4.6 Severe Weather: Severe Winter Weather, High Winds, and Tornados

The New River Valley experiences a variety of severe weather events. Most of these do not cause catastrophic damages, however. Rather, most threats to life can generally be minimized through attention to personal safety. Threats to property may be minimized in a variety of ways. Most of these hazard events are not associated with particular places. In this update of the New River Valley Hazard Mitigation Plan, several changes and updates have been made to this severe weather HIRA. The HIRA includes severe winter weather (freezing temperatures and significant snowfall), high non-rotational winds, and tornados. Severe winter weather and high non-rotational winds are common hazards in the NRV. The previous plan did a cursory analysis of history and frequency of hail and lightning that are not included in this revision due to lack of consistent data.

4.6.1 Severe Winter Weather

Severe Winter Weather in the New River Valley includes freezing temperatures, snowfall, and ice storms. These three events can occur independently or concurrently when the right atmospheric conditions exist. The NRV can have relatively mild winters with little snowfall and only moderately frosty days; it can have relatively severe winters with long periods of moderate to severe frost and significant snow accumulations; or it can have what statistically would be "average winters" with a little of everything. There is no definite character for winter weather in this region due to the geographic location and the typical weather patterns that occur over the winter period.

The New River Valley is a mountainous region that is subject to weather systems entering predominantly from the west and the northwest (moisture from the west, sometimes from the southwest, e.g., Gulf influence). Arctic fronts with cold and dry air come in from the northwest (Upper Midwest and Canada), and moist air masses are brought in by Atlantic Coastal storms that are moving in a north-westerly direction. The moist Atlantic air that is pushed upwards from the coastal plains and the Piedmont into this region loses its capacity to hold moisture due to orographic uplifting, causing the air mass to cool and release its moisture as precipitation. When this occurs, the region will experience anything from a severe snow storm, to a severe ice storm, to high volumes of precipitation consisting of near-freezing rain (which can locally then turn into ice-rain). Heavy snow storms followed almost immediately by a thaw resulting in flooding of local streams are relatively common. This is particularly sudden when prolonged periods of frost have preceded the snow, rendering the soil impermeable due to freezing. In such cases, the melt water cannot filter through the soil, but has to run off across the surface, resulting in rapid peak-flows and flooding.

4.6.1.1 History

Severe winter weather is not unusual in the New River Valley, but the region can have back-to-back mild winters with no significant weather events. Since the early 1990s, the NRV has recorded 73 winter weather events, including extreme cold, ice storms, and heavy snows, with just under $6.6 million reported in damages, as recorded by the National Climatic Data Center.

The NRV does have a history of memorable winter storm events, such as the Blizzard of 1993, the Ice Storm of 1994, the Blizzard of 1996, the flooding as a result of rapid snow melt of 1996, the Winter Storm of 1998, the Ice Storm of 1998, the Winter Storm of February 2000, the Ice

Storm of December 2002, the flooding from rapid melting in February 2003, and the extreme cold in the winter of 2001/2002. Impacts from a few of those storms can be seen in Figure 4-17 and Figure 4-18. Significant snowfall levels, such as in 2009, do not necessarily imply an emergency. As in 2009, the cumulative snowfalls that year were sufficiently spread out to allow for clearing of the roads in between. The winter of 2009-2010 brought several significant snowfall events to the region. Due to a December 2009 snowfall that left 12-16" of snow across the region, Montgomery County was part of a Presidential Disaster Declaration. In addition to that event, February 2010 brought more snow to the region. On February 5, 2010, approximately 8-11" of snow fell across the region.

Figure 4-17. Heavy Ice, Floyd County, December 2002

Figure 4-18. Wind Damage, Pembroke, February 2003

Similar to the Fujita and Saffir-Simpson scales used to characterize the magnitude of tornadoes and hurricanes, Paul Kocin and Louis Uccellini of the National Weather Service developed the Northeast Snowfall Impact Scale (NESIS) to characterize the impact of snow events (http://www.ncdc.noaa.gov/snow-and-ice/nesis.php). The NESIS characterizes and ranks high-impact snowstorms occurring in the northeastern United States. NESIS scores are a function of the area affected by the snowstorm, the amount of snow, and the number of people living in the path of the storm. Table 4-22 below summarizes the NESIS categories. The storms that occurred in December 2009 and February 2010 were both categorized by this system as Significant and Major, respectively.

Table 4-22. NESIS Categories

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

Map 29 shows the average number of days with at least 6 inches of snow, while Map 30 illustrates the average annual days with temperatures below 32° F (source: CGIT analysis of

NCDC data for VDEM, 2008). High snowfall levels as well as low temperatures are particularly common in the mountainous areas of the NRV.

4.6.1.2 Risk Assessment and Vulnerability

Ice storms are of high concern in the region. Damage to trees can significantly increase the fire-danger in subsequent years, as dead biomass accumulates on the forest floor. Damage to infrastructure from ice storms (roads rendered impassable because of ice, fallen trees, accidents; power lines downed because of ice buildup or because of trees/branches falling on lines after breakage due to ice build-up; failure of communication systems due to breakage of lines) do occur frequently. Since the temperature that leads to ice storms rather than rain are often only a degree or two different and with local variations in conditions conducive to a build-up of ice (e.g., cold valleys, areas where cold air falls from higher elevations) predicting the effect of ice storms for specific areas of the NRV is difficult at best. Observations have been made where one valley had ice build-up, while the next valley had rain, and another had snow. Locally, there are tremendous differences in microclimatic situations causing these variations from place to place.

Whenever a major winter storm occurs, it is likely to severely affect the highways and power lines. Heavy snowfall and ice storms can immobilize an entire region such as the NRV and adjoining areas. Snow and ice storm-related deaths are typically the result of accidents, overexertion, and exposure. Flooding may follow major winter storms. Heavy snow built-up on some roofs may lead to their collapse, resulting in structural damage. There is no known way to predict damage from winter storms to a particular region, nor is there data to support such predictions. The National Climatic Data Center reports damage by storm events, but not by locality.

