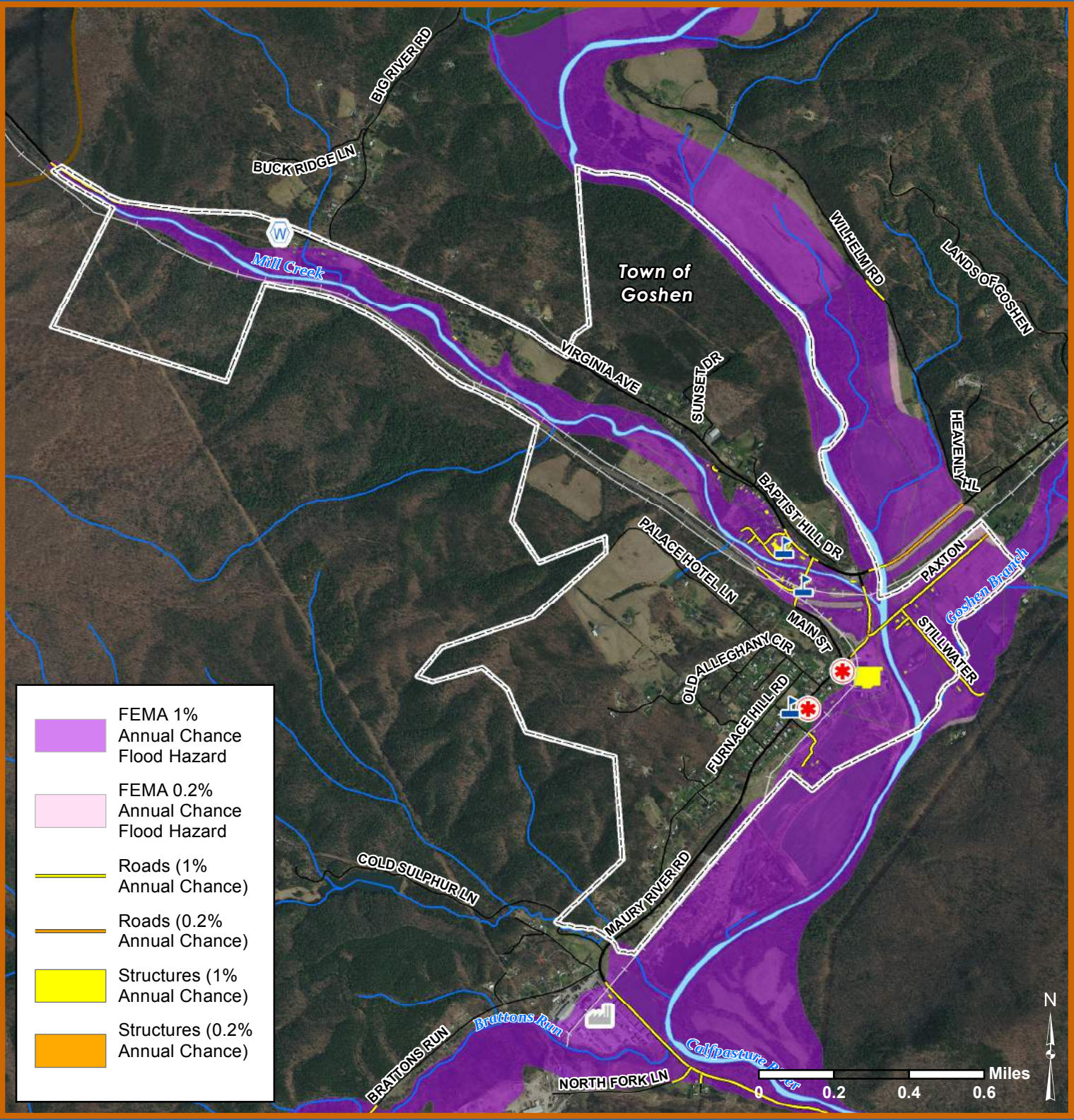
Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, Town of Glasgow
Sept. 18, 2019

Critical Facility

- CHURCH
- EMERGENCY RESPONSE
- GOVERNMENT
- SUB POWER UTILITY
- WW WASTEWATER TREATMENT

Central Shenandoah Planning District

Critical Facilities and FEMA Floodplains - Town of Goshen



CSPDC

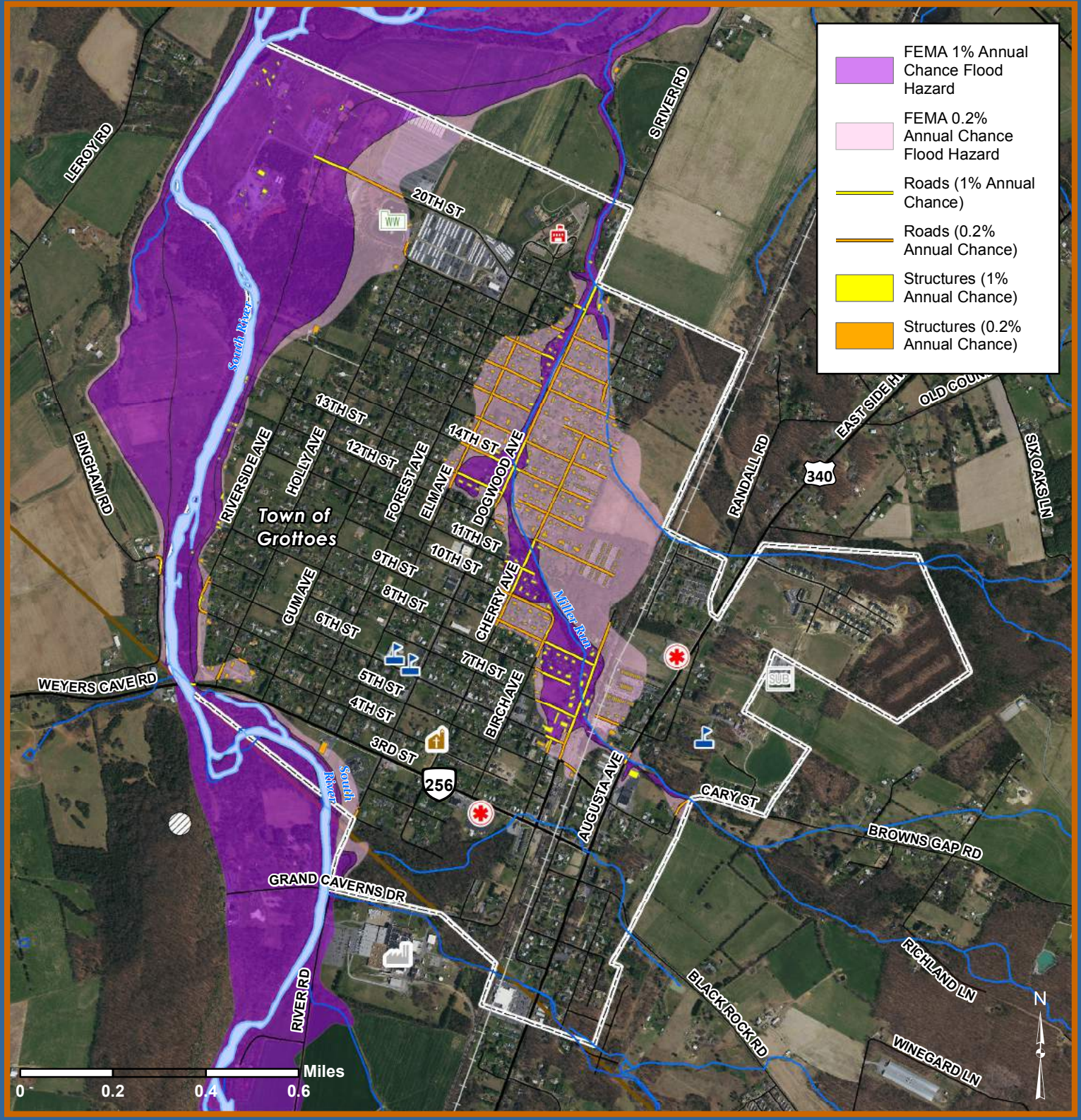
Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, Town of Goshen
Sept. 18, 2019

Critical Facility

- EMERGENCY RESPONSE
- INDUSTRY
- GOVERNMENT
- WATER TREATMENT

Central Shenandoah Planning District

Critical Facilities and FEMA Floodplains - Town of Grottoes



CSPDC

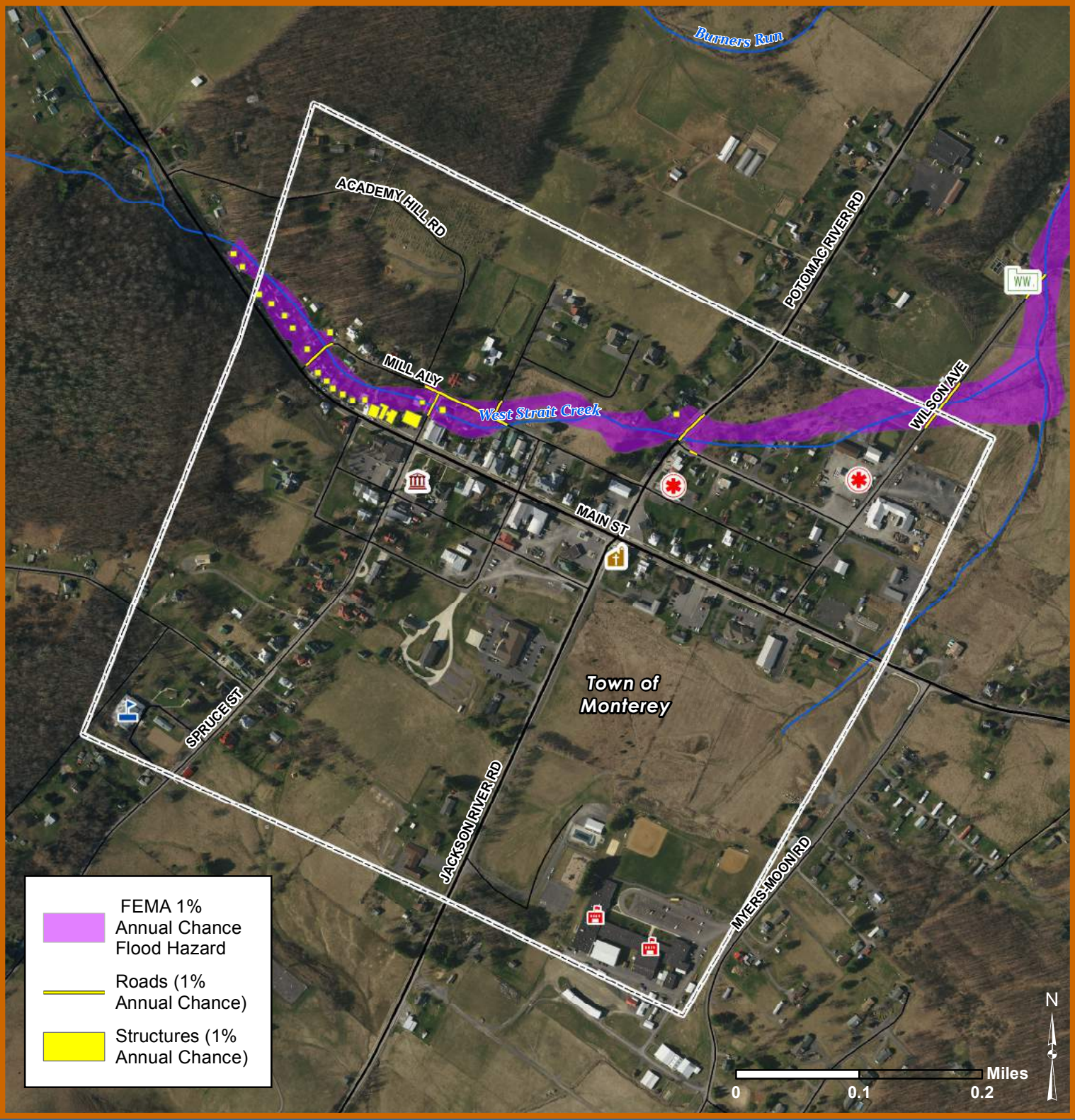
Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, Town of Grottoes
October 17, 2019

Critical Facility

- CHURCH
- EMERGENCY RESPONSE
- GOVERNMENT
- INDUSTRY
- POWER UTILITY
- SCHOOL
- WASTEWATER TREATMENT
- WATER TANK

Central Shenandoah Planning District

Critical Facilities and FEMA Floodplains - Town of Monterey



CSPDC

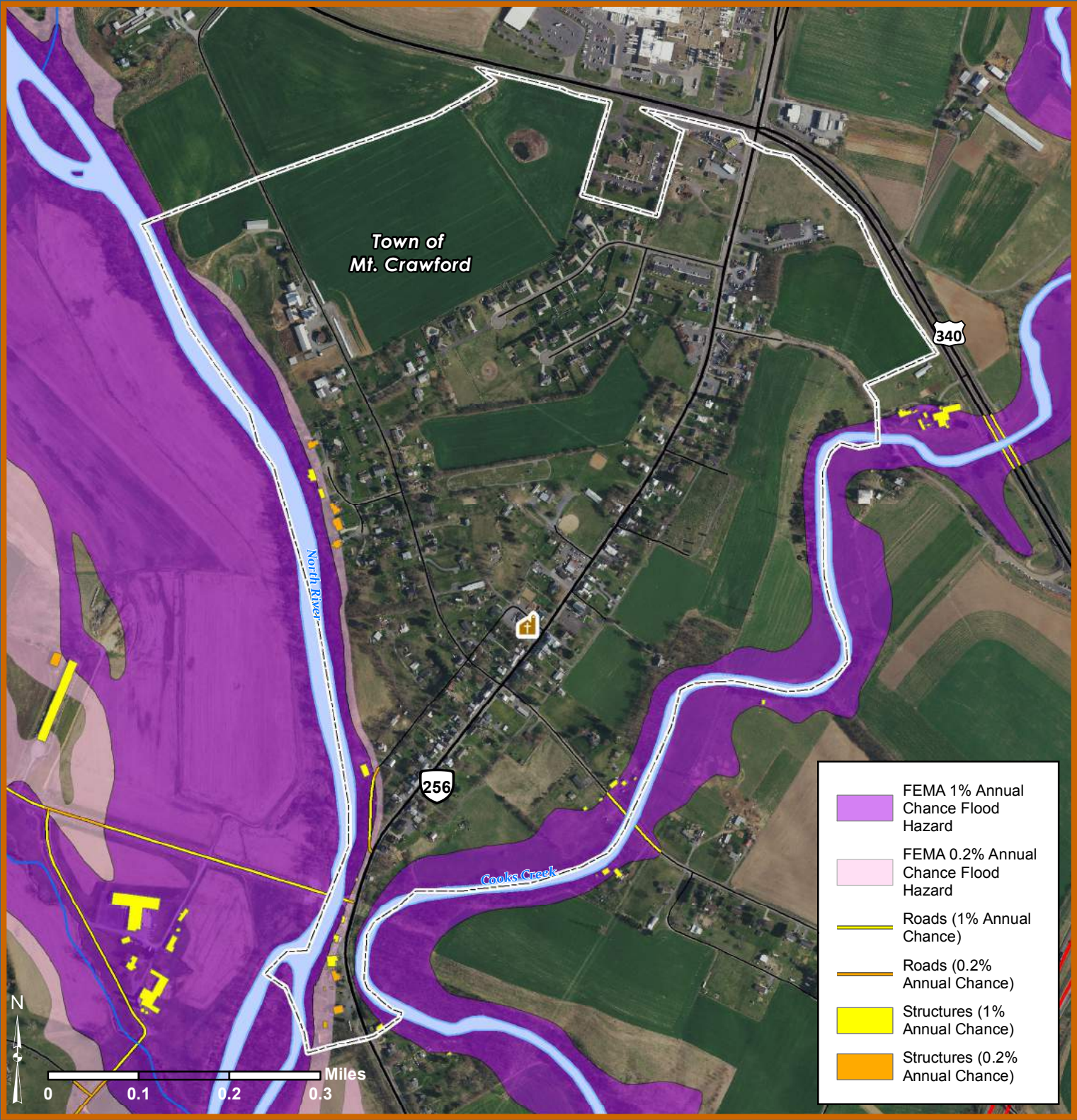
Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, Town of Monterey
Sept. 18, 2019

