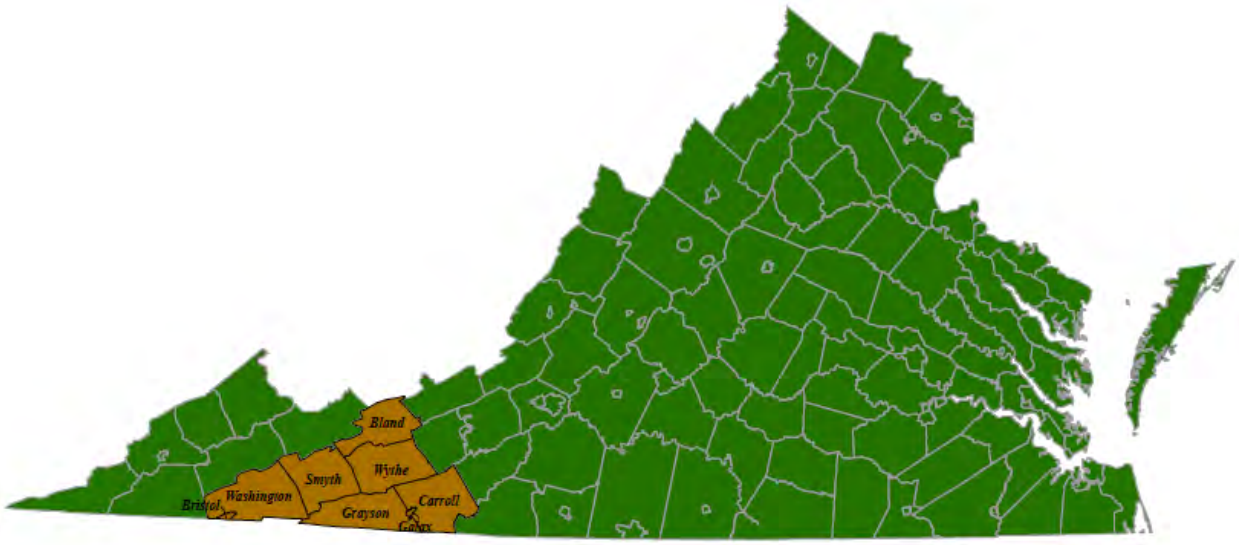
Mount Rogers Hazard Mitigation Plan
2011 Update

For the Counties of Bland, Carroll, Grayson, Smyth, Washington, and Wythe, the Cities of Bristol and Galax, and the Towns of Abingdon, Chilhowie, Damascus, Fries, Glade Spring, Hillsville, Independence, Marion, Rural Retreat, Saltville, Troutdale, and Wytheville



Prepared by

Mount Rogers Planning District Commission

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INTRODUCTION

The Mount Rogers Hazard Mitigation Plan 2011 update is a revision to the region's original plan, adopted and approved by FEMA in December 2005. In this updated plan, new data and analysis has improved the hazard identification and risk assessment used to determine mitigation strategies. All sections of this plan have been updated to include the newest information and data available. In the past five years, the participating local governments (Bland, Carroll, Grayson, Smyth, Washington, and Wythe Counties, the Cities of Bristol and Galax, and the Towns of Abingdon, Chilhowie, Damascus, Fries, Glade Spring, Hillsville, Independence, Marion, Rural Retreat, Saltville, Troutdale, and Wytheville), have participated in a yearly overview and update of the strategies and goals set forth in the original plan.

The Pre-Disaster Hazard Mitigation Update is meant to describe natural hazards and their impacts to people and property; recommend mitigations to reduce or eliminate those hazards; and outline the strategy for maintaining and updating the Plan.

This Plan addresses natural hazards of importance to the Mount Rogers Planning District region of southwest Virginia. This is a rural, mountainous region covering 2,777 square miles that stands within both the Ridge & Valley and Blue Ridge geologic provinces. This plan will focus primarily on natural hazards: dam safety, drought, earthquakes, flooding, karst & sinkholes, landslides, severe winter storms/ice, thunderstorms/lightning, tornadoes/hurricanes, wildfires and windstorms.

HAZARD MITIGATION PLANNING

The purpose of this plan is to meet the requirements set forth in the Disaster Mitigation Act 2000 (DMA 2000). The DMA 2000 requires state and local government to identify hazards, assess their risks and community vulnerability, and to describe actions to mitigate those risks and vulnerabilities. The plan is meant to be a framework for decreasing needs for post disaster funds for recovery and reconstruction through pre-disaster actions.

Adoption of this plan and approval from FEMA is required for localities to remain eligible to apply for the five Hazard Mitigation Assistance (HMA) Programs. They include the four annual grant programs; Pre-Disaster Mitigation Program (PDM), Flood Mitigation Assistance (FMA), Repetitive Flood Claims (RFC), and Severe Repetitive Loss (SRL) and the post-disaster Hazard Mitigation Grant Program (HMGP). Three of these programs (FMA, RFC, and SRL) are directly linked to the National Flood Insurance Program (NFIP). HMGP and PDM can also be used to fund tornado safe rooms, wildfire mitigation, etc.

There are four basic phases of emergency management: mitigation, preparedness, response, and recovery. Preparedness and mitigation measures occur prior to a disaster event. Preparedness refers to plans and strategies for efficiently handling disasters as they occur. Response and

recovery occur during and after a disaster event, respectively, to return the community to normal operations as quickly as possible. Mitigation includes the long-term strategies determined to reduce risk to life and property from a disaster event.

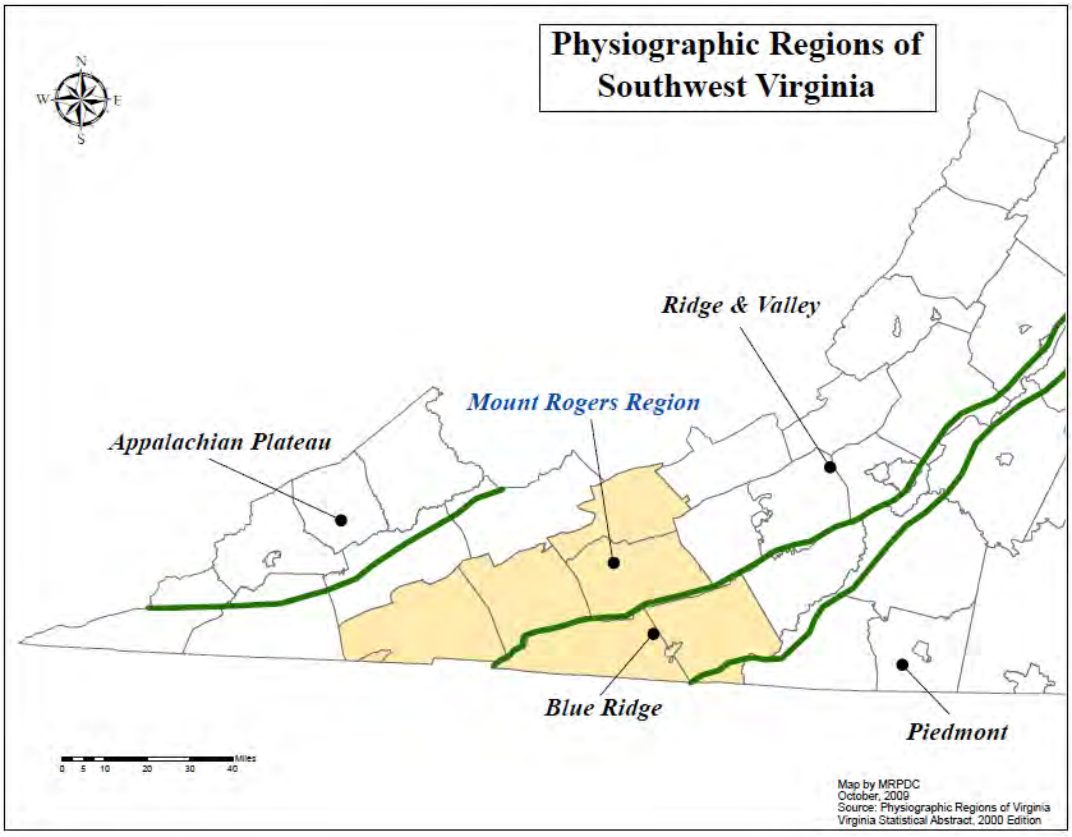
The benefits of planning to mitigate for natural hazards include a systematic approach for identifying hazards, their risks, and strategies for minimizing those risks. In planning prior to a disaster, the high emotions and rushed environment are absent allowing a diverse group of stakeholders to collaborate to develop strategies from which the community derives the most benefits. The opportunities offered by approaching mitigation planning proactively allow local communities to shape not only post-disaster recovery, but also achieve additional community objectives, such as recreation and housing and economic development.

Implementation of mitigation strategies is the final step of these planning efforts. Mitigation strategies can take many forms, most commonly directed towards flooding, hurricanes, and earthquakes, three historically catastrophic events. The true community benefits of mitigation planning are not realized until the construction or installation of these projects is completed.

COMMUNITY PROFILE

NATURAL FEATURES

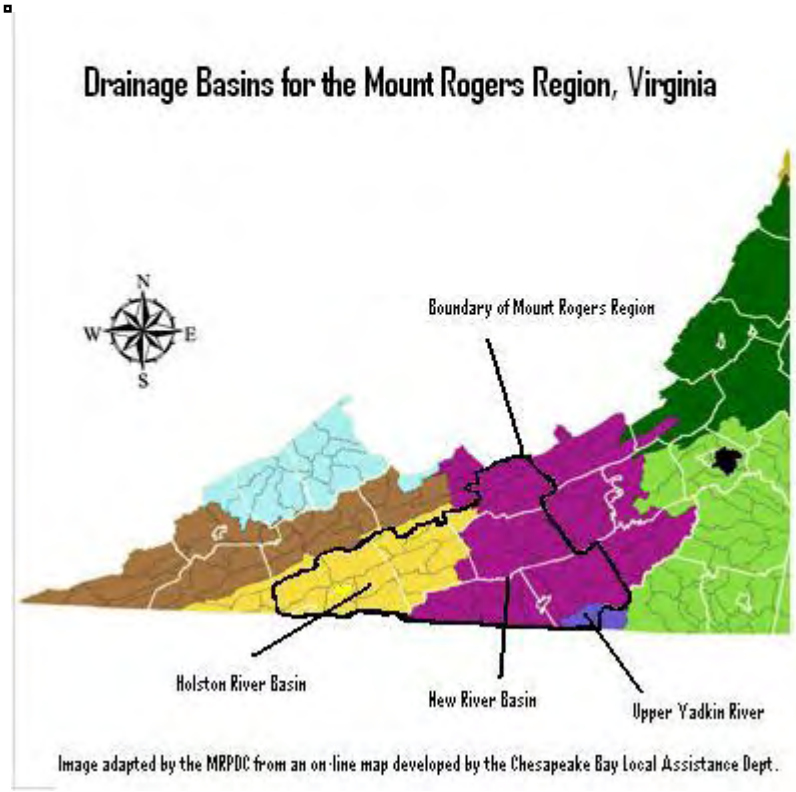
The region covers 2,777 square miles and stands within both the Ridge & Valley and the Blue Ridge geologic provinces of Virginia. An image (Physiographic Regions of Southwest Virginia) is shown below.



In the Ridge & Valley section, the land is characterized by valleys with low to moderate slopes underlain by carbonate rocks; this area starts in Bristol and runs in a northeasterly direction through Washington, Smyth and Wythe counties in a track toward Roanoke. Elevations generally range between 1,200 and 2,300 feet. The Blue Ridge portion generally includes Grayson and Carroll counties. The land appears as a broad upland plateau with moderate slopes. The elevations are higher, generally ranging from 2,400 to 3,000 feet, and sometimes much higher. Mount Rogers itself, located near the junction of Grayson, Smyth and Washington counties, stands at more than 5,729 feet.

NATURAL RESOURCES

The principal watersheds that drain the region include the Holston River system (including the North, South and Middle Forks), the New River, and a small portion of the Upper Yadkin River drainage as shown on the map below.



The Holston River Basin flows in a southwesterly direction to join with the Tennessee River system. The New River flows in a northerly direction into West Virginia, while the Upper Yadkin flows south into North Carolina. Much of the Mount Rogers region contains state and national forest, including the Mount Rogers National Recreation Area. The mountainous terrain generally precludes intensive development other than in the limited valley regions of the district. Mineral resources of the region include limestone, sandstone, granite, gravel, sand, shale, iron oxide, quartzite and salt. All are actively mined, according to the state Department of Mines, Minerals and Energy. Historically important minerals in the region included coal, iron, lead, zinc, salt, gold, and gypsum. The richer mineral resources of the west have long since replaced much of the local mining activity in the Mount Rogers region.

TEMPERATURES AND CLIMATE

The local region stands within a temperate climate zone influenced by the mountainous nature of southwest Virginia. Temperatures range from average lows of 15^0 F-25^0 F (in January) to average highs of 80^0 F-90^0 F (in July). The differing elevations and lay of the land account for the range of differences in local weather. Local annual precipitation also is highly variable. It ranges from 62" annually in the highest mountains (Mount Rogers and surrounding area in the Blue Ridge) to 46" annually in other parts of the district. Weather patterns and climate are influenced by the Appalachian and Blue Ridge mountain ranges, the direction of airflow and the effects of the major river valleys. Weather systems typically move from west to east. Cloud systems may pass up and over the mountains. As clouds rise, their moisture content condenses and falls as rain or snow; that often results in heavy precipitation on the western slopes of the mountains and little or no precipitation on the eastern (or rain shadowed) slopes of the mountains. Weather systems and storms also may follow the river valleys, running parallel to the mountain ranges.

POLITICAL BOUNDARIES

The Mount Rogers region, as designated by the Virginia General Assembly, includes six counties Bland, Carroll, Grayson, Smyth, Washington, and Wythe, two cities Bristol and Galax, twelve towns Abingdon, Chilhowie, Damascus, Fries, Glade Spring, Hillsville, Independence, Marion, Rural Retreat, Saltville, Troutdale, and Wytheville.

Key transportation systems within the region include the interstate highways (I-81 and I-77), U.S. Route 58 and U.S. Route 11, several local airports, some limited public transit service, and service from local taxicabs and Greyhound Bus Lines. The Norfolk Southern Railway is an important private hauler of freight. Passenger rail service presently is lacking in the region.

The region is variable in nature. It ranges from the very rural character of Bland County, with a population of 6,824 to the rapidly urbanizing character of the largest county, Washington, with a growing population of 54,876. Grayson and Carroll counties are known as places for second home development, especially in areas with views of the New River. The two mid-size counties, Smyth and Wythe, with populations of roughly 30,000 each, serve as centers of commerce and manufacturing. The three largest towns, each with populations greater than 5,000, are Abingdon, Marion and Wytheville.

Population

The region-wide population numbered 193,595 as of the 2010 Census, up approximately 2.4% from the 2000 level of 188,984. The growth is distributed unevenly within the region, with the

greatest rate of increase occurring in Wythe County and Washington County. Carroll County, and the Cities of Bristol and Galax saw a slight increase, while Bland, Grayson, and Smyth Counties saw a slight decrease in population from 2000 to 2010.

Median family income for the region as of 2009 came to $35,840, which lags behind the statewide level of $59,372, as reported by the U.S. Census Bureau. This number reflects a 3% decrease in median household income for the Mount Rogers region over the past ten years. Incomes in the Mount Rogers region have traditionally lagged behind statewide averages, along with the region's rate of new job creation. At the same time, unemployment generally runs higher than the statewide average, reflecting disparities between the high job growth rates in northern Virginia compared against job growth rates in southwest Virginia.

Ethnically, the Mount Rogers region is dominated by whites (nearly 96%). Of a total population of 193,595 in the region the largest significant minority populations are African American totaling 2.2% and Hispanics totaling 2.1%.

ECONOMY

Manufacturing stands as one of the key employment sectors for the Mount Rogers region, though foreign competition is undermining the sector. From 2000 through 2011, the region lost 10,000 manufacturing jobs, with the total going from 24,274, to 14,106 a decrease of 41%. This number may be slightly skewed due to the economic hardships that have hit the region and the United States as a whole since the economic downturn beginning in 2008. The sector includes production of refrigeration and heating equipment, clothing, truck trailers and motor vehicle parts, glass products, furniture, wood products, hardware, sporting and athletic goods, and mining equipment.

The next largest employment sector falls in the services category, with more than 17,000 jobs in 2011, followed by retail trade and services and public administration.

Farming offers relatively few jobs but remains an important industry to the Mount Rogers region. Chief products include livestock, poultry, and burley tobacco. Though not classified as an agricultural product, Christmas trees, raised in the higher elevations, also are important to the region.

PLANNING PROCESS

PLANNING TEAM

Since 2010 the Mount Rogers Planning District staff has been working with its localities to update the Pre-Disaster Hazard Mitigation Plan that was approved by FEMA in 2005. Prior to this, each year the staff at Mount Rogers facilitates a yearly update of the mitigation strategies. The hazard mitigation steering committee was composed of county administrators, town managers, members of the boards of supervisors, emergency management personnel, local and state personnel, and any interested stakeholders from the public. The steering committee oversaw the plan update process as well as coordinated with local fire, rescue, and police personnel. This committee played a valuable role in the information input process of the plan.

PLANNING PROCESS

The Mount Rogers Planning District Commission initiated the plan update process at the beginning of 2011. A regional kick-off meeting was held at the offices of the Mount Rogers Planning District Commission in Marion, Virginia on January 21, 2011. At this meeting, the MRPDC and the stakeholders from the various localities reviewed the process for updating the plan, as well as outlining how the old plan would be improved upon.

The steering committee continued to meet throughout the year until the summer of 2011. Other meetings were called on April 21, June 3, June 15, and August 22. From January until July 2011 the committee first reviewed the existing data that was produced in the original Hazard Mitigation Plan. Throughout the 2011 Hazard Mitigation Plan Update process the materials from each section of the original plan as well as any new changes were looked over. For the most part in the past five years there were few changes the committee felt needed to be added to the updated plan due to the fact that little has changed in our region in the past five years. Focus and discussion was placed on each hazard identified to be a potential threat to the district. The committee brought in their own knowledge of any disasters that had happened in their districts within the past five years since the plan's original adoption. The committee took these ideas back to their localities and met with their local representatives in the emergency services field and gathered any additional information they could find concerning how natural disasters are dealt with, as well as any areas where the localities had vulnerabilities or difficulties in responding to disasters. All meetings were open to the public.

Following any reviews of the data gathered, the group then brainstormed mitigation objectives and strategies to include in the plan update. The final component of the committee meetings was a capabilities and vulnerability assessment. Participants that could not or had trouble attending the meetings due to lack of staff numbers were either met on a one on one bases with the MRPDC staff, or coordinated through telephone conversations or emails. Each member of the

committee was encouraged to discuss with any person or group, or with an agency or the public that may have valuable input to add to the plan update.

Plan Participation

Below are two tables, the first outlining the localities and agencies that had input in developing the Hazard Mitigation Plan update. Some participated on the steering committee that met at the Mount Rogers PDC offices. Others participated by personal visits, phone calls, or through email. The second outlines the localities that participated in the plan update as well as the original drafting of the Hazard Mitigation Plan.

Planning Committee Member	Representing	Steering Committee	Other Participation
Garrett Jackson	Abingdon	X	
Lorin Hanshew	Bland County		X
Andrew Trivette	Bristol		X
Mike Mock	Carroll County		X
	Chilhowie		X
Aaron Sizemore	Damascus	X	
Brian Reed	Fries	X	
Keith Barker	Galax		X
Toby Boian	Glade Spring	X	
Mitch Smith Larry Bartlett	Grayson County	X X	
	Hillsville		X
Kenneth Vaught	Independence	X	
Ken Heath	Marion	X	
Ray Matney	Rural Retreat		X
	Saltville		X
Michael Carter Charles Harrington	Smyth County	X X	
Scott Booth	Troutdale		X
Pokey Harris	Washington County		X
R. Cellell Dalton Wythe B. Sharitz	Wythe County	X X	
Wayne Sutherland	Wytheville	X	
Robbie Coats	VDEM		X
Steve Buston Donny Necessary	VDOT	 X	
Jim Baldwin	Cumberland Plateau PDC		X

Angela Beavers			X
Christy Straight	New River Valley PDC		X

LOCALITY PARTICIPATION 2005 & 2011

Locality	2005 Participation	2011 Participation
Abingdon	X	X
Bland County	X	X
Bristol	X	X
Carroll County	X	X
Chilhowie	X	X
Damascus	X	X
Fries	X	X
Galax	X	X
Glade Spring	X	X
Grayson County	X	X
Hillsville	X	X
Independence	X	X
Marion	X	X
Rural Retreat	X	X
Saltville	X	X
Smyth County	X	X
Troutdale	X	X
Washington County	X	X
Wythe County	X	X
Wytheville	X	X

PLAN UPDATE

For the five-year update for the Mount Rogers Hazard Mitigation Plan, the planning team and steering committee reviewed and updated each chapter of the plan. Each of the Hazard Identification and Risk Assessment (HIRA) sections were revised based on current information

and the updated analysis conducted by the Mount Rogers Staff. The committee discussed both historical information focused on each hazard as well as brainstorming new mitigation objectives and strategies. These new strategies are included in each hazard section and in the mitigation strategy chapter. The Community Summaries chapter was updated through discussions with each community's representative to the steering committee. Information was also gathered by the staff from emergency management personnel as well as interest individuals in the public. Through these discussions, new information was added where necessary and specific mitigation projects identified by the localities were included. The planning team reviewed numerous local documents to include in various sections of the updated plan, including but not limited to local comprehensive plans, emergency operations plans, and capital improvement plans. In some cases the 2005 Hazard Mitigation plan was included in discussions and updates of these plans. For example, in the 2011 update process for the Town of Marion comprehensive plan, the Mount Rogers Hazard Mitigation Plan was referred to specifically in reference to the developed floodplain along the Middle Fork of the Holston River. The information gathered from these sources was included as data in the HIRA chapter, as well as providing some of the basis of the capabilities assessment section.

PUBLIC INVOLVEMENT

Public input was solicited throughout the planning process. All committee members were asked to go to their localities and solicit input from their citizens. All meeting at the Mount Rogers PDC were open to the public as well. A project website was created so the public could review the original Hazard Mitigation plan and provide input toward sections of the plan update they were interested in. The website allowed the public to view the plan and share input if they could not attend the called meetings. Also at least one public meeting will be held during the adoption process to give anyone an opportunity to comment on the entire plan before its official adoption by each locality.

OTHER INVOLVEMENT

Mount Rogers also discussed update ideas with our neighboring regional government offices Cumberland Plateau, and the New River Valley Planning District Commissions. Emory and Henry College as well as Radford University were also invited to give their input into the plan update. In our meetings with our local officials we stressed to not limit data gathering and input to local governments, fire and rescue. We asked them to talk to anyone in their community as well as local business owners and land owners to make the fact finding process as thorough as possible.

HAZARD IDENTIFICATION AND RISK ASSESSMENT (HIRA)

INTRODUCTION

The Mount Rogers Region is susceptible to a wide range of natural hazards**.** Fortunately the inland and mountainous setting of the Mount Rogers region protects it from most coastal phenomena such as hurricanes and tropical storms. This also shelters us from the brunt of most tornados. However, the parts of the region suffered severe damage in the spring of 2011 from an F3 tornado. The mountains, steep slopes, forests, and other geographic factors subject the region to many kinds of other natural hazards. These include:

Dam Safety	Karst & Sinkholes	Tornadoes/Hurricanes
Drought	Landslides	Wildfires
Earthquakes	Severe Winter Storms/Ice	Windstorms
Flooding	Thunderstorms/Lightning	

This section discusses each of the natural hazards possible in the region, including history, risk assessment and vulnerability, and past or existing mitigation. The hazard risk assessment and vulnerability looks specifically at two criteria: locations where the hazard is most likely to have negative impacts and the probability and severity of the hazard should it occur. When information is available, the specific impacts of a hazard is discussed, sometimes based on the usual impact in the region. These sections haven been completely revised since the 2005 plan to include additional, more helpful information.

RISK ASSESSMENT

Risk assessment seeks to define the probability of events and the likely consequences of events. The risk assessment and vulnerability presented herein is a result of an extensive analysis of historic event data, scholarly research and field work.

MITIGATION

Many times mitigation seeks to prevent the impacts of hazards on life and property. The primary goal of mitigation is to learn to live within the natural environment. This plan reviews past

mitigation efforts in the Mount Rogers Region and identifies both strategies and specific projects that could further mitigate these impacts.

Mitigation options fall generally into six categories: prevention, property protection, natural resource protection, emergency services, structural projects and public information. Prevention projects are those activities that keep hazard areas from getting worse through effective regulatory planning efforts, such as comprehensive planning, building code update and enforcement, burying utility lines and water source planning. Property protection activities are usually undertaken on individual properties or parcels with coordination of the property owner, such as elevation, relocation and acquisition of frequently flooded or damaged structures, eliminating fuel sources surrounding the property, installing rain catchment systems and purchasing additional insurance. Natural resource protection activities seek to preserve or restore natural areas or natural functions of floodplain and watershed areas. They are often implemented by parks, recreation, or conservation agencies or organizations. Emergency services measures are taken during a hazard event to minimize its impact. These measures can include response planning, regional coordination and collaboration and critical facilities protection. Structural projects include activities associated with building new or additional infrastructure or features to minimize impacts from a hazard. The final category of public information is possibly the most important, empowering residents to take action to protect themselves and their property in the event of a hazard event. This category can include additional information available to the public, such as maps, brochures, and workshops.

OVERVIEW OF ASSESSMENTS

The following section describes each of these hazards, their history, severity and impact, and likelihood of causing damage. Describing the hazards separately is problematic because natural hazards often combine. Flooding often follows severe winter storms. Thunderstorms contain lightning, high winds, and, rarely, tornadoes. Heavy rain can cause flooding and landslides. These descriptions, however, will provide detailed information and a basis for further analysis.

DAM SAFETY

DESCRIPTION

Dams exist to serve various functions within the Mount Rogers region. These include farm use, recreation, hydroelectric power generation, flood and stormwater control, navigation, water supply, fish or wildlife ponds, debris control, and tailings (from mining operations). In some cases, a single dam structure can serve multiple functions, such as generating hydroelectric power and providing recreational opportunities to boaters and fishermen.

State and federal governments regulate dam construction, maintenance and repair. On the state level, the Virginia Dam Safety Act of 1982 serves as the guiding legislation. With certain exceptions, dams that must abide by this statute fall under one of two categories:

- Dams 25 feet tall or higher, with a maximum storage capacity of 15 acre-feet or more.
- Dams 6 feet tall or higher, with a maximum storage capacity of 50 acre-feet or more.

Dams not regulated by the state include those with an agricultural exemption (95 statewide), a federal license (114 statewide), a mining exemption (20 statewide), or a size exemption (879 in the state). Spillways are channels designed to keep water from overflowing the top of the dam and to prevent erosion at the bottom, or toe, of the dam. State law regulates spillway construction based on the dam's hazard classification and site classification. The federal government maintains an inventory of dams through the National Dam Inspection Act of 1972 and, more recently, the Water Resources Development Act of 1996. Maintained by the U.S. Army Corps of Engineers, the inventory has been available on-line since January 1999. It is called the National Inventory of Dams, and its database covers roughly 77,000 dams, including several in the Mount Rogers region. A map showing the location of all dams in the Mount Rogers Region is located in the section titled Appendix I at the end of the document.

DAM HAZARD CLASSIFICATION

The state and federal governments have adopted slightly different methods of classifying dam hazard potential. For the federal national inventory, dams are grouped into one of three categories, based on two criteria: the potential for loss of human life and the potential to cause economic, environmental and lifeline losses, in the event of a dam failure.

Virginia's dam classification system varies in that it classifies the state-regulated dams into one of four categories. 1.) Loss of human life probable with excessive economic impact, 2.) loss of human life possible with appreciable economic impact, 3.) no loss of human life expected with minimal economic impact, and 4.) no loss of human life expected with no economic impact.

Under the state system, dam operation and maintenance plans, as well as inventory reports, must be completed every six years. Re-inspection reports, performed by professional engineers, must be made at 2-year intervals for Class I dams and 3-year intervals for Class II dams. In addition, dam owners must inspect their own dams and submit annual reports in years when professional inspections are not required.

DAM HAZARD HISTORY

In the Mount Rogers region there has been some history of dam failures over the years, although obtaining a complete record has proven difficult for the purposes of this Hazard Mitigation report. Regulatory agencies at the state and federal governments are reluctant to release full information on dams, inspection histories, and known hazards. Hazard classifications, in and of themselves, serve as a bureaucratic indicator of potential hazard in the event of dam failure, but the classification does not reflect the present physical condition or status of any given dam.
In Bland County, a failure in the Crab Orchard Creek Dam at about noon on January 29, 1957 flooded the community of Bland as a result of three days and nights of continuous rains. The water went through a crack that opened when a slate hillside on one side gave way. While no one was hurt, the flooding destroyed or severely damaged many homes and also swept away outbuildings, cars, fences, machinery, livestock, and household equipment. The flooding also damaged several downtown businesses. One house floated a mile downstream and came to rest against a bridge and other wreckage. One home was tilted on edge and carried 200 yards downstream to come to rest against a concrete bridge in the community. Estimated damages came to $500,000. The local unit of the American Red Cross provided $30,363 in emergency aid, with nearly $22,395 going for structural repairs. This photo shows the tilted home (see far right of image) that was swept 200 yards downstream during the Crab Orchard dam failure and flood of 1957.