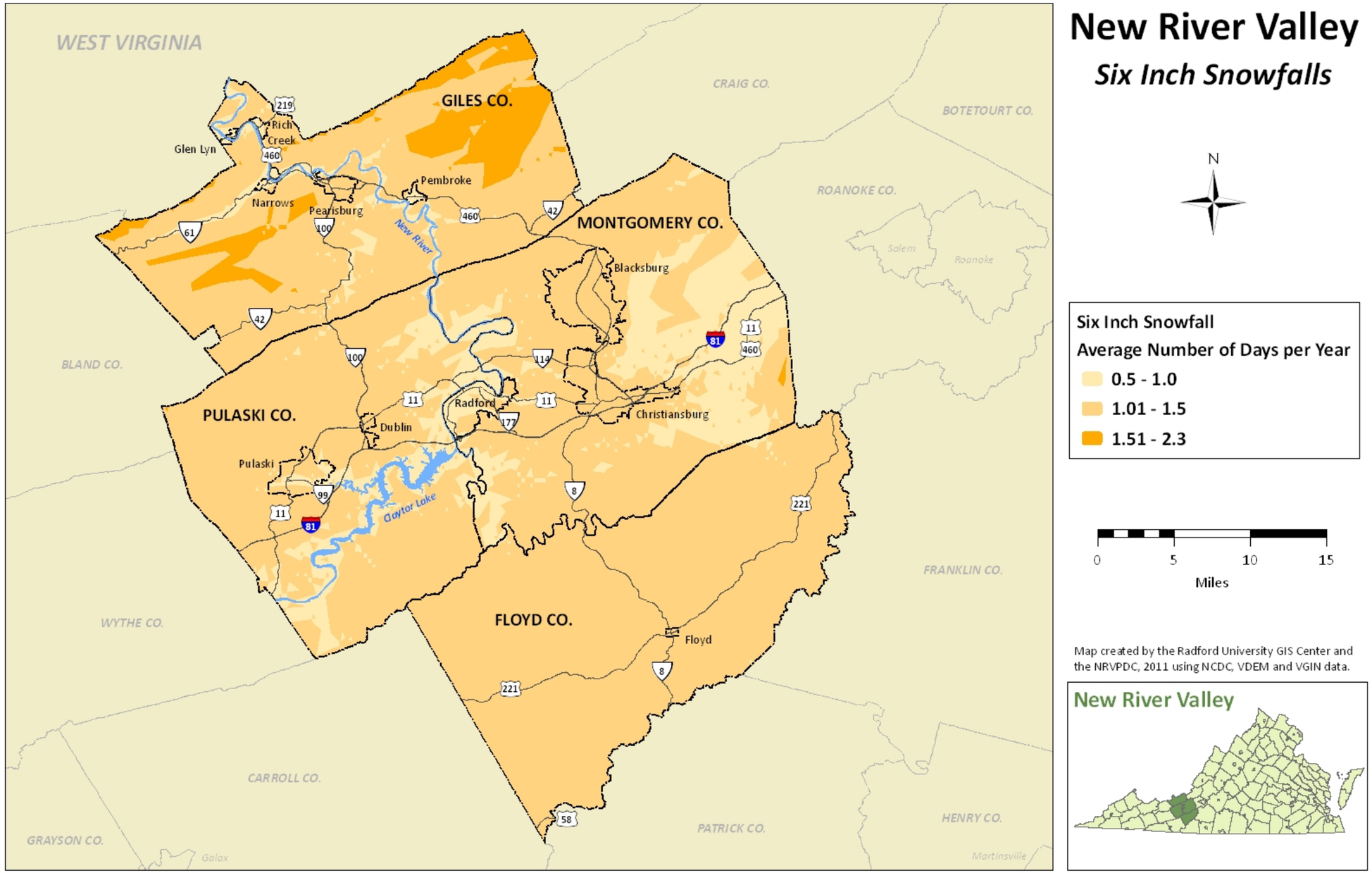
The occurrence of winter storms and ice can cause death and injury. Such storms can trap people in their vehicles or in their homes due to impassable roads. Downed power lines may further exasperate the situation by limiting the access of residents to heat and potentially also to clean water.