Critical Facility

- CHURCH
- COURTHOUSE
- EMERGENCY RESPONSE
- GOVERNMENT
- SCHOOL
- WW WASTEWATER TREATMENT

Central Shenandoah Planning District

Critical Facilities in FEMA Floodplains - Town of Mt. Crawford



CSPDC

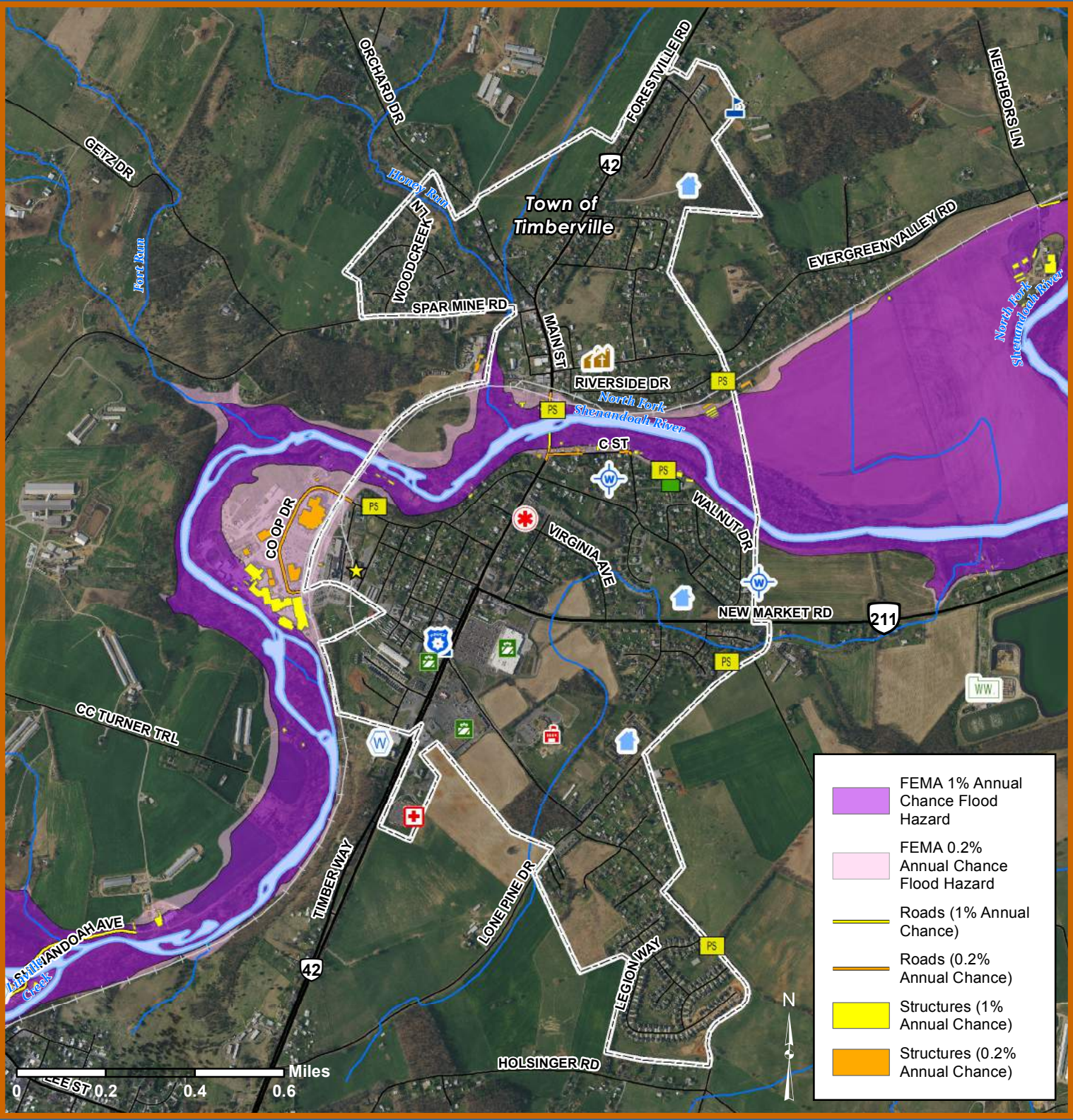
Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, Town of Mt. Crawford
Sept. 18, 2019

Critical Facility

CHURCH

Central Shenandoah Planning District

Critical Facilities and FEMA Floodplains - Town of Timberville



CSPDC

Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, FEMA, Commonwealth of VA, Town of Timberville
Sept. 18, 2019

Critical Facility

- CHURCH
- COMMUNITY CENTER
- EMERGENCY RESPONSE
- GOVERNMENT
- MEDICAL FACILITY
- POLICE DEPT
- PUBLIC WORKS
- RETAIL
- SCHOOL
- SENIOR LIVING
- WASTEWATER PUMP STATION
- WASTEWATER TREATMENT
- WATER TREATMENT
- WELL

CSPDC Critical Facilities and Relative Snow Risk

Critical Facility

Relative Snow Risk

- Low Potential
- Medium Potential
- High Potential

West Virginia

Highland

Bath

Alleghany

Covington

Augusta

Rockingham

Harrisonburg

Staunton

Waynesboro

Rockbridge

Lexington

Buena Vista

Frederick

Shenandoah

Page

Madison

Greene

Nelson

Fluvanna

Amherst

Buckingham

Botetourt

Craig

Lynchburg

Appomattox

Cumberland

Charlottesville

Albemarle

Bedford

Campbell

Prince Edward

Salem

Roanoke

Franklin

Pittsylvania

N

0 8.5 17 Miles

Celebrating 50 Years CSPDC Central Shenandoah Planning District Commission

Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, USGS, Commonwealth of VA, VT CGIT, NOAA, VirginiaView
October 22, 2019

CSPDC Critical Facilities and Relative Ice Risk

Critical Facility

Relative Ice Risk

Low Potential

Medium Potential

West Virginia

Frederick

Shenandoah

Page

Rockingham

Harrisonburg

Madison

Highland

Augusta

Greene

Staunton

Waynesboro

Bath

Charlottesville

Albemarle

Rockbridge

Alleghany

Lexington

Buena Vista

Covington

Nelson

Fluvanna

Amherst

Buckingham

Botetourt

Craig

Lynchburg

Appomattox

Cumberland

Bedford

Salem

Campbell

Prince Edward

Roanoke

Franklin

Pittsylvania

N

0 8.5 17 Miles

Map prepared and produced by Central Shenandoah PDC.
Map to be used for planning purposes only.
Data Source(s): CSPDC, USGS, Commonwealth of VA,
VT CGIT, NOAA, VirginiaView
October 22, 2019

Appendix E - Repetitive Losses

Appendix E. Repetitive Losses in the CSPDC region

Community Name	NFIP Community Number	Number of Repetitive Loss Properties
AUGUSTA COUNTY	510013	13
BATH COUNTY	510196	2
BRIDGEWATER, TOWN OF	510134	2
BROADWAY, TOWN OF	510135	2
BUENA VISTA, CITY OF	510027	39
CRAIGSVILLE, TOWN OF	510014	1
DAYTON, TOWN OF	510136	0
ELKTON, TOWN OF	510137	1
GLASGOW, TOWN OF	515526	11
GOSHEN, TOWN OF	510217	3
GROTTOES, TOWN OF	510138	0
HARRISONBURG, CITY OF	510076	2
HIGHLAND COUNTY	510311	0
LEXINGTON, CITY OF	510089	4
MONTEREY, TOWN OF	510379	0
MT. CRAWFORD, TOWN OF	510224	0
ROCKBRIDGE COUNTY	510205	24
ROCKINGHAM COUNTY	510133	18
STAUNTON, CITY OF	510155	1
TIMBERVILLE, TOWN OF	510139	0
WAYNESBORO, CITY OF	515532	52
TOTAL FOR CSPDC REGION:		**175**

Community Name	NFIP Community Number	Number of Severe Repetitive Loss Properties
AUGUSTA COUNTY	510013	0
BATH COUNTY	510196	0
BRIDGEWATER, TOWN OF	510134	0
BROADWAY, TOWN OF	510135	0
BUENA VISTA, CITY OF	510027	0
CRAIGSVILLE, TOWN OF	510014	1
DAYTON, TOWN OF	510136	0
ELKTON, TOWN OF	510137	0
GLASGOW, TOWN OF	515526	0
GOSHEN, TOWN OF	510217	0
GROTTOES, TOWN OF	510138	0
HARRISONBURG, CITY OF	510076	0
HIGHLAND COUNTY	510311	0
LEXINGTON, CITY OF	510089	0
MONTEREY, TOWN OF	510379	0
MT. CRAWFORD, TOWN OF	510224	0
ROCKBRIDGE COUNTY	510205	1
ROCKINGHAM COUNTY	510133	0
STAUNTON, CITY OF	510155	0
TIMBERVILLE, TOWN OF	510139	0
WAYNESBORO, CITY OF	515532	4
TOTAL FOR CSPDC REGION:		**6**

Appendix F - Drought History

Month	Year	Augusta	Bath	Highland	Rockbridge	Rockingham	Lexington	Buena Vista	Waynesboro	Staunton	Harrisonburg
January	2000										
February	2000										
March	2000										
April	2000										
May	2000										
June	2000										
July	2000										
August	2000										
September	2000										
October	2000										
November	2000				D1						
December	2000		D1								
January	2001										
February	2001										
March	2001				D1						
April	2001										
May	2001	D1	D1, D2	D1		D1	D1	D1	D1	D1	D1
June	2001			D1							
July	2001			D1							
August	2001			D1							
September	2001			D1							
October	2001			D1							
November	2001	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1
December	2001	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1
January	2002	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2
February	2002	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2
March	2002	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3
April	2002	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3
May	2002	D1, D2	D1		D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1
June	2002	D1, D2	D1	D1	D1, D2	D1	D1	D1, D2	D1	D1	D1
July	2002	D1, D2	D1	D1	D1, D2	D1	D1, D2	D1, D2	D1, D2	D1	D1
August	2002	D1, D2	D1		D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1, D2	D1
September	2002	D1, D2, D3	D1, D2, D3	D1, D2	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2
October	2002	D1, D2, D3	D1, D2	D1, D2	D1, D2, D3	D1, D2	D1, D2, D3	D1, D2, D3	D1, D2, D3	D1, D2	D1, D2
November	2002	D1			D1		D1	D1	D1		
December	2002										
January	2003										
February	2003										
March	2003										
April	2003										
May	2003										

Month	Year	Augusta	Bath	Highland	Rockbridge	Rockingham	Lexington	Buena Vista	Waynesboro	Staunton	Harrisonburg
June	2003										
July	2003										
August	2003										
September	2003										
October	2003										
November	2003										
December	2003										
January	2004										
February	2004										
March	2004										
April	2004										
May	2004										
June	2004										
July	2004										
August	2004										
September	2004										
October	2004										
November	2004										
December	2004										
January	2005										
February	2005										
March	2005										
April	2005										
May	2005										
June	2005										
July	2005										
August	2005										
September	2005	D1							D1		
October	2005	D1			D1	D1			D1	D1	D1
November	2005										
December	2005										
January	2006										
February	2006										
March	2006				D1		D1	D1			
April	2006				D1		D1	D1			
May	2006				D1	D1	D1	D1	D1	D1	
June	2006				D1	D1	D1	D1	D1	D1	
July	2006										
August	2006	D1			D1	D1		D1	D1	D1	D1
September	2006										
October	2006										

Month	Year	Augusta	Bath	Highland	Rockbridge	Rockingham	Lexington	Buena Vista	Waynesboro	Staunton	Harrisonburg
November	2006										
December	2006										
January	2007										
February	2007										
March	2007										
April	2007										
May	2007										
June	2007										
July	2007	D1				D1			D1	D1	D1
August	2007	D1	D1		D1	D1	D1	D1	D1	D1	D1
September	2007	D1	D1		D1	D1	D1	D1	D1	D1	D1
October	2007	D1, D2			D1	D1, D2	D1	D1	D1	D1	D1
November	2007	D1			D1	D1			D1		
December	2007	D1			D1	D1			D1		
January	2008					D1					
February	2008					D1					
March	2008					D1					
April	2008				D1	D1					
May	2008				D1						
June	2008										
July	2008										
August	2008	D1			D1		D1	D1	D1		
September	2008	D1			D1		D1	D1			
October	2008			D1	D1						
November	2008		D1	D1							
December	2008	D1	D1	D1	D1	D1					
January	2009	D1	D1	D1	D1	D1					
February	2009	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1
March	2009	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1
April	2009		D1								
May	2009										
June	2009										
July	2009										
August	2009										
September	2009			D1		D1					
October	2009										
November	2009										
December	2009										
January	2010										
February	2010										
March	2010										

Month	Year	Augusta	Bath	Highland	Rockbridge	Rockingham	Lexington	Buena Vista	Waynesboro	Staunton	Harrisonburg
April	2010										
May	2010										
June	2010										
July	2010	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1
August	2010	D1				D1, D2			D1		D1
September	2010	D1	D1	D1	D1	D1, D2			D1	D1	D1
October	2010	D1	D1	D1		D1					
November	2010	D1	D1	D1		D1					
December	2010										
January	2011	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1
February	2011	D1		D1	D1	D1	D1	D1	D1	D1	D1
March	2011	D1		D1	D1	D1	D1	D1	D1	D1	D1
April	2011	D1			D1	D1			D1	D1	D1
May	2011										
June	2011										
July	2011										
August	2011										
September	2011										
October	2011										
November	2011										
December	2011										
January	2012										
February	2012										
March	2012										
April	2012										
May	2012										
June	2012										
July	2012					D1					
August	2012										
September	2012										
October	2012										
November	2012	D1			D1	D1			D1	D1	D1
December	2012	D1			D1	D1			D1	D1	D1
January	2013	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1
February	2013										
March	2013										
April	2013										
May	2013										
June	2013										
July	2013										
August	2013										

Month	Year	Augusta	Bath	Highland	Rockbridge	Rockingham	Lexington	Buena Vista	Waynesboro	Staunton	Harrisonburg
September	2013										
October	2013										
November	2013										
December	2013										
January	2014										
February	2014										
March	2014										
April	2014										
May	2014										
June	2014										
July	2014										
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April	2015										
May	2015										
June	2015										
July	2015										
August	2015										
September	2015										
October	2015										
November	2015										
December	2015										
January	2016										
February	2016										
March	2016										
April	2016	D1		D1		D1					
May	2016	D1		D1		D1					
June	2016										
July	2016										
August	2016										
September	2016										
October	2016										
November	2016										
December	2016										
January	2017										

Month	Year	Augusta	Bath	Highland	Rockbridge	Rockingham	Lexington	Buena Vista	Waynesboro	Staunton	Harrisonburg
February	2017	D1				D1			D1		
March	2017	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1
April	2017	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1
May	2017	D1	D1	D1		D1			D1	D1	D1
June	2017										
July	2017										
August	2017										
September	2017										
October	2017										
November	2017										
December	2017	D1			D1	D1	D1	D1	D1	D1	D1
January	2018	D1			D1	D1	D1	D1	D1	D1	D1
February	2018	D1			D1	D1		D1	D1	D1	D1
March	2018										
April	2018										
May	2018										
June	2018										
July	2018										
August	2018										
September	2018										
October	2018										
November	2018										
December	2018										
January	2019										
February	2019										
March	2019										
April	2019										
May	2019										
June	2019										
July	2019										
August	2019										
September	2019	D1	D1		D1		D1	D1	D1		
October	2019	D1	D1, D2		D1, D2	D1	D1	D1, D2	D1		
November	2019										
December	2019										

Source: National Drought Mitigation Center (NDMC), U.S. Department of Agriculture (USDA), and the National Oceanic and Atmospheric Association (NOAA); U.S. Drought Monitor Statistics, 2000 to 2019.

Note: Data was only compiled for drought intensities of D1 Moderate Drought through D4 Exceptional Drought. Data was not included on this chart for D0 Abnormally Dry Conditions.

Appendix G – HAZUS Reports

Hazus: Flood Global Risk Report

Region Name: CSPDC

Flood Scenario: 100

Print Date: Monday, August 19, 2019

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

FEMA

RiskMAP
Increasing Resilience Together

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

- Virginia

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is approximately 3,438 square miles and contains 17,149 census blocks. The region contains over 111 thousand households and has a total population of 286,781 people (2010 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 118,565 buildings in the region with a total building replacement value (excluding contents) of 31,788 million dollars. Approximately 92.00% of the buildings (and 78.42% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 118,565 buildings in the region which have an aggregate total replacement value of 31,788 million dollars. Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	24,927,457	78.4%
Commercial	4,053,304	12.8%
Industrial	1,273,474	4.0%
Agricultural	254,378	0.8%
Religion	558,559	1.8%
Government	174,125	0.5%
Education	546,526	1.7%
Total	**31,787,823**	**100%**

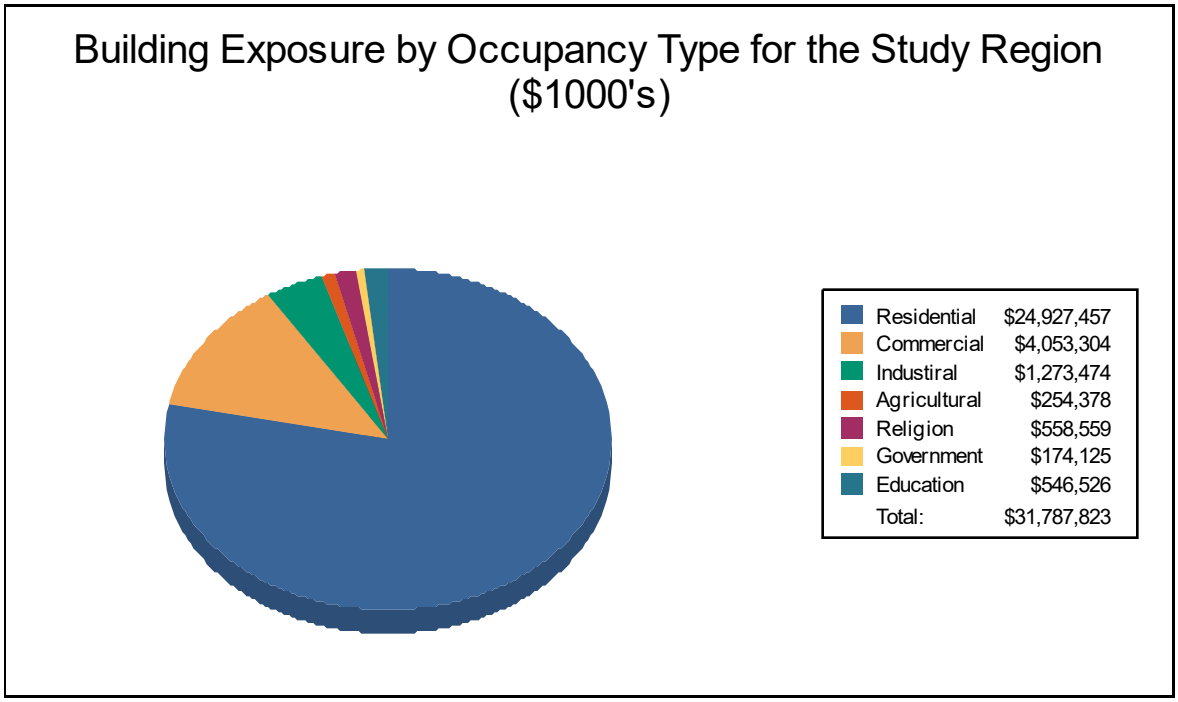
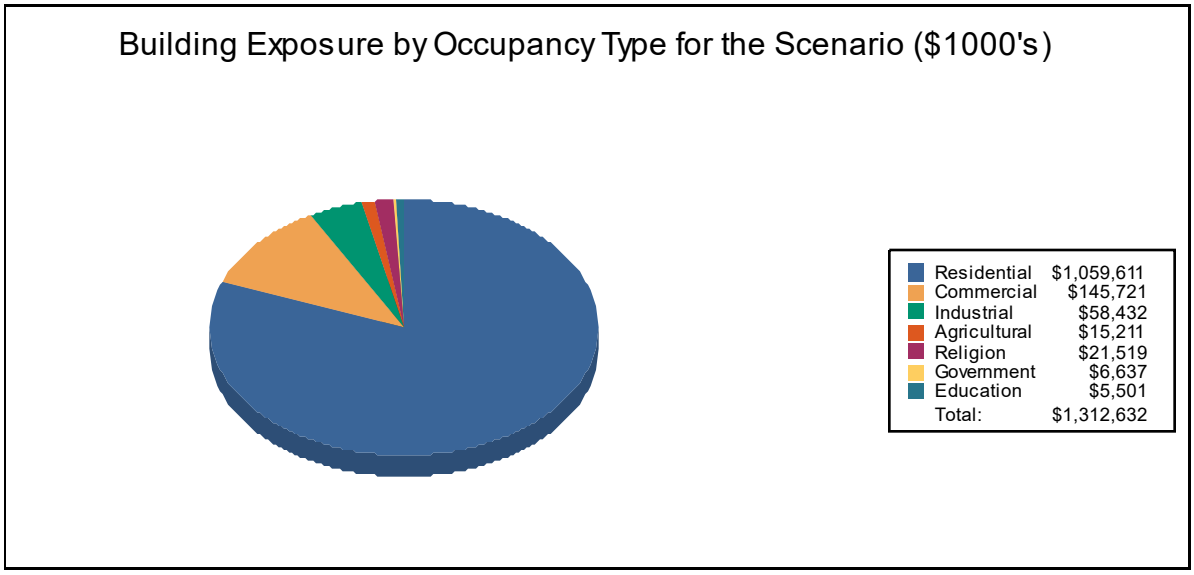


Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	3,810,435	75.9%
Commercial	658,005	13.1%
Industrial	329,164	6.6%
Agricultural	58,172	1.2%
Religion	86,295	1.7%
Government	28,178	0.6%
Education	50,813	1.0%
Total	**5,021,062**	**100%**



Essential Facility Inventory

For essential facilities, there are 7 hospitals in the region with a total bed capacity of 543 beds. There are 144 schools, 52 fire stations, 28 police stations and 9 emergency operation centers.