Some now believe that Interstate 77, which passes between the dam and the community, will protect Bland from a similar occurrence in the event the dam should fail again. However, the state's hazard rating on the dam was upgraded in 2004 from significant hazard (Class II) to high-hazard status (Class I). The dam owner hired an engineer as part of an effort to show why the Crab Orchard Creek Dam does not deserve a Class I rating. Another locally known dam failure occurred on Christmas Eve in 1924, when the muck dam at Saltville broke and flooded the community of Palmertown, killing 19 people and dislodging several homes from their foundations. According to at least one news account at the time, the dam failure occurred due to

human intervention; police accused a 27-year-old man named Roy Patrick of using dynamite to blow up the dam.

RISK ASSESSMENT AND VULNERABILITY

For the purposes of hazard mitigation, this report takes note of dams classified with a potential for high or significant hazard in the event of failure, as defined under the National Inventory of Dams. Those dams classified with a low hazard potential were not considered.

High-hazard and significant-hazard dams (14 total) in the Mount Rogers region primarily consist of earthen structures built for recreational use. Four of the dams are used to generate hydroelectric power, although three of those also offer recreational uses. Several of the dams combine recreational uses with flood or stormwater control. Clear Creek Dam in Washington County, near the City of Bristol, serves multiple uses. These include flood and stormwater control, recreation, water supply, and other uses.

Of the 14 previously mentioned dams, six come under federal regulations. These include the Byllesby Dam and Buck Dam on the New River in Carroll County, Hale Lake Dam in Grayson County, and Beaver Creek Dam, Clear Creek Dam and Edmondson Dam (which has been breached), all located in Washington County. These dams mainly serve to provide hydroelectric power or flood control.

Due to recent changes in state dam safety regulations, two more of the region's dams – Laurel Creek Dam and Fields Dam, both in Grayson County – will be required to prepare Emergency Action Plans. EAPs, contained in county emergency operations plans to govern emergency response for natural and man-made disasters, define roles by dam owners and emergency services personnel for monitoring of dams' physical condition and notification of downstream communities in the event of flooding or potential dam failure. For more details on all the region's dams classified as High Hazard and Significant Hazard, please see the table found at the end of this section.

There is no way to predict the likelihood of a dam failure, since failures relate to the structure, condition, age, maintenance, and natural forces (and storm events) that can affect the integrity of the dam. A well-maintained dam classified as a High Hazard structure may in fact pose little risk to downstream community.

Dam regulation first began in this country due to failures of poorly built dams in the early part of the 20th century. More regulations came following a series of dam failures in the 1970s. Legally, dam owners hold the responsibility for the safety, upkeep, and maintenance of dam structures. Of

the 75,000 dams listed by the National Inventory of Dams, 95% fall to the regulation of state governments

The possibility of failure generally increases with age, with many dams designed for an effective life of 50 years. Six of the 14 high-hazard and significant-hazard dams in the Mount Rogers region are at least 50 years old. Dams with known structural problems can be given conditional operating permits, which point to the need to make improvements. There are 30 such dams in Virginia, with none located in the Mount Rogers region.

PROPERTY EXPOSURE DATA FOR DOWNSTREAM COMMUNITIES MOUNT ROGERS REGION

Dam and Location	Nearest Downstream Community	Structures at Risk	Notes
Crab Orchard Creek Dam (Bland Co.)	Bland	19 occupied homes 18 businesses	Based on 1995 Emergency Operations Plan for Bland County. The state now regulates this as a Class I dam.
Byllesby Dam (New River, Carroll Co.)	Ivanhoe Austinville	N/A	Data not available. This is a federally regulated hydroelectric dam.
Buck Dam (New River, Carroll Co.)	Ivanhoe Austinville	N/A	Data not available. This is a federally regulated hydroelectric dam.
Stewarts Ck-Lovills Ck Dam (Carroll Co.)	Mt. Airy, N.C.	N/A	
Hidden Valley Estates Dam (Grayson Co.)	Not given	N/A	
Laurel Creek Dam (Grayson Co.)	Fox Creek	N/A	Downstream risks have not yet been assessed due to prior size exemption for this dam. The state will require an EAP under new rules adopted in 2002.
Fields Dam (New River, Grayson Co.)	Fries	N/A	Downstream risks have not yet been assessed due to prior size exemption for this dam. The state will require an EAP under new rules adopted in 2002.
Hale Lake Dam (Wolf Pen Branch, Grayson Co.)	None given	N/A	Data not available. This is a federally regulated fish & wildlife dam.
Hungry Mother Dam (Smyth Co.)	Marion	Campground A few houses	
Beaver Creek Dam (Washington Co.)	Bristol	N/A	Data not available. This is a federally regulated flood control dam owned by TVA.
Clear Creek Dam (Washington Co.)	Bristol	N/A	Data not available. This is a federally regulated flood control dam owned by TVA.
Edmondson Dam (M.F.	Mock Mill	N/A	Data not available. This is a federally regulated hydroelectric dam.

Holston River, Washington Co.)			
Hidden Valley Lake Dam (Brumley Creek, Washington Co.)	Duncanville	N/A	
Rural Retreat Dam (S. Fork Reed Creek, Wythe Co.)	State Rt. 749	N/A	

Legally dam owners must properly monitor and maintain their dams, while state and federal regulators act as overseers and enforcers. But the Association of State Dam Safety Officials and others point out that the effectiveness of regulation vary among states and dam owners often lack the financial resources necessary to undertake costly repairs.

Events that can lead to dam failures include the following: overtopping, structural failure, loss of stability in the dam's foundation, cracking in the dam structure from natural settling, poor upkeep, and piping (resulting from improper filtration in the dam structure, allowing seepage and passing of soil particles to gradually create sinkholes in the dam). The vulnerability of structures and homes at risk of dam failure has not changed in the five years since the drafting of the original Hazard Mitigation Plan, and no dam failures have occurred in that time.

DROUGHT

DESCRIPTION

In simple terms, drought can be defined as "a condition of moisture deficit sufficient to have an adverse effect on vegetation, animals, and man over a sizeable area." Drought can also be defined in terms of its effects and divided into categories, as suggested by FEMA:

Meteorological drought: Defined solely on the degree of dryness, expressed as departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.

Hydrologic drought: Related to the effects of precipitation shortfalls on streamflows and reservoir, lake, and groundwater levels.

Agricultural drought: Defined mainly in terms of soil moisture deficiencies relative to water demands of plant life, usually crops.

Socioeconomic drought: This occurs when the demand for water exceeds the supply as a result of a weather-related supply shortfall.

Drought occurs as part of the regular climatic regime in virtually all climates, and can occur throughout the entire Mount Rogers Region. Its causes are complex and not readily predictable, especially in variable climates. Compared to storm events such as hurricanes and floods, drought has a slow onset and can last for months, years or even decades. Estimated dollar losses caused by drought can far exceed those of major storm events.

Some measures of drought, also known as drought indices, include:

- **Percent of Normal**: Calculated by dividing actual precipitation by normal precipitation (usually defined as the 30-year average) and multiplying by 100%. Effective for a single region or a single season. A disadvantage is the average precipitation is often not the same as the median precipitation.
- **Standardized Precipitation Index**: Index based on the probability of precipitation for any time scale. This is used by the National Drought Mitigation Center. It can provide early warning of drought, can assess drought severity and is less complex than some indices.
- **Palmer Drought Severity Index**: This is a measure of soil moisture and was the first comprehensive drought index created in the country, in 1965. It works best in areas of even topography but is less suitable for mountainous areas or places with frequent climatic extremes. Palmer values may lag emerging droughts by several months.

- **Crop Moisture Index**: A derivative of the Palmer Index. It reflects moisture supply across major crop-producing regions. It is not intended to assess long-term droughts.
- **Deciles**: This approach groups monthly precipitation events into deciles so that, by definition, "much lower than normal" weather cannot occur more than 20% of the time. This provides an accurate statistical measurement of precipitation, but its accuracy relies on a long climatic data record.

History

The U.S. Geological Survey has noted four major droughts statewide since the early 1900s. These occurred in 1930-1932 (one of the most severe droughts on record for the state), 1938-1942, 1962-1971 and 1980-1982 (the least severe). Other sources suggest the record is somewhat different for the Mount Rogers region. The table below gives a brief review of the some of the major droughts that have affected southwest Virginia.

Droughts In Southwest Virginia

Date	Location	Details	Impact
2-12-03	Carroll, Grayson, Smyth, large parts of SW VA	**USDA disaster declaration** due to severe drought for 46 counties. Primary disaster for Carroll, Grayson, Smyth counties. Contiguous declaration for Galax and Washington County.	Low-interest emergency loans for farmers.
July and August 2002	Statewide	**State emergency drought declaration** for July and August. USDA disaster declarations for Bland, Carroll, Grayson, Smyth, Wythe counties.	Significant crop damage. Reduced streamflow and groundwater levels.
9-1-99 (NCDC)	Bland, Carroll, Galax, Grayson, Smyth, Wythe, large parts of SW VA	Dry conditions began in July 1998, subsided for several months, then returned in June 1999 and through early Sept. Drought largely ended due to heavy rain from remnants of Hurricane Dennis on Sept. 4-5, 1999.	$8.25 million in crop damage. Very low water levels in creeks, streams and rivers.
July to October 1998 (NCDC)	Bland, Carroll, Galax, Grayson, Smyth, Wythe, large parts of SW VA	Dryness began in July, subsided in August, resumed in September. Low water levels in creeks, streams, rivers, lakes and some shallow wells.	Water levels low. $7.7 million crop damage.
9-1-95 (NCDC)	Bland, Carroll, Galax, Grayson, Smyth, Wythe, large parts of SW VA.	A drought that started earlier in the summer peaked in many sections of the state during the first two weeks of Sept. **State of emergency** declared. Widespread rainfall on Sept. 17 helped to alleviate the dryness.	Crops damaged. Many lakes and rivers with well-below normal water levels.
1988	Mount Rogers region	Drought based on the Palmer Drought Severity Index, with the region in severe drought up to nearly 50% of the time. One of the worst droughts on record for the nation (1988-1989).	
1954-1956	Mount Rogers region	Drought based on the Palmer Drought Severity Index. Region in severe drought up to nearly 40% of the time.	
1928-1934	Mount Rogers region	Drought based on the Palmer Drought Severity Index. Region in severe drought up to nearly 20% of the time.	

One major drought disaster occurred since 2005 in Carroll, Grayson, Smyth, and Wythe Counties. The event occurred in September of 2007, causing $8,000,000 in crop damage.

For the Mount Rogers region the worst period came in 1988, with the region in severe drought 40%-49.99% of the time. Over the long-term severe drought conditions in the Mount Rogers region occurred only up to 10% of the time.

RISK ASSESSMENT AND VULNERABILITY

In recent years, major agricultural droughts have occurred five times from 1995 through 2003. The historical record is not as well developed for the years prior to 1995, though major droughts are known to have occurred in 1928-1934, 1954-1956 and in 1988.

For the 100-year period from 1895 to 1995, the region has been estimated to experience drought less than 10% of the time. In the five year time span since the original Hazard Mitigation Plan was written, the region's vulnerability to drought has not changed.

History shows drought conditions reaching disaster proportions can affect the entire Mount Rogers region. For some parts of the region, especially in Carroll County, well development is difficult and often produces a dry hole.

The impacts appear to have the greatest impact for the farming community. In these cases the U.S. Department of Agriculture makes damage assessments and provides financial aid to qualifying farmers through the local farm service agencies.

Water issues also are a concern for the general public, local governments, business and industry. Several engineering studies from the mid- to late-1990s, as well as a 1996 health department survey, identified issues regarding water quantity, water quality and reliability of supply. In the unincorporated areas, most parts of the region depend upon groundwater supplies. The reported problems include low quantity, poor quality (due to mineral or bacterial content), turbidity, petroleum contamination and dry holes. Limited quantities restrict fire-fighting capabilities. Inadequate or limited water supplies also restrict future growth potential for business and industry. The table below describes in more detail water related problems in the Mount Rogers District.

Water Problems Reported to the Mount Rogers Health District	
Bland County	**Complaints**
Little Creek area	Bacteria in recently drilled wells.
Hollybrook	Mineral quality/iron bacteria. Cisterns used for some supplies.
Seddon	Appearance of dry wells. Cisterns used for some supplies. Mineral quality.
Waddletown	Poor quality with some wells and springs. Cisterns used for some supplies.
Laurel Creek/Dry Fork	Poor quality in some springs and wells.
Ceres	Poor quality in springs and iron bacteria in wells.
Bastian/Hicksville Crandon/Mechanicsburg	Mineral quality/iron bacteria concerns.
Carroll County	Complaints
Paul's Creek (Cana area) Dugspur (Rt. 753) Star (Rt. 1105) Woodlawn Piper's Gap Fancy Gap (Rt. 683) Chestnut Yard Rt. 645 (below Laurel Fork) Short Creek (Rt. 640/I-77)	Iron, turbidity, low-yield wells.
Grayson County	Complaints
Old Town – Fries Hill	High iron levels.
Flatwood Community	Many wells are drilled deep. Many dry holes found.
Helton/Cabin Creek Area	Well construction difficult due to rock formations.
Other Comments:	Many springs used as private water supplies, especially in western areas of the county. Many springs have bacteria contamination.
Smyth County	**Complaints**
Walker Mountain area	High iron/sulphur content.
Washington County	**Complaints**
Mendota (Rt. 802 area)	High iron/sulphur content in private water supplies.
Rt. 91 (S.F. Holston to Rhea Valley)	Low-yield wells and bacteria contamination.
Wythe County	**Complaints**
Poplar Camp, Crockett, Gateway Trailer Park (Grahams Forge), Rosenbaum Chapel area	Petroleum contamination.

Sand Mountain area Stony Fork area	Dry holes and low-yield wells. High iron/sulphur levels.

EARTHQUAKES

DESCRIPTION

An earthquake can be defined as a sudden motion or trembling caused by an abrupt release of accumulated strain on the tectonic plates that comprise the earth's crust. The theory of plate tectonics has been described since 1967 and is based on the idea the earth's crust is composed of several major plates that move slowly and continuously, at times bumping and grinding against each other and at other times creating separations.

The tectonic plates are thought to bump, slide, catch or hold as they move together. An earthquake happens when faults located near plate boundaries slip when the stress against the rock formations becomes too great. This sudden movement results in surface faulting, ground failure and tsunamis.

Surface faults are thought to occur in various forms, including strike-slip faults, normal faults (with strong vertical movement), and reverse (thrust) faults (mainly horizontal movement). Ground failure is expressed through liquefaction, when coarse soils lose their strength and act like fluids flowing over the landscape. Ground failure created by liquefaction includes lateral spreads, flow failures (the most catastrophic form), and loss of bearing strength (causing buildings to settle and tip). Tsunamis are phenomena associated with the west coast and are not considered further in this report.

Earthquakes are described in various fashions, including by intensity and magnitude. Intensity is defined as a measure of earthquake effects at a particular place on humans, structures or the land. Magnitude is a measure of the strength of an earthquake or the strain energy released by it (originally defined by Charles Richter in 1935).

HISTORY

Sources such as the Virginia Department of Mines, Minerals and Energy describe the statewide risk of earthquakes as moderate, in keeping with most other states in the eastern seaboard of the United States.

More than 300 earthquakes have been documented in Virginia since 1774. Of these, 18 have been reported with intensities of VI or greater. Much of the activity has been in the southwest and eastern parts of the state. Counties and cities that have experienced earthquakes of intensity VI and higher include Smyth, Washington and Wythe in the local region. Local earthquake history is described by Stover and Coffman and also by the U.S. Geological Survey, through its Earthquake Hazards Program. The table below describes in more detail major recorded earthquakes in the Mount Rogers Region.

Modified Mercalli Scale

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X

Earthquakes In The Mount Rogers Region
Date/Location, Intensity, and Description

Date/Location	Intensity	Description
March 9, 1828 Southwest VA	V (MM)	Felt over 218,000 sq. miles, from Pennsylvania to South Carolina and the Atlantic coastal plain to Ohio. Doors and windows rattled.
April 29, 1852 Wytheville	VI (MM)	Severe earthquake shook down a chimney near Wytheville and shook down tops of chimneys at Buckingham Courthouse. Homes shook in Staunton. A brick fell from a chimney in Davie County, N.C.
Aug. 31, 1861 Southwest VA	VI (MM)	Epicenter in extreme southwest Virginia or western North Carolina. Bricks fell from chimneys at Wilkesboro, NC. Felt from Washington, D.C. to the Midwest and south to Columbus, GA.
Sept. 1, 1886 South Carolina	V (MM)	Epicenter in Charleston, S.C., with estimated intensity of X. Caused minor structural damages in various parts of Virginia (fallen plaster and chimneys, cracked walls, broken windows).
May 3, 1897	VII (MM)	Greatest severity at Radford, where some chimneys were destroyed and plaster

Giles County		fell from walls. Felt in most of southwest Virginia and in a region of 89,500 sq. miles.
May 31, 1897 Giles County	VIII (MM)	Largest known earthquake originating in Virginia in history. Felt over 280,000 sq. miles. Largest effects felt from Lynchburg to Bluefield, W. Va. and from Giles County south to Bristol, Tenn. Many downed chimneys, changes in flow springs and appearance of some earth fissures.
Feb. 5, 1898 Wytheville or Pulaski	VI (MM)	Earthquake felt over 34,000 sq. miles. Bricks fell from chimneys and furniture shifted in a few houses. Effect felt throughout southwest Virginia and south to Raleigh, N.C.
April 23, 1959 Giles County	VI (MM)	Several chimneys were damaged, plaster cracked and pictures fell from walls in Eggleston and Pembroke. Felt over 2,900 sq. miles in southwest Virginia.
Nov. 11, 1975 Giles County	VI (MM)	Windows were broken in Blacksburg and plaster cracked at Poplar Hill (south of Pearisburg, Giles County). Also felt in Pulaski County.
Sept. 13, 1976 Carroll County	VI (MM)	One of the most persistent areas of activity in recent years, with five small earthquakes felt near Hillsville. Effects felt in the Carolinas and West Virginia.
Aug. 23, 2011 Mineral, VA	VIII (MM)	The earthquake was felt in some of the eastern parts of the Mount Rogers Region, but no damage was reported.

One notable earthquake occurred in May 1897 and was based in Giles County. It was the largest Virginia-based earthquake in recorded history. Chimneys were shaken down throughout southwest Virginia, including in Wytheville and as far west as Knoxville, Tenn. Effects of the earthquake were felt from Georgia to Pennsylvania and from the Atlantic Coast to Indiana and Kentucky. The effects were strong at Pearisburg, where brick walls cracked and some earth fissures appeared. The magnitude of this quake has been estimated at VII and VIII on the Modified Mercali intensity scale. This event, felt over 11 states, is described as the third largest earthquake in the eastern part of the country in the past 200 years.

RISK ASSESSMENT AND VULNERABILITY

For the Mount Rogers region, the likelihood of earthquakes appears to be moderate, based on measurements related to maximum ground acceleration and as described by FEMA. This data is

incorporated into probabilistic ground motion maps published in the 1994 edition of the National Earthquake Hazards Reduction Program's *NEHRP Recommended Provisions*.

The southwest Virginia region faces a moderate chance of experiencing earthquakes. While recent history shows some part of the region experiences earthquakes roughly once every 18 years, the resulting damage has been relatively minor.

The entire Mount Rogers region is subject to the effects of an earthquake, as shown by the historical record from larger events such as the Giles quake from May 1897.

The Mount Rogers region in total covers 2,786 square miles, with over 69,000 households and a population of 193,595. The region includes 71,000 buildings with an estimated structural replacement value of $7,374 million. An estimated 98% of the buildings and 78% of the building value is in residential housing.

While earthquakes can create widespread destruction and death, the damages experienced in southwest Virginia are more moderate, based on the historical record. It should be noted that earthquake analysis is tricky, given that the historical record covers a period of less than 175 years. A much better record for earthquakes would cover hundreds, even thousands, of years. The risk assessment in this report is based upon this limited range of data. In the five year time span since the original Hazard Mitigation Plan was written, the region's vulnerability to earthquakes have not changed.

For the Mount Rogers region, the worst of the earthquakes experienced historically appear to correspond to an intensity of VI on the Modified Mercali Scale. For purposes of analysis, we assumed an intensity of 6.3 and applied the HAZUS 99-SR2 computer model to reflect the characteristics of the Giles earthquake of May 1897.

At the 6.3 level magnitude, HAZUS predicted moderate damage to 3,902 buildings and slight damage to 7,423 buildings. Only 65 buildings would be completely destroyed. Other estimates by HAZUS were as follows:

- $6.8 million damage to bridges, railways and airports.
- Minor injuries to 47 people, with 9 hospitalized and 1 dead.
- Economic losses of $118 million (or 1% of the total replacement value of the region's buildings).
- $3 million in damages to communication facilities.
- Significant loss of function in several schools, especially in Bland, Carroll and Wythe counties.

FLOODING

DESCRIPTION

Flooding is regarded as the most damaging natural hazard in Virginia. Average annual flood damages statewide amount to $100 million. Nationwide, between 1983 and 1997, Virginia ranked 14th with flood damages of $1,507 million.

In the Mount Rogers region, flood damages can cost millions of dollars. In November 1977, flood damages to business and industry in Smyth County was estimated at up to $8.6 million. In the previous flood of April 1977, damages were estimated at $7.8 million for 16 jurisdictions.

More recently, in March 2002, Smyth County alone sustained an estimated $2 million in flood damages, compared to $100,000 in Wythe County and $360,000 in Washington County. Preliminary estimates from the November 2003 flooding came to $485,000 for Bland County, $251,000 for Carroll County and $878,000 for Smyth County.

Flood-Related Definitions

Base Flood: Flood with a 1% chance of being equaled or exceeded in any given year. The Base Flood is the standard used by the National Flood Insurance Program.
Base Flood Elevation: The elevation of the water surface resulting from a flood that has a 1% chance of occurring in any given year.
Floodplains: Lowlands, adjacent to rivers, lakes and oceans, subject to recurring floods.
Floodway: The stream channel and that part of the adjacent floodplain that must remain open to permit passage of the Base Flood without raising the water surface elevation by more than one foot. Flooding is the most intense and poses the greatest risk in the floodway area.

Flood hazards in the local region include *riverine flooding* and the *flash floods* that result from sudden, violent storms that produce large amounts of rainfall in short amounts of time. *Riverine flooding* involves overflows from rivers and streams. The form of flooding is often more gradual in nature and may allow more time for advance warning. *Flash flooding* – such as occurred in November 2003, resulting in federal disaster declarations for several localities may occur with little warning and yet cause significant damage.

History

The Mount Rogers region of Virginia has a long history of flooding. The floods typically result from heavy rains or from melting following a severe winter storm. Heavy rains during thunderstorms can cause flash flooding in localized areas. The region has experienced at least 16 presidential disaster declarations and at least three state-level emergency declarations from September 1972 through November 2006. This data only relates to major flood events and does not reflect the full range of flood events that have affected the region over the years.

Major Floods In The Mount Rogers Region
(Federal disaster declarations shown in shaded areas)

Date	Affected Localities	Description
11-18-03	Bland, Smyth, Galax; 12 counties and two cities in SW VA and NE TN	Heavy rains of 1.88" to more than 5" caused heavy flooding Nov. 18-19. Federal disaster declaration for Bland, Smyth, Galax in local region. $12 million damage across entire 12-county region.
2-15-03	Southwest Virginia (Wythe County declared a disaster)	State of emergency declared on 2-17-03 due to snow & ice in northwest VA and more than 4" of rain in southwest VA that caused flooding and mudslides. Federal disaster declared 4-28-03.
2-14-03	Washington, Bristol	Flooding from 4-day rainfall of 2-6" across southwest VA. See state of emergency declaration above.
4-17-02	Smyth, Washington, Wythe	Severe storms and flooding
3-17-02	Southwest Virginia	State of emergency declared on 3-18-02 due to heavy rainfall and flash flooding.
8-20-01	Washington	Severe storms and flooding
8-9-01	Smyth	Severe storms and flooding
7-26-01	Smyth, Washington	State of emergency declared on 7-29-01. This was part of the same weather pattern causing flooding on 7-8-01.
2-2-96	Bland, Grayson, Washington, Wythe	Flooding (resulting from Blizzard of 1996)
5-17-94	Galax	Severe ice storms and flooding
3-28-94	Bristol	Severe ice storms and flooding
3-10-94	Bland, Carroll, Grayson, Smyth, Washington, Wythe	Severe ice storms and flooding
5-19-92	Carroll	Severe storms and flooding
5-29-84	Washington	Severe storms and flooding
5-07-84	Town of Damascus	Flooding on Beaverdam Creek. Town declared a federal disaster area for damage to sewer system, Virginia Creeper Trail and private homes.
11-17-77	Carroll	Severe storms and flooding
11-12-77	Grayson, Smyth, Washington	Severe storms and flooding
10-02-77	Bristol	This 20-year flood caused $3 million in damage in 1977 dollars.
4-21-77	Carroll	Severe storms and flooding
4-7-77	Bland, Grayson, Smyth, Washington, Wythe	Severe storms and flooding
9-8-72	Smyth, Galax	Tropical Storm Agnes (flooding)
March 1867	Bristol	Flood of record for Beaver Creek in Bristol, TN and Bristol, VA. This was a 250-year flood.

Flooding events causing damage of $40,000 or more since 2003

6-12-04	Washington County	This flood caused $250,000 in damage
3-4-08	Smyth County	Severe storms and flooding caused $500,000 in damage
2-28-11	Bristol	Severe storms and flooding caused $40,000 in damage
5-13-11	Grayson County	This flash flood caused $85,000 in damage
6-9-11	Bland County	This flood cause $250,000 in damage

For Bristol the flood of record occurred in March 1867. This 250-year flood on Beaver Creek and its tributaries caused $1 million worth of damages (in 1867 dollars). More recently, in

October 1977, a 20-year flood caused $3 million worth of damages (in 1977 dollars) on the Bristol, Virginia side alone. The worst and most costly of flood damages on an annual basis occurs along the main stem of Beaver Creek.

For the Mount Rogers region as a whole, the worst flooding within the past 50 years occurred in April and November of 1977. The floods of 1977 later led to engineering reports that encouraged people to move out of the floodplain.

Engineering Studies

An engineering study in 1978 on flooding in Smyth County eventually led to a special project in Chilhowie that relocated 67 families and created the Chilhowie Recreation Park. Building on flood study work begun by the Tennessee Valley Authority in the late 1950s, the Town of Damascus also undertook projects to relocate 34 homes (88 residents) and three businesses out of the floodplain following the 1977 flooding.

The Middle Fork Holston River Flood Control Improvements Study, completed in March 1978, studied flooding issues in Smyth County, with special focus on the Town of Chilhowie/Seven Mile Ford community and the Town of Marion/Atkins community.

Initial recommendations from that 1978 study carried a total implementation cost of $18 million. Later the study was reduced to three sub-projects, but the price tag still proved very high. The recommendations included channelizing parts of the Middle Fork Holston River, with rip rap or concrete reinforcement, flood-proofing for selected businesses and industries, rebuilding several bridges to accommodate the widened river channel, relocations out of the floodplain, and installing some levees and pump stations. Of all the proposals discussed in the 1978 study, channelizing the river was deemed as a top priority with the potential for making the greatest impact on future flood levels.

The recommendations also included removing obstructions from the Middle Fork (including the breached dam at the old Marion Ice Plant), development of six flood storage reservoirs along six tributaries, and implementation of floodplain ordinances to limit future development in the floodplain area.

Although the 1977 floods had serious impacts for several industries located in the Middle Fork Holston floodplain, the industries declined to implement the recommendations due to the high cost. The local communities felt equally intimidated by the proposed mitigation costs, and there was little hope of major help from among a range of federal agencies to provide the 100% grant funding needed to carry out any of the proposed projects. The Planning District Commission finally decided to try to get the most for the funds available by demolishing the most flood-prone structures in Chilhowie and relocating families out of the floodplain.

The project that eventually emerged was a $2.8 million multi-part proposal to relocate families out of the Middle Fork Holston floodplain in Chilhowie, build replacement housing in a new

subdivision created for the relocation, and to provide water treatment improvements for the town of Chilhowie. The project area included 72 homes, three churches, three businesses and one lodge. To succeed at all, the effort had to overcome numerous complications created by the funding agencies, the attitudes of local residents, and the feelings of the town council, which observers felt cared more about the water treatment project than the flood mitigation project.

In the end, 67 families moved out of the floodplain. Of those, 53 families had help from the Tennessee Valley Authority and 14 had help through the Department of Housing and Urban Development. Due to the time it took to form the Chilhowie Redevelopment and Housing Authority (created in July 1979) and the new subdivision, most families relocated elsewhere. Only six families opted to relocate to the subdivision as planned. The town had the abandoned property demolished and built a community recreation park in the floodplain area (between Holston Street and Railroad Avenue). The project took seven years to complete.

Historically a flood-prone community due to development along Beaverdam and Laurel Creeks, along with obstructions in the creeks, Damascus suffered three major floods in 1977 (in April, October, and November). Twice in 1977 the community qualified as a federal disaster area. The 1977 flood events 1977 led to a comprehensive flood mitigation study completed in 1979. An initial cost estimate of more than $3.2 million would have built a levee emergency access route, relocated flood-prone homes out of the floodplain, flood-proofed some homes and businesses, removed two abandoned dams from Laurel Creek, installed storm drainage collection systems, and required more control of floodplain development by the town. In 1981, a follow-up flood mitigation program proposed by the town was estimated at $4.3 million.