4.6.1.3 Past or Existing Mitigation

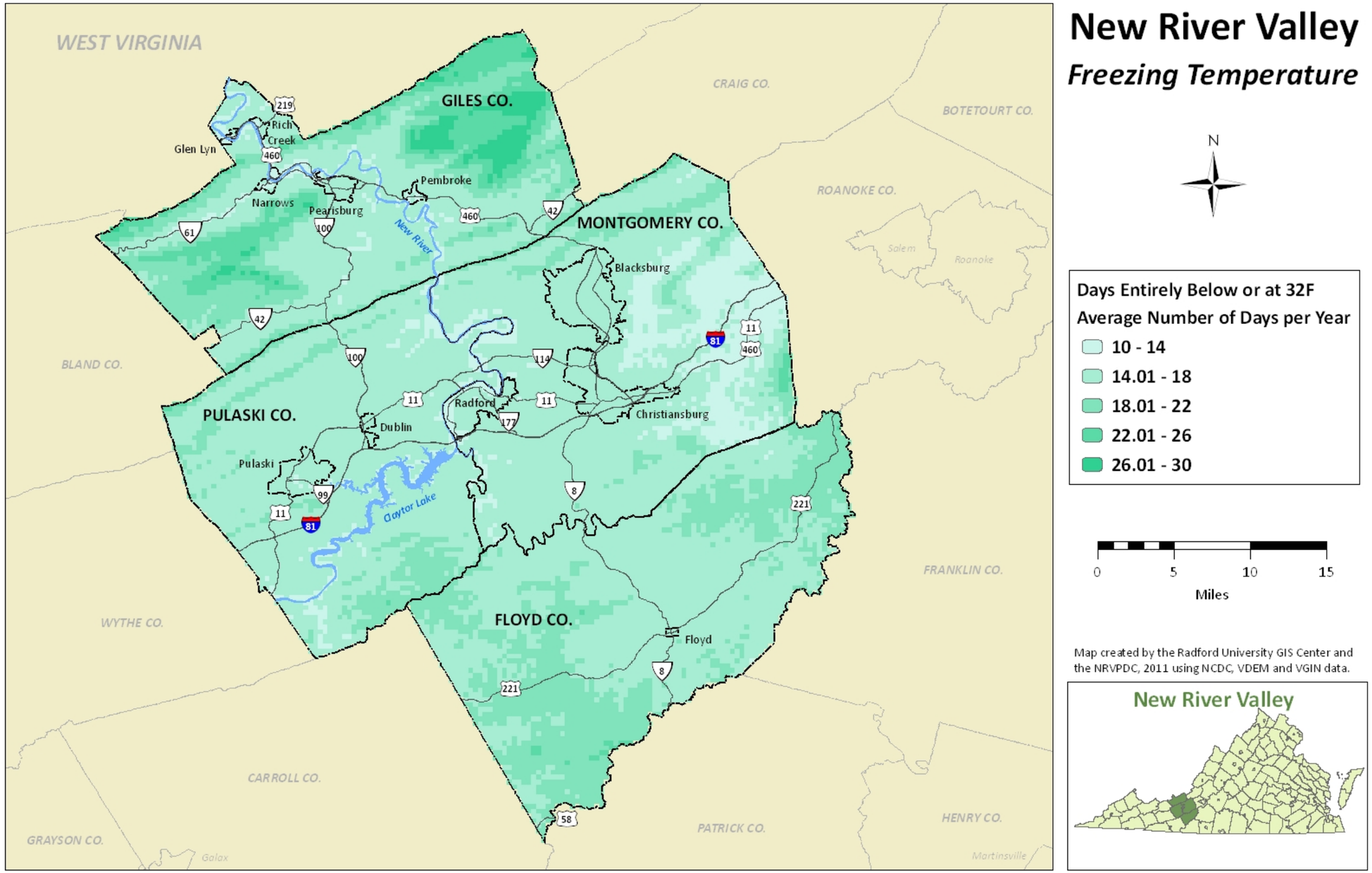
Winter storms (snow and ice) regularly result in closure of schools. Storm forecasts commonly result in early school closings to reduce the risk from accidents that may occur with buses on snow covered or icy roads. Business activities are regularly affected by winter storms, in part because customers and clients chose to stay home rather than venture out during or right after winter storms.

VDOT deals directly with the effect of winter storms. Clearing of primary roads is a major concern (Interstate, US highways), before secondary roads and residential areas are cleared. VDOT has been pro-active in recent years by applying liquid chloride when storms are forecast.

Map 29. NRV Six-inch Snowfalls



Map 30. NRV Freezing Temperature



4.6.2 High Winds (Non-Rotational)

High winds occurring in the New River Valley are of two primary types: winter high winds and high winds associated with thunderstorms. High winds can be particularly damaging to structures, pulling off roofing or siding. Additionally, high winds can cause objects to become airborne, causing additional damage to structures and property loss. In particularly wet conditions, high winds can cause trees to fall. Downed trees can cause damage to property and disruptions in utility services to surrounding areas should the tree fall on a utility line.

Wind events generally do not cause death, but six injuries were reported during wind events in the NRV over the period of record. Only one injury was associated with winter wind events; the other injuries were associated with thunderstorm events.

Sporadic reports from the 1960s, 1970s, and 1980s, and more consistent records from 1990 to the present indicate that there have been almost 200 notable wind events in the NRV. Approximately 156 of the recorded events are associated with thunderstorms, predominately in the summer months. Severe thunderstorms are storms with wind gusts in excess of 58 mph and hail stones larger than ¾ of an inch. The remaining 42 high wind events were recorded during the winter months as individual events, generally not associated with a winter storm event. The winter high wind events caused significantly more damage to structures and crops with $1.6 million and $215,000 reported respectively over the period of record. In contrast, wind events associated with thunderstorms caused only $590,000 in damages and no reported damages to crops or agriculture. Historical records show that wind events occur multiple times a year, so the probability of future occurrences is high.

The Beaufort Wind Scale estimates the speed and strength of high winds on a scale of F0 through F12 (from http://www.spc.noaa.gov/faq/tornado/beaufort.html),

Table 4-23. Beaufort Wind Scale

Force	Wind (Knots)	WMO Classification	Appearance of Wind Effects	
			On the Water	**On Land**
0	Less than 1	Calm	Sea surface smooth and mirror-like	Calm, smoke rises vertically
1	1-3	Light Air	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes
2	4-6	Light Breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move
3	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Small waves 1-4 ft. becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move
5	17-21	Fresh Breeze	Moderate waves 4-8 ft taking longer form, many whitecaps,	Small trees in leaf begin to sway

			some spray	
6	22-27	Strong Breeze	Larger waves 8-13 ft, whitecaps common, more spray	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Sea heaps up, waves 13-20 ft, white foam streaks off breakers	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Moderately high (13-20 ft) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks	Whole trees in motion, resistance felt walking against wind
9	41-47	Strong Gale	High waves (20 ft), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Very high waves (20-30 ft) with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	56-63	Violent Storm	Exceptionally high (30-45 ft) waves, foam patches cover sea, visibility more reduced	
12	64+	Hurricane	Air filled with foam, waves over 45 ft, sea completely white with driving spray, visibility greatly reduced	

4.6.2.1 Risk Assessment and Vulnerability

High wind events are generally common in the region and can cause significant structural damage; wind events can be highly unpredictable. Figure 4-19 below illustrates the overall risk assessment for the state as conducted by VDEM and CGIT for the 2010 State Plan. NRV localities have varying risk:

- Giles and Radford are ranked medium risk which suggest hazards in the range of 60 to 73.9 mp wind speed;
- Pulaski is rated low; indicating winds likely to be less than 60 mph;
- Floyd is rated high, with winds likely to be more than 95 mph in a significant event; and
- Montgomery is rated at medium high risk, in the 74 to 94.9 mph category..