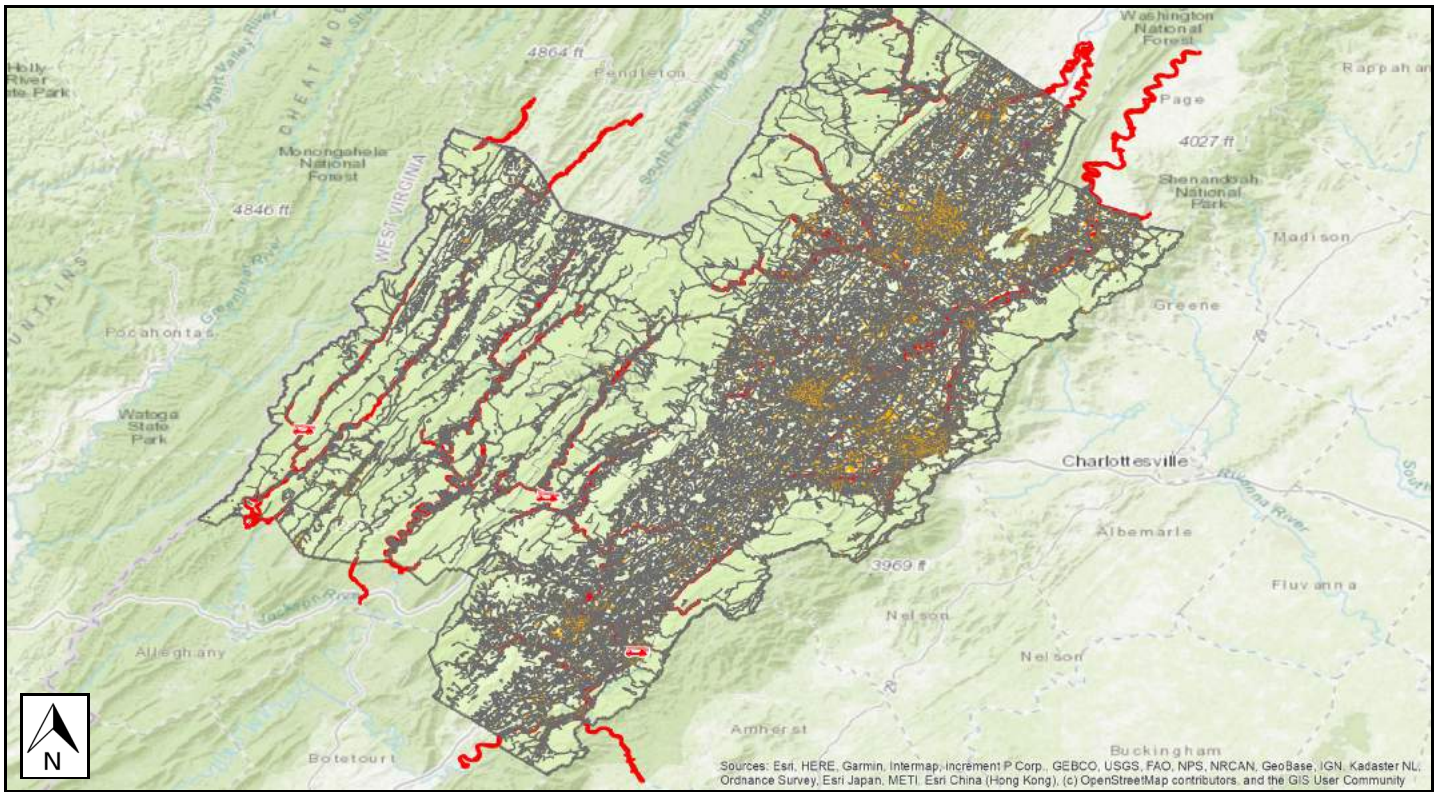
Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	CSPDC
Scenario Name:	100
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



Building Damage

General Building Stock Damage

Hazus estimates that about 486 buildings will be at least moderately damaged. This is over 55% of the total number of buildings in the scenario. There are an estimated 146 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Total Economic Loss (1 dot = $300K) Overview Map

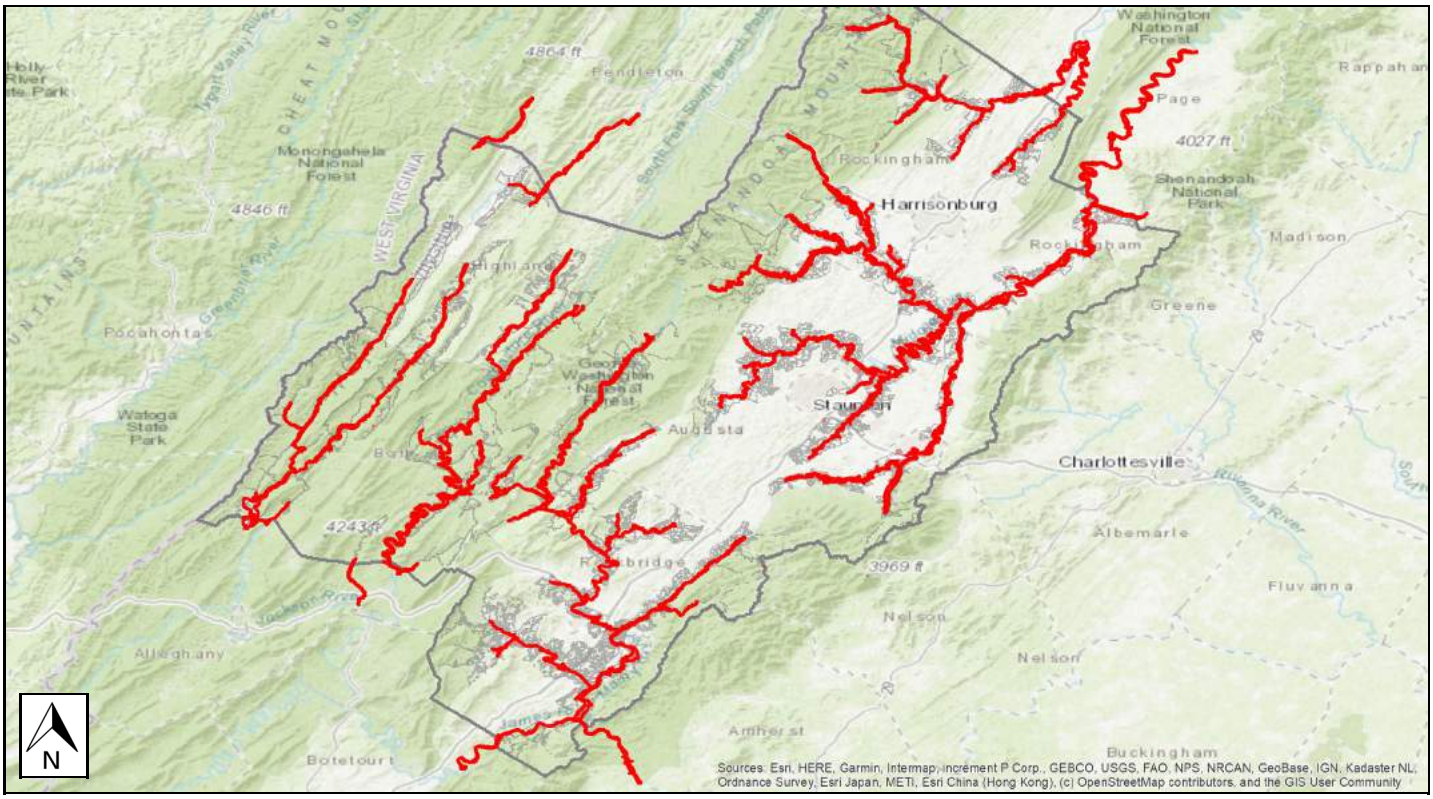


Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	9	26	14	40	7	20	2	6	1	3	2	6
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	1	50	0	0	1	50	0	0	0	0
Industrial	0	0	3	43	0	0	1	14	2	29	1	14
Religion	0	0	6	100	0	0	0	0	0	0	0	0
Residential	67	13	153	30	71	14	48	9	30	6	143	28
Total	**76**		**177**		**78**		**52**		**33**		**146**	

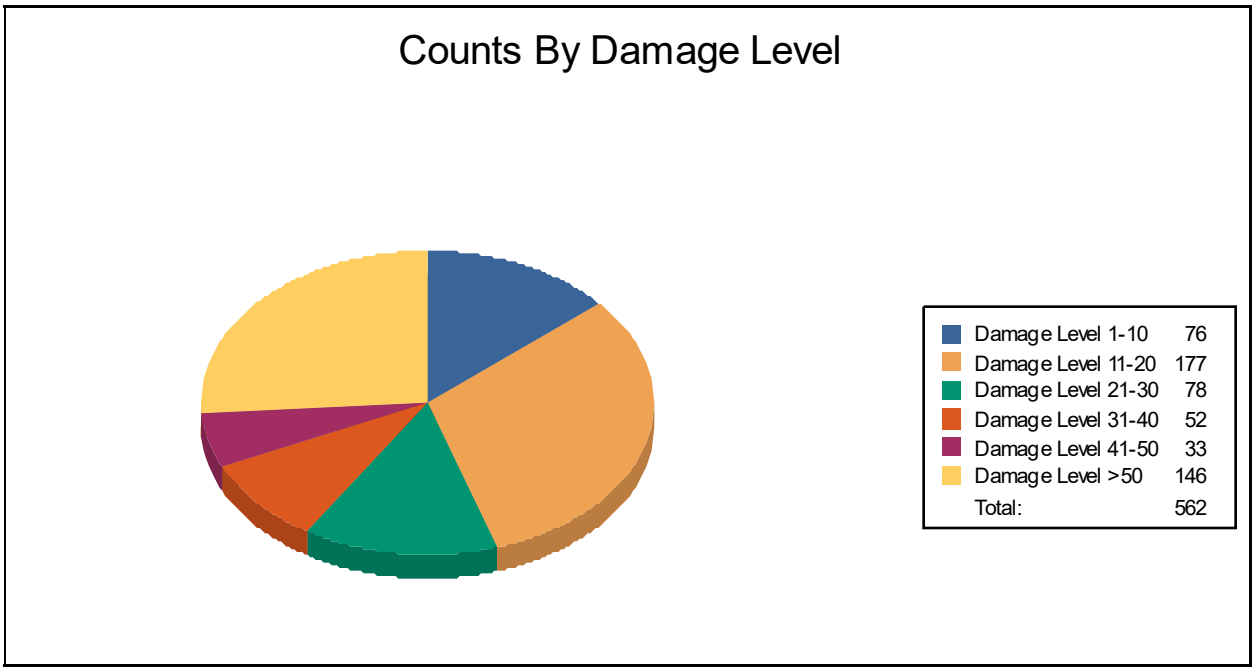


Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
Manuf Housing	0	0	0	0	0	0	0	0	0	0	4	100
Masonry	15	16	30	33	12	13	8	9	4	4	23	25
Steel	5	17	12	41	6	21	3	10	1	3	2	7
Wood	60	13	138	29	66	14	46	10	30	6	131	28

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 543 hospital beds available for use. On the day of the scenario flood event, the model estimates that 543 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operation Centers	9	0	0	0
Fire Stations	52	3	0	3
Hospitals	7	0	0	0
Police Stations	28	1	0	1
Schools	144	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

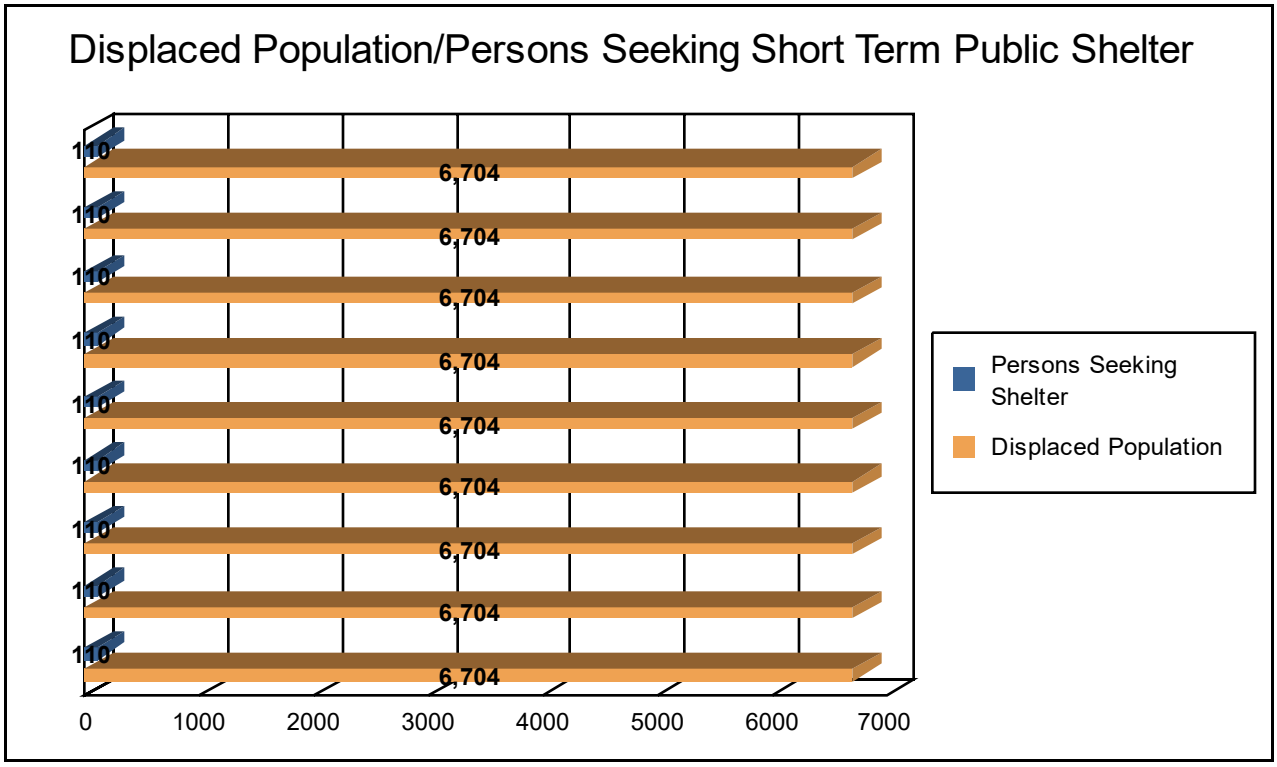
Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

Analysis has not been performed for this Scenario.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 2,235 households (or 6,704 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 110 people (out of a total population of 286,781) will seek temporary shelter in public shelters.



Economic Loss

The total economic loss estimated for the flood is 1,003.58 million dollars, which represents 19.99 % of the total replacement value of the scenario buildings.