Successful efforts by Damascus to mitigate its flooding problems over the years have included the following:

Successful efforts by Damascus to mitigate its flooding problems over the years have included the following:

- A $559,000 grant from the HUD in 1981 to install storm sewers along Mock, Surber, and Haney Hollows (finished in 1983).
- State and federal disaster assistance following another major flood in May 1984 helped make repairs to nearly $86,000 worth of damage to the community.
- Grant funding in 1984 ($700,000 from the

state CDBG program and $190,000 from the Tennessee Valley Authority) to relocate 34 families (88 people) and three local businesses out of the floodplain (1985 through 1988).

- The town also converted the old Damascus Elementary School for housing under a project funded by the state CDBG program.

RECENT FLOOD EVENTS

The more recent flood events from 2001-2011 were less drastic in extent and damages compared to the floods of 1977. Nonetheless the floods disrupted the lives of those who had to endure them, including the first major flood in several decades for the City of Galax.

The events of 2001 occurred in late July and early August. Heavy rainstorms caused flooding that forced more than 100 Smyth County residents from their homes, according to news accounts. Smyth and Washington counties became federal disaster areas. In all the flooding affected nine counties in southwest Virginia and led to at least $4.4 million in state and federal aid.

The next round of disaster-level flooding occurred March 17-20, 2002. Three to six inches of rain fell in a 36-hour period and led to federal disaster declarations for Smyth, Washington and Wythe counties.

The event affected numerous homes and businesses, with residential evacuations along the North Fork Holston River in Smyth County and in a remote part of Washington County. The floods also created overflows for water and sewer plants in the three counties, ruined some businesses and temporarily stranded some communities, such as downtown Chilhowie. FEMA disaster aid came to more than $500,000 in the local region as of June 2002, with an estimated $2.5 million total in damages. For the entire southwest Virginia region state and federal disaster assistance had reached $8 million.

The 2002 flooding led Chilhowie to undergo a preliminary $100,000 study by the U.S. Army Corps of Engineers on causes of the flooding and potential solutions, including river dredging and use of levees. In March 2004, the town manager recommended buy-outs of the 15 properties that flood most often. In Smyth County a decision was made to offer the buy-out option to six homeowners located on River Bottom Circle along the North Fork Holston River.

The flood disasters continued into 2003, with a federal declaration resulting from two back-to-back snowstorms February 15-28, affecting 10 southwest Virginia counties. In total the storm cost $37 million in snow removal costs and $71 million in damages to homes, businesses, public facilities, roads and other property. In the local region, Bland and Wythe counties sought federal aid for flood damages to public and private property.

On November 18-19, 2003, heavy rains caused severe flooding across 10 counties in northeast Tennessee and southwest Virginia. In Bland County damages were estimated at $485,000, with $878,000 in damage in Smyth County and $251,000 in damage in Carroll County. This included major damage or destruction of numerous homes, numerous flooded roadways, damage to public and private property, some evacuations and temporary closure of area schools.

The City of Galax suffered its first major flooding since 1940; initial reports to FEMA included damage to 10 businesses and 70 homes in an area that included the city's main business district along Chestnut Creek. Some sinkholes appeared, and there was flooding in several nearby residential communities. Total damages amounted to $100,000, with about half consumed by the cost of cleanup by the city, according to city officials. Because Galax does not participate in the National Flood Insurance Program, the designated floodplain area was not eligible for federal disaster assistance. The city so far has resisted suggestions it consider re-joining the flood insurance program. Damaged properties located out of the designated floodplain were eligible for disaster assistance. City officials have said many flooding problems are caused by undersized and deteriorated stormwater drainage systems.

In the past five years only one flood event in the Town of Fries was recorded. In May of 2011 a flash flood caused minor flooding at the elementary school, damaged approximately 20 vehicles, and caused some minor damage at an RV park. This flood also caused a manure spill that caused some localized water contamination. The town residents were asked by officials at the water treatment plant to conserve water. The town had enough water in reserve until the spill was cleaned.

NATIONAL FLOOD INSURANCE PROGRAM

Most communities with flooding issues in the local region participate in the National Flood Insurance program (NFIP). Participation in NFIP allows homeowners and commercial businesses to obtain flood damage protection. For single-family homes, the insurance provides up to $250,000 for structural damages and up to $100,000 for contents damages. Commercial businesses can be covered for up to $500,000 in structural damages and up to $500,000 in contents damages.

Flood insurance helps cover flood damages during minor and major flood events. Insurance coverage through NFIP also covers a larger amount for losses than typically would be available during a federal disaster. Emergency aid that is available following declaration of a federal

disaster most often comes in the form of a low-interest loan. FEMA promotes participation in NFIP for all qualifying communities

Community Participation in NFIP
Mount Rogers Region, Virginia

Jurisdiction	NFIP Status			
	Y	N	N/A	CRS Class
Bland County	X			na
Carroll County	X			na
Grayson County	X			na
Smyth County	X			na
Washington County	X			na
Wythe County	X			na
City of Bristol	X			na
City of Galax		X		na
Town of Abingdon	X			na
Town of Chilhowie	X			na
Town of Damascus	X			na
Town of Fries	X			na
Town of Glade Spring	X			na
Town of Hillsville	X			na
Town of Independence	X			na
Town of Marion	X			na
Town of Rural Retreat	X			na
Town of Saltville	X			na
Town of Troutdale		X		na
Town of Wytheville	X			na

As shown in table above, most of the localities participate in floodplain management and make NFIP coverage available to property owners. The City of Galax, with Chestnut Creek flowing through the city's downtown industrial district, participated in NFIP for a few years before dropping out. As a result of the November 2003 flood disaster, the city met with state and federal flood program officials. The city has opted to remain a non-participant. Galax recently submitted a request to the US Army Corps of Engineers to look at possible projects upstream of Chestnut Creek through the Flood Damage Reduction Program (Section 205 of the 1948 Flood Control Act). The end result would be a project that would reduce the 100-year flood plain to the Chestnut Creek channel. The Town of Troutdale due to its small size and the fact that relative little water runs through the town does not find it feasible to participate in the NFIP. In the past five years three other localities have joined the NFIP that did not previously participate at the time of the 2005 Hazard Mitigation Plan. These localities are Fries, Hillsville and Rural Retreat.

One major drawback for the floodplain maps in effect for the Mount Rogers region, as well as for many communities nationwide, is the age and relative inaccuracy of the maps. Although a fine effort has been made by FEMA to update the existing maps digitally, many of the existing maps in the local region date back to the 1980s, and some bate back to the 1970s.

In addition, most local floodplains have not been subject to hydrological studies to determine the Base Flood Elevations; the floodplain extent in such cases has been estimated based on the local topography.

As shown in the table below, Smyth County has received a relatively large share of payments under the National Flood Insurance Program, due to the frequency and severity of flooding in that county.

Loss Statistics Under NFIP
Mount Rogers Region, Virginia
Jan. 1, 1978 through Sept. 30, 2011

Locality	Total Losses	Closed Losses	Open Losses	CWOP Losses	Total Payments	

Abingdon	11	10	0	1	$158,110	
Bland County	52	39	0	13	$656,857	
Bristol	12	10	0	2	$71,753	
Carroll County	14	11	0	3	$102,649	
Chilhowie	35	28	0	7	$192,438	
Damascus	10	4	0	6	$6,311	
Galax*	2	2	0	0	$3,227	
Glade Spring	1	1	0	0	$4,347	
Grayson County	5	3	0	2	$14,563	
Marion	32	21	0	11	$192,958	
Saltville	1	1	0	0	$1,271	
Smyth County	83	57	1	25	$782,880	
Washington County	41	31	0	10	$431.088	
Wythe County	12	8	0	4	$56,214	
Wytheville	1	1	0	0	$35,472	
Mt. Rogers Region	**312**	**227**	**1**	**84**	**$2,710,138**	

RISK ASSESSMENT AND VULNERABILITY

The Mount Rogers region has experienced 18 presidential disaster declarations or state-level emergencies related to flooding over 30 years. That does not account for the more minor flooding that may occur from time-to-time due to a brief but severe rainstorm or thunderstorm causing small stream flooding in localized areas.

The FEMA floodplain maps available for communities participating in the National Flood Insurance Program (NFIP) depict 100-year floodplains for flood-prone areas. That means, in any given year, the floodplain area faces a 1% chance of having a flood.

Repetitive loss properties are those that have received federal aid more than once due to a flood disaster. There are 25 such properties in the Mount Rogers Region. The breakdown by locality is as follows:
Abingdon 1 (residential)
Bland County 6 (all residential)
Bristol 1 (residential)
Carroll County 1 (residential)
Chilhowie 4 (3 non-residential, 1 residential)
Smyth 7 (all residential)
Washington County 4 (2 residential, 2 non residential)
Wythe County 1 (residential)

While we have no way of knowing how much damage any given flood might cause, we can make some rough estimates based on repetitive loss payments. The average payment for damages on 25 repetitive loss properties comes to $16,667. New flood maps have been provided for parts of the Mount Rogers Region. They seem to be a digitization of the existing flood plain maps

Flooding causes damages ranging from blocked roadways and flooded basements to severe damage and destruction of homes and businesses. People sometimes die when they attempt to cross flood-swollen creeks that under normal circumstances appear fairly harmless. Severe flooding can take out bridges and sections of roadway. Flooding can also force people out of their homes into emergency shelters as a way to save lives and prevent people in flood-prone areas from becoming stranded. Fortunately, despite the constant threat of flooding for much of the Mount Rogers region, few people have died. Many more have sustained property damage, and some have been relocated out of the floodplain through government-sponsored programs. A map showing the 100 year floodplain for all localities in the Mount Rogers Region is located in the section titled Appendix I at the end of the document.

The localities in the Mount Rogers Region do not allow construction inside the floodplain unless the structure is elevated above the 100 year floodplain elevation. For this reason the vulnerability of structures inside the floodplain has not changed since the original writing of the 2005 Hazard Mitigation Plan.

KARST AND SINKHOLES

DESCRIPTION

Karst and sinkholes are features in the landscape usually associated with carbonate rock (limestone, dolomite, gypsum) that has been dissolved over millions of years by groundwater. This process leads to creation of underground cracks, fissures and caves that can serve as a direct route of transport of surface pollutants into the groundwater system. Karst features in Virginia also are associated with exceptionally rare plant and animal habitats, some found nowhere else in the world.

Sinkholes can appear when the underground system has become weakened through withdrawal of groundwater, mining activities, wetlands drainage, or as a result of the continued dissolution of the underlying rock deposits. Sinkholes may appear as depressions in the landscape or as open holes.

The appearance of sinkholes and subsidence of the landscape can occur gradually and broadly, as is often typical with the drainage of wetlands. Subsidence also can happen abruptly with the sudden formation of localized sinkholes; this occurs most often in abandoned mines, but also is known to occur along highways such as Interstate 81. At times subsidence happens on a more massive scale, with creation of holes large enough to swallow a house or other surface structures.

The Valley and Ridge geologic province includes a system of aquifers that contain carbonate rock (karst) and undifferentiated sedimentary rock. This is a particular problem for Bland, Wythe, Smyth and Washington counties. The Virginia Speleogical Survey has accounted for at least 562 caves among the four counties. Karst terrain, which includes more than just caves, is a factor in 20% of Bland County, 30% of Smyth and Wythe counties and 50% of Washington County.

Sinkholes are of particular concern because they serve as conduits between surface water and groundwater. This interaction can lead to rapid transport of surface pollutants introduced by various means such as urban runoff and use of sinkholes as trash dumps. The underground drainage system can also be blocked by erosion and sedimentation from construction sites and other human activities. Because so many people rely on groundwater (and wells) for drinking water, it is critical to protect the purity of groundwater, especially in the environmentally sensitive karst terrain. A map showing karst areas in the Mount Rogers Region is located in the section titled Appendix I at the end of the document.

History

In the local region, sinkholes suddenly appear from time to time on Interstate 81, which passes through the karst region of Virginia. One recent incident occurred in October 2003, when a sinkhole appeared on I-81 about one mile past the junction with I-77 in Wythe County. Both the Virginia Department of Transportation and Duke Energy said the sinkhole appeared in connection with drilling under the highway in connection with installation of a 24-inch natural gas pipeline. The incident blocked a northbound lane of I-81 for a few days before VDOT completed the needed repairs and the reopened the lane to regular use.

Subsidence also has been a problem for Saltville due to mining for salt and gypsum. Salt mining first began in 1782 and continued until 1972 with the shutdown of Olin Industries, once a major employer in Saltville. Commercial production of salt resumed in 2000 with completion of an evaporator plant by Virginia Gas Company, which was removing brine from the underground caverns to make room for natural gas storage.

Gypsum mining began in 1815 and continued under the U.S. Gypsum Company, starting in the early 1900s. U.S. Gypsum, which has since moved to production of artificial gypsum, closed its Saltville area facilities in 2000.

In 1960 a major collapse occurred in a section of the high-pressure brine field located just southwest of Saltville. The collapse involved four wells spaced closely together and considered shallow, ranging from 450 to 800 feet deep, according to expert testimony. Over time the bottom cavities of the wells appeared to have merged together. The underground collapse moved upwards through the relatively thin rock "roof" layers (themselves 200-316 feet thick) to the surface. This resulted in a crater 400 feet wide and 250 feet deep.

More recently, a section of State Rt. 91 collapsed into a 50-foot wide sinkhole in front of the offices of U.S. Gypsum. In the past gypsum mining had occurred under the collapse site and may have been a contributing factor. Blame was also placed on a leaking water line that had apparently dissolved the underlying limestone, thereby weakening the underground support structure and leading to the collapse. It should be noted these incidents have resulted from human-induced activities, while the focus of this study has been on hazards created by nature.

In the Wythe County community of Ivanhoe an underlying sinkhole eventually caused the floor of the local post office to fall through. A new post office has since been established for Ivanhoe. Karst terrain also is a factor in the Town of Chilhowie, which is investigating why the town water system loses 16 million gallons a month; some is thought to leak into the underlying terrain. Construction workers for Duke Energy Gas Transmission also encountered karst terrain during the recent installation of the Patriot Extension natural gas pipeline near New River Trail State Park (near Foster Falls in Wythe County).

RISK ASSESSMENT AND VULNERABILITY

There is no known way to predict when sinkholes might open up or when subsidence might occur. There is only limited data available on karst terrain, its extent, and its importance from an ecological standpoint and as a natural hazard.

The ecological importance of this landform is only beginning to be understood through the efforts of various state and federal agencies and by groups such as the Karst Waters Institute, Cave Conservancy of the Virginias, The Nature Conservancy, and others.

As noted in the section on landslides, detailed basic geology maps are still under development in the state and local region. It is not possible to make any risk assessment other than in a generalized fashion. This task may become possible in the future under a new program on karst and subsidence hazards proposed for the National Cooperative Geologic Mapping Program. The NCGMP is a digitized mapping effort by the U.S. Geological Survey in coordination with the Association of American State Geologists. The Geologic Mapping Act of 1992 mandated creation of a national geologic database.

The Karst and Subsidence Hazards program has been planned to develop better understanding of groundwater contamination, sinkhole formation, new techniques for karst analysis through remote sensing and geophysics, regional karst issues in the Appalachians, and understanding of karst issues on a national scale through development of a new National Atlas karst map.

Karst terrain is a special concern for Bland, Wythe, Smyth and Washington counties as a feature of the Valley and Ridge geological province. In the five year time span since the original Hazard Mitigation Plan was written, the region's vulnerability to karst and sinkholes have not changed.

Karst as a natural hazard can be a costly matter for the community. There are the long-term costs associated with environmental pollution and contamination of the groundwater supply. There also are costs associated with damage created by subsidence, such as the collapse of State Rt. 91 into a sinkhole near Saltville in 1977. In 2004 VDOT was nearing completion on relocating 0.5 miles of Rt. 91 at an estimated cost of $2 million.

Due to the lack of mapping of significant karst terrain, incidents involving the sudden appearance of sinkholes and leakage often come as a surprise to local governments. No historical events have occurred since 2005.

LANDSLIDES

DESCRIPTION

Landslides can be defined as the downward and outward movement of soils and slope-forming materials reacting under the force of gravity. These movements can be triggered by floods, earthquakes, volcanic eruptions and excessive rain. The three important natural factors include topography, geology and precipitation. Human-caused factors include cut-and-fill highway construction, mining and construction of buildings and railroads.

Types of landslides include slides, flows, falls and topples (which occur rapidly), and lateral spreads (which occur much more slowly).

The Appalachian Highlands, along with other mountainous regions of the United States, are known to be highly susceptible to landslides. These come in the form of earth flows, debris flows and debris avalanches, mainly in areas of weathered bedrock and colluvium. Debris avalanches can occur during period of continual steady rainfall followed by a sudden heavy downpour. Areas prone to landslides include the plateau of the western Appalachian Highlands (especially in Tennessee and Kentucky) and southeast of the Appalachian Plateau, in the flanks of the Appalachian Ridge and the Blue Ridge (which includes the Mount Rogers region). For the most part these movements are comprised of slowly moving debris slides.

On a generalized scale, hazard-prone areas have been mapped by the U.S. Geological Survey. However, this information needs to be evaluated at ground level to more clearly identify the landslide-prone areas of the Mount Rogers region. A map showing landslide incidence and susceptibility in the Mount Rogers Region is located in the section titled Appendix I at the end of the document.

HISTORY

Information is limited regarding landslides and debris flows for the Mount Rogers region. While generalized statewide geology maps have been published, detailed maps for the local region are still in development. These will become the basic geology maps that in the future can be used in landslide risk assessment. Geologists with the Virginia Department of Mines, Minerals and Energy were in the process in 2003 of creating basic geology maps in Washington County and were planning to move into Smyth County and other parts of the Interstate 81 corridor. In the past most geologic mapping related to resources of economic value, such as coal.

The record is scant concerning landslide incidents in the Mount Rogers region. A staff review of a comprehensive, nationwide database giving locations of debris flows, debris avalanches, and mud flows revealed no information pertaining to the local region.

Events that do appear in the literature include a major landslide in Madison County during the summer of 1995, debris flows and flooding in the Potomac and Cheat River basins in 1985, and debris flows created by Hurricane Camille in Nelson County in 1969. The Madison County event resulted from an intense June rainstorm that caused hundreds of debris flows and later led to a federal disaster declaration, with damages estimated at more than $100 million.

Three days' worth of rainstorms in November 1985 caused debris flow and flooding in northern Virginia and West Virginia. The event caused $1.3 billion in damage and resulted in 70 deaths. In 1969 the destruction created by Hurricane Camille included 150 deaths and more than $100 million in property damage.

Small-scale landslides are known to occur on steep slopes and can sometimes block roadways. The Virginia Department of Transportation makes emergency repairs as needed. On occasion a major landslide can block a roadway for as much as two weeks, as happened some years ago long Route 600 in Smyth County. Heavy rains and the annual freeze-thaw cycle can trigger these landslides.

More recently in March of 2011 a rockslide occurred in Carroll County. The event happened on Interstate 77 at mile marker 3.8 in the left northbound lane. A boulder roughly the size of a car fell onto the highway. A man struck the boulder with his car killing him instantly. VDOT officials surveyed the cliff above and determined that no other rocks were in danger of falling.

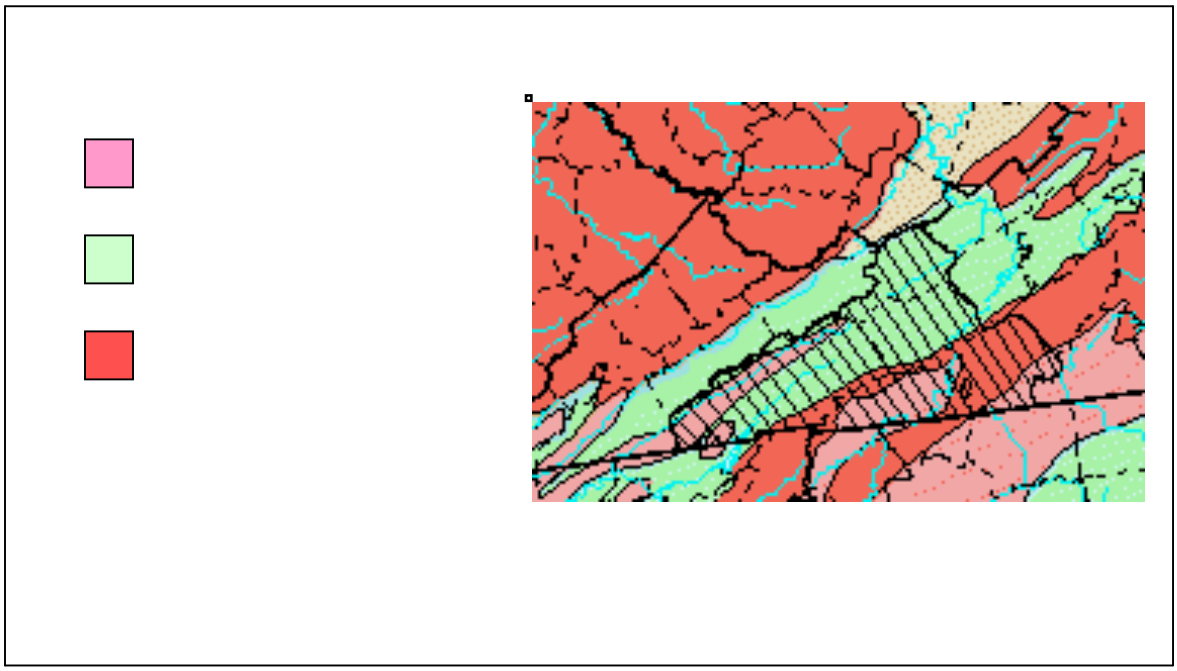
Source: "Landslide Overview Map of the Conterminous United States," Geological Survey Professional Paper 1183 (1982), as modified by the MRPDC. The Mount Rogers region is shown in the area shaded with slanting lines.

RISK ASSESSMENT AND VULNERABILITY

The Mount Rogers region is mountainous in nature, and its steep slopes make parts of the region susceptible to landslides. The hazard-prone areas have been generally mapped by the U.S. Geological Survey, as shown below.

The USGS divides landslide risk into six categories. These six categories were grouped into three, broader categories to be used for the risk analysis and ranking; geographic extent is based off of these groupings. These categories include:

High Risk
1. High susceptibility to landsliding and moderate incidence.
2. High susceptibility to landsliding and low incidence.
3. High landslide incidence (more than 15% of the area is involved in landsliding).
Moderate Risk
4. Moderate susceptibility to landsliding and low incidence.
5. Moderate landslide incidence (1.5 - 15% of the area is involved in landsliding).
Low Risk
6. Low landslide incidence (less than 1.5 % of the area is involved in landsliding).
The six categories were grouped into High (categories 1-3), Medium (categories 4 – 5), and Low (category 6) to assess the risk to state faculties, critical facilities and jurisdictions.



Certain types of rocks and geologic conditions, when they occur on slopes, make an area prone to landsliding. These types include fine-grained clastic rocks (those consisting mainly of silt and clay-sized particles), highly sheared rocks and loose slope accumulations of fine-grained surface debris, which give way during times of intense or sustained rainfall. Steep slopes also can add to the likelihood of landslides. Debris flows, for instance, are known to occur mainly on slopes steeper than 25^{o}.

There is no accepted method for determining the likelihood of a landslide in the Mount Rogers region. Given the relative lack of historical data on catastrophic landslides affecting the region, our best guess is a major landslide incident appears to be unlikely.

Landslides are not well understood in the Mount Rogers region. Most geologic studies have been focused on mineral resources (especially coal) of economic importance. Basic geologic mapping is only beginning to get underway in the region. More information will be needed before any detailed risk assessment can be made for localities in the Mount Rogers region.

Please see the image above (Generalized Landslide Image of Southwest Virginia) for a visual depiction of potential landslide risk areas in the local region.

Generally speaking, the areas posing the greatest landslide risk include the pink and red regions. The pink regions include parts of Washington, Smyth and Grayson counties and a corner of Carroll County. The red regions include much of Carroll County and the border area between Washington, Smyth and Grayson counties.

Landslides can damage or destroy roads, railroads, pipelines, utilities and infrastructure, forests, fisheries, parks and farms. Damages can include economic losses to local, state and federal agencies – because of the impacts to public infrastructure – and to the private sector for impacts to land and buildings. When located near communities, sudden landslides also can cause death. In the five year time span since the original Hazard Mitigation Plan was written, the region's vulnerability to Landslides have not changed.

SEVERE WINTER STORMS AND ICE

DESCRIPTION

Blizzards represent the worst of the winter season, combining heavy snowfall, high winds, extreme cold and ice storms. Severe winter storms can be characterized by heavy snowfall but lacking the severity usually associated with blizzards. They often begin as mid-latitude depressions or cyclonic weather systems and sometimes follow the jet stream.

For the Mount Rogers region storm systems travel in from the Midwest and Tennessee Valley, from the Gulf Coast region and sometimes as a result of a major coastal storm that passes inland.

On the northern side, extreme cold weather and Arctic cold fronts move in from Canada and are known to sweep into the Mid-Atlantic region. The severity of these storms may result from high snowfall accumulations that lead to major snowdrifts and blizzard conditions or that later melt and cause flooding. Wetter storms may have only limited amounts of snow but are severe due to accumulations of ice. A light covering of ice can easily create numerous traffic accidents. Both ice and heavy snow can tear down tree limbs, trees, power lines and telephone lines, creating major disruptions that sometimes cannot be cleared up for weeks. A map showing the heaviest average snow accumulations in the Mount Rogers Region is located in the section titled Appendix I at the end of the document.

History

The historical record for snowstorms and blizzards in the Mount Rogers regions gives numerous examples of how bad these storms can get. Though the data reported in the table below only covers a 10-year period, major winter events in the region resulted in seven federal disaster declarations and at least four state emergency declarations.

Major Winter Storms, Cold And Ice Mount Rogers Region, Virginia 1993-2003

DATE	LOCALITIES	DESCRIPTION
4-28-03	Wythe County	Severe winter storm, near record snowfall, heavy rain, flooding, and mudslide. 39 jurisdictions had disaster declarations. Wythe qualified in April for public assistance as result of the March storm.
3-30-03	Bland, Carroll, Grayson, Smyth, Wythe, Galax	Winter storm with heavy snow that began during the predawn hours of the 30th and continued through the early afternoon. Snow accumulated 6-12", brought down numerous tree limbs and power lines, resulting in more than 50,000 power outages.
2-15-03	Bland, Grayson, Wythe	**State emergency declaration** due to severe winter storm, impassable roads and flooding. SW Virginia got more than 4" of rain. Evacuations from homes in Bland and Wythe counties. Public assistance for debris removal, emergency protection and repair of damaged public facilities.
12-11-02	Carroll, Galax	**State emergency declaration** due to icy conditions creating massive power outages. Accretions of ¼" of ice. An icy winter storm followed on Dec. 13.
12-04-02	Bland, Carroll, Grayson, Smyth, Washington, Wythe, Galax.	Winter storm affected a wide area of SW Virginia. Snowfall amounted to 5-10" and ice of 1" or more in Carroll and Floyd counties. Numerous traffic accidents.
May 2002	Bland, Carroll, Wythe, Bristol, Galax	Freeze damage affected Christmas tree growers. USDA was working to address the problem.
2-28-00	Bland, Carroll, Grayson, Smyth, Washington, Wythe	Severe winter storm. 107 jurisdictions had disaster declarations for winter storm from Jan. 25-30, 2000.

1-25-00	Bland, Carroll, Grayson, Wythe, Galax	**State emergency declaration** due to winter storm with high winds that dumped up to 18" of snow across much of the state, with drifting and blizzard conditions. Local storm occurred on Jan. 29. Snow mixed with sleet amounting to 4-8" inches, 11" in higher elevations.
3-15-99	Bland, Carroll, Smyth, Wythe, Galax	Winter storm developed with rain and sleet changed to a wet snow early in the morning. Snow amounts of 4-8", with up to 10" in the higher elevations. The snow downed power lines and small trees, resulting in power outages.
3-03-99	Bland, Carroll, Grayson, Smyth, Wythe, Galax	Winter storm resulted from rain changing to sleet and then snow, with accumulations of 6-12". Numerous motor vehicle accidents. Motorists stranded for 5-6 hours on I-77.
12-23-98	Bland, Carroll, Grayson, Smyth, Wythe, Galax	Ice storm created ice accretions of ½" and sometimes as much as 1". Ice downed tree limbs and power lines and created numerous power outages. Many traffic accidents and some injuries due to ice-covered roads and bridges.
1-28-98	Bland, Carroll, Grayson, Smyth, Wythe, Galax	**State emergency declaration** for severe winter storm with heavy snowfall in the western part of the state causing riverine flooding. Snowfall of 15-32" closed schools, businesses & church services & stranded people in vehicles & homes. Numerous traffic accidents. A charter bus overturned on I-81 near Marion, injuring 20 people. I-81 was closed for several hours during the height of the storm. Power lines, tree limbs and trees were knocked down.
12-29-97	Bland, Carroll, Grayson, Smyth, Wythe, Galax	Heavy winter snowstorm produced accumulations of 5-10", with 4-7" in Bland County. Bad road conditions resulted in numerous traffic accidents.
3-28-96	Bland, Carroll, Wythe, Galax (Bath County hardest hit)	Ice storm with freezing rain all day created significant ice cover above 1900 feet. Ice downed tree limbs, power lines, telephone lines. Numerous power outages and some traffic accidents.
2-02-96	Bland, Carroll, Grayson, Smyth, Washington, Wythe, Bristol, Galax	**State emergency declaration** for a winter storm with heavy snow, followed by extreme cold Feb. 3rd -6th. Burkes Garden in Bland County recorded 22° below zero. Most locations had morning lows on the 5th of zero to 12° below zero. Emergency declaration based on an Arctic air mass moving across state Feb. 1-4, with potential to cause widespread power outages.
1-06-96	Bland, Carroll, Grayson, Smyth, Wythe, Galax	**Blizzard of 1996**. **State emergency declaration** for a predicted winter storm with blizzard conditions and snowfall of 12-24" expected. **Statewide disaster declaration**. Occurred Jan. 6-13.
Winter of 1995-96	VDEM "Virginia Winters" account	Unusually heavy snowfall for the winter. Burkes Garden had 97", while Bland had 62". Some schools lost up to 15 days due to snow.
3-28-94	Bristol	Severe ice storms, flooding
3-10-94	Bland, Carroll, Grayson, Smyth, Washington, Wythe	Severe ice storms, flooding. May be related to the **state emergency declaration** of March 2, 1994.
3-12-93 to 3-13-93	Bland, Caroll, Grayson, Smyth, Wythe, Galax (affected a region from Florida to New England)	**Blizzard of 1993**. 43 jurisdictions received disaster declarations statewide. Extreme cold and heavy snowfall, along with high winds, sleet and freezing rain left many motorists stranded. $5 million property damage. It was the biggest storm in a decade in Virginia. SW VA got 24-42" of snow. Interstate highways were closed and emergency shelters were opened to house up to 4,000 motorists.
12-18 2009	Grayson, Carroll, Smyth, Washington.	**Grayson County received federal assistance.** A total of $600,000 of damage was reported

Source: Virginia Department of Emergency Management and National Climatic Data Center.
Note: Items with dates appearing in boldface and shading resulted in presidential disaster declarations.