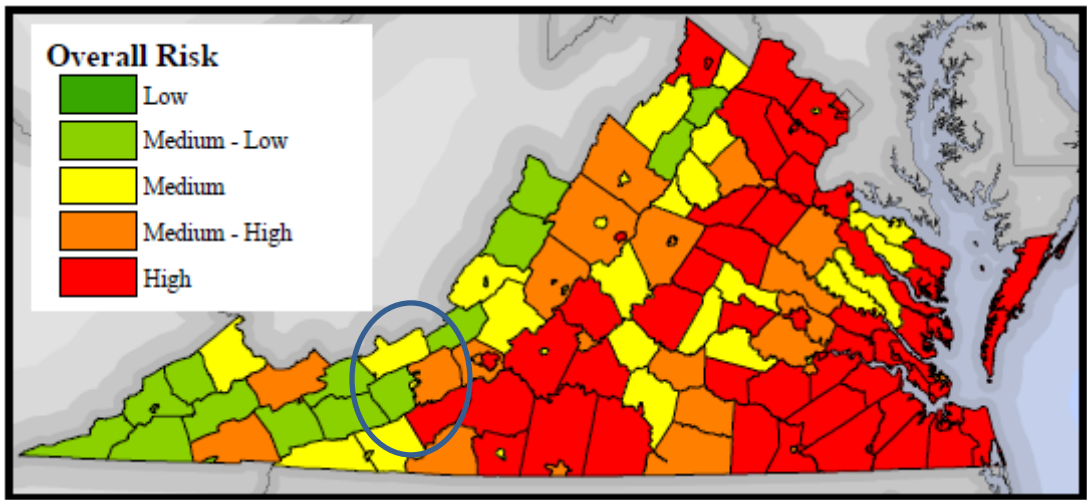


Figure 4-19. Non-Rotation Wind Risk Assessment (2010 State Plan, Figure 3.8a-6)

The following table shows the annualized loss estimates for the region as determined through the HAZUS analysis conducted for this plan for a 100-year event (modeling suggested no significant economic loss to buildings in a 50-year event). The total amounts below include potential damage to residential, commercial and industrial buildings. The loss estimates show that even where risk may be low, damage to in the event of a severe windstorm will have significant impact to the structures in the region.

Table 4-24. HAZUS-MH Hurricane Wind Annualized Losses

Locality	Annualized Loss Amount
Montgomery County	$106,000
Floyd County	$90,000
Pulaski County	$174,000
Giles County	$87,000
City of Radford	$106,000

4.6.3 Tornado

A tornado is a highly intense, destructive cyclonic rotation of air that develops in response to extremely low air pressure, often associated with a cumulonimbus cloud. A tornado is commonly associated with a mesocyclone formation. As more moisture-laded air is drawn up into the circulation of a mesocyclone, more energy is liberated, and the rotation becomes more rapid. A tornado can then develop as the dark funnel cloud that pulses from the bottom side of the parent cloud. When and where this funnel cloud reaches down to the surface, tremendous destructive winds that can reach speeds of over 300 mph have been measured. The destructive force of tornadoes is measured in the Enhanced Fujita Tornado Measurement Scale (http://www.spc.noaa.gov/faq/tornado/ef-scale.html).

Table 4-25. Enhanced Fujita Scale

EF Number	3 Second Gust Speed (MPH)
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	Over 200

4.6.3.1 History

The New River Valley does not have an extensive record of tornados in the region. Since the 1980s until 2010, four tornados have been recorded in the NRV. Table 4-26 below describes these events. The EF-1 and EF-2 tornadoes that struck two different areas of Pulaski County on April 8, 2010. They affected Draper and the Town of Pulaski, damaging or destroying as many as 400 homes, at an estimated value of $5.25 million. The associated storm left 4,600 customers without power and water system users were advised to boil water.

Table 4-26. NRV Tornados 1987-2011

Location	Date	Intensity	Property Damage
Montgomery County	3/30/1987	F1	$2.5 Million
Radford	6/11/1998	F0	$0
Indian Valley, Floyd County	1/23/1999	F1	$12,000
Indian Valley, Floyd County	5/2/2009	F0	$10,000
Draper, Pulaski County	4/8/2010	EF-1	$3.57 Million
Town of Pulaski, Pulaski County	4/8/2010	EF-2	$1.68 Million

4.6.3.2 Risk Assessment and Vulnerability

F0 and F1 tornados are considered weak and generally are short lived. Tornados of these intensities make up approximately 80% of all tornado reports nationwide.

During an F0 tornado, damage is characterized by superficial damage to structures and vegetation. Well-built structures are typically unscathed, sometimes sustaining broken windows, with minor damage to roofs and chimneys. Billboards and large signs can be knocked down. Trees may have large branches broken off and can be uprooted if they have shallow roots.

During an F1 tornado, damage has caused significantly more fatalities than that caused by EF0 tornadoes. At this level, damage to mobile homes and other temporary structures becomes significant, and cars and other vehicles can be pushed off the road. Permanent structures can suffer major damage to their roofs.

VDEM and CGIT have modeled the annual probability of both a tornado event and an F2+ tornado occurring throughout the state. Map 31 shows the NRV's probability of experiencing any tornado in a given year in the state, while Map 32 shows a slightly reduced probability of

experiencing an F2+ tornado event. Both show the locations of tornado events in the region [dates of data]. Figure 4-20 and Figure 4-21 below show the entire state model for tornado probability. The unpredictable nature of these storms, and the fact that they typically involve relatively small areas at a time, makes a prediction of costs highly unrealistic. The map does show, however, that along the eastern edge of the NRV there is a higher probability for tornadoes than in the western half of the region.