Building-Related Losses

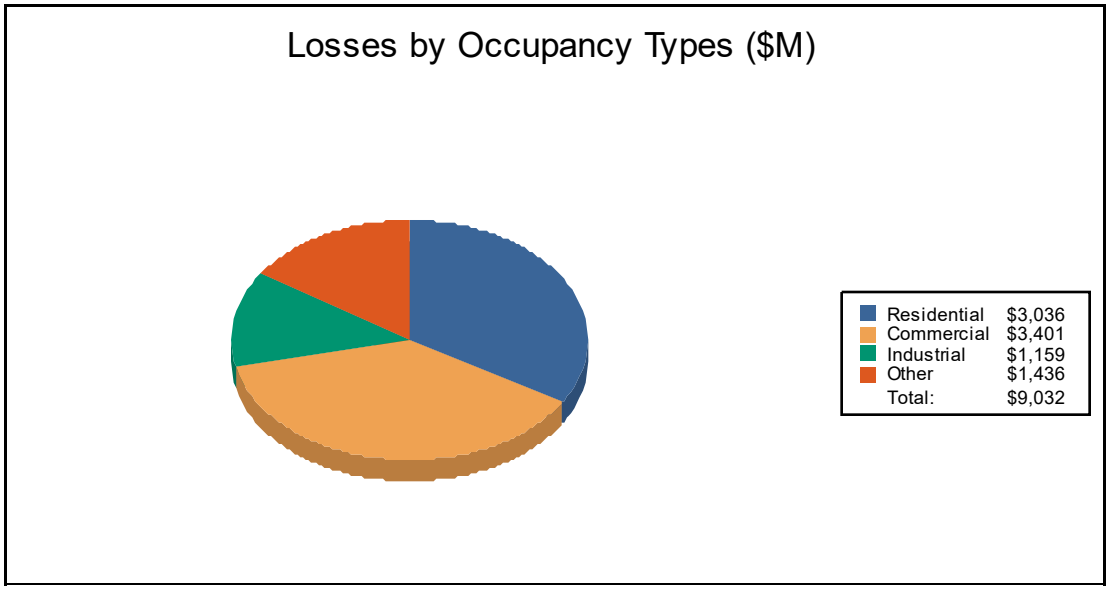
The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the

The total building-related losses were 606.05 million dollars. 40% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 33.62% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	1,653.99	396.05	295.10	67.04	2,412.19
	Content	842.51	1,023.56	670.28	328.27	2,864.62
	Inventory	0.00	36.97	136.64	4.02	177.63
	Subtotal	**2,496.50**	**1,456.59**	**1,102.02**	**399.33**	**5,454.44**
Business Interruption						
	Income	13.03	737.01	14.14	105.98	870.16
	Relocation	370.14	225.90	15.80	46.48	658.32
	Rental Income	125.67	166.58	3.96	5.74	301.95
	Wage	31.02	815.08	22.91	878.29	1,747.31
	Subtotal	**539.87**	**1,944.57**	**56.82**	**1,036.49**	**3,577.73**
ALL	**Total**	**3,036.37**	**3,401.15**	**1,158.84**	**1,435.82**	**9,032.18**



Appendix A: County Listing for the Region

Virginia

- Augusta
- Bath
- Highland
- Rockbridge
- Rockingham
- Buena Vista
- Harrisonburg
- Lexington
- Staunton
- Waynesboro

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Virginia				
Harrisonburg	48,914	3,460,375	1,630,540	5,090,915
Rockingham	76,314	6,609,137	1,260,787	7,869,924
Lexington	7,042	714,506	243,342	957,848
Highland	2,321	320,363	46,946	367,309
Staunton	23,746	2,264,098	782,529	3,046,627
Rockbridge	22,307	2,182,496	429,798	2,612,294
Augusta	73,750	6,296,301	1,337,630	7,633,931
Buena Vista	6,650	509,866	214,901	724,767
Bath	4,731	739,486	78,123	817,609
Waynesboro	21,006	1,830,829	835,770	2,666,599
Total	**286,781**	**24,927,457**	**6,860,366**	**31,787,823**
Total Study Region	**286,781**	**24,927,457**	**6,860,366**	**31,787,823**

Quick Assessment Report

August 16, 2019

Study Region : CSPDC
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	3,438
Number of Census Blocks	17,149
Number of Buildings	
Residential	109,076
Total	118,565
Number of People in the Region (x 1000)	287
Building Exposure ($ Millions)	
Residential	24,927
Total	31,788

Scenario Results

Shelter Requirements

Displaced Population (# Households)	2,235
Short Term Shelter (# People)	110

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	0
Total Property (Capital Stock) Losses ($ Millions)	0
Business Interruption (Income) Losses ($ Millions)	0

Disclaimer:

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Quick Assessment Report

October 31, 2019

Study Region : Augusta
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	971
Number of Census Blocks	4,370
Number of Buildings	
Residential	29,645
Total	31,566
Number of People in the Region (x 1000)	74
Building Exposure ($ Millions)	
Residential	6,296
Total	7,634

Scenario Results

Shelter Requirements

Displaced Population (# Households)	702
Short Term Shelter (# People)	35

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	68
Total Property (Capital Stock) Losses ($ Millions)	108
Business Interruption (Income) Losses ($ Millions)	56

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Quick Assessment Report

November 1, 2019

Study Region : Bath
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	535
Number of Census Blocks	777
Number of Buildings	
Residential	3,262
Total	3,360
Number of People in the Region (x 1000)	5
Building Exposure ($ Millions)	
Residential	739
Total	818

Scenario Results

Shelter Requirements	
Displaced Population (# Households)	91
Short Term Shelter (# People)	0
Economic Loss	
Residential Property (Capital Stock) Losses ($ Millions)	30
Total Property (Capital Stock) Losses ($ Millions)	52
Business Interruption (Income) Losses ($ Millions)	23

Disclaimer:

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Quick Assessment Report

October 29, 2019

Study Region : Bridgewater
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	2
Number of Census Blocks	99
Number of Buildings	
Residential	1,670
Total	1,825
Number of People in the Region (x 1000)	6
Building Exposure ($ Millions)	
Residential	473
Total	586

Scenario Results

Shelter Requirements

Displaced Population (# Households)	19
Short Term Shelter (# People)	0

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	2
Total Property (Capital Stock) Losses ($ Millions)	2
Business Interruption (Income) Losses ($ Millions)	1

Disclaimer:

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Quick Assessment Report

October 29, 2019

Study Region : Broadway
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	2
Number of Census Blocks	64
Number of Buildings	
Residential	1,359
Total	1,459
Number of People in the Region (x 1000)	4
Building Exposure ($ Millions)	
Residential	311
Total	379

Scenario Results

Shelter Requirements

Displaced Population (# Households)	23
Short Term Shelter (# People)	0

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	2
Total Property (Capital Stock) Losses ($ Millions)	6
Business Interruption (Income) Losses ($ Millions)	7

Disclaimer:

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Quick Assessment Report

November 7, 2019

Study Region : BuenaVista
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	7
Number of Census Blocks	551
Number of Buildings	
Residential	2,607
Total	2,897
Number of People in the Region (x 1000)	7
Building Exposure ($ Millions)	
Residential	510
Total	725

Scenario Results

Shelter Requirements	
Displaced Population (# Households)	269
Short Term Shelter (# People)	13
Economic Loss	
Residential Property (Capital Stock) Losses ($ Millions)	23
Total Property (Capital Stock) Losses ($ Millions)	46
Business Interruption (Income) Losses ($ Millions)	44

Disclaimer:

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Quick Assessment Report

October 28, 2019

Study Region : Craigsville
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	2
Number of Census Blocks	49
Number of Buildings	
Residential	423
Total	436
Number of People in the Region (x 1000)	1
Building Exposure ($ Millions)	
Residential	64
Total	70

Scenario Results

Shelter Requirements

Displaced Population (# Households)	34
Short Term Shelter (# People)	0

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	3
Total Property (Capital Stock) Losses ($ Millions)	3
Business Interruption (Income) Losses ($ Millions)	1

Disclaimer:

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Quick Assessment Report

October 29, 2019

Study Region : Dayton
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	1
Number of Census Blocks	71
Number of Buildings	
Residential	524
Total	585
Number of People in the Region (x 1000)	2
Building Exposure ($ Millions)	
Residential	118
Total	151

Scenario Results

Shelter Requirements	
Displaced Population (# Households)	20
Short Term Shelter (# People)	1
Economic Loss	
Residential Property (Capital Stock) Losses ($ Millions)	1
Total Property (Capital Stock) Losses ($ Millions)	5
Business Interruption (Income) Losses ($ Millions)	2

Disclaimer:

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Quick Assessment Report

October 29, 2019

Study Region : Elkton
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	3
Number of Census Blocks	126
Number of Buildings	
Residential	1,147
Total	1,262
Number of People in the Region (x 1000)	3
Building Exposure ($ Millions)	
Residential	241
Total	295

Scenario Results

Shelter Requirements

Displaced Population (# Households)	5
Short Term Shelter (# People)	0

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	0
Total Property (Capital Stock) Losses ($ Millions)	0
Business Interruption (Income) Losses ($ Millions)	0

Disclaimer:

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Quick Assessment Report

October 28, 2019

Study Region : Glasgow
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	1
Number of Census Blocks	42
Number of Buildings	
Residential	480
Total	506
Number of People in the Region (x 1000)	1
Building Exposure ($ Millions)	
Residential	81
Total	116

Scenario Results

Shelter Requirements

Displaced Population (# Households)	8
Short Term Shelter (# People)	0

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	1
Total Property (Capital Stock) Losses ($ Millions)	9
Business Interruption (Income) Losses ($ Millions)	2

Disclaimer:

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Quick Assessment Report

October 28, 2019

Study Region : Goshen
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	2
Number of Census Blocks	24
Number of Buildings	
Residential	188
Total	192
Number of People in the Region (x 1000)	0
Building Exposure ($ Millions)	
Residential	28
Total	29

Scenario Results

Shelter Requirements

Displaced Population (# Households)	14
Short Term Shelter (# People)	0

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	2
Total Property (Capital Stock) Losses ($ Millions)	2
Business Interruption (Income) Losses ($ Millions)	1

Disclaimer:

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Quick Assessment Report

October 29, 2019

Study Region : Grottoes
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	2
Number of Census Blocks	126
Number of Buildings	
Residential	1,027
Total	1,100
Number of People in the Region (x 1000)	3
Building Exposure ($ Millions)	
Residential	186
Total	228

Scenario Results

Shelter Requirements

Displaced Population (# Households)	35
Short Term Shelter (# People)	2

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	1
Total Property (Capital Stock) Losses ($ Millions)	1
Business Interruption (Income) Losses ($ Millions)	1

Disclaimer:

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Quick Assessment Report

November 6, 2019

Study Region : Harrisonburg
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	17
Number of Census Blocks	818
Number of Buildings	
Residential	11,175
Total	12,756
Number of People in the Region (x 1000)	49
Building Exposure ($ Millions)	
Residential	3,460
Total	5,091

Scenario Results

Shelter Requirements	
Displaced Population (# Households)	476
Short Term Shelter (# People)	110
Economic Loss	
Residential Property (Capital Stock) Losses ($ Millions)	31
Total Property (Capital Stock) Losses ($ Millions)	68
Business Interruption (Income) Losses ($ Millions)	121

Disclaimer:

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Quick Assessment Report

November 5, 2019

Study Region : Highland
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	416
Number of Census Blocks	745
Number of Buildings	
Residential	1,814
Total	1,887
Number of People in the Region (x 1000)	2
Building Exposure ($ Millions)	
Residential	320
Total	367

Scenario Results

Shelter Requirements

Displaced Population (# Households)	51
Short Term Shelter (# People)	1

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	12
Total Property (Capital Stock) Losses ($ Millions)	13
Business Interruption (Income) Losses ($ Millions)	2

Disclaimer:

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Quick Assessment Report

November 6, 2019

Study Region : Lexington
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	3
Number of Census Blocks	219
Number of Buildings	
Residential	2,030
Total	2,344
Number of People in the Region (x 1000)	7
Building Exposure ($ Millions)	
Residential	715
Total	958

Scenario Results

Shelter Requirements

Displaced Population (# Households)	25
Short Term Shelter (# People)	1

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	2
Total Property (Capital Stock) Losses ($ Millions)	3
Business Interruption (Income) Losses ($ Millions)	2

Disclaimer:

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Quick Assessment Report

October 28, 2019

Study Region : Monterey
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	0
Number of Census Blocks	20
Number of Buildings	
Residential	118
Total	135
Number of People in the Region (x 1000)	0
Building Exposure ($ Millions)	
Residential	25
Total	37

Scenario Results

Shelter Requirements

Displaced Population (# Households)
Short Term Shelter (# People)

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	0
Total Property (Capital Stock) Losses ($ Millions)	0
Business Interruption (Income) Losses ($ Millions)	0

Disclaimer:

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Quick Assessment Report

October 29, 2019

Study Region : MountCrawford
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	35
Number of Census Blocks	228
Number of Buildings	
Residential	1,358
Total	1,474
Number of People in the Region (x 1000)	4
Building Exposure ($ Millions)	
Residential	261
Total	306

Scenario Results

Shelter Requirements

Displaced Population (# Households)	24
Short Term Shelter (# People)	0

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	2
Total Property (Capital Stock) Losses ($ Millions)	3
Business Interruption (Income) Losses ($ Millions)	1

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific flood. These results can be improved by using enhanced inventory data and flood hazard information.

Quick Assessment Report

November 6, 2019

Study Region : Rockbridge
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	601
Number of Census Blocks	2,540
Number of Buildings	
Residential	10,703
Total	11,468
Number of People in the Region (x 1000)	22
Building Exposure ($ Millions)	
Residential	2,182
Total	2,612

Scenario Results

Shelter Requirements

Displaced Population (# Households)	300
Short Term Shelter (# People)	6

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	44
Total Property (Capital Stock) Losses ($ Millions)	105
Business Interruption (Income) Losses ($ Millions)	57

Disclaimer:

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Quick Assessment Report

November 5, 2019

Study Region : Rockingham
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	853
Number of Census Blocks	5,531
Number of Buildings	
Residential	31,035
Total	33,500
Number of People in the Region (x 1000)	76
Building Exposure ($ Millions)	
Residential	6,609
Total	7,870

Scenario Results

Shelter Requirements

Displaced Population (# Households)	809
Short Term Shelter (# People)	25

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	75
Total Property (Capital Stock) Losses ($ Millions)	117
Business Interruption (Income) Losses ($ Millions)	63

Disclaimer:

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Quick Assessment Report

November 6, 2019

Study Region : Staunton
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	20
Number of Census Blocks	711
Number of Buildings	
Residential	9,111
Total	10,118
Number of People in the Region (x 1000)	24
Building Exposure ($ Millions)	
Residential	2,264
Total	3,047

Scenario Results

Shelter Requirements	
Displaced Population (# Households)	98
Short Term Shelter (# People)	3
Economic Loss	
Residential Property (Capital Stock) Losses ($ Millions)	10
Total Property (Capital Stock) Losses ($ Millions)	75
Business Interruption (Income) Losses ($ Millions)	147

Disclaimer:

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Quick Assessment Report

October 29, 2019

Study Region : Timberville
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	1
Number of Census Blocks	57
Number of Buildings	
Residential	1,060
Total	1,112
Number of People in the Region (x 1000)	3
Building Exposure ($ Millions)	
Residential	219
Total	238

Scenario Results

Shelter Requirements

Displaced Population (# Households)	14
Short Term Shelter (# People)	0

Economic Loss

Residential Property (Capital Stock) Losses ($ Millions)	2
Total Property (Capital Stock) Losses ($ Millions)	2
Business Interruption (Income) Losses ($ Millions)	1

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

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Quick Assessment Report

November 6, 2019

Study Region : Waynesboro
Scenario : 100
Return Period: 100
Analysis Option: 0

Regional Statistics

Area (Square Miles)	15
Number of Census Blocks	887
Number of Buildings	
Residential	7,694
Total	8,669
Number of People in the Region (x 1000)	21
Building Exposure ($ Millions)	
Residential	1,831
Total	2,667

Scenario Results

Shelter Requirements	
Displaced Population (# Households)	567
Short Term Shelter (# People)	65
Economic Loss	
Residential Property (Capital Stock) Losses ($ Millions)	63
Total Property (Capital Stock) Losses ($ Millions)	280
Business Interruption (Income) Losses ($ Millions)	182

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific flood. These results can be improved by using enhanced inventory data and flood hazard information.

Hazus: Hurricane Global Risk Report

Region Name: CSPDC_Hurricane

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Wednesday, October 30, 2019

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 10 county(ies) from the following state(s):

- Virginia

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 3,437.64 square miles and contains 62 census tracts. There are over 110 thousand households in the region and a total population of 286,781 people (2010 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 118 thousand buildings in the region with a total building replacement value (excluding contents) of 31,788 million dollars (2014 dollars). Approximately 92% of the buildings (and 78% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 118,565 buildings in the region which have an aggregate total replacement value of 31,788 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

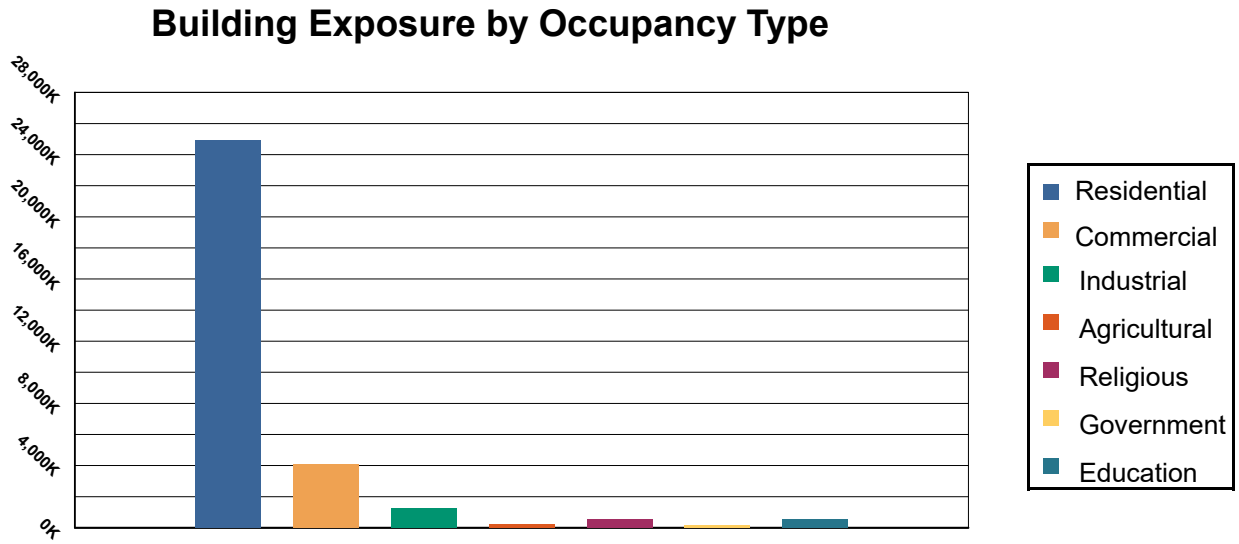


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	24,927,457	78.42 %
Commercial	4,053,304	12.75%
Industrial	1,273,474	4.01%
Agricultural	254,378	0.80%
Religious	558,559	1.76%
Government	174,125	0.55%
Education	546,526	1.72%
Total	**31,787,823**	**100.00%**