Major storms such as the Blizzard of 1993 closed down interstate highways, stranded motorists in their vehicles and trapped people in their homes. The event also brought high winds, sleet and

freezing rain, adding to the disruptions created by the snowfall. In southwest Virginia, snowfall ranged from 24 to 42 inches in what was the largest snowstorm in a decade for the state. The Blizzard of 1996 (January 6-13) began in the southeastern states and moved into the northeastern states to cover the entire eastern seaboard. Snowfall amounted to one to four feet, with the greatest impacts for Virginia and West Virginia. On a statewide level, Virginia had 48 inches of snow, followed by West Virginia with 43 inches of snow. Much of the same region experienced two more snowstorms that dumped up to 12 inches more within the next 10 days. The National Climatic Data Center listed the storm of December 2009 as the only winter storm since the writing of the original plan that caused major monetary damage.

Below is the Northeast Snowfall Impact Scale that characterizes and ranks high impact winter storms.

Category	NESIS Value	Description
1	1—2.499	Notable
2	2.5—3.99	Significant
3	4—5.99	Major
4	6—9.99	Crippling
5	10.0+	Extreme

Annual Snowfall Data, Mount Rogers Region, Virginia

Locality	Avg. Annual Total Snowfall	Time Period
Abingdon	16.3"	12/69-3/03
Bland	25.5"	9/51-3/03
Burkes Garden	46.3"	8/48-3/03
Byllesby	11.4"	5/67-3/03
Chilhowie	19.2"	4/52-9/76
Damascus	22.0"	8/48-7/74
Galax Radio	19.1"	8/48-3/03
Hillsville	18.9"	8/48-3/03
Independence	20.2"	1/53-6/89
Mendota	15.6"	8/48-9/76
Saltville	13.4"	1/30-3/62
Speedwell	8.0"	8/48-9/85
Troutdale	20.2"	8/48-3/03
Wytheville	19.9"	1/30-3/03

Source: Period of Record Monthly Climate Summary, Southeast Regional Climate Center at http://cirrus.dnr.state.sc.us.

Snowstorms pose a threat not only because of dangerous driving conditions and downed power lines, but also due to the melting that can lead to flooding. During the 2002-2003 winter season, severe winter storms later created flooding problems in Bland, Grayson and Wythe counties, with Wythe declared eligible for federal disaster assistance.

Due to variable topography and other factors, average annual snowfall amounts vary greatly throughout the Mount Rogers region, based on available weather records shown in the accompanying table shown at left. The data covers time periods as long as 81 years.

RISK ASSESSMENT AND VULNERABILITY

Winter storms are a regular part of the weather regime for the Mount Rogers region. The severity of the season varies from year-to-year and can be highly variable among the localities for any given storm event. The variability can be due to differences in elevation, differences in temperature and the track of given storm systems.

In recent years there have been at least 11 state and/or federal disaster declarations due to severe winter storms over a 10-year period, as shown in the table on Major Winter Storms, Cold and

Ice. Based on this brief time period, it is likely localities in the Mount Rogers region will experience at least one major snow and/or ice storm per year with the potential to become a federal disaster. The winter season typically runs from November to April of each year.

The average winter season in the Mount Rogers region can create annual snowfall amounts ranging from 8 to 46 inches. The average snow season in Roanoke produces 23 inches per year. The average winter season in the Mount Rogers region can create annual snowfall amounts ranging from 8 to 46 inches. The average snow season in Roanoke produces 23 inches per year (over 49 years) and in the Bristol-Johnson City-Kingsport, Tenn. area produces 15.6 inches per year (over 59 years).

Any major winter storm or blizzard is likely to affect the entire Mount Rogers region, with the most direct impacts affecting highways and power lines. Most snow-related deaths result from traffic accidents, overexertion, and exposure. Sometimes also there is damage to buildings from collapsed roofs and other structural damage. In the five year time span since the original Hazard Mitigation Plan was written, the region's vulnerability to winter storms have not changed. There is no way that we know of to calculate the likely costs of a major winter snow or ice storm. The available data, through the National Climatic Data Center, reports damages by storm event, but this is not broken down by locality.

Severe winter storms and ice can cause death and injury on the highways and trap people in their motor vehicles or in their homes due to impassable roads. Snowstorms also regularly result in the closing of schools; in some years, the local schools have been closed as much as 15 days due to winter conditions. Forecasts of impending snowstorms also regularly result in early school closings to reduce risk from bus and traffic accidents. Likewise, winter conditions can result in temporary disruptions of business activity, with workers advised to remain home until driving conditions improve.

The Virginia Department of Transportation deals directly with the effects of snowstorms. On average in the past five years, VDOT has spent $80 million annually on snow removal. As a general rule, the first priority is to plow interstate highways, major primary roads and secondary roads. Plowing in subdivision and residential areas are the second priority during winter storms. VDOT seeks to get ahead of snow conditions on the roadways through pre-treatments with liquid chloride and close monitoring of storm conditions and incoming storms.

For American Electric Power the main concern is icing, which can tear down overhead power lines. AEP is sometimes hampered in its efforts to restore power during major snowstorms due to the poor condition of the roads. The state's system of highway maintenance, carried out by several private contractors, at times creates uneven results during snow clearing.

THUNDERSTORMS AND LIGHTNING

DESCRIPTION

Thunderstorms arise from atmospheric turbulence caused by unstable warm air rising rapidly into the atmosphere, enough moisture to form clouds and rain and an upward lift of air currents caused by colliding warm and cold weather fronts, sea breezes or mountains. Thunderstorms are always accompanied by lightning, but they may also be associated with heavy rains, hail and violent thunderstorm winds.

Thunderstorms occur most often during the spring and summer months and can occur throughout the entire Mount Rogers Region. Nationwide the average storm is 15 miles wide and generally last less than 30 minutes at any given location. Some storm systems have been known to travel more than 600 miles. A map showing the favored high wind areas in the Mount Rogers Region is located in the section titled Appendix I at the end of the document.

HISTORY

Storm events reported to the National Climatic Data Center reflect the kind of activity and damages resulting from high winds and thunderstorm winds. Describing the data can be problematic, since storms often travel over wide regions. The reported damages represent those for the entire storm event and are not usually limited to a given locality. The data given in the table below offers a guide to thunderstorm history in the Mount Rogers region.

Storm Event History For Thunderstorm Winds
Mount Rogers Region, Virginia

Location	Time Period	No. Of Years	No. Of Events	Avg. Per Year	Reported Damages
Bland County	May 1989-July 2011	22	30	1.4	$254,000
Carroll County	June 1960-July 2011	51	69	1.4	$1,350,000
Grayson County	May 1962-July 2011	49	51	1.1	$515,000
Smyth County	April 1972-May 2011	39	50	1.3	$498,000
Washington County	June 1995-Aug. 2011	16	112	7.0	$1,560,700
Wythe County	July 1962-Aug. 2011	49	47	1.0	$632,000
City of Bristol	July 1980-Aug. 2011	31	45	1.5	$252,000
City of Galax	Jan. 1998-May 2011	13	8	0.6	$9,000

Another event, on July 4, 1997, captured in the NCDC data involved a **supercell thunderstorm** and associated severe thunderstorms affecting a region stretching from Tazewell to Pittsylvania counties. Thunderstorm winds estimated at 60-80 mph and hail the size of golf balls damaged at least 29 homes, 16 mobile homes, five outbuildings, four businesses and a church in a two-mile path near Wytheville. There was also widespread damage to vehicles, roofs, sidings, satellite dishes, trees and a large sign knocked down by the winds. Wytheville Community College sustained 100 broken windows. Hail drifts amounted to six to eight inches deep in several locations. The event caused an estimated $300,000 in property damage.

A **supercell thunderstorm**, while rare, is the often the most violent known form of thunderstorm and is associated with tornadoes, damaging straight-line winds and large hail. These events are defined as long-lived thunderstorms with a persistent rotating updraft. They often contain a mesocylone, or storm-scale regions of rotation typically two to six miles in diameter that may produce tornadoes.

LIGHTNING

Thunderstorms are always accompanied by lightning, which can cause fires, injury and death. Florida is known for having the greatest number of thunderstorms and the highest density lightning strikes in the contiguous United States.

Lightning becomes a problem when the discharge of a lightning bolt connects with an object or surface on the ground. Lightning will be considered together with thunderstorms in judging the importance of this hazard for the Mount Rogers region.

RISK ASSESSMENT AND VULNERABILITY

Southwest Virginia experiences 60-80 thunderstorms on average per year. Most of these occur during the summer months, extending from May through September, with July the peak month for thunderstorms statewide, according to the state climatology office. This is moderate compared to other parts of the country with more than 130 thunderstorms annually. During the peak of the thunderstorm season in the local region, storms may roll through at the rate of three or four per week, which is relatively frequent.

People and property throughout the Mount Rogers region are subject to damages and injuries created by lightning and thunderstorms. But any individual storm is likely to affect only a very limited area. In the five year time span since the original Hazard Mitigation Plan was written, the region's vulnerability to thunderstorms and lightning has not changed.

Virginia experiences a moderate number of thunderstorms and lightning strikes compared to other parts of the country, according to research cited by FEMA. Thunderstorms in the Mount Rogers region typically last 70-80 minutes in any given location, which falls in the mid-range for storm duration nationwide. In some areas thunderstorms last 130 minutes or more, based on findings by the National Weather Service for the years 1949-1977.

These storms can cause serious structural damage to buildings, start forest fires and wildfires, blow down trees and power lines, and cause death. On rare occasions, events such as the supercell thunderstorm from July 1997 can cause widespread damage, as previously discussed on the history section.

Nationally, Virginia falls in the mid-range for lightning fatalities, based on the cited research through the National Oceanic and Atmospheric Administration. States such as Florida, North Carolina, New York and Tennessee rank far ahead of Virginia. The lightning that accompanies thunderstorms in the Mount Rogers region averages 4-6 strikes per square kilometer, which is relatively low.

It is not possible based on available data to quantify the impacts of thunderstorms and lightning for localities in the Mount Rogers region. Available data from the National Climatic Data Center, which tracks incidents of thunderstorms and thunderstorm wind damage, is reported on a regionalized basis often covering numerous localities as a storm system moves through. Data resources will have to improve in the future to be able to make these calculations on the local level.

TORNADOES AND HURRICANES

DESCRIPTION

A tornado appears as a rapidly spinning vortex or funnel of air extending to the ground from an overhead storm system (usually a thunderstorm). Tornadoes come in many sizes, ranging from several yards to more than a mile wide. The severest tornadoes can achieve wind speeds of more than 300 mph, though most are 100 mph or less. The weakest tornadoes may last only about a minute, while the stronger ones may continue for 30 minutes at a time and travel miles before dissipating. Virginia is said to have an average of seven reported tornadoes per year (1950 through 2006), though the actual number of tornadoes may be higher.

Statistically the peak month for tornadoes in Virginia is July, though the tornado season goes from spring through fall. Tornadoes spring from an estimated 1% of all thunderstorms; of the group that produces tornadoes, only about 2% are considered violent with winds over 200 mph (categories F3, F4 and F5 on the Fujita scale). Tornadoes also can be associated with hurricanes, though hurricanes are not a significant factor in southwest Virginia.

FUJITA SCALE			DERIVED EF SCALE		**OPERATIONAL EF SCALE**	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)	**EF Number**	**3 Second Gust (mph)**
0	40-72	45-78	0	65-85	**0**	**65-85**
1	73-112	79-117	1	86-109	**1**	**86-110**
2	113-157	118-161	2	110-137	**2**	**111-135**
3	158-207	162-209	3	138-167	**3**	**136-165**
4	208-260	210-261	4	168-199	**4**	**166-200**
5	261-318	262-317	5	200-234	**5**	**Over 200**

As seen in table shown above, tornadoes are measured on the Enhanced Fujita Scale, with categories ranging from F0 to F5. The categories are defined according to wind speed and the types and severity of damage caused. Parts of southwest Virginia show some tendency toward tornadoes in an area that extends from Tennessee into Bristol and Washington County due to the lay of the land and its influence on storm systems. Maps showing tropical cyclone tracts and

tornado hazard frequency in the Mount Rogers Region are located in the section titled Appendix I at the end of the document.

HISTORY

Between 1950 and 2005, Virginia experienced six tornadoes per year or 1.6 tornadoes annually per 10,000 square miles. Two storms per year on average were rated as strong or violent (F2-F5), with 0.5 such storms per 10,000 square miles per year.

Tornado History: Mount Rogers Region1950 through 2011

Locality	Date	Time	Dead	Hurt	F Scale
Bland Co.	-	-	-	-	-
Carroll Co.	Aug. 1, 1965	0230	0	5	F1
	Aug. 21, 1977	1700	0	0	F2
	July 4, 1979	1620	0	0	F1
	May, 6 2009	2126	0	0	F0
Grayson Co.	July 10, 1959	1500	0	0	F1
	May, 6 2009	2125	0	0	F0
Smyth Co.	April 4, 1974	0405	0	3	F3
	Jan. 25, 1975	2335	0	2	F2
	June 5, 1975	1815	0	0	F0
	July 13, 1975	1900	0	0	F1
	April 28, 2011	0200	0	1	F2
	April 28,2011	0015	0	0	F2
Washington Co.	April 30, 1953	1845	0	0	F0
	June 10, 1953	1500	0	0	F1
	June 3, 1962	1600	0	0	F2
	April 4, 1974	0400	1	1	F3
	Jan. 25, 1975	2330	0	0	F2
	April 30, 1990	1725	0	0	F0
	April 28, 2011	0100	4	50	F3
Wythe Co.	-	-	-	-	-
City of Bristol	April 4, 1974	0300	0	0	F0
City of Galax	-	-	-	-	-

Totals:	**20 events**		**5**	**61**	

For the Mount Rogers region there have been 20 reported tornadoes from 1950 through April 2011, with 5 people killed and 61 people injured. The highest intensity ever recorded for these storms was F3. See the table above for more details.

On the Fujita scale, an F3 category tornado is considered severe, with winds up to 206 mph. This fits with the FEMA Wind Zone III designation for the region. By definition Zone III communities are known to experience winds of 160-200 mph.

The tornadoes of April 4, 1974 were part of what is known as the "Super Outbreak," when severe thunderstorms at the leading edge of a cold front moved into southwest Virginia. Eight

tornadoes struck statewide, killing one person and hurting 15. The destruction affected more than 200 homes and barns and more than 40 mobile homes and trailers. The storm event in total spawned 148 tornadoes killed 315 people and injured 5,484. "Super Outbreak" created the most tornadoes ever recorded in a 24-hour period and the worst tornado outbreak since Feb. 19, 1884. This was true until the tornado outbreak of April 25-28 of 2011. This outbreak produced at least 336 tornados in 21 states from Texas to New York and even created isolated tornadoes in Canada. The storms caused $10 billion worth of damage and tragically resulted in 346 deaths. In the Mount Rogers Planning District the storms resulted in 4 fatalities and caused $38.5 million in damages.

One of the tornadoes, rated at F0 to F1, struck near Bristol, demolishing several mobile homes and hurting four people. A stronger F3 tornado hit the Saltville area, traveling up the valley of the North Fork Holston River from Washington County, then following Tumbling Creek into Poor Valley and traveling up the Poor Valley to Cardwell Town. The storms resulted in one dead, one injured and destruction of two houses, two mobile homes, a church and three barns. There was also damage to 42 homes, two mobile homes and the roof of a high school. Wind damage was reported in Bland and Wythe counties.

HURRICANES

Generally speaking, the Mount Rogers region does not have hurricanes and is not considered hurricane-susceptible like communities all along the east coast. Hurricanes become a factor on those rare occasions when the storm systems take an inland route as they pass over the Mid-Atlantic region. Two of the most significant hurricanes in recent decades affecting the Mount Rogers region were *Hurricane Agnes* (June 1972) and *Hurricane Hugo* (September 1989).

Hurricane Agnes, originating off the coast of the Yucatan Peninsula in Mexico, became a tropical storm on June 16, 1972 and then a hurricane in June 19, 1972. It crossed the Florida panhandle on June 19 and passed through Georgia, South Carolina and North Carolina before returning to the Atlantic Ocean to regain strength. The storm made landfall a second time on June 22, 1972 in southeastern New York and moved west across the southern tier of New York and into north-central Pennsylvania, where the $3.1 billion hurricane made its greatest impact.

Though the local record is scanty for this storm, 106 jurisdictions in Virginia qualified for a presidential disaster declaration due to widespread flooding. Those included Smyth County and the City of Galax. Most notable for damage caused by flooding, Agnes dropped an average of 6-10 inches of rain over the Mid-Atlantic region from June 20-25, 1972. The storm in Virginia created an estimated $126 million in damages and resulted in 13 deaths.

Hurricane Hugo began as a cluster of thunderstorms moving west off the coast of Africa. As the storm system passed over the Atlantic Ocean, it gained strength to become a tropical depression and then a hurricane, on Sept. 13, 1989. Once classified as a Category 5 storm (highest intensity hurricane) on the Saffir-Simpson Scale, Hugo did great damage in the Caribbean and Puerto Rico. By Sept. 19 the storm had weakened and moved back over the Atlantic, where Hugo regained strength and became a Category 4 hurricane with winds up to 135 mph when it made

landfall near Charleston, S.C. on Sept. 22, 1989. By the time Hugo passed west of Charlotte, N.C., it had weakened to a tropical storm with peak winds of 87 mph. The storm continued tracking north over southwest Virginia and West Virginia; the Appalachian Mountains helped weaken the storm further as it continued into western New York and passed out of the country. In the end six Virginians died as a result of Hugo. As the storm passed over the Appalachians, orographic effects were thought to cause locally heavy rainfalls of more than six inches over western North Carolina and southwest Virginia, causing small stream flooding. Orographic effects are defined as those caused by the presence of mountains; most commonly, this occurs when air rises over the mountains and then cools, creating condensation and rainfall. In total Hugo was estimated as a $9 billion storm in damages and economic losses, with $7 billion of that total occurring on the mainland, particularly in the Carolinas.

RISK ASSESSMENT AND VULNERABILITY

The Mount Rogers region appears to face a low risk of tornadoes and hurricanes. FEMA classifies the region under Wind Zone III, meaning winds can reach speeds ranging from 160 mph to 200 mph. The region also, based on historical information, experiences less than one tornado per 1,000 square miles. Tornadoes are rare for the Mount Rogers region.

FEMA High Wind Matrix
Tornado and Hurricane Risk

		Wind Zone			
		I	II	III	IV
No. of Tornadoes per 1,000 sq. miles	< 1	Low Risk	Low Risk ✹	Low Risk ✹	Moderate Risk
	1-5	Low Risk	Moderate Risk ✹	High Risk	High Risk
	6-10	Low Risk	Moderate Risk ✹	High Risk	High Risk
	11-15	High Risk	High Risk	High Risk	High Risk
	> 15	High Risk	High Risk	High Risk	High Risk

Saffir-Simpson Scale

Category	Winds	Effects
One	74-95 mph	No real damage to building structures. Damage primarly to unanchored mobile homes, shrubbery, and trees. Also, some coastal road flooding and minor pier damage
Two	96-110 mph	Some roofing material, door, and window damage to buildings. Considerable damage to vegetation, mobile homes, and piers. Coastal and low-lying escape routes flood 2-4 hours before arrival of center. Small craft in unprotected anchorages break moorings.
Three	111-130 mph	Some structural damage to small residences and utility buildings with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures with larger structures damaged by floating debris. Terrain continuously lower than 5 feet ASL may be flooded inland 8 miles or more.
Four	131-155 mph	More extensive curtainwall failures with some complete roof strucutre failure on small residences. Major erosion of beach. Major damage to lower floors of structures near the shore. Terrain continuously lower than 10 feet ASL may be flooded requiring massive evacuation of residential areas inland as far as 6 miles.
Five	greater than 155 mph	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Major damage to lower floors of all structures located less than 15 feet ASL and within 500 yards of the shoreline. Massive evacuation of residential areas on low ground within 5 to 10 miles of the shoreline may be required.

A tool to judge damage potential from tornadoes and hurricanes can be found in a FEMA publication called *Taking Shelter From the Storm: Building a Safe Room Inside Your House*. The tool appears in the table above.

The matrix and the wind zone assignments are based on 40 years of tornado history and more than 100 years of hurricane history in the United States, as well as research by the Wind Engineering Research Center at Texas Tech University. This serves as the basis for a low risk rating for the Mount Rogers region.

Tornadoes, though rare for the Mount Rogers region, have been known to achieve an F3 intensity rating, based on the Fujita scale. These most severe known tornado incidents have occurred in Smyth and Washington counties. An F3 intensity tornado contains sufficient power to tear roofs and walls from well-built homes, uproot most trees, and lift objects such as

automobiles off the ground and send them flying through the air. These storms can generate wind speeds of 158-206 mph.

As for hurricanes, the Mount Rogers region stands far inland and is not part of the coastal zone region where hurricanes cause most of their damage. Generally speaking, the local region experiences the outer effects of hurricanes; this can include high winds and heavy rainfall. Since heavy rainfall mainly results in flooding, hurricane impacts in this plan are covered in the section on flooding. In the five year time span since the original Hazard Mitigation Plan was written, the region's vulnerability to tornadoes and hurricanes has not changed.

WILDFIRES

DESCRIPTION

Wildfires occur as a regular part of the natural environment and are fueled by trees, brush and grasses. The three primary factors that influence these fires are topography, fuel and weather. Nationwide, the most frequent and worst of the wildfires occur in the western states, due to the dry climate and the prevalence of conifer and brush fuel types.

Wildfires also occur as a result of human actions, with increasing numbers of people choosing to live in wooded and wildland settings (described as the wildland urban interface), a factor that is also an issue for the eastern states, including the Mount Rogers region.

It is possible to group wildfires into four categories, as follows:

Wildland fires occur in national forests and parks and are fueled by natural vegetation. Federal agencies typically hold the lead role for fire management and suppression for this group of fires.

Interface or intermix fires happen at or near the junction between natural vegetation and the built environment.

Firestorms are high-intensity fire events that are impossible to control or suppress until conditions change or the available fuel is gone. Firestorms have been a particular problem in the western states.

Prescribed fires and prescribed natural fires include those that are intentionally set and those that are allowed to burn as part of a fire management program to help clear out excessive accumulations of vegetative fuels.

A map showing wildfire risk in the Mount Rogers Region is located in the section titled Appendix I at the end of the document.

HISTORY

Wildfires in the Mount Rogers region are not as prevalent or as damaging as the massive fire events that occur every year in the western states. But the risks still exist due to the amount of forested land in the region, presence of contributing factors (steep slopes, pine woods, wildfire history), and residential development in remote, wooded areas throughout the region.

From 1995 through 2011 the Mount Rogers region had roughly 505 fires causing an estimated $730,000 in damages as shown in the table below. Total property saved from destruction was estimated at more than $23 million, according to data by the Virginia Department of Forestry (VDOF). The greatest number of fires occurred in Carroll County. Though it had fewer fires during the seven-year period, Washington County sustained fire damage to the largest total land mass.

Causes of Fires in Mount Rogers Region
1995-2011

FIRE CAUSES	Bland	Carroll	Grayson	Smyth	Wash.	Wythe	TOTALS
debris burning	17	76	43	34	67	21	**257**
incendiary	12	24	8	36	29	4	**113**
equipment use	-	12	8	4	1	6	**31**
miscellaneous	2	13	7	4	5	9	**40**
smoking	-	4	2	1	8	3	**18**
children	1	13	6	-	3	3	**26**
campfire	-	4	2	2	1	-	**9**
lightning	-	2	2	-	2	2	**8**
railroad	-	-	-	-	-	1	**1**
not given	-	-	1	1	-	-	**2**
Total Fires:	**32**	**148**	**79**	**82**	**116**	**49**	**505**

VDOF data also points to debris burning and incendiary (arson) sources as the most common cause of fires in the Mount Rogers region. Those two sources accounted for 370, or 73%, of the 505 fires occurring between 1995 and 2011. Less frequent fire causes included equipment use, miscellaneous, smoking and children.

On the federal level, catastrophic fire losses in the western states have led to the development of the National Fire Plan and the Healthy Forests Initiative.

The National Fire Plan has resulted in more spending by state and federal agencies for improved prevention of wildfires. In the George Washington and Jefferson National Forests, which include the Mount Rogers region, the added funding supported efforts to reduce levels of fire-prone fuels and to establish a Type I firefighting crew. The National Fire Plan aims to provide sufficient resources for firefighting, rehabilitate fire-damaged ecosystems, reduce levels of fire-prone fuels found in the forests, and reduce fire risk faced by woodland property owners.

The Healthy Forests Initiative is a long-term plan promoted by federal agencies to improve management of federal lands and expedite forest and rangeland restoration projects. This effort is focused on communities near the wildland urban interface, in high-risk municipal watersheds, in watersheds containing habitat for threatened and endangered species, and where ecosystems are being destroyed by insect and disease epidemics and face increased threat of catastrophic wildfire. The wildland urban interface, particularly where rural housing development intermingles with the forest, is a concern for the Mount Rogers region.

RISK ASSESSMENT AN VULNERABILITY

The Mount Rogers region covers an estimated 1.77 million acres of land. Of that total, an estimated 1 million acres of land (roughly 58%) is classified as forestland, with nearly all used as timberland. Areas subject to fire risk include the forestlands and places where people are building homes and residential subdivisions in wooded settings.

Virginia Department of Forestry (VDOF) criteria for determining areas of highest risk take into account factors such as density of historical wildfires, nature of the land cover (pines are more flammable than hardwoods), steepness and orientation of slope, population density, distance to roads, road density and developed areas, and presence of railroads. VDOF is incorporating its data into a GIS-based mapping system called ForestRIM to help make wildfire risk assessments and to identify woodlands home communities.

VDOF statistics for the state show most fires occur during the spring fire season (February-May) and on a lesser level during the fall fire season (October-December). More fires occur during these periods due to drier weather conditions, higher winds and the presence of cured fuels that can easily ignite. Causes of fires statewide include: open burning (30%), arson (20%), smokers (14%), miscellaneous (11%), children (9%), equipment use (7%), railroads (5%), lightning (3%), and campfires (1%).

In any given year on average, the Mount Rogers region may experience 70 wildfires, based on the state forestry data over the past 15 years.

Information on wildfire risk was being developed through VDOF and its GIS-based ForestRIM program, which mapped areas of risk into categories of low, moderate and high, based on criteria described above. The VDOF data did not include information on wildfires occurring on federal lands (which would include the national forests and the Mount Rogers National Recreation Area).

The VDOF wildfire risk data as available in early 2004 showed:

- **Carroll** and **Washington** counties contained the largest amount of land subject to high risk of wildfire (more than 100,000 acres for each county).
- **Washington County** appeared to have the highest number of woodland homes subject to high risk of wildfire, followed by Carroll County.
- Substantial regions of high wildfire risk were also apparent for **Smyth County** (in its midsection and far northwestern corner, roughly 70,000 acres) and **Grayson County** (all along its eastern border and generally along the U.S. Rt. 58 corridor, roughly 60,000 acres).
- Areas with lesser acreages subject to high risk of wildfire included **Bland** (approximately 27,000 acres) and **Wythe** counties (roughly 20,000 acres).

Loss estimates have been based on the preliminary data available through the ForestRIM program (for housing counts) and estimates (for housing values) as applied by the MRPDC.

The values shown in the table below reflect the estimated value of all woodland homes in the region. In any given wildfire, only a portion of this housing stock would be at risk of destruction. However, any given woodland home that catches on fire faces a high risk of substantial or total destruction in some of the more remote parts of the local region. We have no way of estimating the potential loss for any given wildfire event.