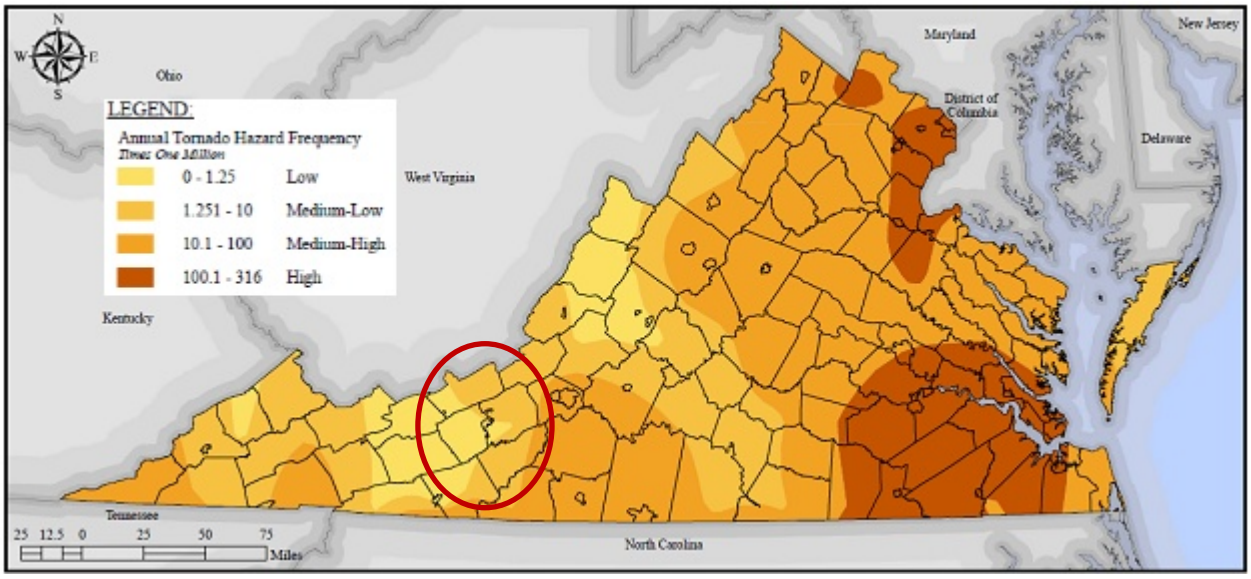


Figure 4-20. Virginia Tornado Hazard Frequency (2010 State Plan, Figure 3.8b-3)

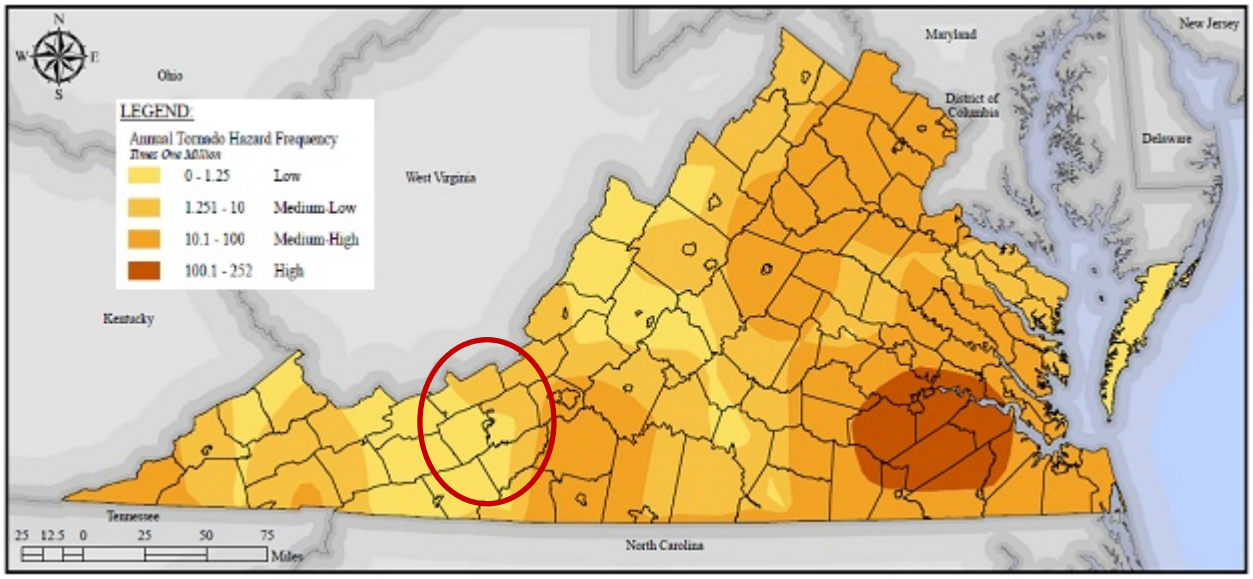


Figure 4-21. Virginia Significant Tornado Hazard Frequency F2+ (2010 State Plan, Figure 3.8b-4)

The maps below indicate the relative risk of tornado based on a statewide analysis. Table 4-27 below describes the probability and risk of tornado based on this analysis.

Table 4-27. Tornado Hazard and Frequency

Tornado Hazard	Annual Tornado Hazard Frequency (times 1 million)
Low	<1.25
Medium-Low	1.25-10
Medium-High	10-100

4.6.3.3 Past or Existing Mitigation

The only tornado mitigation currently in effect is the statewide building code and notifications of tornado watches and warnings issued by the National Weather Service.