Essential Facility Inventory

For essential facilities, there are 7 hospitals in the region with a total bed capacity of 543 beds. There are 144 schools, 52 fire stations, 28 police stations and 9 emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 1 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

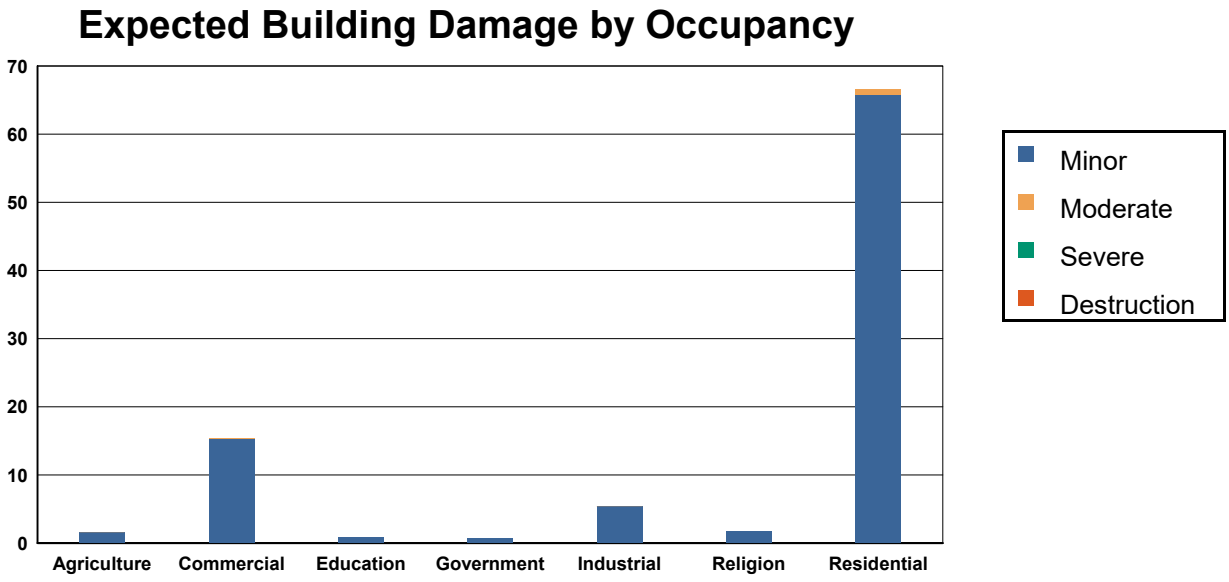


Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	786.47	99.81	1.53	0.19	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	5,665.63	99.73	15.34	0.27	0.02	0.00	0.00	0.00	0.00	0.00
Education	276.14	99.69	0.86	0.31	0.00	0.00	0.00	0.00	0.00	0.00
Government	220.27	99.67	0.73	0.33	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	1,704.59	99.68	5.41	0.32	0.01	0.00	0.00	0.00	0.00	0.00
Religion	810.26	99.79	1.74	0.21	0.00	0.00	0.00	0.00	0.00	0.00
Residential	109,009.36	99.94	65.82	0.06	0.83	0.00	0.00	0.00	0.00	0.00
Total	**118,472.71**		**91.43**		**0.85**		**0.00**		**0.00**	

Table 3: Expected Building Damage by Building Type : 100 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	1,146	99.58	5	0.42	0	0.00	0	0.00	0	0.00
Masonry	27,676	99.82	50	0.18	1	0.00	0	0.00	0	0.00
MH	9,682	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	4,316	99.67	14	0.33	0	0.00	0	0.00	0	0.00
Wood	75,626	99.98	14	0.02	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 543 hospital beds (0%) are available for use by patients already in the hospital and those injured by the hurricane. After one week, none of the beds will be in service. By 30 days, none will be operational.

Thematic Map of Essential Facilities with greater than 50% moderate

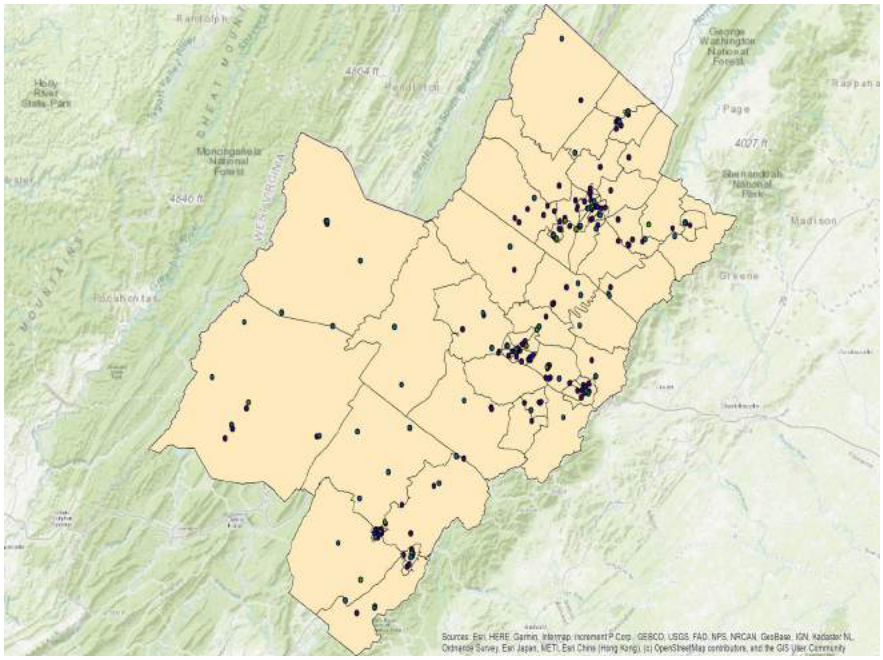
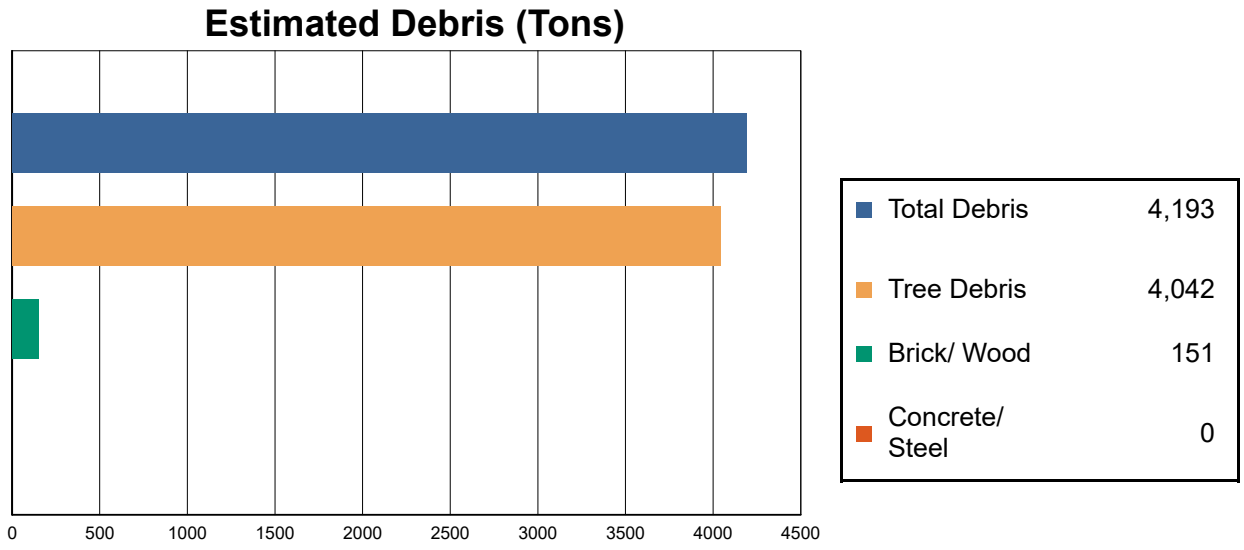


Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
EOCs	9	0	0	9
Fire Stations	52	0	0	52
Hospitals	7	0	0	7
Police Stations	28	0	0	28
Schools	144	0	0	144

Induced Hurricane Damage

Debris Generation

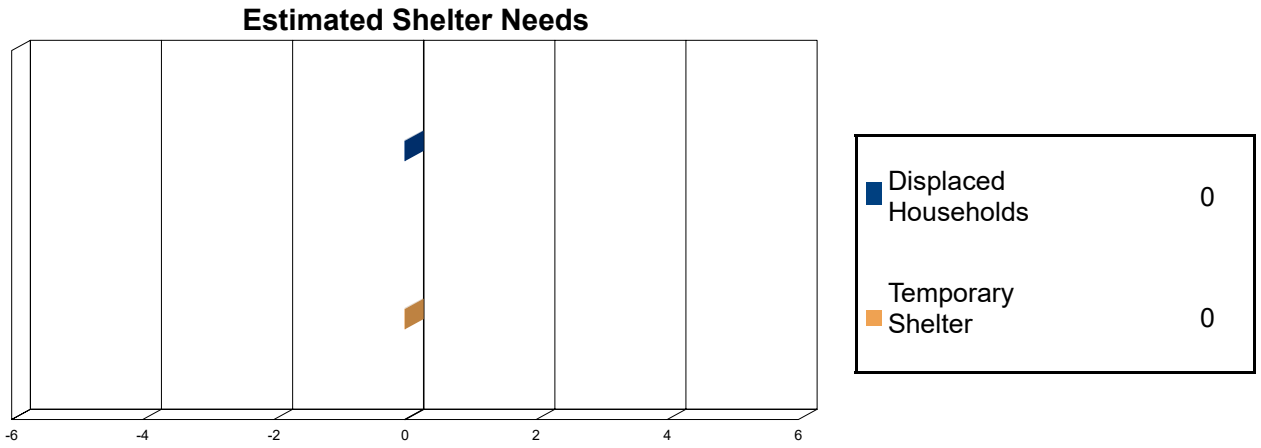


Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 4,193 tons of debris will be generated. Of the total amount, 3,065 tons (73%) is Other Tree Debris. Of the remaining 1,128 tons, Brick/Wood comprises 13% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 6 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 977 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement



Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 286,781) will seek temporary shelter in public shelters.

Economic Loss

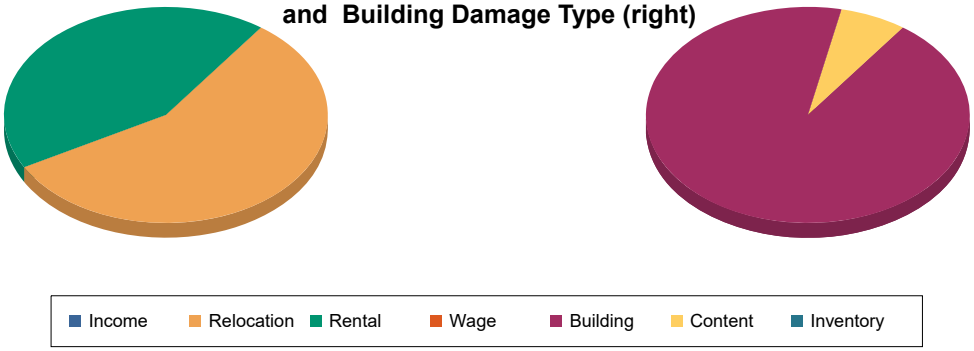
The total economic loss estimated for the hurricane is 5.1 million dollars, which represents 0.02 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 5 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 98% of the total loss. Table 5 below provides a summary of the losses associated with the building damage.

Loss by Business Interruption Type (left) and Building Damage Type (right)



Loss Type by General Occupancy

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	4,622.01	56.56	23.83	27.76	4,730.16
	Content	334.04	0.00	0.00	0.00	334.04
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**4,956.05**	**56.56**	**23.83**	**27.76**	**5,064.20**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	2.81	0.10	0.00	0.00	2.91
	Rental	2.21	0.00	0.00	0.00	2.21
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**5.02**	**0.10**	**0.00**	**0.00**	**5.12**

Total

Total	**4,961.07**	**56.66**	**23.83**	**27.76**	**5,069.32**

Appendix A: County Listing for the Region

Virginia
- Augusta
- Bath
- Highland
- Rockbridge
- Rockingham
- Buena Vista
- Harrisonburg
- Lexington
- Staunton
- Waynesboro

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Virginia				
Augusta	73,750	6,296,301	1,337,630	7,633,931
Bath	4,731	739,486	78,123	817,609
Buena Vista	6,650	509,866	214,901	724,767
Harrisonburg	48,914	3,460,375	1,630,540	5,090,915
Highland	2,321	320,363	46,946	367,309
Lexington	7,042	714,506	243,342	957,848
Rockbridge	22,307	2,182,496	429,798	2,612,294
Rockingham	76,314	6,609,137	1,260,787	7,869,924
Staunton	23,746	2,264,098	782,529	3,046,627
Waynesboro	21,006	1,830,829	835,770	2,666,599
Total	**286,781**	**24,927,457**	**6,860,366**	**31,787,823**
Study Region Total	**286,781**	**24,927,457**	**6,860,366**	**31,787,823**

Quick Assessment Report

October 30, 2019

Study Region : CSPDC_Hurricane

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	3,438
Number of Census Tracts	62
Number of People in the Region	286,781

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	109,076	24,927,457
Commercial	5,681	4,053,304
Other	3,808	2,807,062
Total	118,565	31,787,823

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	20	0	0	0	20
100	66	1	0	0	67
200	158	3	0	0	161
500	880	35	0	0	915
1000	2,228	110	1	1	2,339

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	31	0	0	0	31
100	91	1	0	0	92
200	194	4	0	0	198
500	961	38	1	0	1,000
1000	2,374	121	2	1	2,498

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	0	0
200	0	0
500	0	0
1000	0	0

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		*Business Interruption*
ReturnPeriod	***Residential***	***Total***	***(Income) Losses***
10	0	0	0
20	0	0	0
50	214	214	0
100	4,956	5,064	5
200	15,705	16,347	32
500	44,891	46,220	1,022
1000	76,205	78,679	4,886
Annualized	359	379	20

Quick Assessment Report

October 31, 2019

Study Region : Augusta

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	971
Number of Census Tracts	13
Number of People in the Region	73,750

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	29,645	6,296,301
Commercial	1,029	744,145
Other	892	593,485
Total	31,566	7,633,931

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	2	0	0	0	2
100	8	0	0	0	8
200	38	0	0	0	39
500	266	7	0	0	273
1000	683	25	0	1	709

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	5	0	0	0	5
100	13	0	0	0	13
200	46	0	0	0	47
500	286	7	0	0	293
1000	719	28	0	1	748

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	0	0
200	0	0
500	0	0
1000	0	0

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		*Business Interruption*
ReturnPeriod	***Residential***	***Total***	***(Income) Losses***
10	0	0	0
20	0	0	0
50	8	8	0
100	1,448	1,472	0
200	4,685	4,814	11
500	13,402	13,674	374
1000	22,154	22,729	1,237
Annualized	111	116	6

Quick Assessment Report

November 1, 2019

Study Region : Bath

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	535
Number of Census Tracts	1
Number of People in the Region	4,731

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	3,262	739,486
Commercial	49	43,825
Other	49	34,298
Total	3,360	817,609

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	0	0	0	0	0
100	0	0	0	0	0
200	1	0	0	0	1
500	8	0	0	0	8
1000	26	0	0	0	26

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	0	0	0	0	0
100	1	0	0	0	1
200	1	0	0	0	1
500	9	0	0	0	9
1000	26	1	0	0	27

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	0	0
200	0	0
500	0	0
1000	0	0

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		*Business Interruption*
ReturnPeriod	***Residential***	***Total***	***(Income) Losses***
10	0	0	0
20	0	0	0
50	0	0	0
100	20	20	0
200	241	249	0
500	721	729	2
1000	1,376	1,392	17
Annualized	7	7	0

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

Quick Assessment Report

November 7, 2019

Study Region : BuenaVista

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	7
Number of Census Tracts	1
Number of People in the Region	6,650

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	2,607	509,866
Commercial	163	60,555
Other	127	154,346
Total	2,897	724,767

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	1	0	0	0	1
100	1	0	0	0	1
200	4	0	0	0	4
500	24	1	0	0	24
1000	82	4	0	0	86

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	1	0	0	0	1
100	2	0	0	0	2
200	5	0	0	0	5
500	26	1	0	0	27
1000	89	4	0	0	93

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	0	0
200	0	0
500	0	0
1000	0	0

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		*Business Interruption*
ReturnPeriod	***Residential***	***Total***	***(Income) Losses***
10	0	0	0
20	0	0	0
50	1	1	0
100	87	87	0
200	336	357	2
500	909	948	7
1000	1,849	2,004	145
Annualized	9	10	1

Disclaimer:

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Quick Assessment Report

November 6, 2019

Study Region : Harrisonburg

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	17
Number of Census Tracts	11
Number of People in the Region	48,914

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	11,175	3,460,375
Commercial	1,128	1,093,970
Other	453	536,570
Total	12,756	5,090,915

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	0	0	0	0	0
100	9	0	0	0	9
200	18	1	0	0	19
500	86	6	0	0	92
1000	206	16	0	0	222

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	0	0	0	0	0
100	13	0	0	0	13
200	24	1	0	0	25
500	99	6	0	0	105
1000	227	17	0	0	245

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	0	0
200	0	0
500	0	0
1000	0	0

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		*Business Interruption*
ReturnPeriod	***Residential***	***Total***	***(Income) Losses***
10	0	0	0
20	0	0	0
50	0	0	0
100	314	315	0
200	1,313	1,473	2
500	4,369	4,685	95
1000	7,750	8,208	717
Annualized	35	39	3

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Quick Assessment Report

November 5, 2019

Study Region : Highland

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	416
Number of Census Tracts	1
Number of People in the Region	2,321

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	1,814	320,363
Commercial	37	21,392
Other	36	25,554
Total	1,887	367,309

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	0	0	0	0	0
100	0	0	0	0	0
200	0	0	0	0	0
500	4	0	0	0	4
1000	13	0	0	0	14

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	0	0	0	0	0
100	0	0	0	0	0
200	1	0	0	0	1
500	4	0	0	0	4
1000	14	0	0	0	14

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	0	0
200	0	0
500	0	0
1000	0	0