LOSS ESTIMATES FOR WOODLAND HOMES
Mount Rogers Region, Virginia

Locality	Est. Number Homes at Risk	Total Value of Homes at Risk	Est. Total Land Mass at Risk
Bland County	265	$34,430,390	27,000 acres
Carroll County	712	$92,507,312	> 100,000 acres
Grayson County (incl. Galax)	258	$33,520,908	60,000 acres
Smyth County	475	$56,895,500	70,000 acres
Washington County	804	$96,303,120	> 100,000 acres
Wythe County	No data avail.	--	20,000 acres
City of Bristol	No data avail.	--	--
City of Galax	67	$8,705,042	--

People with homes in woodland communities can face a substantial risk of wildfire and catastrophic loss. These homes generally cannot be insured against loss, which places the entire financial burden on the homeowners. In some cases private housing developments in wooded settings contain narrow, poorly designed roads that cannot accommodate fire-fighting equipment. Other potentially serious issues include lack of access to a water supply, remote location, unidentified roads, and presence of vegetation (pines, broom sage) that is more prone to catch on fire. Wildfire can result in loss of property, injury and loss of life. In the five year time span since the original Hazard Mitigation Plan was written, the region's vulnerability to wildfires has not changed. This is due to a lack of development in this short time span, and or lack of historical events.

The table below shows a detailed breakdown the land cover in the Counties of the Mount Rogers Region.

Land Cover Information: Mount Rogers Region

County	All Land	Forest Land				Non-forest Land
		Total	Timberland	Woodland	Reserved	
Bland	229,545	172,214	166,519	na	5,695	57,331
Carroll	308,115	162,291	160,499	na	1,792	144,141
Grayson	285,304	173,873	161,883	na	11,991	111,431
Smyth	289,337	183,428	178,103	na	5,325	105,909
Washington	368,481	192,734	191,190	na	1,544	174,119
Wythe	296,480	153,942	153,610	na	332	142,538
Total	**1,777,262**	**1,038,482**	**1,011,804**	**na**	**26,679**	**735,469**

WINDSTORMS

Description

Wind can be defined as the motion of air relative to the earth's surface. Extreme wind events may come in the form of cyclones, severe thunderstorms, tornadoes, downbursts and microbursts.

Wind speeds may vary from 0 at ground level to 200 mph in the upper atmosphere. Nationwide the mean annual wind speed falls in the 8-12 mph range. Frequently, wind speeds reach 50 mph and sometimes exceed 70 mph. Coastal areas from Texas to Maine may experience tropical cyclone winds with speeds of greater than 100 mph. The Mount Rogers region is located in Wind Zone III, with winds reaching up to 200 mph. A *special wind region* is known to occur in an area reaching from northeast Tennessee into southwest Virginia.

HISTORY

High winds in the Mount Rogers region blow down trees and power lines and cause varying amounts of property damage. A wind tunnel effect observed in a *special wind region* reaching from northeast Tennessee into southwest Virginia sometimes blows tractor trailers off I-77 in Carroll County. Some winds have lifted trucks off the highway and deposited them some distance away, like the effects of tornadoes. The image below is of such a storm that occurred in January 2003.

Since the writing of the original Hazard Mitigation Plan in 2005, the state transportation department in has installed a highway warning system, (overhead signs) designed to alert truck drivers to wind and fog incidents in the Fancy Gap area as well as other areas along the interstate system. The system is intended to help drivers avoid these hazards to the extent possible. In the Mount Rogers region, high winds have been known to tear down trees and power lines, blow in

parts of buildings, and cause other kinds of property damage. An accounting of several recent high-wind incidents in the region is shown in the table below.

High Wind Incidents - Mount Rogers Region, Virginia

Date	Location	Description	Damages
10-5-95	Entire Mount Rogers region, plus much of SW VA	No description available.	$20,000 property
11-11-95	Bland, Carroll, Galax	Two windstorms occurred on same day.	$8,000 property
1-19-96	Carroll, Galax	No description available.	None reported
9-6-96	Carroll, Galax, Floyd, Franklin, Patrick	No description available.	$175,000 property, $200,000 crops
4-1-97	Carroll, Galax	Tractor-trailer blown over on I-77.	$7,000 property
2-4-98	Carroll, Galax, Patrick	Winds downed trees and damaged some mobile homes.	$15,000 property
3-3-99	Bland, along with Floyd, Giles, Montgomery, Pulaski	Winds downed trees and power lines.	$11,000 property
4-12-99	Carroll, Galax, Franklin, Patrick	High winds blew over a tractor-trailer on Rte. 58 and a mobile home (Patrick County). Winds blew over two tractor-trailers 5 miles south of Fancy Gap on I-77.	$14,000 property
1-13-00	Entire Mount Rogers region, plus much of SW VA	Winds downed large trees and power lines, caused minor property damage in all counties. Winds at 68 knots in Bland County.	$180,000 property
3-20-00	Smyth, Wythe	Winds downed trees and power lines.	$6,000 property
1-10-01	Carroll, Galax, Bedford	Winds of 65 knots blew over 3 tractor-trailers on I-77. Much damage in Bedford County with shingles and siding stripped off more than 90 homes. Winds also downed power lines, power poles and numerous trees.	$410,000 property
3-6-01	Carroll, Galax, Grayson, Patrick	Winds associated with a snowstorm downed trees and power lines. Winds blew in a wall and partly collapsed a roof on an auto repair shop in Carroll County.	$80,000 property
3-10-02	Carroll, Galax, Grayson	High winds downed trees across Grayson and Carroll counties.	None reported
12-25-02	All of Mount Rogers region, plus wide area of SW VA	Winds downed numerous trees and power lines. A tree fell on a house in Roanoke, damaging the roof and crushing the front porch.	$20,000 property
1-8-03	Carroll, Galax, Grayson, other parts of SW VA	Winds of 50 knots downed trees and power lines. Many downed trees in Grayson County damaged several homes.	$80,000 property
1-9-03	Carroll, Galax, Wythe, plus 6 other SW VA counties	Winds of 60 knots downed trees and power lines.	None reported
1-23-03	Carroll, Galax, Wythe, other parts of SW VA	Winds of 100 knots blew over 6 tractor-trailers on I-77, near Fancy Gap. Trees and power lines downed throughout region.	$50,000 property
2-22-03	All of Mount Rogers region, plus wide reaches of SW VA	Winds of 80 knots downed numerous trees and power lines. Many people lost power across the region. Roof blown off an outbuilding in Tazewell County.	$3,000 property
5-11-03	Bland County	Winds of 70 knots downed several trees and power lines.	None reported
7-15-05	Grayson County	A small microburst causing winds of 70 knots blew the roof off a vacant hotel, and damaged 10 trees.	None reported
3-06-11	Carroll County	High winds overturned 2 tractor trailers on Interstate 77 at the 2.8 mile marker.	$200,000 property

The details for these high wind events were drawn from the National Climatic Data Center's database, as well as from news reports and emergency management personnel. For some incidents, even when damages are reported, an accompanying description of the event is not always available.

RISK ASSESSMENT AND VULNERABILITY

Of the high wind events reported to the National Climatic Data Center, some part of the Mount Rogers region experienced damaging winds at least 15 times in eight years. That amounts to an average of roughly twice a year when winds are known to cause at least some damage.

Though the entire region is subject to high winds, Carroll County and the City of Galax appear to be hit the most often. Given the regionalized nature of the available data, it is not possible to quantify what a typical wind incident might consist of and how much cost it may create for the community or to private individuals.

Damage estimates through the National Climatic Data Center are reported by incident rather than by locality, unless the damages are confined to a small geographic area. Based on the reported incidents, damages may range from zero to up to more than $400,000

The reported damages include downed trees, tree limbs and power lines; shingles, siding and roofs torn away from homes; damage and uprooting of mobile homes; tractor-trailers blown over and sometimes lifted off the highway, particularly near the Fancy Gap area of Interstate 77; and loss of electrical power. High wind events, while they occur frequently, appear to cause only scattered property damage. This hazard does not appear to pose a disaster-level hazard to the Mount Rogers region as a whole, although some localities regularly sustain high winds. In the five year time span since the original Hazard Mitigation Plan was written, the region's vulnerability to windstorms has not changed.

HAZARD IDENTIFICATION AND RISK ASSESSMENT: CONCLUSIONS

HAZARD RISK MATRIX

The risk assessment analysis has been used to create the Hazard Risk Matrix shown below to provide a guideline on the relative importance of natural hazards across the entire Mount Rogers region. The rankings for individual localities will differ from the regional matrix due to differences in terrain, impacts from flooding, potential for wildfire, and so on. This plan rates natural disasters as an average over time. It was the view of the steering committee that our risk to various natural hazards in the Mount Rogers Region has not changed in the past five years since the original plan was written.

HAZARD RISK MATRIX
Mount Rogers Region, Virginia

Hazard	Frequency	Geographic Extent	Impact	Hazard Risk Index Rating
Dam Safety	3	1	3	7
Drought	2	4	1	7
Earthquakes	2	2	1	5
Flooding	4	2	3	9
Karst and Sinkholes	2	1	1	4
Landslides	1	1	2	4
Snow/Ice	4	4	1	9
Thunderstorms/Lightning	4	1	1	6
Tornadoes/Hurricanes	4	1	1	6
Wildfires	4	1	2	7
Winds	4	2	1	7

Note: Highest numbers mean highest risk or impact.

The **frequency column** is based on likelihood of occurrence:

4 = More than once in 10 years
3 = More than once in 10-100 years
2 = More than once in 100-1,000 years
1 = Less than once in 1,000 years

The **geographic extent column** relates to the extent any given hazard affects the jurisdiction:

4 = More than 50% of jurisdiction affected
3 = Estimated 25-50% of jurisdiction affected
2 = Estimated 10-25% of jurisdiction affected
1 = Less than 10% of jurisdiction affected

The **impact column** relates to the amount of death, injury, destruction and inconvenience created for the affected area, as shown below:

4 = Many deaths and injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.
3 = Multiple injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities more than one week.
2 = Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities more than one day.
1 = Very few injuries, if any. Only minor property damage and minimal disruption of quality of life. Temporary shutdown of critical facilities.

Natural hazards on a regional basis can then be ranked as shown in the table below. As already noted, there will be some variances for some localities.

HAZARD RISK CATEGORIES
Mount Rogers Region, Virginia

High Risk Hazards (score 8 or higher) ➡	**Flooding** **Severe Winter Storms/Ice**
Moderate Risk Hazards (score of 7) ➡	**Dam Safety** **Drought** **Wildfires** **Winds**
Low Risk Hazards (score of 6 or less) ➡	**Earthquakes** **Karst and Sinkholes** **Landslides** **Thunderstorms/Lightning** **Tornadoes/Hurricanes**

HAZARD RISK ASSESSMENT BY JURISDICTION

The main natural hazards faced by the 20 local jurisdictions in the Mount Rogers region are displayed in the matrix shown below. This data has been drawn from the descriptions given in the preceding pages of this section. The table below was reviewed and updated by the steering committee in the Hazard Mitigation Plan Update.

Identified Natural Hazards, By Locality
Mount Rogers Region, Virginia (6 counties, 2 cities, and 12 towns)

Hazard Type	Hazards Identified	Individual Localities																			
		Bland County	Carroll County	Grayson County	Smyth County	Wash. County	Wythe County	City Bristol	City Galax	Abingdon	Chilhowie	Damascus	Fries	Glade Spring	Hillsville	Independence	Marion	Rural Retreat	Saltville	Troutdale	Wytheville
Avalanche																					
Coastal Erosion																					
Coastal Storm																					
Dam Safety	X	X	X	X	X	X	X	na	na	na	na	na	na	na	na	na	na	na	na	na	na
Drought	X	M	M	M	M	M	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Earthquake	X	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Expansive Soils																					
Extreme Heat																					
Flood	X	H	L	H	H	H	H	H	H	H	H	H	H	H	L	L	H	L	H	L	M
Hailstorm																					
Hurricane (see Tornadoes)																					
Karst and Sinkholes	X	X	na	na	X	X	X	na	na	na	na	na	na	na	na	na	na	na	na	na	na
Landslide	X	L	H	H	H	H	L	na	na	na	na	na	na	na	na	na	na	na	na	na	na
Severe Winter Storm/Ice	X	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Tornadoes/Hurricanes	X	L	L	L	M	M	L	L	L	M	M	L	L	M	L	L	L	L	L	L	L
Tsunami																					
Volcano																					
Wildfire	X	M	H	M	H	H	H	na	M	na	na	na	na	na	na	na	na	na	na	na	na
Windstorm	X	M	H	M	M	M	M	M	H	M	M	M	M	M	H	M	M	M	M	M	M
Thunderstorms/Lightning	X	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

Notes:
The term "na" means the hazard data is not available.
The H, M, and L symbols refer to the relative likelihood and/or relative severity of given hazards, comparing one locality to another. H = highest likelihood, M = moderate likelihood, and L = low likelihood. X indicates the hazard was identified, but further hazard assessment data was lacking.

MITIGATION STRATEGY

DEFINING HAZARD MITIGATION

FEMA defines hazard mitigation as "sustained actions taken to reduce or eliminate long-term risk from hazards and their effects."

These sustained actions can come in the form of physical projects (enlargement of drainage culverts, streambank stabilization and restoration, vegetation removal, installation of advance warning systems, etc.) or educational programs designed to help local officials and property owners understand and reduce hazard risk (media campaigns, special mailings, special events, self-help guides, etc.).

For some hazards, these actions could involve simply getting out of the way – such as not building in the floodplain or removing structures from the floodplain, when feasible. For other hazards, such as major weather events that cover large areas of landscape, the mitigations could involve more indirect methods, such as improved building codes to strengthen structures and reduce damages from violent windstorms or major blizzards. Some hazards – such as an F4 or F5 tornado – carry such force that a direct hit means destruction is assured, although properly built "safe rooms" can reduce loss of life.

In the previous section of this study, we have identified and ranked the main natural hazards that can afflict communities in the Mount Rogers region of southwest Virginia. We are now moving on in this next section to describe the following:

- Planning process used to develop the hazard mitigation strategy.
- Goals and objectives for the overall hazard mitigation strategy for the region.
- Recommended hazard mitigations on a locality-by-locality basis.

PROCESS USED TO DEVELOP MITIGATION STRATEGY

MRPDC staff, the Hazard Mitigation Advisory Team, and representatives from the local jurisdictions worked together to develop the Hazard Mitigation Strategy for the Mount Rogers region.

Following the guidance found in the FEMA Local Multi-Hazard Mitigation Planning Guidance, MRPDC staff identified the at risk hazards that affect the region and its 20 local jurisdictions. This was done based on available data. With the basic data assembled, the MRPDC organized a Hazard Mitigation Steering Committee to review and make comments on the hazard vulnerability assessments. Some of the recommended mitigations emerged from those discussions, such as a suggestion by a representative from American Electric Power to work to improve coordination among emergency response organizations to improve snow-removal and accelerate restoration of electric power following major snow and ice storms. In addition, the MRPDC mailed out draft copies of the hazard vulnerability assessments to the 20 local jurisdictions and invited comments from local planners, emergency services personnel, and the public.

MRPDC staff moved on to develop the specifics for both the Hazard Mitigation Strategy and proposed mitigations. In some cases we have followed the advice of experts, such as the applications of Firewise methods to reduce wildfire risks. In other cases we have proposed mitigation strategies based on limitations of the available data and on long-understood shortcomings, such as the lack of accurate floodplain mapping (as determined by hydrological engineering studies) and the lack of floodplain mapping in some areas known to be flood-prone but passed over by previous mapping efforts.

For flood hazards, which affect much of the population of the Mount Rogers region, MRPDC staff applied the principles of FRED (i.e., Fix and Repair, Elevate, Relocate or Demolish). Staff developed generalized cost estimates based on the experience of the staff and others in the region that had past experience in such matters.

All participants in the process have always recognized that any major undertakings will only be possible with outside funding support (i.e., state and federal grants), since most localities in the Mount Rogers region are sparsely populated, sparsely staffed, and lack the financial means to provide little other than basic government programs and services.

Regional Hazard Mitigation Strategy

The following outline consists of goals and objections for the natural hazard mitigation strategy to be applied in the Mount Rogers region of Virginia. These goals were reviewed by the members of the steering committee as well as other stakeholders during the update process. They were reviewed in our meetings throughout the summer months of 2011, as well as reviewed by participants on an individual basis.

Goal: Protect Lives and Property from Flooding
Objective: Increase Public Awareness

Strategy:

--Promote and make the public aware of the need for mitigation

--Promote planning as well as membership in the National Flood Insurance Program

Objective: Improve data resources to improve the regional Hazard Mitigation opportunities.

Strategy:

--Update FEMA flood plain maps throughout the Mount Rogers region.

--Develop new FEMA floodplain maps not previously mapped.

Objective: Provide opportunities for property owners of flood prone and/or repetitive loss properties to acquire and relocate from the flood plain, elevate structures, acquire and demolish, flood proof their property, or apply for funds to construct minor localized flood control projects.

Strategy:

--Pursue funding for such projects from federal and state agencies such as FEMA, VDEM, as well community development block grants.

Cost Benefit: The benefits of flood protection are ongoing. Money should be invested wisely to protect existing structures, as well as to prevent future losses to new structures. This will be a savings to the localities, as well as to the property owners in the form of repair and insurance cost. $100,000 spent today, could save millions of dollars in damage over long periods of time, as well as save lives.

Responsible Office: MRPDC \ local Board of Supervisors \ Local Emergency Management

Goal: Encourage Public Safety in the Event of Snowstorms/Ice and High Winds/ Earthquakes/Landslides/Tornadoes/Hurricanes/Drought

Objective: Increase public awareness of actions before, during, and after such events.

Strategy:

--Educate public on the methods recommended by the American Red Cross to prepare for these events.

--Inform motorist of high wind potential along selected highways.

Cost Benefit: Public awareness is crucial to prevent losses due to natural hazards. Not only prevention, but a large savings of time and money could be seen during and after such adverse weather. $100,000-$500,000 spent on increased road advisories will save money on working traffic accidents, as well as work hours lost in Traffic.

Responsible Office: VDOT \ Local Board of Supervisors \ Red Cross

Goal: Increase Dan Safety for the Mount Rogers Region

Strategy:

--Improve the availability of data resources for dam safety to save lives and property coordinated through agencies such as FEMA and the Department of Conservation and Recreation.

Cost Benefit: Knowledge and being aware of potential hazards plays a key role in their prevention. Due to many recent events, information on dams in the region is hard to come by. Property owners in a high risk area could benefit from greater knowledge of possible dangers. For a minimal cost, this could save property as well as lives.

Responsible Office: Department of Conservation and Recreation; Corps of Engineers

Goal: Minimize the Impact of Wildfires on Woodland Communities.
Objective: Increase public awareness.
Strategy:

--Educate homeowners on Firewise and Department of Forestry programs on methods to cope with drought.
--Support and encourage the existing education efforts of the American Red Cross in ways homeowners can reduce the risk of wildfires by property maintenance and cleanup.
--Projects creating perimeters around homes, structures, and critical facilities through the removal of reduction of flammable vegetation.
--Projects that apply ignition resistant techniques and/or non-combustible materials on new and existing homes, structures, and critical facilities.
--Projects that remove vegetative fuels proximate to the at-risk structure that, if ignited, pose significant threat to human life and property, epically critical facilities.

Cost Benefit: Education is invaluable to prevent Wildfires. For a minimal cost, educational programs for homeowners in woodland communities will help minimize fire damage to property, and natural resources.

Responsible Office: USDA; VA Dept. of Forestry; FireWise, Local Fire and Rescue

Goal: Encourage Citizens to Prepare for Possible Damage from Sinkholes and Karst
Objective: Increase public awareness
Strategy:

--Make sure local building codes and zoning ordinances address placement of structures in such areas.
--Educate the public on karst safety through educational efforts such as agencies like the Virginia Cave Board.
--Map areas that are in danger of karst and sinkholes with the state division of mineral resources, and the Virginia Cave Board.

Cost Benefit: Having and making available good data where land is susceptible to karst and sinkholes can pay dividends in the future. Accurate mapping of such

areas made available to local officials can greatly reduce the risk of structures and roads being damaged by these hazards.

Responsible Office: Local Building inspector; VDOT, Department of Conservation and Recreation

Goal: Minimize Damage due to Thunderstorms as well as Tornadoes/Hurricanes
Strategy:

--Support and encourage existing efforts by the American Red Cross to educate homeowners on retrofitting and mitigation.

--Educate citizens on tornado and severe storm safety.

Cost Benefit: Public awareness is crucial to prevent losses due to natural hazards. Not only prevention, but a large savings of time and money could be seen during and after such adverse weather.

Responsible Office: Local emergency management departments

Goal: Reduce the risk of hazards on new buildings and infrastructure.
Objective: Encourage continued practice of proper building site construction.
Strategy:

--Incorporate the hazard mitigation plan into comprehensive planning.

--Use the hazard mitigation plan in the permit process for new construction in floodplain or high hazard areas.

Cost Benefit: Proper planning in new construction will result in a large savings after natural disasters.
Responsible Office: Local building inspectors.

REGIONAL STRATEGIC PRIORITIES

This section outlines the top regional priorities for Pre-Disaster Hazard Mitigation in the Mount Rogers region. These have been determined through discussions among MRPDC staff and the members of the Hazard Mitigation Steering Committee.

The priorities presented in this section correspond to the objectives listed under the six goal statements given for the regional strategic plan described above. MRPDC staff initially

developed the goals-and-objectives outline, and then presented it to the Hazard Mitigation Advisory Team for comment.

The Steering Committee ranked individual objectives as follows, high priority, mid-level priority, and lowest priorities. More than one objective could be assigned to any given priority level. Each marker carried a value of one point, with the highest point scores indicating the objectives of highest importance. The Steering Committee reviewed the table below from the original 2005 Hazard Mitigation Plan, and determined that it was still applicable.

Prioritized Listing of Hazard Mitigation Objectives
Mount Rogers Region, Virginia

Objective	Points
Promote need for pre-disaster mitigation to prevent future losses.	12
Update FEMA floodplain maps as applicable throughout the Mount Rogers Region.	12
Promote prevention methods homeowners can undertake.	12
Implement in-the-ground projects to reduce natural hazard risks.	9
Provide copies of the Pre-Disaster Hazard Mitigation Plan to the 20 local jurisdictions in the Mount Rogers region.	8
Support projects offering the best benefit/cost ratio.	6
Publicize successful mitigation projects.	5
Support guidelines for flood mitigation: ▪ A property is a candidate for relocation if the first floor floods twice (or more) in 50 years. ▪ A property is a candidate for elevation or flood-proofing if flooding occurs below the first floor twice (or more) in 50 years. ▪ Meet requirements of the Uniform Relocation Act. ▪ The top priorities for federal relocation assistance should be based on need, frequency of flooding, and a favorable benefit/cost ratio.	5
Create project serving multiple objectives (social, community, economic, mitigation).	4
Support educational efforts of existing organizations, such as the American Red Cross.	4
Develop new FEMA floodplain maps for flood-prone areas not previously mapped.	3
Promote useful programs, such as the National Flood Insurance Program.	1
Support state/federal efforts to improve data resources for dam safety, drought, karst and sinkholes, landslides, thunderstorms, and windstorms.	1

CAPABILITIES ASSESSMENT

Most localities in the Mount Rogers region are for the most part limited by financial issues and staff size. The capabilities of the localities are largely defined through staff and organizational capacity, technical capacity, and fiscal capacity. Most of our localities epically the towns, require assistance due to the size of budgets, and number of personal. Many of the strategies from the 2005 plan have not been completed due to the lack of existing resources.

COMMUNITY SUMMARIES & RECOMMENDED MITIGATIONS

The following section provides descriptions, by jurisdiction, of high- and moderate-risk natural hazards, past or ongoing mitigations (if any), and recommended mitigations resulting from this study. For the hazards of floods, wildfire, dam safety, snowstorms/ice, and high winds, landslides, sinkholes/karst, drought, hurricanes/tornados, and earthquake mitigation strategies for each locality are included in the recommended mitigations section. The hazard of thunderstorm/lightening did not warrant a local mitigation action due to its low risk. The section is organized in alphabetical order by county and the towns contained within that county, followed by the cities. This includes:

- Bland County
- Carroll County and the Town of Hillsville
- Grayson County and the towns of Fries, Independence, and Troutdale
- Smyth County and the towns of Chilhowie, Marion, and Saltville
- Washington County and the towns of Abingdon, Damascus, and Glade Spring
- Wythe County and the towns of Rural Retreat and Wytheville
- The City of Bristol
- The City of Galax.

Recommended Mitigations: Mount Rogers Region

Mount Rogers Mitigations

Rank	Activity	Hazard Addressed	Responsible Party	Timeline/ Status	Comments
Low	Provide public outreach and start an educational campaign to inform citizens of actions to take before, during, and after an earthquake strikes.	Earthquake	All Localities/ MRPDC	Long Term/ Not Started	Funding is needed
Low	Make sure local building codes and zoning ordinances address placement of structures in areas susceptible to karst and sinkholes, and map areas that are in danger of such hazards.	Karst/Sinkholes	All Localities/ MRPDC	Long Term/ Not Started	Funding is needed
Low	Make sure local building codes and zoning ordinances address placement of structures in areas susceptible to landslides, and map areas that are in danger of such hazards.	Landslides	All Localities/ MRPDC	Long Term/ Not Started	Funding is needed
Low	Provide public outreach and start an educational campaign to inform citizens of actions to take before, during, and after a tornado or hurricane event strikes.	Tornados/Hurricanes	All Localities/ MRPDC	Long Term/ Not Started	Funding is needed
Low	Provide public outreach and start an educational campaign to inform citizens of actions to take during a severe drought if water supplies are depleted.	Drought	All Localities/ MRPDC	Long Term/ Not Started	Funding is needed

Bland County

Community Hazard Profile

Bland County is a rural, lightly populated community of nearly 6,824 with Interstate 77 bisecting the county as the highway travels in a north-south direction. There are no incorporated towns, though county administrative functions are centered in the community of Bland, located at the junction of I-77 and State Rt. 42. The Appalachian Trail crosses through parts of the county.

The main natural hazards faced in Bland County are flooding, severe snow and ice storms, wildfire, and potential dam failure. Due to its mountainous terrain, communities are subject to flash flooding caused by heavy rainfalls and snowmelt; this is especially true for Rocky Gap, a small, unincorporated community located almost entirely in the floodplain. Bland County also experiences its share of high-wind conditions, though these have not been known to create natural disasters.

In January 1957, the community of Bland sustained substantial damage from a failure in the Crab Orchard Creek Dam, which had been under development as a privately owned recreation attraction. The dam break occurred following three days and nights of continuous rain, and the resulting flood caused $500,000 worth of damage to the small community. There is now some thought that, with construction of I-77 (which passes between the dam and the community), a similar event would not happen again, since I-77 and its drainage systems would redirect the flood flows.

Past or Ongoing Mitigations

Bland County centralizes its emergency response system through its E-911 and emergency services coordinator (one individual). Emergency responders include a system of local volunteer fire departments and rescue squads, as well as the sheriff's department and state police. The county's building codes are in line with the most recent statewide revisions known as the Uniform Statewide Building Code, which took effect in 2009.

Bland County has not engaged in pre-disaster mitigation efforts in the past.

For flood hazards, Bland County contains six repetitive loss properties, including three in the community of Rocky Gap. These properties have an average claim of $19,952.95

Recommended Mitigations: Bland County

Bland County and Localities Mitigations

Rank	Activity	Hazard Addressed	Responsible Party	Timeline/ Status	Comments
High	Conduct hydrological/engineering studies to properly determine Base Flood Elevations in those watersheds with estimated floodplains.	Floods	Bland County/ MRPDC	Long Term/ Not Started	Funding is needed
High	Conduct detailed studies to determine the most cost-effective mitigations for communities with flooding issues, which include Bland, Bastian, and Rocky Gap.	Floods	Bland County/ MRPDC	Long Term/ Not Started	Funding is needed
High	Use the flood analysis as a basis for consideration of future relocation/demolition and flood-proofing projects.	Floods	Bland County/ MRPDC	Long Term/ Not Started	Funding is needed
High	Mitigate against future flood losses, with highest priority given to repetitive loss properties.	Floods	Bland County/ MRPDC	Long Term/ Not Started	Funding is needed
High	Comply with NFIP for floodplain identification and mapping, responsible floodplain management, and the promotion of flood insurance.	Floods	Bland County/ MRPDC	Short Term Ongoing	Done through compliance with NFIP
Medium	Promote the Firewise program for people who live in woodland communities. An estimated 265 homes fall into this category in various parts of Bland County.	Wildfire	Bland County/ MRPDC/RC&D	Long Term/ Not Started	Funding is needed
Medium	Work with the New River-Highlands RC&D Council a wildfire strategic	Wildfire	Bland County/ MRPDC/RC&D	Long Term/ Not Started	Funding is needed

	plan for Bland County.				
Low	Educate residents on methods recommended by the American Red Cross to prepare for various types of natural disaster.	Floods Snowstorms/Ice High Winds	Bland County/ MRPDC	Long Term/ Not Started	Funding is needed
Low	Continue inspection and enforcement as necessary on the Crab Orchard Creek Dam, rated Class I for hazard potential.	Dam Safety	Bland County/ MRPDC	Short Term/ Ongoing/	Done through Federal State and local codes
Low	Verify the geographic location of all NFIP repetitive losses, and making inquiries as to whether the properties have been mitigated, and if so, by what means.	Floods	Bland County/ MRPDC	Short Term/ Not Started	Will start next year

Carroll County and Hillsville

Community Hazard Profile

Carroll County abuts the northern border of North Carolina and includes a section of the Blue Ridge Parkway and the New River Trail State Park. A community of 30,042, the county includes the incorporated Town of Hillsville, which serves as the county seat, and abuts the City of Galax to the west. Elevations vary from 3,570 feet above sea level at Fisher Peak to 1,100 feet above sea level at Cana. The county also is notable for the Blue Ridge Escarpment (steep slope) that separates the piedmont of North Carolina from the Blue Ridge Plateau. More than half of the land area has slopes greater than 20%, which precludes most development.