4.6.3.4 Mitigation Opportunities

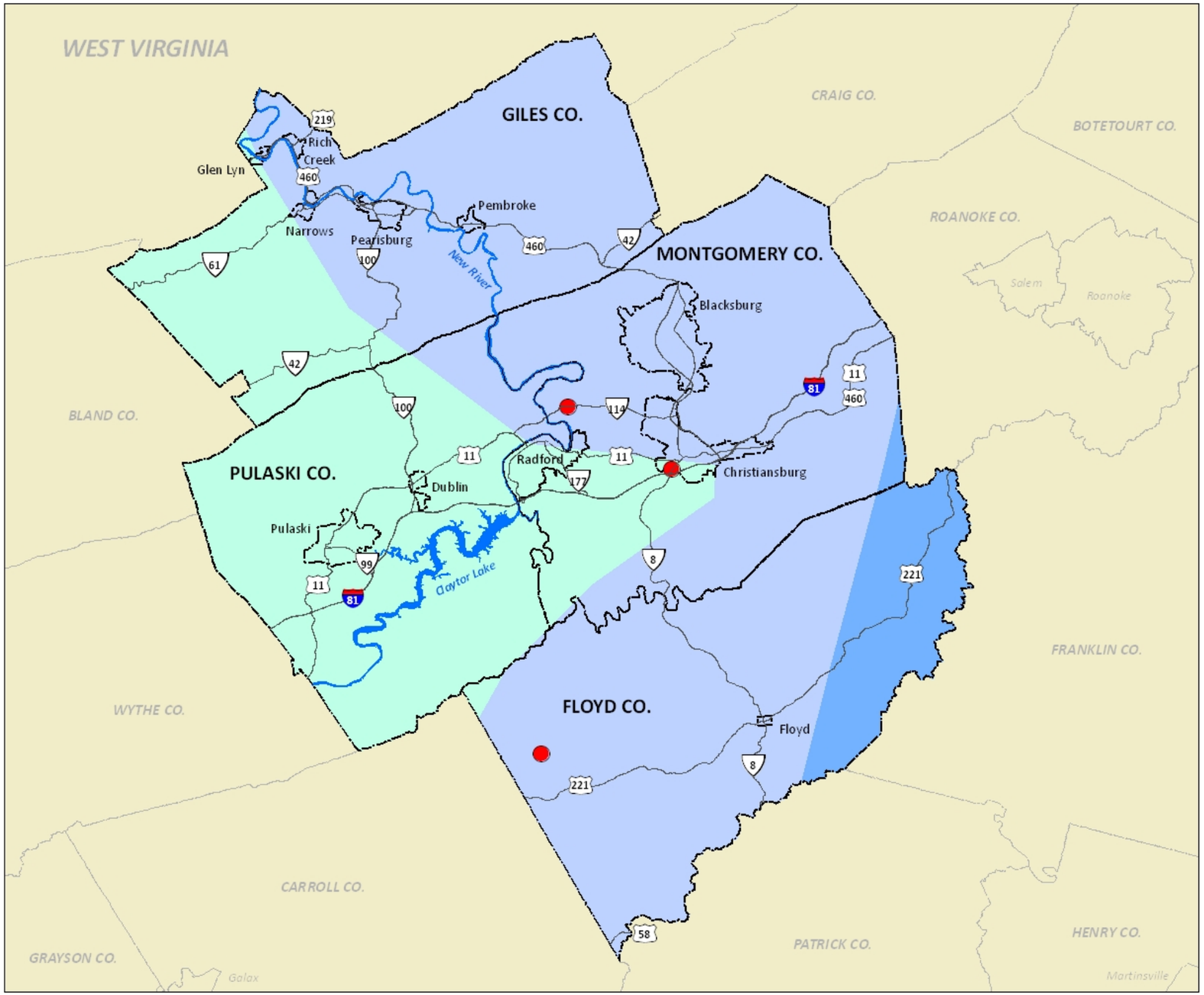
A complete listing of NRV hazard mitigation goals, objectives, and strategies can be found in Chapter 5: Mitigation Strategy. Below are the goals, objectives, and strategies identified by the severe weather working group to specifically lessen the impacts of severe weather hazards in the region.

4. **Minimize impacts of significant weather events, such as winter weather and severe weather events in the NRV.**
    a. *Encourage activities to prevent impacts during storm events.*
        i. Promote the installation and maintenance of drift fences to maintain access during snow events.
        ii. Emphasize that all road maintenance be done prior to storms to prevent access issues.
    b. *Develop educational materials and events to prevent loss of life and property in severe weather events.*
        i. Emphasize what should be done during a storm event (i.e., lightning) to maintain safety.
        ii. Educate landowners about how overhanging utility lines and trees can cause property damage during a storm.
        iii. Continue educational efforts during times when events are not occurring (i.e., brochures, websites, awareness weeks-promotions coordination).
        iv. Create a brochure or handout of local hazards to provide to the community.
        v. Pursue Storm Ready designation for the region's communities.
    c. *Encourage preparation and planning activities that ensure minimal impacts to life and property.*
        i. Encourage personal planning for storm events and their impacts.
        ii. Inventory public facilities to determine the need for back-up power generation.
        iii. Inventory of possible roof collapses through an analysis of building permits to determine need for future mitigation efforts.
        iv. Engage in regional emergency management exercises (table-top and field) to train responders.