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		*Business Interruption*
ReturnPeriod	***Residential***	***Total***	***(Income) Losses***
10	0	0	0
20	0	0	0
50	0	0	0
100	8	8	0
200	103	107	0
500	322	327	1
1000	626	634	5
Annualized	3	3	0

Quick Assessment Report

November 6, 2019

Study Region : Lexington

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	3
Number of Census Tracts	1
Number of People in the Region	7,042

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	2,030	714,506
Commercial	204	144,783
Other	110	98,559
Total	2,344	957,848

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	1	0	0	0	1
100	2	0	0	0	2
200	4	0	0	0	4
500	18	1	0	0	19
1000	58	4	0	0	62

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	2	0	0	0	2
100	2	0	0	0	2
200	5	0	0	0	5
500	20	1	0	0	21
1000	64	5	0	0	69

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	0	0
200	0	0
500	0	0
1000	0	0

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		*Business Interruption*
ReturnPeriod	***Residential***	***Total***	***(Income) Losses***
10	0	0	0
20	0	0	0
50	1	1	0
100	141	141	0
200	344	368	0
500	999	1,047	12
1000	2,082	2,181	167
Annualized	10	11	1

Quick Assessment Report

November 6, 2019

Study Region : Rockbridge

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	601
Number of Census Tracts	4
Number of People in the Region	22,307

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	10,703	2,182,496
Commercial	424	233,051
Other	341	196,747
Total	11,468	2,612,294

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	1	0	0	0	1
100	2	0	0	0	2
200	12	0	0	0	12
500	78	2	0	0	80
1000	273	11	0	0	285

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	3	0	0	0	3
100	3	0	0	0	3
200	15	0	0	0	16
500	84	2	0	0	86
1000	289	13	0	0	302

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	0	0
200	0	0
500	0	0
1000	0	0

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		***Business Interruption***
ReturnPeriod	***Residential***	***Total***	***(Income) Losses***
10	0	0	0
20	0	0	0
50	11	11	0
100	475	495	0
200	1,524	1,565	4
500	4,541	4,624	120
1000	8,781	9,027	524
Annualized	41	43	2

Disclaimer:

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Quick Assessment Report

November 5, 2019

Study Region : Rockingham

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	853
Number of Census Tracts	19
Number of People in the Region	76,314

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	31,035	6,609,137
Commercial	1,310	607,664
Other	1,155	653,123
Total	33,500	7,869,924

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	2	0	0	0	2
100	9	0	0	0	9
200	41	1	0	0	41
500	245	7	0	0	252
1000	769	40	0	2	811

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	5	0	0	0	5
100	13	0	0	0	13
200	51	1	0	0	52
500	267	8	0	0	275
1000	817	45	1	2	864

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	0	0
200	0	0
500	0	0
1000	0	0

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		***Business Interruption***
ReturnPeriod	***Residential***	***Total***	***(Income) Losses***
10	0	0	0
20	0	0	0
50	3	3	0
100	1,071	1,105	1
200	4,339	4,442	18
500	12,259	12,534	436
1000	22,278	22,979	1,191
Annualized	104	109	6

Quick Assessment Report

November 6, 2019

Study Region : Staunton

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	20
Number of Census Tracts	6
Number of People in the Region	23,746

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	9,111	2,264,098
Commercial	670	521,766
Other	337	260,763
Total	10,118	3,046,627

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	2	0	0	0	2
100	5	0	0	0	5
200	12	0	0	0	12
500	68	4	0	0	71
1000	174	11	0	0	185

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	3	0	0	0	3
100	8	0	0	0	8
200	15	0	0	0	16
500	75	4	0	0	79
1000	189	11	0	0	200

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	0	0
200	0	0
500	0	0
1000	0	0

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		***Business Interruption***
ReturnPeriod	***Residential***	***Total***	***(Income) Losses***
10	0	0	0
20	0	0	0
50	1	1	0
100	403	403	0
200	1,163	1,241	1
500	3,893	4,035	34
1000	6,679	6,894	471
Annualized	31	33	2

Disclaimer:

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Quick Assessment Report

November 6, 2019

Study Region : Waynesboro

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	15
Number of Census Tracts	5
Number of People in the Region	21,006

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	7,694	1,830,829
Commercial	667	582,153
Other	308	253,617
Total	8,669	2,666,599

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	3	0	0	0	3
100	4	0	0	0	4
200	14	0	0	0	15
500	74	3	0	0	78
1000	179	10	0	0	189

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	0	0	0	0	0
50	5	0	0	0	5
100	6	0	0	0	6
200	18	0	0	0	19
500	83	4	0	0	87
1000	194	11	0	0	206

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	0	0
200	0	0
500	0	0
1000	0	0

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		***Business Interruption***
ReturnPeriod	***Residential***	***Total***	***(Income) Losses***
10	0	0	0
20	0	0	0
50	2	2	0
100	410	410	0
200	1,407	1,491	7
500	3,911	4,054	48
1000	6,380	6,681	428
Annualized	30	33	2

Disclaimer:

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Hazus: Earthquake Global Risk Report

Region Name	CSPDC_EQ
Earthquake Scenario:	100yr Probablistic Earthquake - Mag 5
Print Date:	August 19, 2019

Disclaimer:
This version of Hazus utilizes 2010 Census Data.
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

Table of Contents

General Description of the Region

Hazus-MH is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 10 county(ies) from the following state(s):

Virginia

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 3,436.75 square miles and contains 62 census tracts. There are over 110 thousand households in the region which has a total population of 286,781 people (2010 Census Bureau data). The distribution of population by Total Region and County is provided in Appendix B.

There are an estimated 118 thousand buildings in the region with a total building replacement value (excluding contents) of 31,787 (millions of dollars). Approximately 92.00 % of the buildings (and 78.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 6,448 and 3,038 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 118 thousand buildings in the region which have an aggregate total replacement value of 31,787 (millions of dollars) . Appendix B provides a general distribution of the building value by Total Region and County.

In terms of building construction types found in the region, wood frame construction makes up 64% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

Hazus breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 7 hospitals in the region with a total bed capacity of 543 beds. There are 144 schools, 52 fire stations, 28 police stations and 9 emergency operation facilities. With respect to high potential loss facilities (HPL), there are no dams identified within the inventory. The inventory also includes 120 hazardous material sites, no military installations and no nuclear power plants.

Transportation and Utility Lifeline Inventory

Within Hazus, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 9,486.00 (millions of dollars). This inventory includes over 741.92 miles of highways, 778 bridges, 42,400.49 miles of pipes.

Table 1: Transportation System Lifeline Inventory

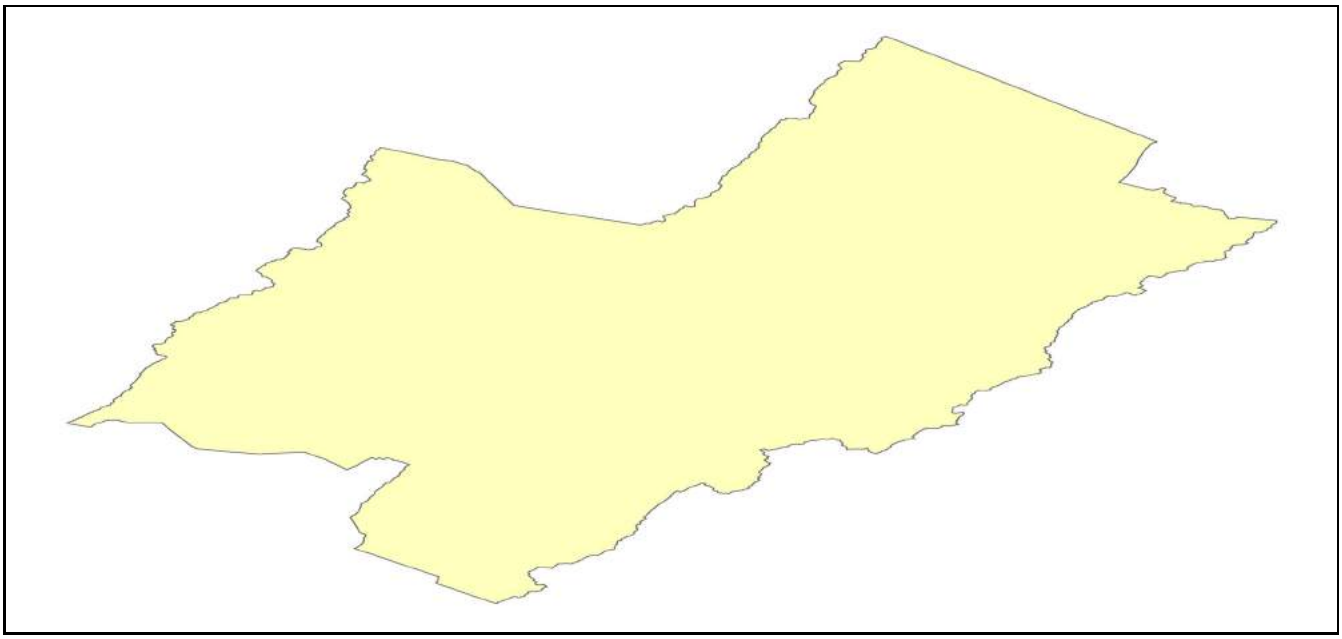
System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	778	460.7884
	Segments	297	5423.5850
	Tunnels	0	0.0000
		Subtotal	**5884.3734**
Railways	Bridges	3	0.1171
	Facilities	2	5.3260
	Segments	222	412.3045
	Tunnels	0	0.0000
		Subtotal	**417.7476**
Light Rail	Bridges	0	0.0000
	Facilities	0	0.0000
	Segments	0	0.0000
	Tunnels	0	0.0000
		Subtotal	**0.0000**
Bus	Facilities	1	1.0137
		Subtotal	**1.0137**
Ferry	Facilities	0	0.0000
		Subtotal	**0.0000**
Port	Facilities	0	0.0000
		Subtotal	**0.0000**
Airport	Facilities	3	31.9530
	Runways	3	113.8920
		Subtotal	**145.8450**
		Total	**6,449.00**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	682.3788
	Facilities	12	371.6280
	Pipelines	0	0.0000
		Subtotal	**1054.0068**
Waste Water	Distribution Lines	NA	409.4273
	Facilities	16	991.0080
	Pipelines	0	0.0000
		Subtotal	**1400.4353**
Natural Gas	Distribution Lines	NA	272.9515
	Facilities	1	1.0137
	Pipelines	0	0.0000
		Subtotal	**273.9652**
Oil Systems	Facilities	0	0.0000
	Pipelines	0	0.0000
		Subtotal	**0.0000**
Electrical Power	Facilities	3	306.9000
		Subtotal	**306.9000**
Communication	Facilities	29	2.6970
		Subtotal	**2.6970**
		Total	**3,038.00**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.



Scenario Name	100yr Probablistic Earthquake - Mag 5
Type of Earthquake	Probabilistic
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	100.00
Longitude of Epicenter	NA
Latitude of Epicenter	NA
Earthquake Magnitude	5.00
Depth (km)	NA
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	NA

Direct Earthquake Damage

Building Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0.00 % of the buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

Damage Categories by General Occupancy Type

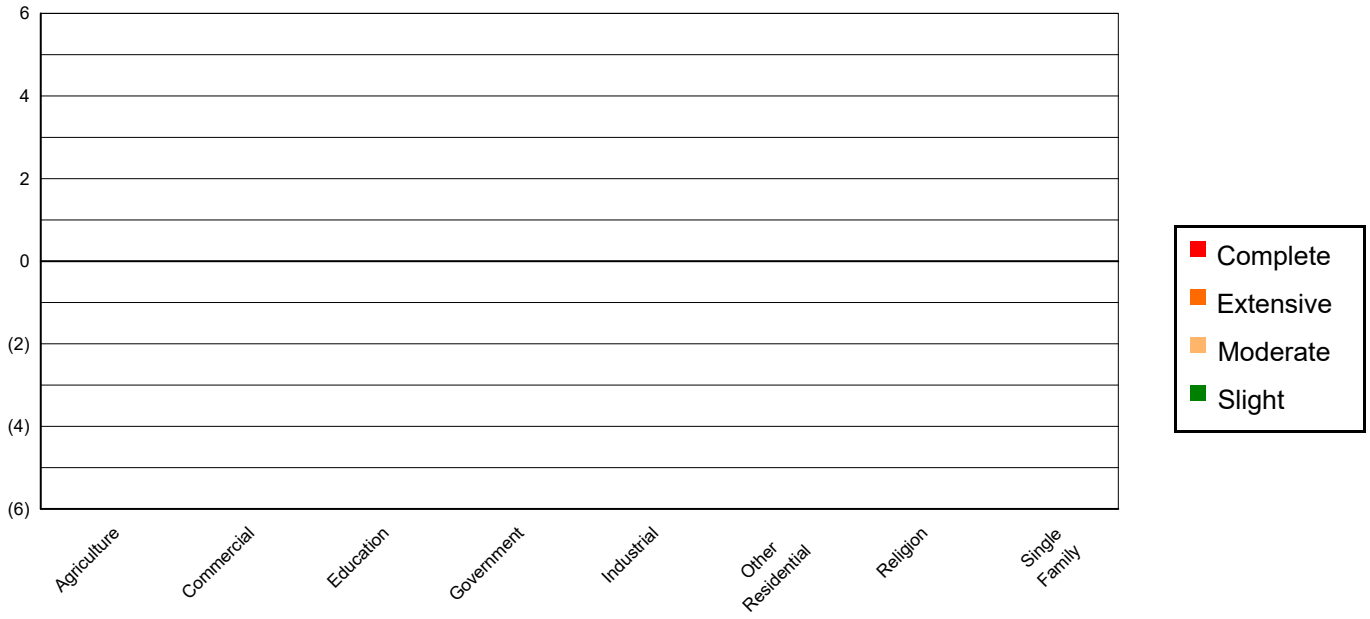


Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	788.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	5681.00	4.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Education	277.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Government	221.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	1710.00	1.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Residential	14316.00	12.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Religion	812.00	0.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Single Family	94760.00	79.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**118,565**		**0**		**0**		**0**		**0**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	75641.90	63.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Steel	4344.47	3.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Concrete	822.76	0.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Precast	324.04	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RM	1151.37	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
URM	26595.46	22.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH	9685.00	8.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**118,565**		**0**		**0**		**0**		**0**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 543 hospital beds available for use. On the day of the earthquake, the model estimates that only 540 hospital beds (100.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 100.00% of the beds will be back in service. By 30 days, 100.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	7	0	0	7
Schools	144	0	0	144
EOCs	9	0	0	9
PoliceStations	28	0	0	28
FireStations	52	0	0	52

Transportation Lifeline Damage

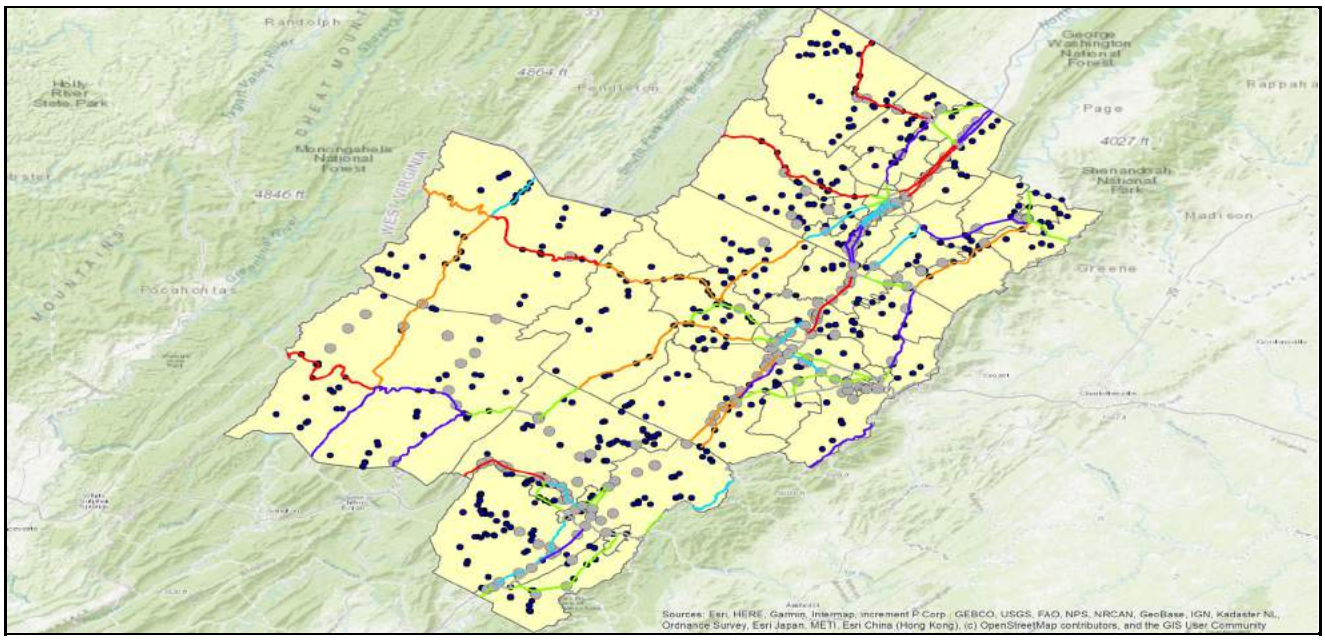


Table 6: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	297	0	0	297	297
	Bridges	778	0	0	778	778
	Tunnels	0	0	0	0	0
Railways	Segments	222	0	0	222	222
	Bridges	3	0	0	3	3
	Tunnels	0	0	0	0	0
	Facilities	2	0	0	2	2
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	1	0	0	1	1
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	3	0	0	3	3
	Runways	3	0	0	3	3

Table 6 provides damage estimates for the transportation system.