Carroll County is bisected by Interstate 77 in a north-south direction and by U.S. Rt. 58 in an east-west direction. The county is known for high wind conditions at Fancy Gap, where tractor trailers sometimes get blown over or even lifted away from the highway altogether and dumped into a field some distance away. Carroll County is part of a Special Wind Region, with potential wind speeds up to 200 mph.

Other natural hazards experienced in Carroll County include severe winter storms and ice, wildfires, drought, and undefined risk potential for landslides and impacts from karst terrain. Flood hazards are limited (one repetitive loss property in or near Hillsville). There are two federally regulated hydroelectric dams and one state-regulated dam in Carroll County.

Past or Ongoing Mitigations

A special project by the New River-Highlands RC&D Council has produced a draft strategic plan for wildfire hazard reduction in Carroll County. For emergency response the area is served

by the Twin County E-911 system, volunteer fire departments and rescue squads, and the sheriff's department and state police.

VDOT has installed a warning system to help truckers get off I-77 and find alternate routes during high-wind conditions and other potentially dangerous conditions, such as fog, another ongoing problem in the Fancy Gap area. Members of the Hazard Mitigation Advisory Team have said the warning system has limited usefulness since there are few exits from the highway.

The county's building codes are in line with the most recent statewide revisions known as the Uniform Statewide Building Code, which took effect in 2009.

Recommended Mitigations: Carroll County and Hillsville

Carroll County and Localities Mitigations

Rank	Activity	Hazard Addressed	Responsible Party	Timeline/ Status	Comments
High	Promote the Firewise program for people who live in woodland communities. An estimated 712 homes fall into this category in various parts of Carroll County. This represents one of the worst natural hazard threats in the region.	Wildfire	Carroll County RC&D, Firewise MRPDC	Long Term/ Not Started	Funding is Needed
High	Educate residents on methods recommended by the American Red Cross to prepare for various types of natural disaster.	Floods Snowstorms/Ice High Winds	Carroll County MRPDC	Long Term/ Not Started	Funding is needed
Medium	Support improved highway warning systems for truckers on I-77 facing high-wind conditions in the Fancy Gap area.	Winds	Carroll County VDOT MRPDC	Short Term/ Ongoing	Some signs are in place
Medium	Comply with NFIP for floodplain identification and mapping, responsible floodplain management, and the promotion of flood insurance.	Floods	Carroll County/ MRPDC	Short Term Ongoing	Done through compliance with NFIP
Low	Consider flood-proofing or relocation/demolition for the repetitive loss property near Hillsville.	Floods	Town of Hillsville MRPDC	Long Term/ Not Started	Funding is needed

Low	Properly inspect and enforce applicable state and federal dam regulations for high- and significant-hazard dams.	Dam Safety	Carroll County MRPDC	Short Term / Ongoing	Done through Federal, State, and Local codes
Low	Verify the geographic location of all NFIP repetitive losses, and making inquiries as to whether the properties have been mitigated, and if so, by what means.	Floods	Carroll County MRPDC	Short Term/ Not Started	Will be looked at next year

Grayson County and Fries, Independence and Troutdale

Community Hazard Profile

Grayson County is a remote, rural area with a population of 15,533. The county is traversed east-west by U.S. Rt. 58, north-south by State Rt. 16 (passing through the Town of Troutdale), and north-south by U.S. Rt. 21 (passing through the Town of Independence). The three incorporated towns include Fries, Independence, and Troutdale. Parts of the county border the independent City of Galax at the county's eastern border. Grayson's mountainous terrain includes Grayson Highlands State Park in the western end and parts of the Mount Rogers National Recreation Area running roughly along the county's northern border.

Chief natural hazards occurring in Grayson County include flooding, severe snow and ice storms, high winds, and risk of wildfire. Flooding affects relatively few properties, and there is no FEMA record of repetitive loss properties. Substantial parts of Grayson, encompassing roughly 60,000 acres, are subject to wildfire risk. Grayson also contains four dams rated for significant hazard potential and has a risk of potential for landslides, especially in the northern part of the county.

Past or Ongoing Mitigations

A special project by the New River-Highlands RC&D Council has produced a draft strategic plan for wildfire hazard reduction in Grayson County. The emergency services system includes the Twin County E-911 center, several volunteer fire departments and rescue squads, the sheriff's department and the state police.

VDOT has been in the process of installing a warning system to help truckers get off I-77 and find alternate routes during high-wind conditions and other potentially dangerous conditions, such as fog, another ongoing problem in the Fancy Gap area. Members of the Hazard Mitigation Advisory Team have said the warning system has limited usefulness since there are few exits from the highway.

The county's building codes are in line with the most recent statewide revisions known as the Uniform Statewide Building Code, which took effect in 2009.

Grayson County has not participated in the pre-disaster hazard mitigation projects in the past, other than what has already been noted. Like the other localities in the Mount Rogers region, most hazard mitigation efforts are not possible without substantial outside support from state and federal grants.

Recommended Mitigations: Grayson County and Fries, Independence, and Troutdale

Grayson County and Localities Mitigations

Rank	Activity	Hazard Addressed	Responsible Party	Status/ Timeline	Comments
High	Support implementation of the strategic plan for wildfire hazard reduction in Grayson County.	Wildfire	Grayson County RC&D MRPDC	Not Started Long Term/	Funding is needed
High	Support educational programs to promote Firewise methods to affected residents of woodland communities. An estimated 258 homes are part of woodland communities in Grayson County.	Wildfire	Grayson County RC&D Firewise MRPDC	Not Started/ Long Term	Funding is needed
High	Educate residents on methods recommended by the American Red Cross to prepare for various types of natural disaster.	Floods Snowstorms/Ice High Winds	Grayson County MRPDC	Not Started/ Long Term	Funding is needed
Medium	Support improved highway warning systems for truckers on I-77 facing high-wind conditions in the Fancy Gap area.	Winds	Grayson County VDOT MRPDC	Ongoing/ Short Term	Some of the warning system is in place
Medium	Conduct hydrological/engineering studies to properly determine Base Flood Elevations in those watersheds with estimated floodplains.	Floods	Grayson County MRPDC	Not Started/ Long Term	Funding is needed
Medium	Conduct hydrological/engineering studies to determine Base Flood Elevations within the Town of Troutdale, which presently lacks a recognized floodplain.	Floods	Grayson County MRPDC	Project Complete	Flood mapping has been provided
Medium	Identify flood prone properties for	Floods	Grayson	Not	Funding is

	potential acquisition/demolition, elevation, flood proofing, and minor localized flood control projects.		County MRPDC	Started/ Long Term	needed
Medium	Conduct hydrological/engineering studies to determine Base Flood Elevations within the Towns of Fries and Independence.	Floods	Town of Independence Town of Fries MRPDC	Not Started/ Long Term	Funding is needed
Medium	Comply with NFIP for floodplain identification and mapping, responsible floodplain management, and the promotion of flood insurance.	Floods	Grayson County MRPDC	Short Term/ Ongoing	Done through compliance with the NFIP
Low	Properly inspect and enforce applicable state and federal dam regulations for high- and significant-hazard dams.	Dam Safety	Grayson County MRPDC	Ongoing/ Short Term	Done though local and state codes

Smyth County and Chilhowie, Marion, and Saltville

Community Hazard Profile

Smyth County, with a population of 32,208, stands along the east-west path of I-81 and also is part of the Mount Rogers National Recreation Area. Population growth is stagnant, due in part to loss of the traditional industrial base and limited housing development. Despite those drawbacks, the county is traversed by the Appalachian Trail, offers appealing country vistas, and stands within easy reach of many natural resource attractions.

The main natural hazards affecting Smyth County include flooding along the North, Middle, and South Forks of the Holston River, as well as several tributaries; severe winter storms and ice; some potential for dam failure; drought; and undetermined risk from landslides and karst terrain, which appears in an estimated 30% of the county's territory. The county also is part of a Special Wind Region (with wind speed potential of 200 mph), but this problem rarely causes enough damage to be considered a major hazard.

Past or Ongoing Mitigations

Due to its long history with disaster-level flooding, Smyth County and its communities have participated in special flood mitigation projects. Record-level disasters resulting from the floods of 1977 led to a flood mitigation engineering study for the towns of Chilhowie and Marion, as

well as the nearby communities of Atkins and Seven Mile Ford. In Chilhowie the work resulted in the eventual relocation of 67 families and the creation of the Chilhowie Recreation Park. Other recommended flood mitigations have not been pursued due to lack of funding.

Smyth County also, as a result of flooding in 2001 and 2002, obtained federal disaster relief funds and relocated five homes out of the floodplain in River Bottom Circle, located near the Broadford community along the North Fork of the Holston River.

More recently the Town of Chilhowie participated in a preliminary flood reduction study by the U.S. Army Corps of Engineers. About 12-15 properties continue to sustain flood damage within town borders. The town has opted against pursuing a more detailed study due to the high cost and instead is advocating for mitigating the most flood-prone structures in the town.

Emergency response is coordinated through Smyth County's centralized E-911 system. The county also creating a modernized countywide communications system for emergency response and direct radio communications among police, fire departments, and rescue squad organizations. The Marion Life Saving Crew, while essentially a volunteer organization, has in recent years begun charging for its services when feasible (through private health insurance) to cover the costs for paid daytime emergency responders.

The county's building codes are in line with the most recent statewide revisions known as the Uniform Statewide Building Code, which took effect in 2009

Recommended Mitigations: Smyth County and Chilhowie, Marion, and Saltville

Smyth County and Localities Mitigations

Rank	Activity	Hazard Addressed	Responsible Party	Timeline/ Status	Comments
High	Mitigate against future flood losses, with highest priority given to the five repetitive loss properties.	Floods	Smyth County MRPDC	Long Term/ Not Started	Funding is needed
High	Conduct hydrological/engineering studies to determine Base Flood Elevations in watersheds containing estimated floodplains.	Floods	Smyth County MRPDC	Long Term/ Not Started	Funding is needed
High	Comply with NFIP for floodplain identification and mapping, responsible floodplain management, and the promotion of flood insurance.	Floods	Smyth County/ MRPDC	Short Term Ongoing	Done through compliance with NFIP
High	Use the flood analysis as a basis for consideration of future relocation/demolition and flood-proofing projects.	Floods	Smyth County MRPDC	Short Term/ Ongoing	When this issue arises flood analysis is

					used
High	Identify flood prone properties for potential acquisition/demolition, elevation, flood proofing, and minor localized flood control projects.	Floods	Smyth County MRPDC	Not Started/ Long Term	Funding is needed
High	Support the continued development of the improved countywide radio communications system to improve emergency response and coordination during major disasters and other emergencies.	All	Smyth County MRPDC	Short Term/ Ongoing	Worked on when possible
Medium	Support educational programs to promote Firewise methods to affected residents of woodland communities. An estimated 475 homes are located in wooded settings and subject to risk of wildfire.	Wildfire	Smyth County RC&D Firewise MRPDC	Long Term/ Not Started	Funding is needed
Low	Educate residents on methods recommended by the American Red Cross to prepare for various types of natural disaster.	Floods Snowstorms/Ice High Winds	Smyth County MRPDC	Long Term/ Not Started	Funding is needed
Low	Properly inspect and enforce applicable state and federal dam regulations for high- and significant-hazard dams. Presently Hungry Mother Dam is regulated as a high-risk potential dam in the county.	Dam Safety	Smyth County MRPDC	Short Term/ Ongoing	Done though federal, state, and local codes
Low	Verify the geographic location of all NFIP repetitive losses, and making inquiries as to whether the properties have been mitigated, and if so, by what means.	Floods	Smyth County MRPDC	Short Term/ Not Started	Will be looked at next year

Washington County and Abingdon, Damascus, and Glade Spring

Community Hazard Profile

Washington County is a rapidly developing area located on the west end of the Mount Rogers region and is bisected by Interstate 81 in an east-west direction. Within the past decade the most change and growth has been occurring along the I-81 corridor between the Town of Abingdon and the City of Bristol, with much housing development, as well as burgeoning commercial development at the Exit 7 area. Former communities consisting largely of open space and farming are being converted into residential subdivisions to accommodate the growing population of 54,876.

The chief natural hazards of concern to Washington County and its localities include flooding, wildfires, severe winter storms and ice, drought, undetermined risk for impacts from landslides and karst terrain (which occurs in 50% of the county's territory), and high winds. While not a frequent event as defined by our hazard matrix, Washington County suffered a severe tornado in April of 2011 that resulted in 4 deaths, and over 50 injuries.

The flooding results from sustained heavy rainfalls, violent thunderstorms, or as the aftermath of a major snowstorm. FEMA records show four repetitive loss properties with an average claim of $10,063.89. Wildfire risks derive from being located in a rural, forested region and development of woodland home communities (encompassing more than 100,000 acres in the county). Severe winter storms and/or ice have been known to lead to disaster declarations, while drought is only an occasional hazard with impacts mainly for the farming community.

Washington County also contains four dams rated for high- or significant-hazard in the event of failure. Two are flood control structures owned by the Tennessee Valley Authority and one is a hydroelectric dam that has been breached and is no longer active. A fourth dam, owned by the state Department of Game and Inland Fisheries, is a recreational area regulated by the state.

Past or Ongoing Mitigations

Washington County operates its own E-911 system for emergency response from among an array of volunteer fire departments and rescue squads, the sheriff's department and the state police.

A long history of disaster-level flooding led to a comprehensive flood mitigation study for the Town of Damascus completed in 1979. In time, with support from outside grant funding, the town relocated 34 families (88 people) and three local businesses out of the floodplain. The town also was able to install storm drainage systems along flood-prone areas in Mock, Surber, and Haney Hollows. Damascus continues to face a serious flood threat due to its location at the confluence of Beaverdam and Laurel creeks and the lack of developable land outside of the floodplain.

As with the flood mitigation studies done for Smyth County, Damascus could not afford the high cost of the comprehensive approach. In addition, some mitigations considered in the 1970s and 1980s – including stream channelization and installation of levees – would not be allowed under modern state and federal regulations.
The Town of Glade Spring has obtained funding to install upstream and downstream storm detention reservoirs as part of a downtown revitalization effort.

The Town of Abingdon has recently updated some of its floodplain maps but has not been involved in mitigation efforts such as elevations or relocations and demolitions. Currently Abingdon is pursuing funding from FEMA to mitigate against losses associated with flooding in the Country Club Estates and surrounding areas. This area is in the southern portion of the town. Over the past 25 years there have been several rainfall events that have caused localized flooding to several homes in the drainage swale that conveys stormwater from east to west, crossing Fairway Drive, Bogey Drive, and Birdie Drive. After a flooding event in 1992, the Town Council commissioned the "Preliminary Engineering Report, Country Club Estates, Storm

Drainage Improvements, Abingdon, Virginia." This study resulted in solution alternatives with associated cost estimates. Very few, if any, of the recommendations in that report were implemented. There have been other flood events in this area, most recently in July of 2009. During that storm, stormwater encroached nearby and even into several of the residences along the drainage path. Another Preliminary Engineering Report has since been commissioned by the Town Council to update the previous study discussed above.

The Town of Abingdon identifies as an ongoing need for the immediate future the review of all streams and creeks within the Town's corporate limits, which includes the Town Creek and Wolf Creek drainage basins and their tributaries and a drainage swale paralleling Hillman Highway that contributes floodwaters to Fifteen Mile Creek.

Flooding issues affecting private and public property specifically identified within the Town Creek Basin are:

1) Tributary #1 to Town Creek – This tributary is in FEMA Special Flood Hazard Zone A from Hillside Drive downstream to Railroad Street

2) Tributary #2 to Town Creek- This tributary is in FEMA Special Flood Hazard Zone A from Thompson Drive downstream to Tanner Street

3) Tributary #3 to Town Creek – This tributary is in FEMA Special Flood Hazard Zone A from Washington County along Whites Mill Road downstream to Town Creek and

4) Town Creek – In FEMA Special Flood Hazard Zones AE and X and experiences localized flooding from Branch Street to Interstate 81.

Flooding issues specifically identified within the Wolf Creek Basin occur within Tributary #2 to Wolf Creek. Portions of this tributary are in FEMA Special Flood Hazard Zone A and flooding affects private and public property along the drainage path from Hill Street to Wolf Creek.

Although not specifically identified on the Town of Abingdon Flood Insurance Rate Map, private properties located within the drainage swale paralleling Hillman Highway experience damage from floodwaters of the drainage basin. The headwaters of this swale begin near East Main Street and discharge into Fifteen Mile Creek. Continued development within the watershed areas, which includes portions of Washington County, has created additional impervious surfaces, such as roofs and pavements that increase storm water runoff. Portions of all of the aforementioned sections within the Town are prone to flooding, property damage, loss and possible harm to residents.

In order to mitigate the conditions as described briefly above, the Town must perform hydrologic and hydraulic analyses of the watershed areas that specifically identify the problem areas and

develop solutions and plans that address the problems. The aforementioned practices including analysis, planning, establishing priorities and application for available funds will help enable project work to progress so that all concerned can be protected from flooding.

The county's building codes are in line with the most recent statewide revisions known as the Uniform Statewide Building Code, which took effect in 2009.

Recommended Mitigations: Washington County and Abingdon, Damascus, and Glade Spring

Washington County and Localities Mitigations

Rank	Activity	Hazard Addressed	Responsible Party	Timeline/ Status	Comments
High	Conduct hydrological/engineering studies to determine Base Flood Elevations and create new floodplain maps for streams in the Town of Abingdon and Washington Counties, as well as perform hydrologic and hydraulic analyses of areas that convey stormwater in the Town of Abingdon.	Floods	Washington County Town of Abingdon MRPDC	Short Term/ Ongoing	The Town of Abingdon is currently seeking funds for this project
High	Mitigation projects that will result in protection of public or private property from natural hazards. Eligible projects include, but are not limited to: • Acquisition of hazard prone properties • Elevation of flood prone structures • Minor structural flood control projects • Relocation of structures from hazard prone areas • Retrofitting of existing buildings and facilities • Retrofitting of existing buildings and facilities for shelters • Infrastructure protection measures • Storm water management improvements • Advanced warning systems and hazard gauging systems (weather radios, reverse-911,stream gauges, I-flows) • Targeted hazard education • Wastewater and storm water management improvements	Floods/Wildfire	Town of Abingdon MRPDC	Short Term/ Ongoing	The Town of Abingdon is currently seeking funds for this project

	• Wildfire Mitigation Projects				
High	Conduct hydrological/engineering studies to determine Base Flood Elevations in watersheds containing estimated floodplains.	Floods	Washington County MRPDC	Long Term/ Not Started	Funding is needed
High	Encourage more property owners to insure their homes through the National Flood Insurance Program.	Floods	Washington County MRPDC	Short Term/ Ongoing	Residents are encouraged to do so
High	Consider appropriate mitigation projects for the five repetitive loss properties identified by FEMA data.	Floods	Washington County MRPDC	Long Term/ Not Started	Funding is needed
High	Conduct hydrological/engineering studies to determine Base Flood Elevations and create new floodplain map for Cedar Creek in the Meadowview community.	Floods	Washington County MRPDC	Long Term/ Not Started	Funding is needed
High	Use the flood analysis as a basis for consideration of future relocation/demolition and flood-proofing projects.	Floods	Washington County MRPDC	Short Term/ Ongoing	When this issue arises flood analysis is used
High	Comply with NFIP for floodplain identification and mapping, responsible floodplain management, and the promotion of flood insurance.	Floods	Washington County MRPDC	Short Term/ Ongoing	Done through compliance with the NFIP
High	Support educational programs to promote Firewise methods to affected residents of woodland communities. An estimated 804 homes are located in wooded settings and subject to risk of wildfire.	Wildfire	Washington County RC&D Firewise MRPDC	Long Term/ Not Started	Funding is needed
Medium	Educate residents on methods recommended by the American Red Cross to prepare for various types of natural disaster.	Floods Snowstorms/Ice High Winds	Washington County MRPDC	Long Term/ Not Started	Funding is needed
Low	Properly inspect and enforce applicable state and federal dam regulations for high- and significant-hazard dams. There are four such dams in Washington County, one of which has been breached.	Dam Safety	Washington County MRPDC	Short Term/ Ongoing	Done though federal, state, and local codes
Low	Verify the geographic location of all NFIP repetitive losses, and making inquiries as to whether the properties have been mitigated,	Floods	Washington County MRPDC	Short Term/ Not Started	Will be looked at next year

	and if so, by what means.				

Wythe County and Rural Retreat and Wytheville

Community Hazard Profile

Wythe County is a community of 29,235 that is traversed north-south by Interstate 77 and east-west by Interstate 81, as well as routs 21, 52, and 94. The county includes the incorporated towns of Rural Retreat and Wytheville, which serves as the county seat. The county caters to the trucking industry and also facilitated the construction of a major new Pepsi bottling plant along the I-81 corridor. More than 50% of the county contains slopes of more than 20%, which hinders development in those steep areas.

Chief natural hazards experienced in Wythe County and its localities include flooding, severe winter storms and ice, high winds, drought, and undetermined hazards from karst terrain (which appears in roughly 30% of the county's landscape). There is one high-hazard potential dam (Rural Retreat Dam) owned as a recreational attraction by the Virginia Department of Game and Inland Fisheries.

The flooding results from sustained heavy rainfalls, violent thunderstorms, and melting as the aftermath of a major snowstorm. Flood hazards have been identified for the Town of Wytheville and the community of Max Meadows east of Wytheville. There is only one repetitive loss property in Max Meadows.

Past or Ongoing Mitigations

Emergency response is based around the county's E-911 system, the sheriff's department, the state police, and several volunteer fire departments and rescue squads.

The county's building codes are in line with the most recent statewide revisions known as the Uniform Statewide Building Code, which took effect in 2009. These modern codes help protect against hazard damages, such as those from high winds.

Recommended Mitigations: Wythe County and Rural Retreat and Wytheville

Wythe County and Localities Mitigations

Rank	Activity	Hazard Addressed	Responsible Party	Timeline/ Status	Comments
High	Conduct hydrological/engineering studies to determine Base Flood Elevations in watersheds containing estimated floodplains.	Floods	Wythe County MRPDC	Long Term/ Not Started	Funding is needed
High	Comply with NFIP for floodplain identification and mapping, responsible floodplain management, and the promotion of flood insurance.	Floods	Wythe County MRPDC	Short Term/ Ongoing	Done through compliance with the NFIP
High	Use the flood analysis as a basis for consideration of future relocation/demolition and flood-proofing projects.	Floods	Wythe County MRPDC	Short Term/ Ongoing	Used when these projects are looked at
Medium	Support development of strategic wildfire risk reduction plans such as being promoted by the New River-Highlands RC&D Council.	Wildfire	Wythe County RC&D MRPDC	Long Term/ Not Started	Funding is needed
Medium	Support educational programs to promote Firewise methods to affected residents of woodland communities. An estimated 20,000 acres of land (unknown number of woodland homes) are subject to wildfire risk in Wythe County.	Wildfire	Wythe County RC&D Firewise MRPDC	Long Term/ Not Started	Funding is needed
Low	Educate residents on methods recommended by the American Red Cross to prepare for various types of natural disaster.	Floods Snowstorms/Ice High Winds	Wythe County MRPDC	Long Term/ Not Started	Funding is needed

Low	Properly inspect and enforce applicable state and federal dam regulations for high- and significant-hazard dams. Rural Retreat Dam falls into the high-hazard potential category in Wythe County.	Dam Safety	Wythe County MRPDC	Short Term/ Ongoing	Done through Federal, State, and local codes
Low	Verify the geographic location of all NFIP repetitive losses, and making inquiries as to whether the properties have been mitigated, and if so, by what means.	Floods	Wythe County MRPDC	Short Term/ Not Started	Will start next year

City of Bristol

Community Hazard Profile

The City of Bristol, Virginia is a community of 17,835 located along Interstate 81 and abutting the far southwestern reach of Washington County. The city has experienced some transition in some traditional residential areas being converted to commercial uses and some shift toward high-tech industry. Bristol stands in the lowlands of the Valley and Ridge physiographic province, and this area is characterized by karst terrain.

Chief natural hazards experienced in the City of Bristol include flooding, which in the past has caused damages in the millions of dollars according to a study by the U.S. Army Corps of Engineers. Other natural hazards faced in Bristol include severe winter storms and ice, high winds, and undetermined hazard risks from karst terrain and landslides. Two high-hazard potential dams affecting Bristol include Clear Creek Dam and Beaver Creek Dam, both located upstream in Washington County.

Past or Ongoing Mitigations

The City of Bristol, Virginia teamed up with the City of Bristol, Tennessee to work with the U.S. Army Corps of Engineers to conduct the "Flood Damage Reduction Feasibility Study" of 2003 to identify ways to reduce continuing flood damage, especially along the main stem of Beaver Creek, which passes through the center of the adjacent cities. The Corps of Engineers recommended the following flood mitigations in July 2003:

- Widening the Beaver Creek channel near 6th Street (in Bristol, Tenn).
- Replacing a pedestrian bridge and removing the 8th Street Bridge (in Bristol, Tenn.)
- Removing the old Sears commercial building near State Street (in Bristol, Tenn.)
- Replacing the existing outlet structure (a 48-inch diameter pipe) on Beaver Creek Dam with a larger reinforced concrete structure to more effectively hold back flood flows.

The Corps of Engineers estimated the proposed mitigations will reduce total average annual flood damages by 20% and reduce flood levels by nearly one foot in the central business districts of both Bristol, Virginia and Bristol, Tennessee.

The city's building codes are in line with the most recent statewide revisions known as the Uniform Statewide Building Code, which took effect in 2009. These modern building codes help offset damages caused by natural hazards, such as high winds, for new construction.

Recommended Mitigations: City of Bristol

City of Bristol, Virginia Mitigations

Rank	Activity	Hazard Addressed	Responsible Party	Timeline/ Status	Comments
High	Support implementation of the remedies outlined by the U.S. Army Corps of Engineers in July 2003 for the cities of Bristol in Virginia and Tennessee.	Floods	City of Bristol MRPDC	Long Term/ Ongoing	Funded by Bristol, TN/VA
High	Identify flood prone properties for potential acquisition/demolition, elevation, flood proofing, and minor localized flood control projects.	Floods	City of Bristol MRPDC	Not Started/ Long Term	Funding is needed
High	Comply with NFIP for floodplain identification and mapping, responsible floodplain management, and the promotion of flood insurance.	Floods	City of Bristol MRPDC	Short Term/ Ongoing	Done through compliance with the NFIP
Medium	Support educational programs to promote Firewise methods, as appropriate to residents of woodland communities. More specific data for the city was not available at the time this report was written.	Wildfire	City of Bristol Firewise MRPDC	Long Term/ Not Started	Funding is needed
Low	Educate residents on methods recommended by the American Red Cross to prepare for various types of natural disaster.	Floods Snowstorms/Ice High Winds	City of Bristol MRPDC	Long Term/ Not Started	Funding is needed
Low	Properly inspect and enforce applicable	Dam Safety	City of Bristol MRPDC	Short Term/ Ongoing	Done through

	state and federal dam regulations for high- and significant-hazard dams. These include Clear Creek Dam and Beaver Creek Dam.				Federal, State, and Local codes
Low	Verify the geographic location of all NFIP repetitive losses, and making inquiries as to whether the properties have been mitigated, and if so, by what means.	Floods	City of Bristol MRPDC	Short Term/ Not Started	Will start next year

City of Galax

Community Hazard Profile

The City of Galax, a community of 7,042, is located in a hilly area with above-sea elevations ranging from 2,340 feet to 2,980 feet at Ward Knob.

While the City of Galax contains a defined floodplain along Chestnut Creek, which flows north-south through the city core, Galax does not participate in the National Flood Insurance Program and has resisted suggestions it rejoin the program, despite disaster-level flooding in November 2003 and repeat flooding problems in 2004. For communities that refuse to participate in NFIP, disaster help from FEMA is not available in the defined floodplains. Flooding problems also have been evident recently along the tributary of Mill Creek, which is not part of a recognized FEMA floodplain. Flooding on the tributaries occurs because the city's storm drainage system is aging (50 years old), with parts of the piping collapsing; these problems block storm water drainage and worsen flooding problems in some residential neighborhoods.

Other natural hazards faced by the City of Galax include wildfires and high winds. The city, along with much of the Mount Rogers region, is part of a Special Wind Zone (winds up to 200 mph), although the problems created do not appear to be of disaster level and the city does enforce current building codes.

Past or Ongoing Mitigations

The City of Galax grew up around its industrial district along Chestnut Creek in the core of the city. Due to disastrous flooding problems along Chestnut Creek (especially in 1940), the U.S. Army Corps of Engineers in 1950 channelized the creek through the downtown area and flood-proofed the industrial buildings located there. Following the flood disaster from November 2003, Galax city officials said they had developed a P.E.R. to improve the drainage system to help alleviate flooding problems, but this was not in the city budget at this time. Galax recently submitted a request to the US Army Corps of Engineers to look at possible projects upstream of Chestnut Creek through the Flood Damage Reduction Program (Section 205 of the 1948 Flood

Control Act). The end result would be a project that would reduce the 100-year flood plain to the Chestnut Creek channel.