Map 31. NRV Tornado Hazard

New River Valley

Tornado Hazard



N

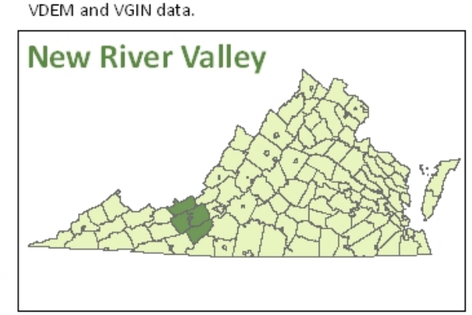
Annual Tornado Hazard Frequency

- Low
- Medium-Low
- Medium-High
- Tornado Touchdown

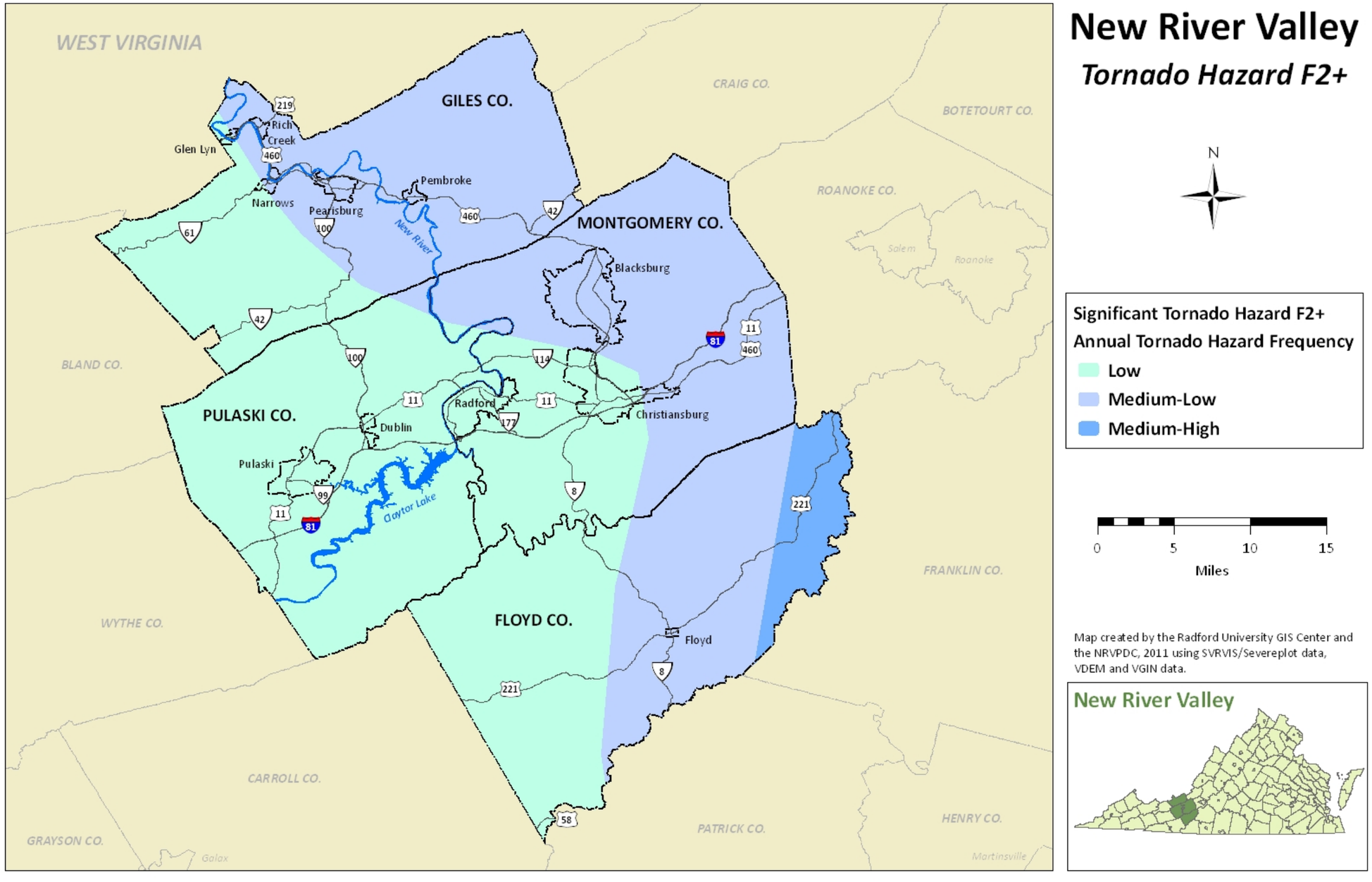
0 5 10 15

Miles

Map created by the Radford University GIS Center and the NRVPDC, 2011 using SVRVIS/Severeplot data, VDEM and VGIN data.



Map 32. NRV Tornado Hazard F2+



4.7 Wildfire

This section of the HIRA has been updated from the previous New River Valley Hazard Mitigation Plan. New information has been provided for the risk assessment and vulnerability section, as well as the past or existing mitigation section by the Virginia Department of Forestry (DOF). Specific communities have been identified by DOF as being at risk on the urban-wildland interface and are discussed as special hazard areas below.

4.7.1 History

The New River Valley has not suffered any devastating fires of the scale that now seem frequent in the western U.S. Yet, small fires are relatively frequent in the New River Valley. For the years 1998-2003, Table 4-28 illustrates the average acreage involved in wildfires based on data from DOF.

Table 4-28. Acreages and Averages for Wildfires 1998-2003

County	Total Fires	Total Acreage	Average Acreage
Floyd	47	71	1.5
Giles	9	44	4.9
Montgomery	68	147.9	2.1
Pulaski	55	229	4.1
New River Valley	179	491.9	3.15

Approximately 68% of the New River Valley is forested. Figure 4-22 below illustrates the various general land uses in the region. Additionally, there is a significant portion of the Jefferson National Forest in the region, also indicated in Figure 4-22.