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	12	0	0	12	12
Waste Water	16	0	0	16	16
Natural Gas	1	0	0	1	1
Oil Systems	0	0	0	0	0
Electrical Power	3	0	0	3	3
Communication	29	0	0	29	29

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	21,201	2	0
Waste Water	12,720	1	0
Natural Gas	8,480	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	110,702	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

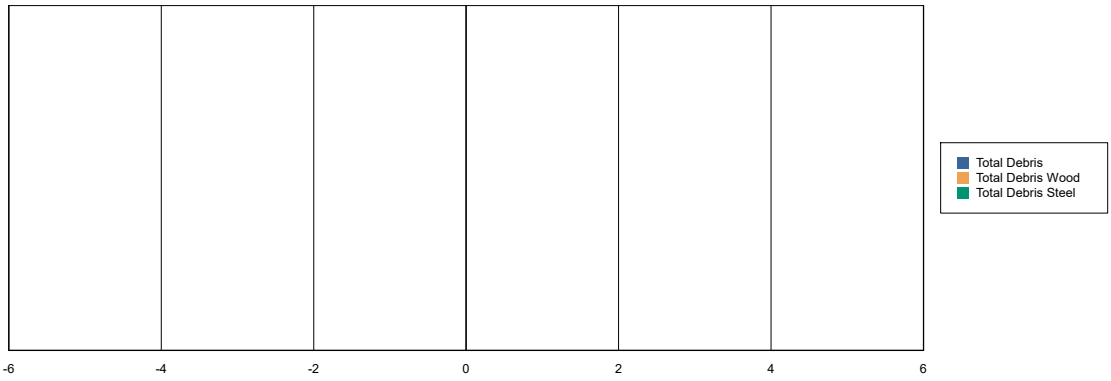
Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

Hazus estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0 tons of debris will be generated. Of the total amount, Brick/Wood comprises % of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Earthquake Debris (millions of tons)



Brick/ Wood	Reinforced Concrete/Steel	Total Debris	Truck Load
		0.00	0 (@25 tons/truck)

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 286,781) will seek temporary shelter in public shelters.

Displaced Households/ Persons Seeking Short Term Public Shelter

Displaced households as a result of the earthquake	Persons seeking temporary public shelter
0	0

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0.00	0.00	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.00	0.00	0.00	0.00
	Other-Residential	0.00	0.00	0.00	0.00
	Single Family	0.00	0.00	0.00	0.00
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0.00	0.00	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.00	0.00	0.00	0.00
	Other-Residential	0.00	0.00	0.00	0.00
	Single Family	0.00	0.00	0.00	0.00
	Total	**0**	**0**	**0**	**0**
5 PM	Commercial	0.00	0.00	0.00	0.00
	Commuting	0.00	0.00	0.00	0.00
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	0.00	0.00	0.00	0.00
	Other-Residential	0.00	0.00	0.00	0.00
	Single Family	0.00	0.00	0.00	0.00
	Total	**0**	**0**	**0**	**0**

Economic Loss

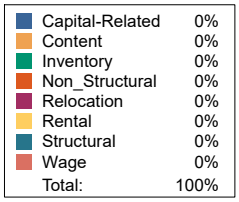
The total economic loss estimated for the earthquake is 0.02 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 0.00 (millions of dollars); 0 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 0 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Earthquake Losses by Loss Type ($ millions)



Earthquake Losses by Occupancy Type ($ millions)

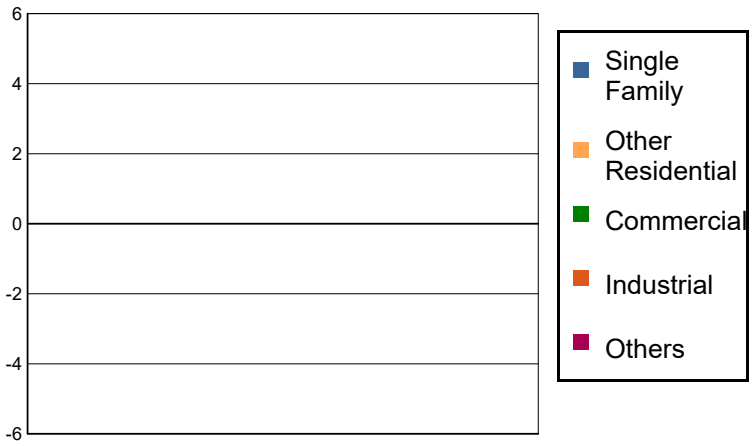


Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Capital-Related	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Rental	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Relocation	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Subtotal	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
Capital Stock Losses							
	Structural	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Non_Structural	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Content	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Inventory	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Subtotal	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	5423.5850	0.0000	0.00
	Bridges	460.7884	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Subtotal	**5884.3734**	**0.0000**	
Railways	Segments	412.3045	0.0000	0.00
	Bridges	0.1171	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	5.3260	0.0007	0.01
	Subtotal	**417.7476**	**0.0007**	
Light Rail	Segments	0.0000	0.0000	0.00
	Bridges	0.0000	0.0000	0.00
	Tunnels	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Bus	Facilities	1.0137	0.0001	0.01
	Subtotal	**1.0137**	**0.0001**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Airport	Facilities	31.9530	0.0038	0.01
	Runways	113.8920	0.0000	0.00
	Subtotal	**145.8450**	**0.0038**	
	Total	**6,448.98**	**0.00**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	371.6280	0.0005	0.00
	Distribution Line	682.3788	0.0087	0.00
	Subtotal	**1054.0068**	**0.0092**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	991.0080	0.0006	0.00
	Distribution Line	409.4273	0.0044	0.00
	Subtotal	**1400.4353**	**0.0050**	
Natural Gas	Pipelines	0.0000	0.0000	0.00
	Facilities	1.0137	0.0000	0.00
	Distribution Line	272.9515	0.0015	0.00
	Subtotal	**273.9652**	**0.0015**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	306.9000	0.0000	0.00
	Subtotal	**306.9000**	**0.0000**	
Communication	Facilities	2.6970	0.0000	0.00
	Subtotal	**2.6970**	**0.0000**	
	Total	**3,038.00**	**0.02**	

Appendix A: County Listing for the Region

Augusta,VA

Bath,VA

Highland,VA

Rockbridge,VA

Rockingham,VA

Buena Vista,VA

Harrisonburg,VA

Lexington,VA

Staunton,VA

Waynesboro,VA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Virginia					
	Augusta	73,750	6,296	1,337	7,633
	Bath	4,731	739	78	817
	Highland	2,321	320	46	367
	Rockbridge	22,307	2,182	429	2,612
	Rockingham	76,314	6,609	1,260	7,869
	Buena Vista	6,650	509	214	724
	Harrisonburg	48,914	3,460	1,630	5,090
	Lexington	7,042	714	243	957
	Staunton	23,746	2,264	782	3,046
	Waynesboro	21,006	1,830	835	2,666
Total Region		**286,781**	**24,923**	**6,854**	**31,781**

Appendix H-

2020 Central Shenandoah Regional Wildfire Protection Plan

APPENDIX H: Central Shenandoah Regional Wildfire Protection Plan

Concurrent to the Central Shenandoah Hazard Mitigation Plan (CSHMP) , Central Shenandoah Planning District Commission staff is completing the Central Shenandoah Regional Wildfire Protection Plan (CSRWPP). The CSRWPP will be a companion document to the CSHMP.

The purpose of this Wildfire Protection Plan is to help the local jurisdictions in the Central Shenandoah Region begin the steps to address forest planning at local level by refining and clarifying their priorities for the protection of life, property, and critical infrastructure in the Wildland Urban Interface (WUI). The CSRWPP is a planning process that involves collaboration between government agencies and other stakeholders involved with the wildland areas in the Region. The Plan examines the vulnerabilities communities in the region have to wildfire and includes strategies for prioritizing fuel reduction and structural ignitability.

The Central Shenandoah Regional Wildfire Plan will be a complimentary and valuable resource for communities interested in wildfire mitigation.

Appendix I –
National Flood Insurance Program (NFIP) Surveys

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) SURVEY

MUNICIPALITY: AUGUSTA COUNTY

1. FLOODPLAIN IDENTIFICATION AND MAPPING

Requirement	*Recommended Action*	*Yes/No*	*Comments*
a. Does the municipality maintain accessible copies of an effective Flood Insurance Rate Map (FIRM)/Digital Flood Insurance Rate Map (DFIRM)? Does the municipality maintain accessible copies of the most recent Flood Insurance Study (FIS)?	Place these documents in the local libraries or make available publicly.	Yes	Paper copies are available at the Community Development Office. Digital is incorporated into the online GIS available to the public
b. Has the municipality adopted the most current DFIRM/FIRM and FIS?	State the date of adoption, if approved.	Yes	Latest revision adopted 8/3/2015
c. Does the municipality support request for map updates?	If yes, state how.	Yes	Augusta County has worked with FEMA through the Cooperating Technical Partners (CTP) program to provide improved mapping along select waterways
d. Does the municipality share with Federal Emergency Management Agency (FEMA) any new technical or scientific data that could result in map revisions within 6 months of creation or identification of new data?	If yes, specify how.	Yes	Any project that would impact other properties is required to obtain a Letter of Map Revision (LOMR) from FEMA
e. Does the municipality provide assistance with local floodplain determinations?	If yes, specify how.	Yes	County will make determinations upon request
f. Does the municipality maintain a record of approved Letters of Map Change?	If yes, specify the responsible office.	Yes	County maintains all LOMC in paper and digital format

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Has the municipality adopted a compliant floodplain management ordinance that, at a minimum, regulates the following:	If yes, answer questions (1) through (4) below.		Yes
(1) Does the municipality issue permits for all proposed development in the Special Flood Hazard Areas (SFHAs)?	If yes, specify the office responsible.	Yes	Office of Community Development
(2) Does the municipality obtain, review, and utilize any Base Flood Elevation (BFE) and floodway data, and/or require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres?	If yes, specify the office responsible.	Yes	Office of Community Development
(3) Does the municipality identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the BFE, including anchoring, using flood-resistant materials, and designing or locating utilities and service facilities to prevent water damage?	If yes, specify the office responsible.	Yes	Office of Community Development
(4) Does the municipality document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures?	If yes, specify the office responsible.	Yes	Office of Community Development
b. If a compliant floodplain ordinance was adopted, does the municipality enforce the ordinance by monitoring compliance and taking remedial action to correct violations?	If yes, specify how.	Yes	Zoning inspection and upon receipt of complaints

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
c. Has the municipality considered adopting activities that extend beyond the minimum requirements? Examples include: • Participation in the Community Rating System • Prohibition of production or storage of chemicals in SFHA • Prohibition of certain types of structures, such as hospitals, nursing homes, and jails in SFHA • Prohibition of certain types of residential housing (manufactured homes) in SFHA • Floodplain ordinances that prohibit any new residential or nonresidential structures in SFHA	If yes, specify activities.	Yes	County prohibits creation of new lots in the floodplain, requires 1 ft of freeboard, and restricts development in the pool area of flood control dams

3. FLOOD INSURANCE			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality educate community members about the availability and value of flood insurance?	If yes, specify how.	Yes	Education provided by CSPDC through Shen Valley Project Impact
b. Does the municipality inform community property owners about changes to the DFIRM/FIRM that would impact their insurance rates?	If yes, specify how.	Yes	Part of the approval process of adopting revised maps
c. Does the municipality provide general assistance to community members regarding insurance issues?	If yes, specify how.	No	Augusta County directs residents and property owners to their insurance provider

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) SURVEY

MUNICIPALITY: BATH COUNTY

1. FLOODPLAIN IDENTIFICATION AND MAPPING

Requirement	*Recommended Action*	*Yes/No*	*Comments*
a. Does the municipality maintain accessible copies of an effective Flood Insurance Rate Map (FIRM)/Digital Flood Insurance Rate Map (DFIRM)? Does the municipality maintain accessible copies of the most recent Flood Insurance Study (FIS)?	Place these documents in the local libraries or make available publicly.	yes	
b. Has the municipality adopted the most current DFIRM/FIRM and FIS?	State the date of adoption, if approved.	Yes 8/29/2011	
c. Does the municipality support request for map updates?	If yes, state how.	n/a	
d. Does the municipality share with Federal Emergency Management Agency (FEMA) any new technical or scientific data that could result in map revisions within 6 months of creation or identification of new data?	If yes, specify how.	n/a	
e. Does the municipality provide assistance with local floodplain determinations?	If yes, specify how.	Yes	Documentation and guidance on obtaining assumed elevations
f. Does the municipality maintain a record of approved Letters of Map Change?	If yes, specify the responsible office.	Yes	Building, Planning & Zoning

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Has the municipality adopted a compliant floodplain management ordinance that, at a minimum, regulates the following:	If yes, answer questions (1) through (4) below.	Yes	
(1) Does the municipality issue permits for all proposed development in the Special Flood Hazard Areas (SFHAs)?	If yes, specify the office responsible.	Yes	Building, Planning & Zoning
(2) Does the municipality obtain, review, and utilize any Base Flood Elevation (BFE) and floodway data, and/or require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres?	If yes, specify the office responsible.	Yes	Building, Planning & Zoning
(3) Does the municipality identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the BFE, including anchoring, using flood-resistant materials, and designing or locating utilities and service facilities to prevent water damage?	If yes, specify the office responsible.	Yes	Building, Planning & Zoning
(4) Does the municipality document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures?	If yes, specify the office responsible.	Yes	Building, Planning & Zoning
b. If a compliant floodplain ordinance was adopted, does the municipality enforce the ordinance by monitoring compliance and taking remedial action to correct violations?	If yes, specify how.	Yes	Corrected to be brought into compliance

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
c. Has the municipality considered adopting activities that extend beyond the minimum requirements? Examples include: • Participation in the Community Rating System • Prohibition of production or storage of chemicals in SFHA • Prohibition of certain types of structures, such as hospitals, nursing homes, and jails in SFHA • Prohibition of certain types of residential housing (manufactured homes) in SFHA • Floodplain ordinances that prohibit any new residential or nonresidential structures in SFHA	If yes, specify activities.	n/a	

3. FLOOD INSURANCE			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality educate community members about the availability and value of flood insurance?	If yes, specify how.	Yes	Supply phone number for them to call
b. Does the municipality inform community property owners about changes to the DFIRM/FIRM that would impact their insurance rates?	If yes, specify how.	Yes	Public hearings when applicable
c. Does the municipality provide general assistance to community members regarding insurance issues?	If yes, specify how.	Yes	Provide information as available

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) SURVEY

MUNICIPALITY: ROCKBRIDGE COUNTY

1. FLOODPLAIN IDENTIFICATION AND MAPPING

Requirement	*Recommended Action*	*Yes/No*	*Comments*
a. Does the municipality maintain accessible copies of an effective Flood Insurance Rate Map (FIRM)/Digital Flood Insurance Rate Map (DFIRM)? Does the municipality maintain accessible copies of the most recent Flood Insurance Study (FIS)?	Place these documents in the local libraries or make available publicly.	yes	In the Office of Community Development and a GIS layer available on our web site
b. Has the municipality adopted the most current DFIRM/FIRM and FIS?	State the date of adoption, if approved.	yes	April 6, 2000
c. Does the municipality support request for map updates?	If yes, state how.	yes	Provide information for Land surveyors
d. Does the municipality share with Federal Emergency Management Agency (FEMA) any new technical or scientific data that could result in map revisions within 6 months of creation or identification of new data?	If yes, specify how.	yes	If we had such data
e. Does the municipality provide assistance with local floodplain determinations?	If yes, specify how.	yes	Floodplain Determination Letters
f. Does the municipality maintain a record of approved Letters of Map Change?	If yes, specify the responsible office.	yes	Office of Community Development

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Has the municipality adopted a compliant floodplain management ordinance that, at a minimum, regulates the following:	If yes, answer questions (1) through (4) below.	yes	
(1) Does the municipality issue permits for all proposed development in the Special Flood Hazard Areas (SFHAs)?	If yes, specify the office responsible.	yes	Office of Community Development Building Department
(2) Does the municipality obtain, review, and utilize any Base Flood Elevation (BFE) and floodway data, and/or require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres?	If yes, specify the office responsible.	yes	Office of Community Development
(3) Does the municipality identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the BFE, including anchoring, using flood-resistant materials, and designing or locating utilities and service facilities to prevent water damage?	If yes, specify the office responsible.	yes	
(4) Does the municipality document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures?	If yes, specify the office responsible.	yes	Building Department
b. If a compliant floodplain ordinance was adopted, does the municipality enforce the ordinance by monitoring compliance and taking remedial action to correct violations?	If yes, specify how.	yes	Office of Community Development Building Department

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
c. Has the municipality considered adopting activities that extend beyond the minimum requirements? Examples include: • Participation in the Community Rating System • Prohibition of production or storage of chemicals in SFHA • Prohibition of certain types of structures, such as hospitals, nursing homes, and jails in SFHA • Prohibition of certain types of residential housing (manufactured homes) in SFHA • Floodplain ordinances that prohibit any new residential or nonresidential structures in SFHA	If yes, specify activities.	no	

3. FLOOD INSURANCE			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality educate community members about the availability and value of flood insurance?	If yes, specify how.	yes	Provide information -
b. Does the municipality inform community property owners about changes to the DFIRM/FIRM that would impact their insurance rates?	If yes, specify how.	no	
c. Does the municipality provide general assistance to community members regarding insurance issues?	If yes, specify how.	yes	Provide maps to landowners and insurance companies

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) SURVEY

MUNICIPALITY: ROCKINGHAM COUNTY

1. FLOODPLAIN IDENTIFICATION AND MAPPING

Requirement	*Recommended Action*	*Yes/No*	*Comments*
a. Does the municipality maintain accessible copies of an effective Flood Insurance Rate Map (FIRM)/Digital Flood Insurance Rate Map (DFIRM)? Does the municipality maintain accessible copies of the most recent Flood Insurance Study (FIS)?	Place these documents in the local libraries or make available publicly.	Yes	
b. Has the municipality adopted the most current DFIRM/FIRM and FIS?	State the date of adoption, if approved.	Yes	August 18, 2014
c. Does the municipality support request for map updates?	If yes, state how.	No	I don't understand this question. If this means does the County undertake mapping projects, then no.
d. Does the municipality share with Federal Emergency Management Agency (FEMA) any new technical or scientific data that could result in map revisions within 6 months of creation or identification of new data?	If yes, specify how.	Yes	Will be doing this process going forward based on recent conversation with DCR Floodplain Staff.
e. Does the municipality provide assistance with local floodplain determinations?	If yes, specify how.	Yes	Provide limited assistance in Approximate A zones, but generally require P.E. involvement.
f. Does the municipality maintain a record of approved Letters of Map Change?	If yes, specify the responsible office.	Yes	Community Development

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Has the municipality adopted a compliant floodplain management ordinance that, at a minimum, regulates the following:	If yes, answer questions (1) through (4) below.	Yes	
(1) Does the municipality issue permits for all proposed development in the Special Flood Hazard Areas (SFHAs)?	If yes, specify the office responsible.	Yes	Community Development
(2) Does the municipality obtain, review, and utilize any Base Flood Elevation (BFE) and floodway data, and/or require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres?	If yes, specify the office responsible.	Yes	Community Development
(3) Does the municipality identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the BFE, including anchoring, using flood-resistant materials, and designing or locating utilities and service facilities to prevent water damage?	If yes, specify the office responsible.	Yes	Community Development
(4) Does the municipality document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures?	If yes, specify the office responsible.	Yes	This process (collecting the 2nd Elevation Certificate) could be improved on our part.
b. If a compliant floodplain ordinance was adopted, does the municipality enforce the ordinance by monitoring compliance and taking remedial action to correct violations?	If yes, specify how.	Yes	Enforcement through building inspection processes if still under construction. If the violations are pre-existing, letters are sent detailing requirements for compliance.