The city's building codes are in line with the most recent statewide revisions known as the Uniform Statewide Building Code, which took effect in 2009. These modern codes help to offset the impacts of natural hazards such as winds for new construction.

For emergency response, the City of Galax participates in the Twin County E-911 system, which covers the entire city, along with the adjoining counties of Carroll and Grayson. Responders include volunteer fire departments and rescue squads, local police and sheriff's departments, and the state police.

Recommended Mitigations: City of Galax

City of Galax, Virginia Mitigations

Rank	Activity	Hazard Addressed	Responsible Party	Timeline/ Status	Comments
High	Educate residents on methods recommended by the American Red Cross to prepare for various types of natural disaster.	Floods Snowstorms/Ice High Winds	City of Galax MRPDC	Long Term/ Not Started	Funding is Needed
Medium	Support development of strategic wildfire risk reduction plans such as being promoted by the New River-Highlands RC&D Council.	Wildfire	City of Galax RC&D MRPDC	Long Term/ Not Started	Funding is Needed
Medium	Support educational programs to promote Firewise methods to affected residents of woodland communities. An estimated 67 homes in Galax are in wooded settings and at risk of wildfire.	Wildfire	City of Galax Firewise RC&D MRPDC	Long Term/ Not Started	Funding is Needed

PLAN MAINTENANCE

PLAN ADOPTION

It is anticipated that the 2011 revision of the Mount Rogers Hazard Mitigation Plan will be adopted in the fall of 2011. All resolutions for adoption of the plan by participating localities will be included in the final document. The plan was available for public comment throughout the update process. The Public will also have an opportunity to view the plan during the final adoption phase by the localities. The MRPDC will assist any locality in guiding the plan through the adoption process with all necessary public hearings, and provide the adoption resolutions.

PLAN IMPLEMENTATION

The Mount Rogers Hazard Mitigation Plan will be implemented as follows: 1) policy changes that avoid development in hazard areas or that protect buildings from future impacts, and 2) implementation projects that physically change the environment to reduce impacts or educate landowners and residents on how to protect themselves and their property in the case of an event. The goal of implementing the identified strategies is to reduce the loss of life and/or property due to natural hazard events. Policy changes are an ongoing way to implement the hazard mitigation plan. As local plans are updated, such as comprehensive plans, zoning and subdivision ordinances, or capital improvement plans, strategies for mitigating hazard impacts can be included. Changes to these plans do require some foresight and public involvement but can be a way for localities to make significant progress with little capital investment. The MRPDC works regularly with its member localities as they update these plans and is willing to provide technical assistance for including hazard mitigation specific strategies and language when requested. Implementing projects require more work and investment from the locality or lead agency. Many of the identified projects are contingent on finding grant funding and partnering with other agencies and organizations to complete the project. Grant funding is especially critical in the current economic situation.

PLAN MAINTENANCE

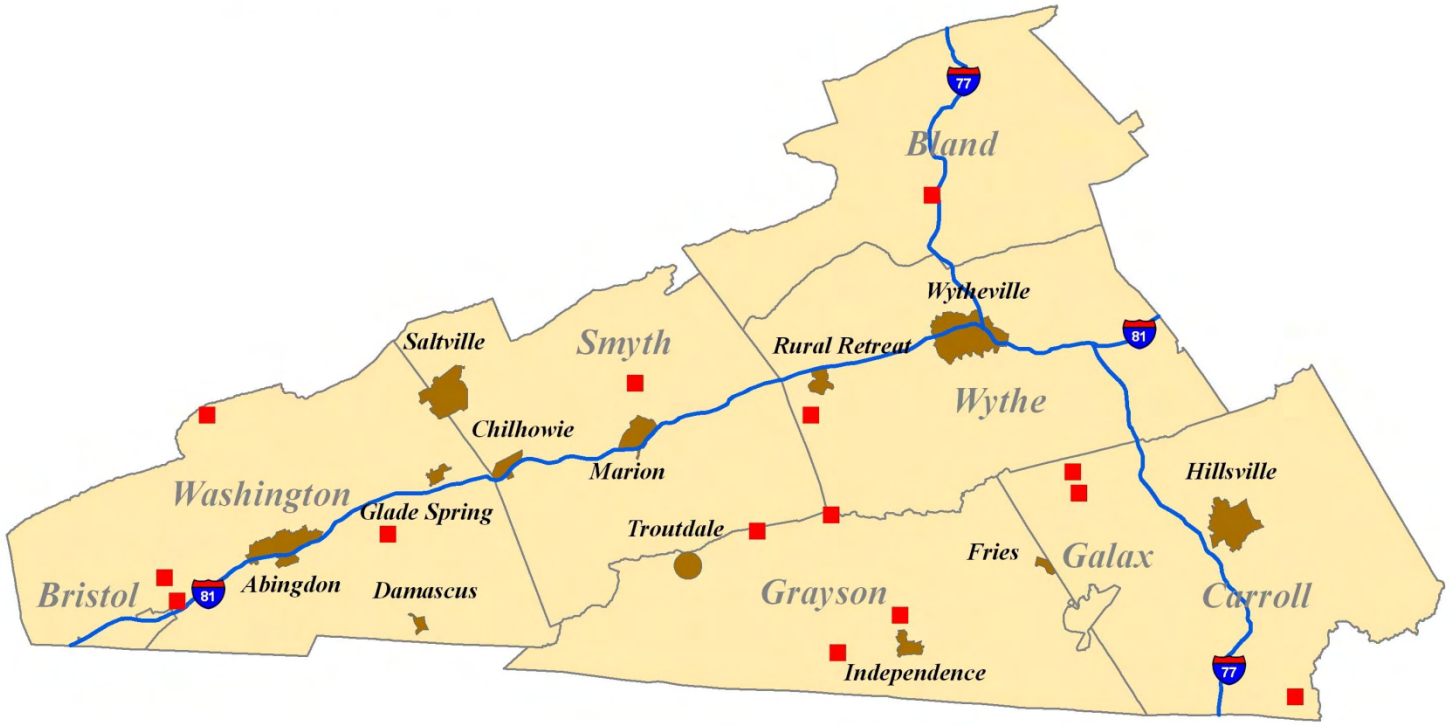
The Mount Rogers Hazard Mitigation Plan will be reviewed annually by the staff of the Mount Rogers Planning District Commission with local government staffs to ensure that the project list stays up-to-date (and completed projects are noted). If necessary, the plan will be reviewed and revised after significant hazard events impacting the region. Cost-effective projects may be added to the locality project list each year, with that local government's approval. This review and potential update may be conducted electronically or through an annual meeting of the Hazard Mitigation Steering Committee. The method of review will depend on the events of the previous year and the extent of potential revisions to be made. An annual report of the status of mitigation actions will be reviewed and sent to VDEM to reduce the burden of evaluating strategies for the required five-year revision.

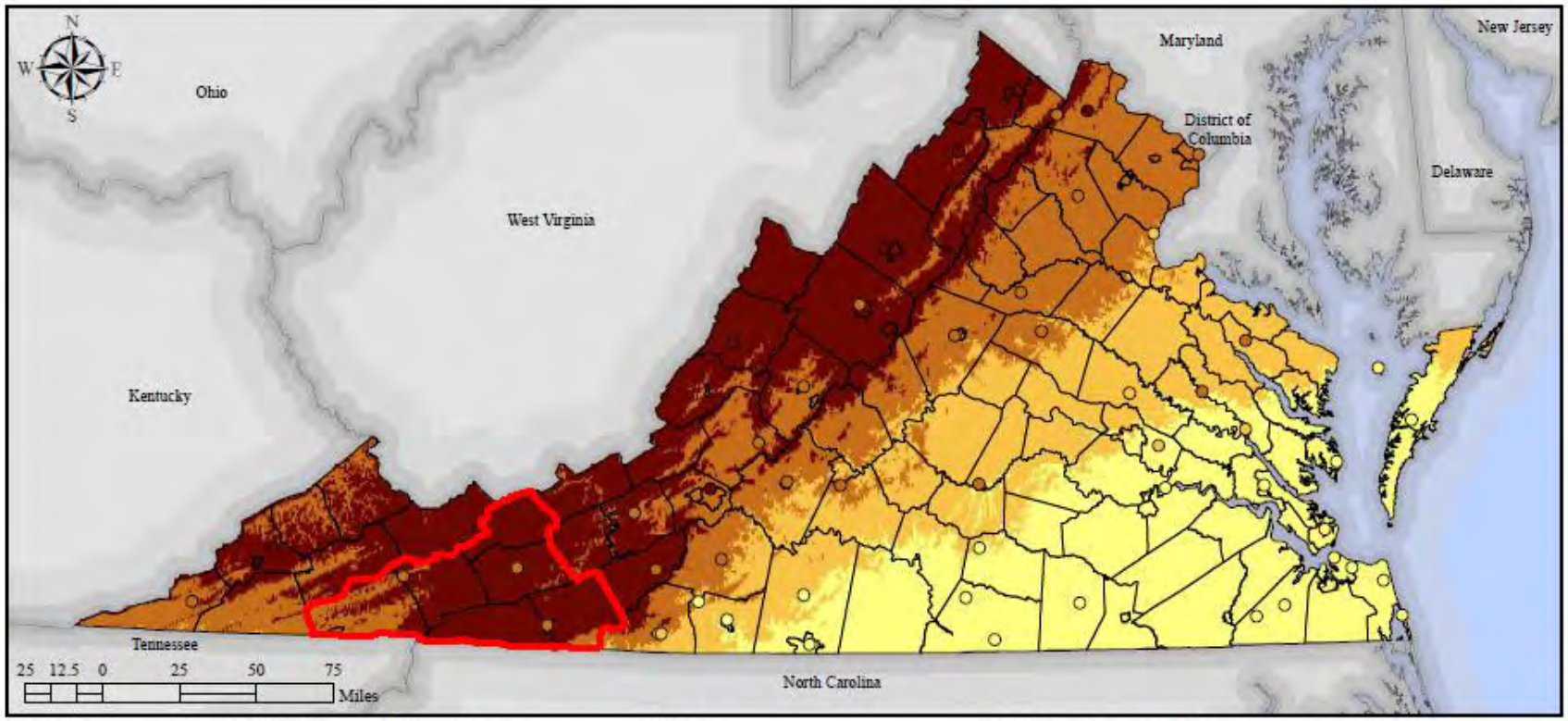
In five years, the Mount Rogers PDC will work to find funding to update the Mount Rogers Hazard Mitigation Plan. Any update of the plan will include a public input session or strategy to engage the community in this planning effort. At the time of the next update, the effectiveness of the mitigation strategies will be evaluated by determining any reduction in vulnerability to a particular hazard. New vulnerabilities will be identified by looking at event history in the past five years, as well as development that may have occurred in hazard areas. During the interceding five years, the Mount Rogers PDC will maintain the hazard mitigation website and will update it periodically with grant funding availability and project updates from localities, if available. This will also allow for continued public input throughout the plan implementation phase.

APPENDIX I

Mount Rogers PDC

Dam Locations





DATA SOURCES:

CGIT analysis of NCDC data
VGIN Jurisdictional Boundaries
ESRI State Boundaries

LEGEND:

Avg. Number of Days per Year

- 1.5 or lower
- 1.51 - 2.0
- 2.01 - 3.0
- 3.01 - 6.72

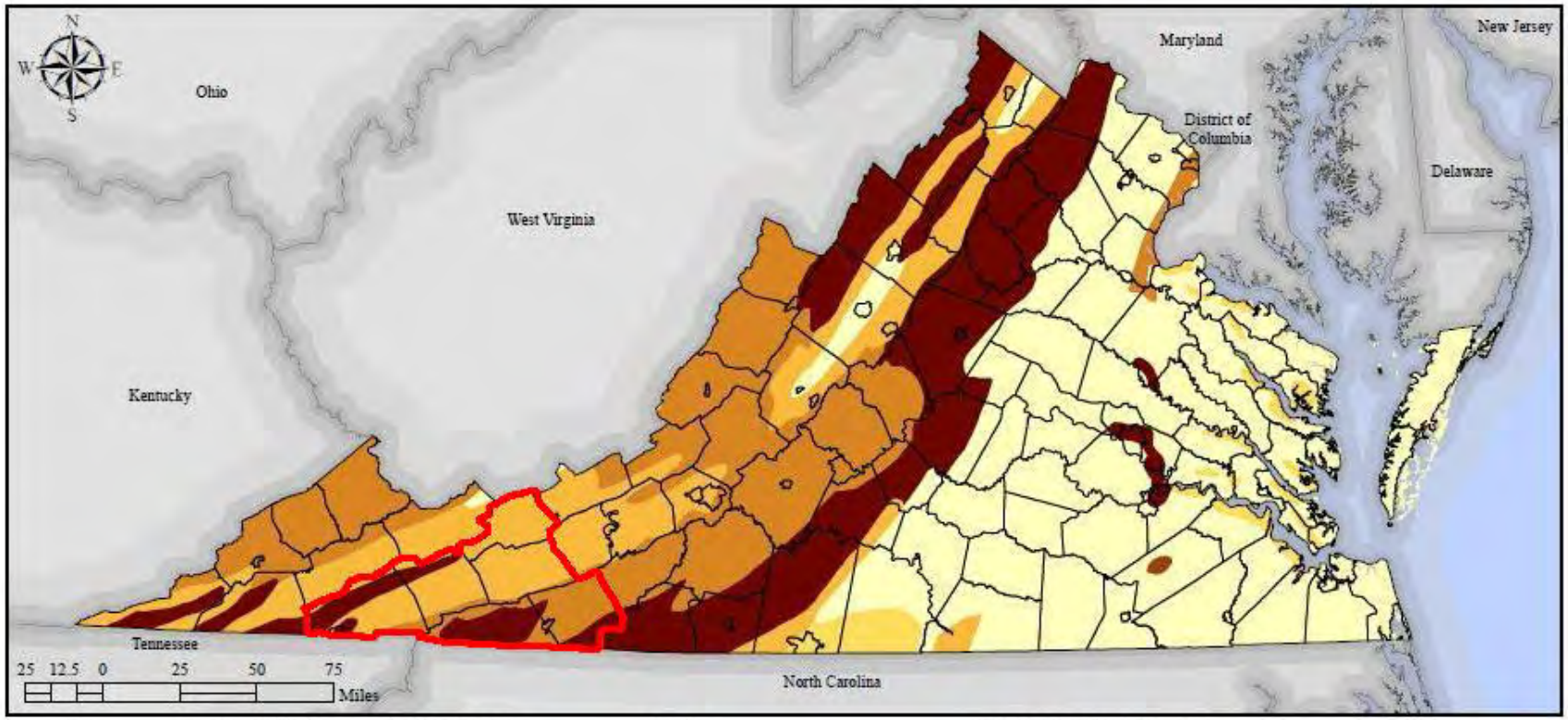
HAZARD IDENTIFICATION:

Winter weather statistics were estimated from daily NCDC weather station reports from 1960 - 2000; the values at the weather stations are symbolized with small round dots, and a statewide regression fit depicts the overall trend in the weather station statistics.

These results depict general trends, and local conditions may vary widely.

PROJECTION: *VA Lambert Conformal Conic*
North American Datum 1983

DISCLAIMER: Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards. In order to identify potential risk in the Commonwealth available data has been used beyond the original intent.



VIRGINIA DEPARTMENT OF EMERGENCY MANAGEMENT

DATA SOURCES:

USGS NLHP
VGIN Jurisdictional Boundaries
ESRI State Boundaries

LEGEND:

Landslide Categories

- High Susceptibility & Moderate Incidence
- High Susceptibility & Low Incidence
- High Incidence
- Moderate Susceptibility & Low Incidence
- Moderate Incidence
- Low Incidence

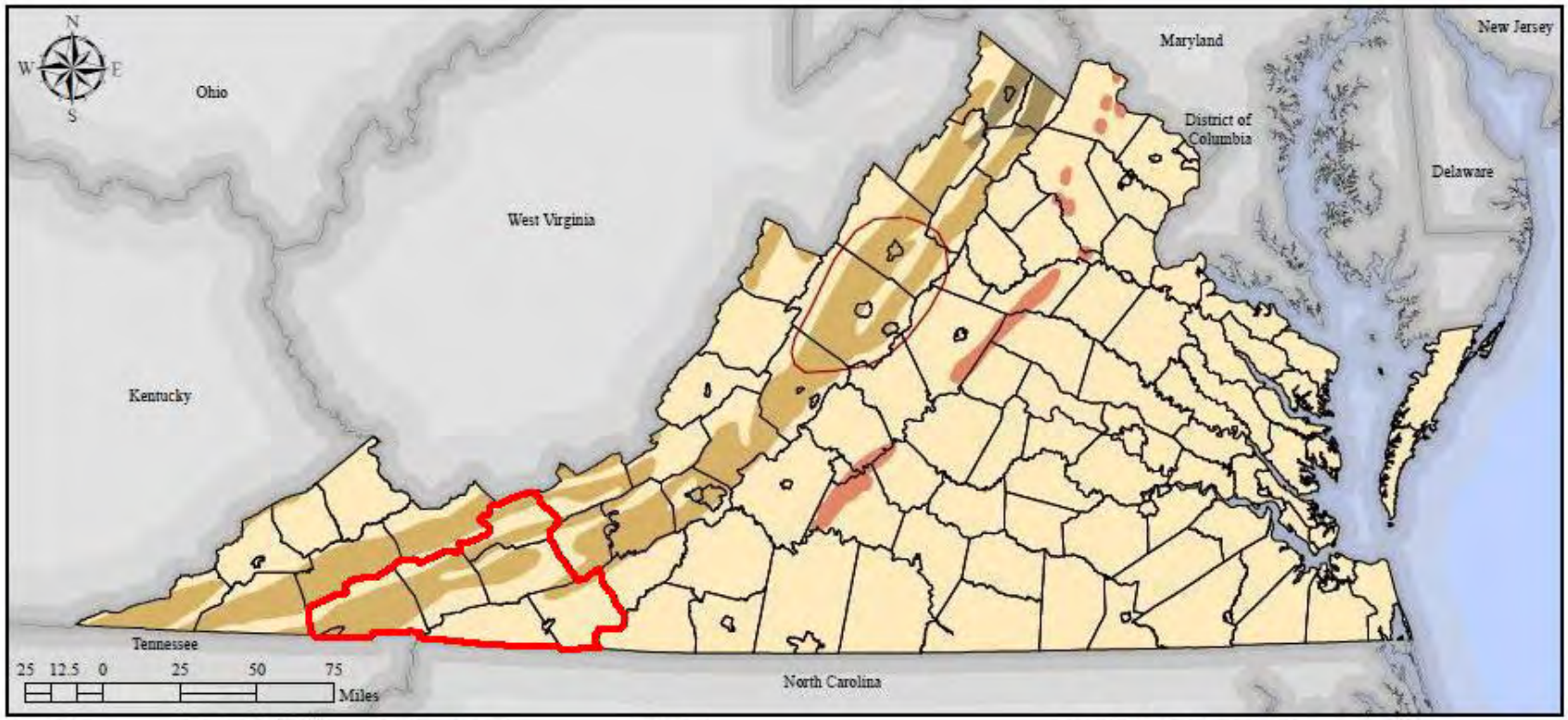
HAZARD IDENTIFICATION:

The Landslide Incidence and Susceptibility map layer shows areas of landslides and areas susceptible to future landsliding. Areas where large numbers of landslides have occurred and areas which are susceptible to landsliding have been delineated in this layer.

Landslides are defined to include most types of gravitational mass movement such as rockfalls, debris flows, and the failure of engineered soil materials.

PROJECTION: *VA Lambert Conformal Conic*
North American Datum 1983

DISCLAIMER: Majority of available hazard data is intended to be used at national or regional scales. The purpose of the data sets are to give general indication of areas that may be susceptible to hazards. In order to identify potential risk in the Commonwealth available data has been used beyond the original intent.



VIRGINIA DEPARTMENT OF EMERGENCY MANAGEMENT

DATA SOURCES:

USGS Engineering Aspects of Karst
VGIN Jurisdicational Boundaries
ESRI State Boundaries

PROJECTION: *VA Lambert Conformal Conic North American Datum 1983*

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LEGEND:

Historical Subsidence

Karst Type (Long)
- In moderately to steeply dipping beds of carbonate rock
- In gently dipping to flat- lying beds of carbonate rock

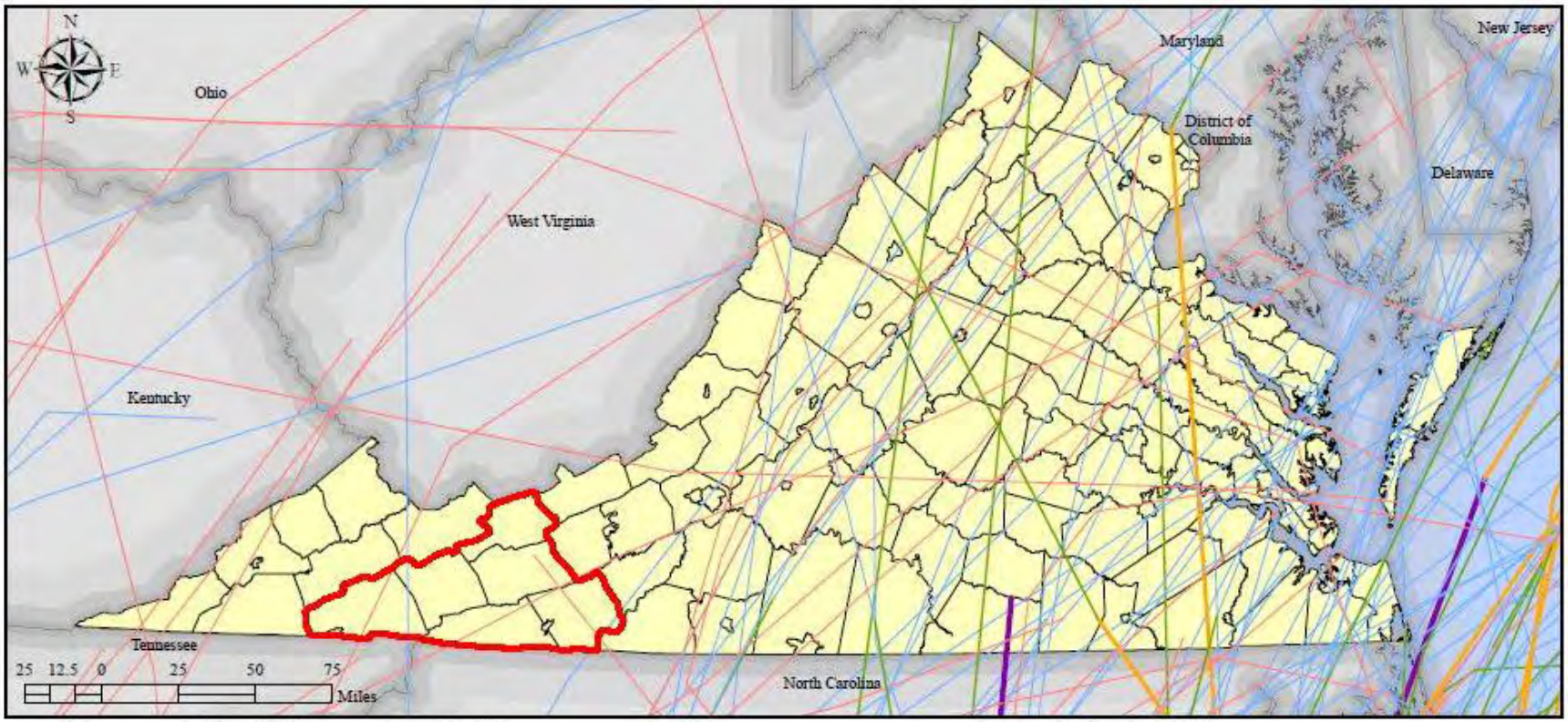
Karst Type (Short)
- In metamorphosed limestone, dolostone, and marble
- In moderately to steeply dipping beds of carbonate rock

HAZARD IDENTIFICATION:

Long Karst Type: Fissures, tubes, and caves over 1,000 ft long; 50 ft to over 250 ft vertical extent

Short Karst Type: Fissures, tubes and caves generally less than 1,000 ft long; 50 ft or less vertical extent

Historical subsidence represents areas of extensive sinkhole development.



VIRGINIA DEPARTMENT OF EMERGENCY MANAGEMENT

DATA SOURCES:

NOAA Hurricane Tracks
VGIN Jurisdictional Boundaries
ESRI State Boundaries

LEGEND:

Saffir-Simpson Hurricane Categories
Tropical Depression (17-38 mph)
Tropical Storm (39-73 mph)
Category 1 (74-95 mph)
Category 2 (96-110 mph)
Category 3 (111-130 mph)

HAZARD IDENTIFICATION:

Map shows all the hurricane tracks in or around Virginia from 1851-2008.

NOAA provided the locations and categories of all hurricanes from 1851-2007. Data for 2008 is approximate and was obtained from Stormpulse.

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North American Datum 1983

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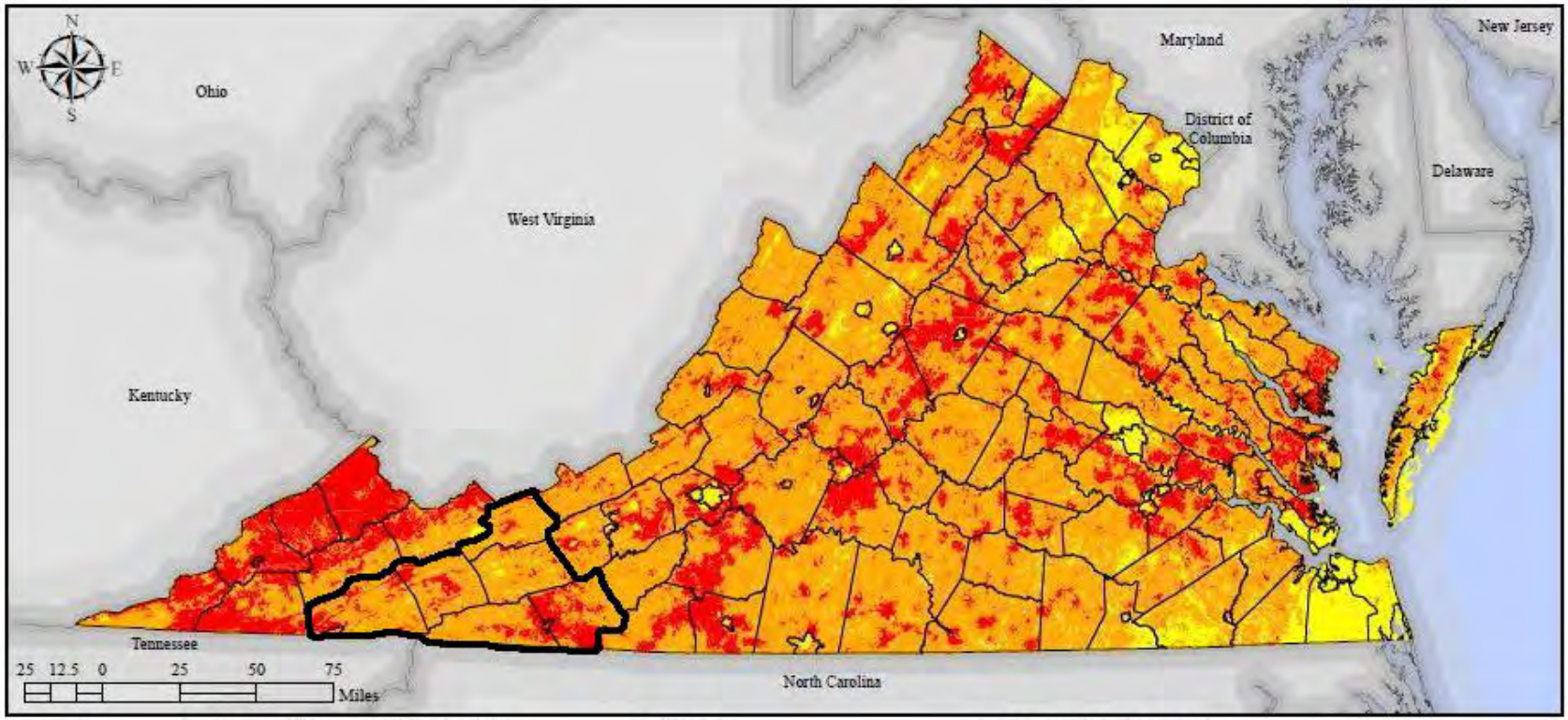

VIRGINIA DEPARTMENT OF EMERGENCY MANAGEMENT

DATA SOURCES:

VDOF Wildfire Risk Assessment
VGIN Jurisdictional Boundaries
ESRI State Boundaries

LEGEND:

Wildfire Risk
- None (Water)
- Low
- Moderate
- High

HAZARD IDENTIFICATION:

Wildfire Risk Assessment model has been developed by the Virginia Department of Forestry. This model aims to identify areas which are more favorable to wildfire occurence and wildfire advancement.

Model inputs included: historical fire incidents, land cover (fuels surrogate), topographic characteristics, population density, and distance to roads.

PROJECTION: *VA Lambert Conformal Conic*
North American Datum 1983

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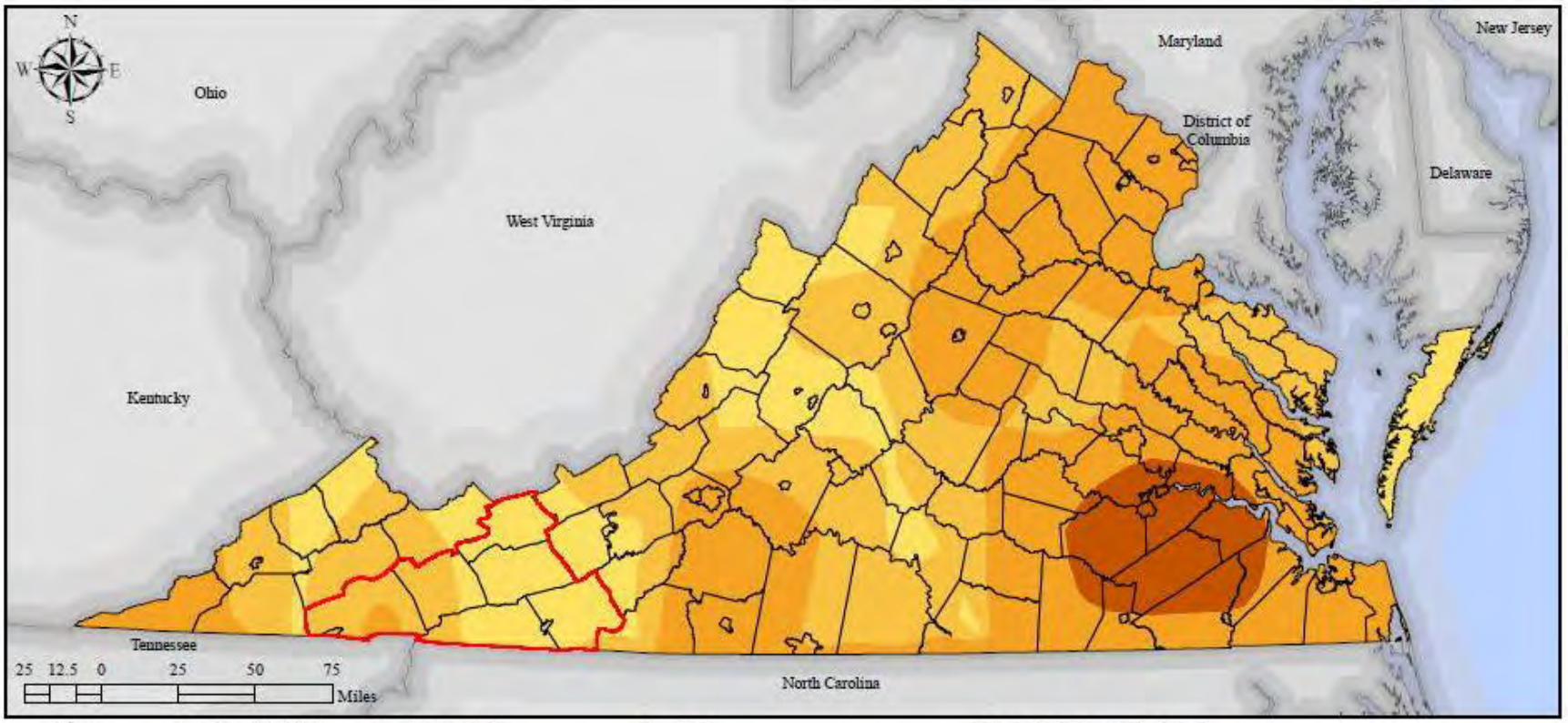

VIRGINIA DEPARTMENT OF EMERGENCY MANAGEMENT

DATA SOURCES:

SVRGIS / SeverePlot
VGIN Jurisdictional Boundaries
ESRI State Boundaries

PROJECTION: *VA Lambert Conformal Conic North American Datum 1983*

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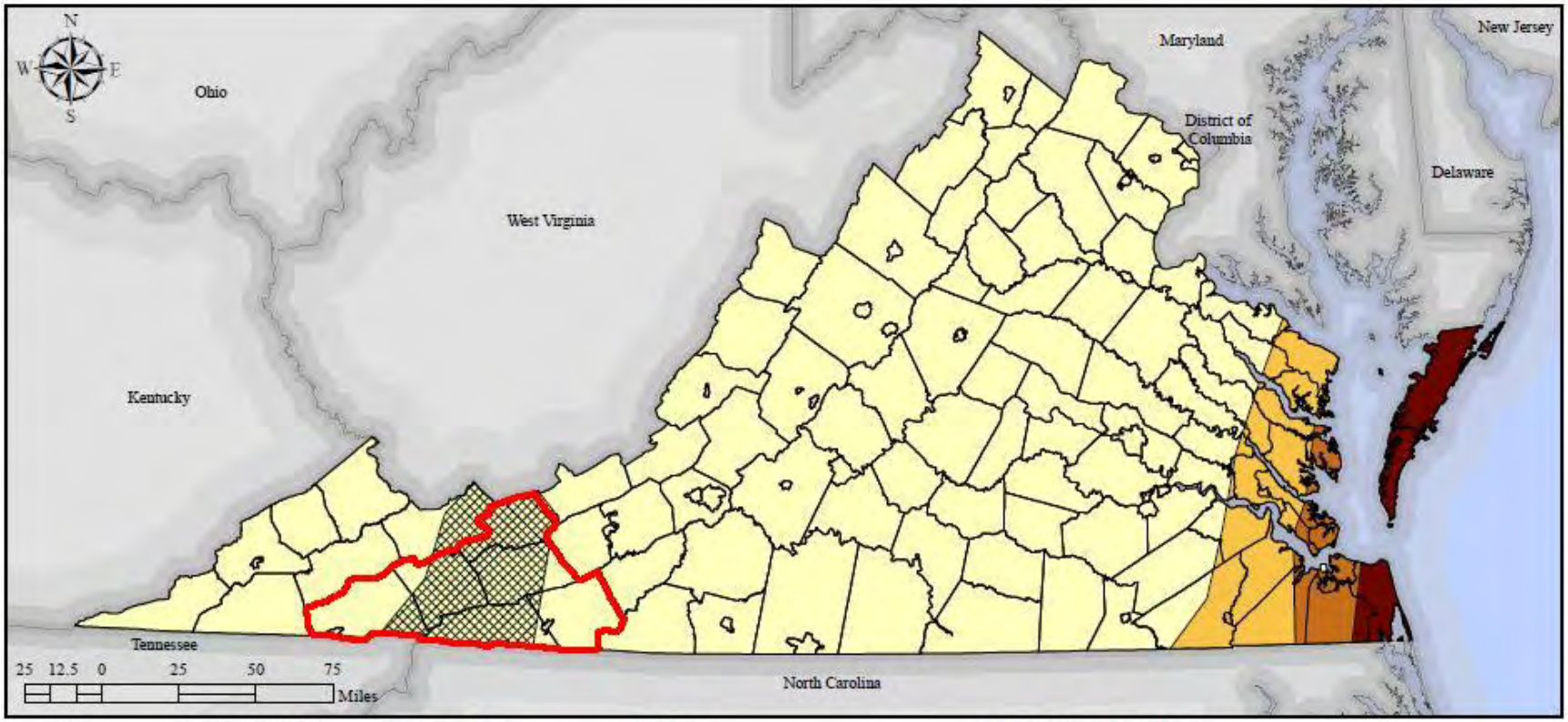
LEGEND:

Annual Tornado Hazard Frequency
Times One Million

0 - 1.25	Low
1.251 - 10	Medium-Low
10.1 - 100	Medium-High
100.1 - 252	High

HAZARD IDENTIFICATION:

Annual tornado hazard frequency is an estimate of the frequency with which a point will experience a tornado, interpolating from neighboring tornado impact areas over the period of record. This map shows hazard frequency of "significant" tornadoes, defined as F2 or greater. Note that "high" frequency in the state of Virginia is still rather low in comparison to many midwestern and southern states.



VIRGINIA DEPARTMENT OF EMERGENCY MANAGEMENT

DATA SOURCES:

ASCE 7-98 Design Wind Speeds
VGIN Jurisdicational Boundaries
ESRI State Boundaries

PROJECTION: *VA Lambert Conformal Conic*
North American Datum 1983

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LEGEND:

Wind Speeds for 3-Second Gust

- < 90 mph
- 90-100
- 100-120
- > 120 mph
- Special Wind Region

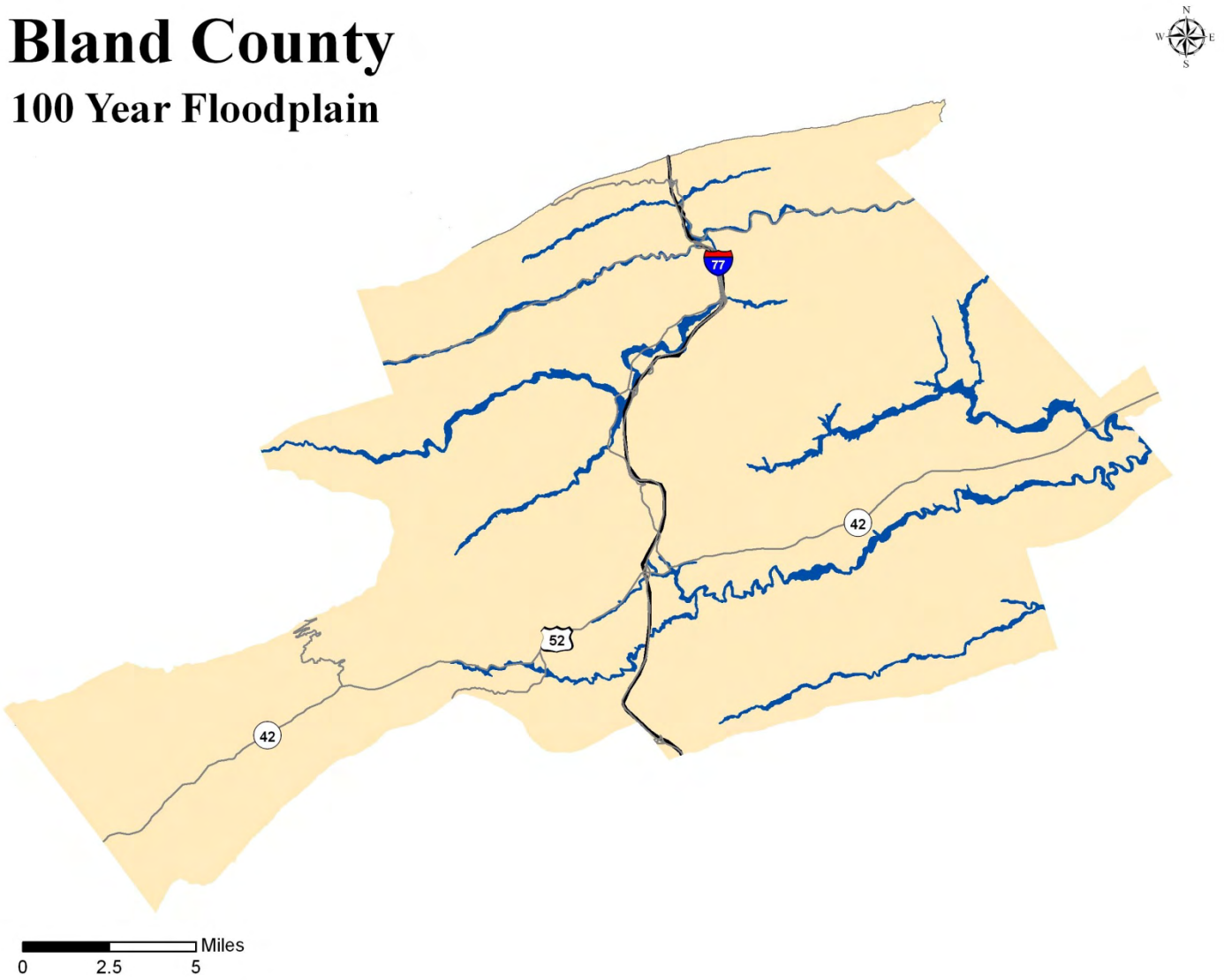
HAZARD IDENTIFICATION:

ASCE basic wind speeds are based on nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 feet (10m) above ground for the 50-year recurrence interval (2% annual probability). Values have been determined by localized research using approved probabilistic methods.

Special Wind Regions are areas of unusual wind conditions.

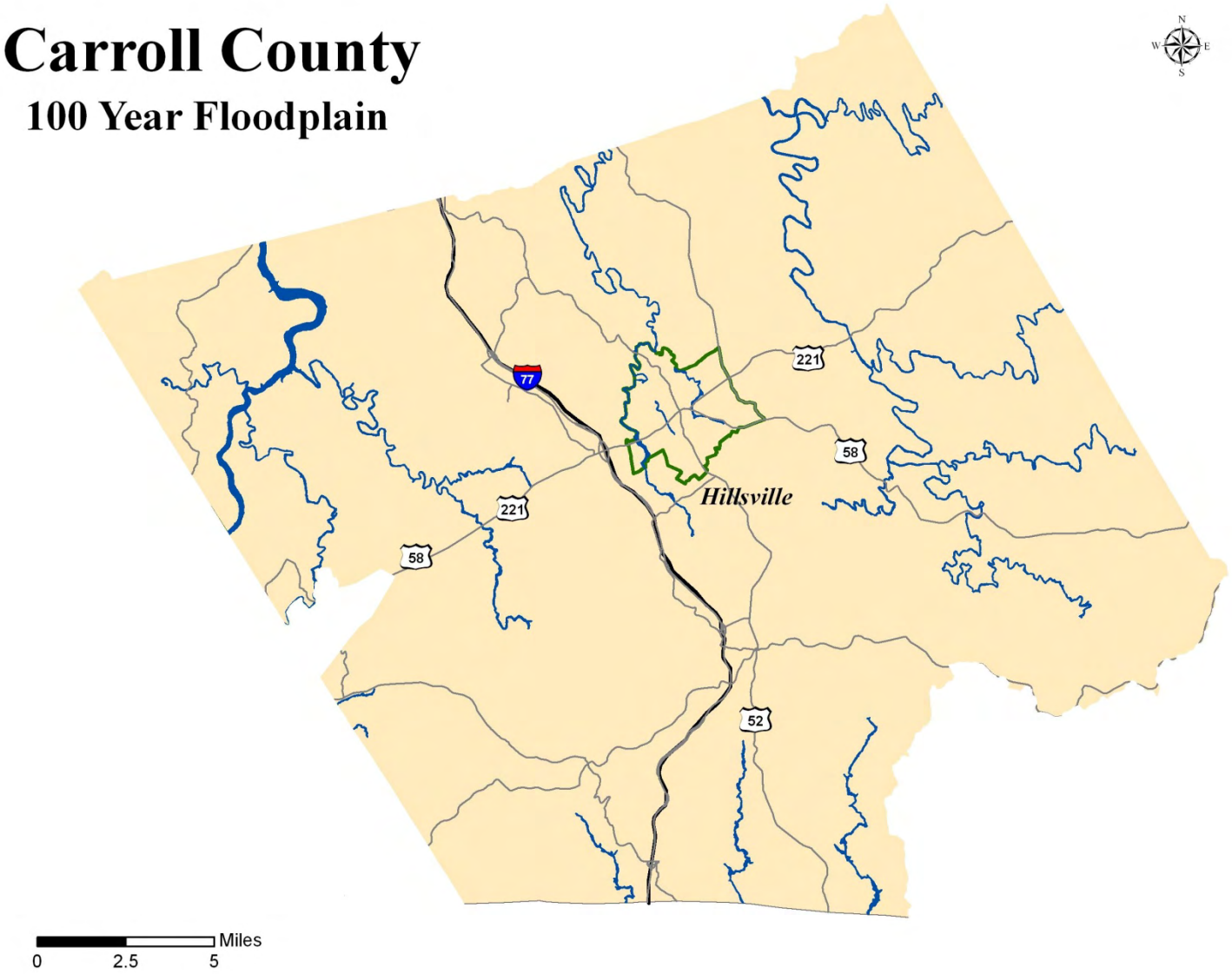
Bland County

100 Year Floodplain



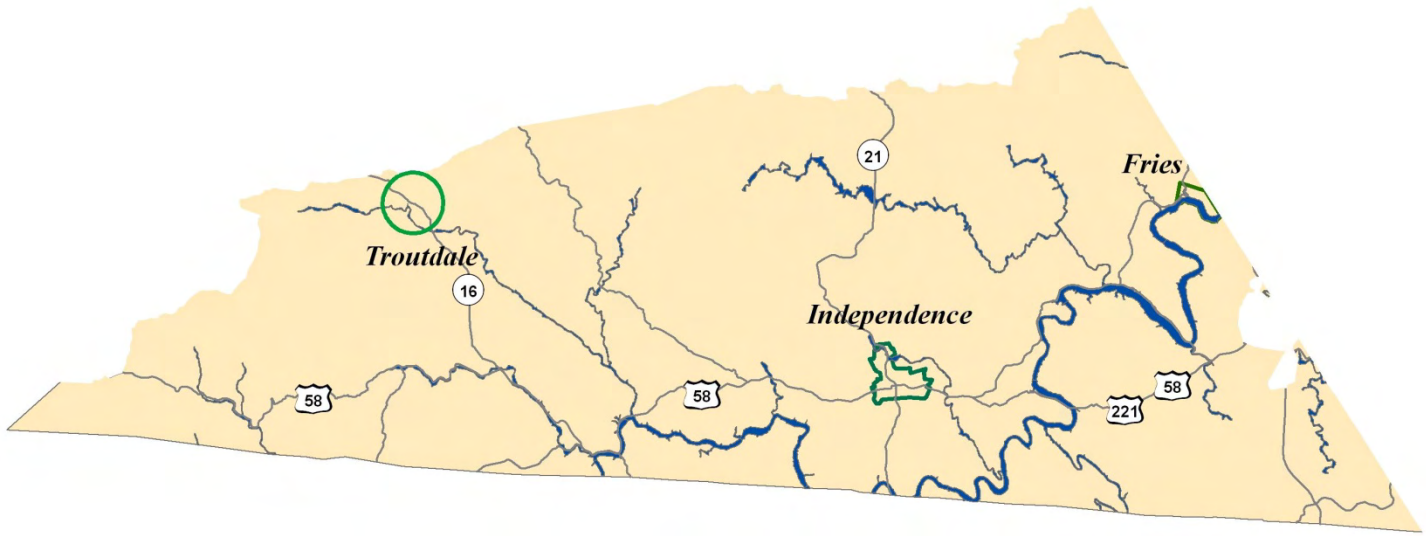
Carroll County

100 Year Floodplain



Grayson County

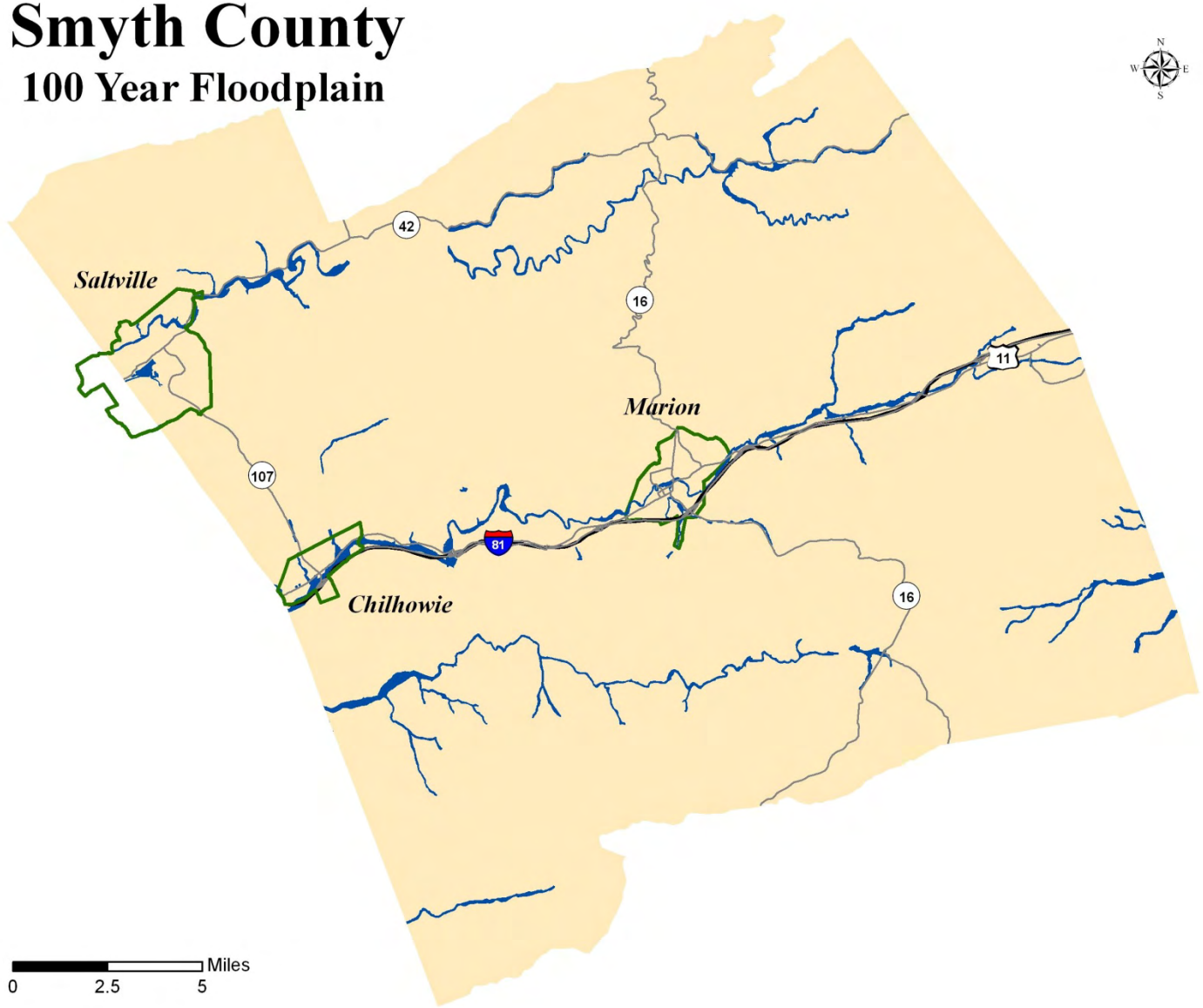
100 Year Floodplain



Miles
0 2.5 5

Smyth County

100 Year Floodplain



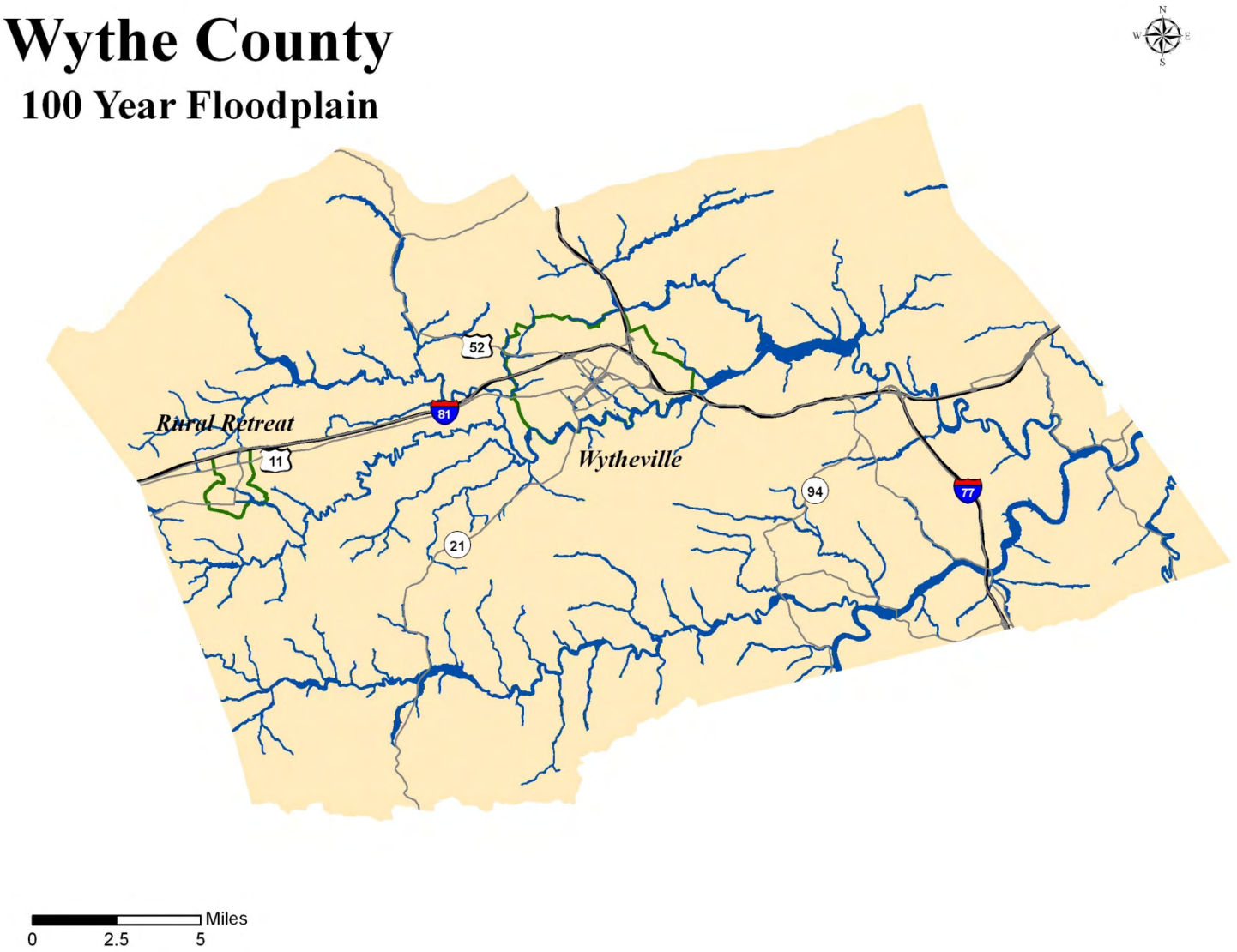
Washington County

100 Year Floodplain

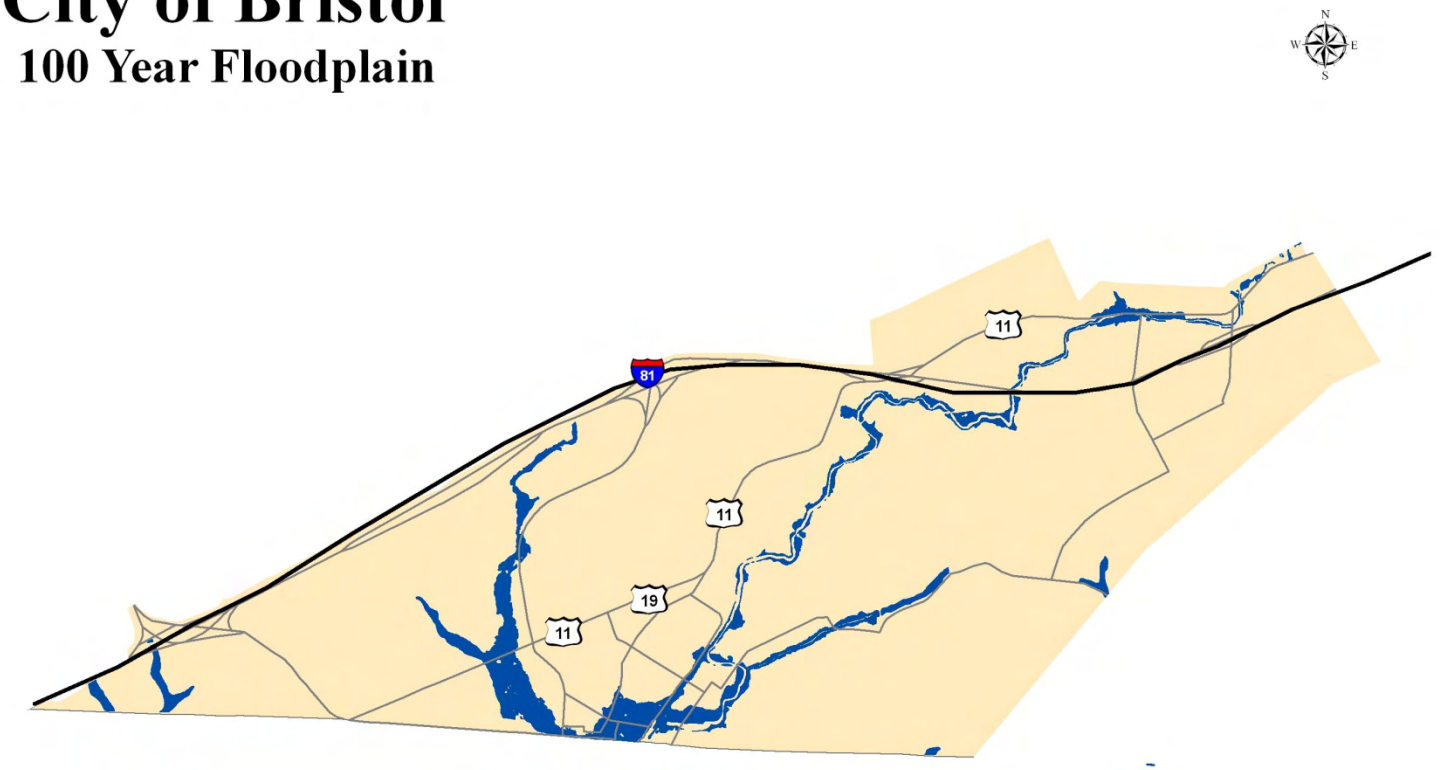
Miles
0 2.5 5

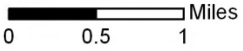
Wythe County

100 Year Floodplain



City of Bristol
100 Year Floodplain





City of Galax
100 Year Floodplain