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
c. Has the municipality considered adopting activities that extend beyond the minimum requirements? Examples include: • Participation in the Community Rating System • Prohibition of production or storage of chemicals in SFHA • Prohibition of certain types of structures, such as hospitals, nursing homes, and jails in SFHA • Prohibition of certain types of residential housing (manufactured homes) in SFHA • Floodplain ordinances that prohibit any new residential or nonresidential structures in SFHA	If yes, specify activities.	Yes	Attempted to prohibit manufactured homes from being constructed in the floodplain, but were challenged by the Virginia Manufactured and Modular Housing Association and did not codify the prohibition. Have considered joining CRS, but do not currently have adequate staffing capacity to manage program requirements.

3. FLOOD INSURANCE			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality educate community members about the availability and value of flood insurance?	If yes, specify how.	Yes	Only by request – no proactive outreach.
b. Does the municipality inform community property owners about changes to the DFIRM/FIRM that would impact their insurance rates?	If yes, specify how.	Yes	Per FEMA letter notification requirements.
c. Does the municipality provide general assistance to community members regarding insurance issues?	If yes, specify how.	Yes	Available to answer questions via phone, email, or in person.

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) SURVEY

MUNICIPALITY: CITY OF BUENA VISTA

1. FLOODPLAIN IDENTIFICATION AND MAPPING

Requirement	*Recommended Action*	*Yes/No*	*Comments*
a. Does the municipality maintain accessible copies of an effective Flood Insurance Rate Map (FIRM)/Digital Flood Insurance Rate Map (DFIRM)? Does the municipality maintain accessible copies of the most recent Flood Insurance Study (FIS)?	Place these documents in the local libraries or make available publicly.	Yes	
b. Has the municipality adopted the most current DFIRM/FIRM and FIS?	State the date of adoption, if approved.	Not Known	City always references most recent DFIRM/FIRM
c. Does the municipality support request for map updates?	If yes, state how.	Yes	City provides contact information and letters of support if needed.
d. Does the municipality share with Federal Emergency Management Agency (FEMA) any new technical or scientific data that could result in map revisions within 6 months of creation or identification of new data?	If yes, specify how.	No	City is unaware of process for this, or of what data would qualify.
e. Does the municipality provide assistance with local floodplain determinations?	If yes, specify how.	Yes	City uses GIS maps to provide general flood hazard zone location, and directs to surveying firms for confirmation.
f. Does the municipality maintain a record of approved Letters of Map Change?	If yes, specify the responsible office.	Yes	Community & Economic Development

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Has the municipality adopted a compliant floodplain management ordinance that, at a minimum, regulates the following:	If yes, answer questions (1) through (4) below.	Yes	
(1) Does the municipality issue permits for all proposed development in the Special Flood Hazard Areas (SFHAs)?	If yes, specify the office responsible.	Yes	Community & Economic Development
(2) Does the municipality obtain, review, and utilize any Base Flood Elevation (BFE) and floodway data, and/or require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres?	If yes, specify the office responsible.	Yes	Community & Economic Development
(3) Does the municipality identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the BFE, including anchoring, using flood-resistant materials, and designing or locating utilities and service facilities to prevent water damage?	If yes, specify the office responsible.	Yes	Community & Economic Development
(4) Does the municipality document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures?	If yes, specify the office responsible.	Yes	Community & Economic Development
b. If a compliant floodplain ordinance was adopted, does the municipality enforce the ordinance by monitoring compliance and taking remedial action to correct violations?	If yes, specify how.	Yes	Building Official/Property Maintenance Official enforces through same process as other code violations

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
c. Has the municipality considered adopting activities that extend beyond the minimum requirements? Examples include: • Participation in the Community Rating System • Prohibition of production or storage of chemicals in SFHA • Prohibition of certain types of structures, such as hospitals, nursing homes, and jails in SFHA • Prohibition of certain types of residential housing (manufactured homes) in SFHA • Floodplain ordinances that prohibit any new residential or nonresidential structures in SFHA	If yes, specify activities.	Yes	City evaluated CRS in 2015 but determined not cost-effective at the time. Other measures listed have not been considered.

3. FLOOD INSURANCE			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality educate community members about the availability and value of flood insurance?	If yes, specify how.	No	Education/promotion plan in development to launch in 2020
b. Does the municipality inform community property owners about changes to the DFIRM/FIRM that would impact their insurance rates?	If yes, specify how.	No	Education/promotion plan in development to launch in 2020
c. Does the municipality provide general assistance to community members regarding insurance issues?	If yes, specify how.	No	Education/promotion plan in development to launch in 2020

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) SURVEY

MUNICIPALITY: CITY OF HARRISONBURG

1. FLOODPLAIN IDENTIFICATION AND MAPPING

Requirement	*Recommended Action*	*Yes/No*	*Comments*
a. Does the municipality maintain accessible copies of an effective Flood Insurance Rate Map (FIRM)/Digital Flood Insurance Rate Map (DFIRM)? Does the municipality maintain accessible copies of the most recent Flood Insurance Study (FIS)?	Place these documents in the local libraries or make available publicly.	Yes	
b. Has the municipality adopted the most current DFIRM/FIRM and FIS?	State the date of adoption, if approved.	2008	
c. Does the municipality support request for map updates?	If yes, state how.	Yes	Send out adjacent property owner notifications before, during, and after sign off on FEMA applications
d. Does the municipality share with Federal Emergency Management Agency (FEMA) any new technical or scientific data that could result in map revisions within 6 months of creation or identification of new data?	If yes, specify how.	No	
e. Does the municipality provide assistance with local floodplain determinations?	If yes, specify how.	Yes	Local Floodplan Administrator makes the determination.
f. Does the municipality maintain a record of approved Letters of Map Change?	If yes, specify the responsible office.	Yes	Depart of Community Development

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Has the municipality adopted a compliant floodplain management ordinance that, at a minimum, regulates the following:	If yes, answer questions (1) through (4) below.	Yes	
(1) Does the municipality issue permits for all proposed development in the Special Flood Hazard Areas (SFHAs)?	If yes, specify the office responsible.	Yes	Community Development
(2) Does the municipality obtain, review, and utilize any Base Flood Elevation (BFE) and floodway data, and/or require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres?	If yes, specify the office responsible.	Yes	Community Development
(3) Does the municipality identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the BFE, including anchoring, using flood-resistant materials, and designing or locating utilities and service facilities to prevent water damage?	If yes, specify the office responsible.	Yes	Community Development
(4) Does the municipality document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures?	If yes, specify the office responsible.	Yes	Community Development
b. If a compliant floodplain ordinance was adopted, does the municipality enforce the ordinance by monitoring compliance and taking remedial action to correct violations?	If yes, specify how.	Yes	It's enforced through the Zoning Ordinance and has a progressive action process starting with written notification and ending through the court system.

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
c. Has the municipality considered adopting activities that extend beyond the minimum requirements? Examples include: • Participation in the Community Rating System • Prohibition of production or storage of chemicals in SFHA • Prohibition of certain types of structures, such as hospitals, nursing homes, and jails in SFHA • Prohibition of certain types of residential housing (manufactured homes) in SFHA • Floodplain ordinances that prohibit any new residential or nonresidential structures in SFHA	If yes, specify activities.	No	

3. FLOOD INSURANCE			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality educate community members about the availability and value of flood insurance?	If yes, specify how.	No	Unless they specifically ask
b. Does the municipality inform community property owners about changes to the DFIRM/FIRM that would impact their insurance rates?	If yes, specify how.	Yes	Notify adjacent properties of changes
c. Does the municipality provide general assistance to community members regarding insurance issues?	If yes, specify how.	Yes	During permitting processes and when asked.

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) SURVEY

MUNICIPALITY: CITY OF LEXINGTON

1. FLOODPLAIN IDENTIFICATION AND MAPPING

Requirement	*Recommended Action*	*Yes/No*	*Comments*
a. Does the municipality maintain accessible copies of an effective Flood Insurance Rate Map (FIRM)/Digital Flood Insurance Rate Map (DFIRM)? Does the municipality maintain accessible copies of the most recent Flood Insurance Study (FIS)?	Place these documents in the local libraries or make available publicly.	Yes	
b. Has the municipality adopted the most current DFIRM/FIRM and FIS?	State the date of adoption, if approved.	Yes	April 6, 2000
c. Does the municipality support request for map updates?	If yes, state how.	?	Have not had a map update request during my tenure (3.5 years)
d. Does the municipality share with Federal Emergency Management Agency (FEMA) any new technical or scientific data that could result in map revisions within 6 months of creation or identification of new data?	If yes, specify how.	?	If we were creating any new technical or scientific data, we would surely share with FEMA
e. Does the municipality provide assistance with local floodplain determinations?	If yes, specify how.	Yes	By request of the floodplain manager
f. Does the municipality maintain a record of approved Letters of Map Change?	If yes, specify the responsible office.	No	FEMA has those

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Has the municipality adopted a compliant floodplain management ordinance that, at a minimum, regulates the following:	If yes, answer questions (1) through (4) below.	Yes	
(1) Does the municipality issue permits for all proposed development in the Special Flood Hazard Areas (SFHAs)?	If yes, specify the office responsible.	Yes	Planning and Development
(2) Does the municipality obtain, review, and utilize any Base Flood Elevation (BFE) and floodway data, and/or require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres?	If yes, specify the office responsible.	Yes	Planning and Development office reviews BFE and floodway data, but there is not enough land in Lexington available for 50 lot subdivisions
(3) Does the municipality identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the BFE, including anchoring, using flood-resistant materials, and designing or locating utilities and service facilities to prevent water damage?	If yes, specify the office responsible.	Yes	Planning and Development
(4) Does the municipality document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures?	If yes, specify the office responsible.	Yes	Planning and Development
b. If a compliant floodplain ordinance was adopted, does the municipality enforce the ordinance by monitoring compliance and taking remedial action to correct violations?	If yes, specify how.	Yes	Compliance is achieved through building permit review process and have not needed to take corrective action in the last 3.5 years

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
c. Has the municipality considered adopting activities that extend beyond the minimum requirements? Examples include: • Participation in the Community Rating System • Prohibition of production or storage of chemicals in SFHA • Prohibition of certain types of structures, such as hospitals, nursing homes, and jails in SFHA • Prohibition of certain types of residential housing (manufactured homes) in SFHA • Floodplain ordinances that prohibit any new residential or nonresidential structures in SFHA	If yes, specify activities.	No	

3. FLOOD INSURANCE			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality educate community members about the availability and value of flood insurance?	If yes, specify how.	No	
b. Does the municipality inform community property owners about changes to the DFIRM/FIRM that would impact their insurance rates?	If yes, specify how.	No	No changes to the DFIRM/FIRM have occurred in the last 3.5 years
c. Does the municipality provide general assistance to community members regarding insurance issues?	If yes, specify how.	No	

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) SURVEY

MUNICIPALITY: CITY OF STAUNTON

1. FLOODPLAIN IDENTIFICATION AND MAPPING

Requirement	*Recommended Action*	*Yes/No*	*Comments*
a. Does the municipality maintain accessible copies of an effective Flood Insurance Rate Map (FIRM)/Digital Flood Insurance Rate Map (DFIRM)? Does the municipality maintain accessible copies of the most recent Flood Insurance Study (FIS)?	Place these documents in the local libraries or make available publicly.	Yes	On the GIS
b. Has the municipality adopted the most current DFIRM/FIRM and FIS?	State the date of adoption, if approved.	Yes	1/6/2010
c. Does the municipality support request for map updates?	If yes, state how.	Yes	
d. Does the municipality share with Federal Emergency Management Agency (FEMA) any new technical or scientific data that could result in map revisions within 6 months of creation or identification of new data?	If yes, specify how.	Yes	
e. Does the municipality provide assistance with local floodplain determinations?	If yes, specify how.	Yes	We answer requests
f. Does the municipality maintain a record of approved Letters of Map Change?	If yes, specify the responsible office.	Yes	Building Services Division

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Has the municipality adopted a compliant floodplain management ordinance that, at a minimum, regulates the following:	If yes, answer questions (1) through (4) below.		
(1) Does the municipality issue permits for all proposed development in the Special Flood Hazard Areas (SFHAs)?	If yes, specify the office responsible.	Yes	Building Services Division
(2) Does the municipality obtain, review, and utilize any Base Flood Elevation (BFE) and floodway data, and/or require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres?	If yes, specify the office responsible.	Yes	Building Services Division
(3) Does the municipality identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the BFE, including anchoring, using flood-resistant materials, and designing or locating utilities and service facilities to prevent water damage?	If yes, specify the office responsible.	Yes	Building Services Division
(4) Does the municipality document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures?	If yes, specify the office responsible.	Yes	Building Services Division
b. If a compliant floodplain ordinance was adopted, does the municipality enforce the ordinance by monitoring compliance and taking remedial action to correct violations?	If yes, specify how.	Yes	Notices sent for violations

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
c. Has the municipality considered adopting activities that extend beyond the minimum requirements? Examples include: • Participation in the Community Rating System • Prohibition of production or storage of chemicals in SFHA • Prohibition of certain types of structures, such as hospitals, nursing homes, and jails in SFHA • Prohibition of certain types of residential housing (manufactured homes) in SFHA • Floodplain ordinances that prohibit any new residential or nonresidential structures in SFHA	If yes, specify activities.	Yes	Currently application in process for CRS

3. FLOOD INSURANCE			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality educate community members about the availability and value of flood insurance?	If yes, specify how.	Yes	Educational programs with the CSPDC.
b. Does the municipality inform community property owners about changes to the DFIRM/FIRM that would impact their insurance rates?	If yes, specify how.	Yes	Public hearing and or Notice
c. Does the municipality provide general assistance to community members regarding insurance issues?	If yes, specify how.	Yes	Meet with and make recommendations.

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) SURVEY

MUNICIPALITY: WAYNESBORO

1. FLOODPLAIN IDENTIFICATION AND MAPPING

Requirement	*Recommended Action*	*Yes/No*	*Comments*
a. Does the municipality maintain accessible copies of an effective Flood Insurance Rate Map (FIRM)/Digital Flood Insurance Rate Map (DFIRM)? Does the municipality maintain accessible copies of the most recent Flood Insurance Study (FIS)?	Place these documents in the local libraries or make available publicly.	yes	
b. Has the municipality adopted the most current DFIRM/FIRM and FIS?	State the date of adoption, if approved.	yes	06/2012
c. Does the municipality support request for map updates?	If yes, state how.	no	
d. Does the municipality share with Federal Emergency Management Agency (FEMA) any new technical or scientific data that could result in map revisions within 6 months of creation or identification of new data?	If yes, specify how.	yes	
e. Does the municipality provide assistance with local floodplain determinations?	If yes, specify how.	yes	
f. Does the municipality maintain a record of approved Letters of Map Change?	If yes, specify the responsible office.	yes	zoning

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Has the municipality adopted a compliant floodplain management ordinance that, at a minimum, regulates the following:	If yes, answer questions (1) through (4) below.	yes	
(1) Does the municipality issue permits for all proposed development in the Special Flood Hazard Areas (SFHAs)?	If yes, specify the office responsible.	yes	
(2) Does the municipality obtain, review, and utilize any Base Flood Elevation (BFE) and floodway data, and/or require BFE data for subdivision proposals and other development proposals larger than 50 lots or 5 acres?	If yes, specify the office responsible.	yes	
(3) Does the municipality identify measures to keep all new and substantially improved construction reasonably safe from flooding to or above the BFE, including anchoring, using flood-resistant materials, and designing or locating utilities and service facilities to prevent water damage?	If yes, specify the office responsible.	yes	
(4) Does the municipality document and maintain records of elevation data that document lowest floor elevation for new or substantially improved structures?	If yes, specify the office responsible.	yes	
b. If a compliant floodplain ordinance was adopted, does the municipality enforce the ordinance by monitoring compliance and taking remedial action to correct violations?	If yes, specify how.	yes	

2. FLOODPLAIN MANAGEMENT			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
c. Has the municipality considered adopting activities that extend beyond the minimum requirements? Examples include: • Participation in the Community Rating System • Prohibition of production or storage of chemicals in SFHA • Prohibition of certain types of structures, such as hospitals, nursing homes, and jails in SFHA • Prohibition of certain types of residential housing (manufactured homes) in SFHA • Floodplain ordinances that prohibit any new residential or nonresidential structures in SFHA	If yes, specify activities.	yes	No crs, cup per regulations from fema

3. FLOOD INSURANCE			
Requirement	***Recommended Action***	***Yes/No***	***Comments***
a. Does the municipality educate community members about the availability and value of flood insurance?	If yes, specify how.	yes	
b. Does the municipality inform community property owners about changes to the DFIRM/FIRM that would impact their insurance rates?	If yes, specify how.	no	
c. Does the municipality provide general assistance to community members regarding insurance issues?	If yes, specify how.	yes	

Appendix J - Locality Resolutions

The Plan will go before each of the 21 jurisdictions for adoption after approval of the Plan is received from VDEM and FEMA. The final copy of the Plan will include the Locality Resolutions.