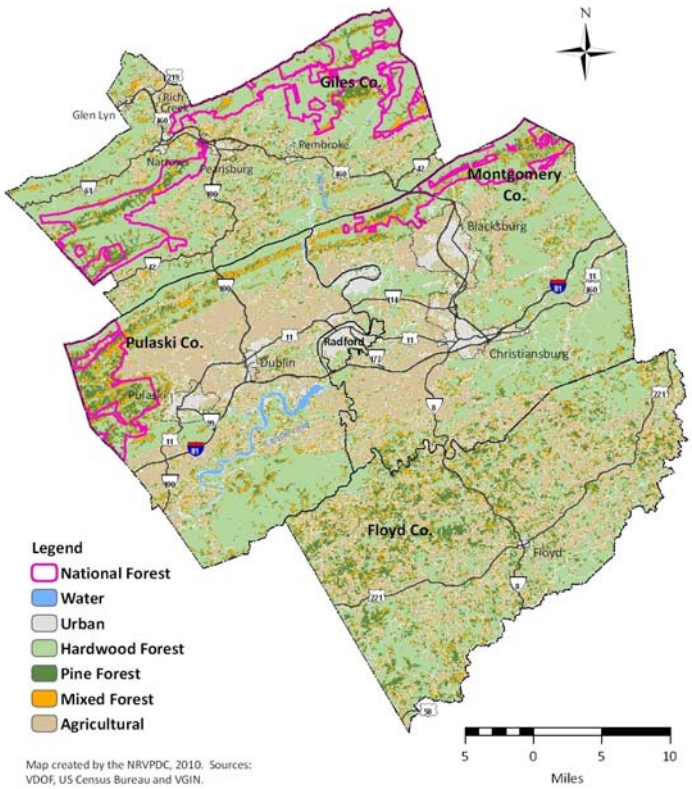


Figure 4-22. Forested Lands in the New River Valley

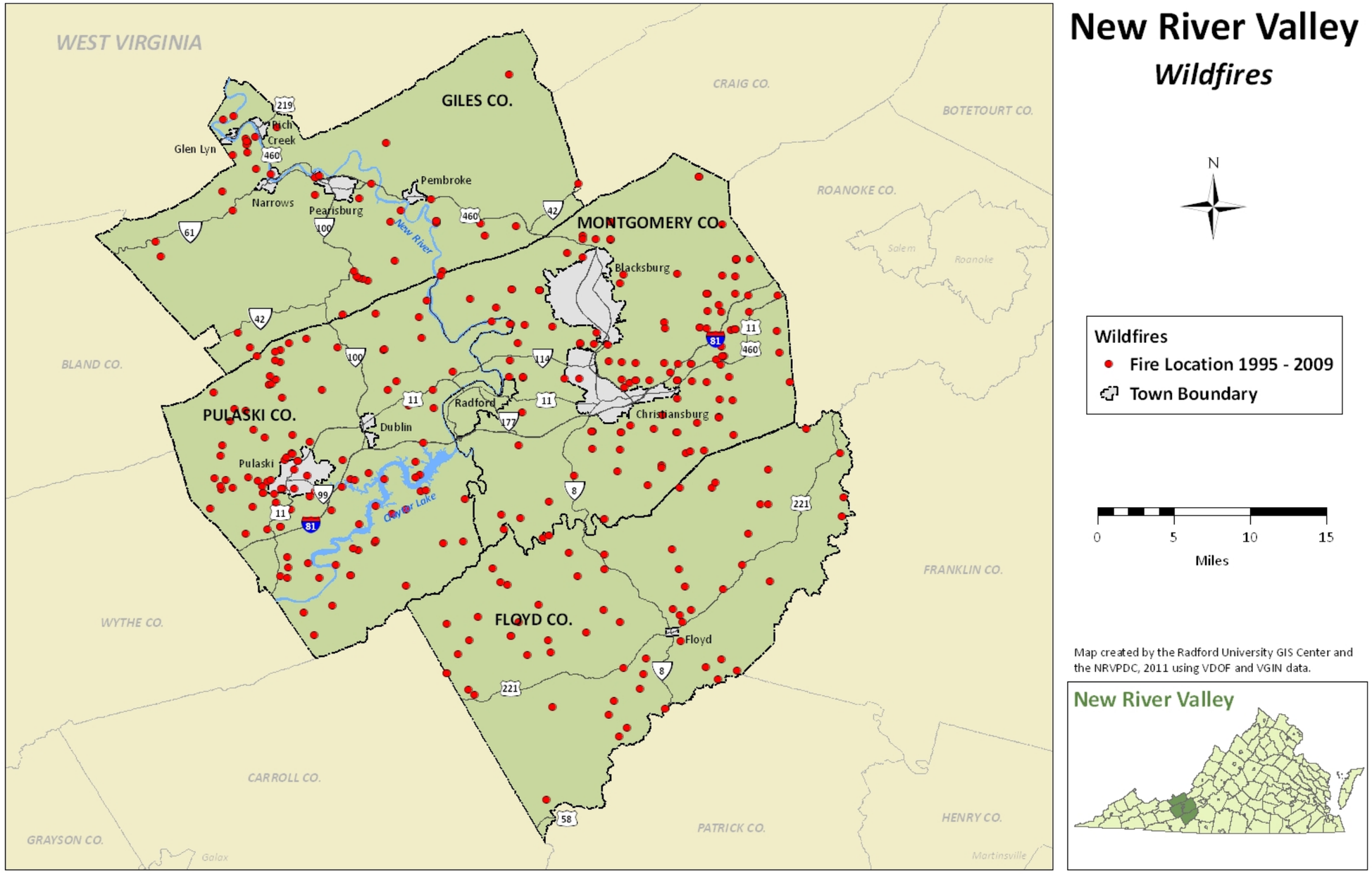
Between 1995 and 2009, there were 345 recorded wildfires in the New River Valley. On average, that is approximately 18 fires each year throughout the region. Map 33 below indicates the location of all these fires.

Two significant wildfires occurred simultaneously in 2003 despite the heavy moisture in the winter and spring. From April 16-19, 2003, 142 acres burned on Draper Mountain in Pulaski County and about 100 acres burned on Poor Mountain in Montgomery County (Figure 4-23).

Wildfires sometimes damage homes and structures, as well as destroying wildlife habitat, merchantable timber and critical watersheds. While the NRV has been spared devastating fires, numerous fires have caused thousands of dollars of damage.

Figure 4-23. Helicopter flies over Poor Mountain Fire, 2003

Map 33. NRV Wildfires



4.7.2 Risk Assessment and Vulnerability

The DOF has created a very useful wildfire risk assessment map that illustrates areas of high, medium, and low risk for wildfire. When creating this model, DOF used six factors to determine the level of risk. These factors include land cover and railroad buffer, density of wildfires, aspect, percent slope, population density, road density and developed areas, and distance to roads. Land cover affected the wildfire risk as different fuels ignite more easily, burn with greater intensity and can facilitate more rapid fire advancement. Proximity to railroads increased fire risk as a small percentage of wildfires has been found to be ignited by railroad operation or maintenance. It was assumed that the density of historic wildfires would remain similar and risk was assessed using that assumption.

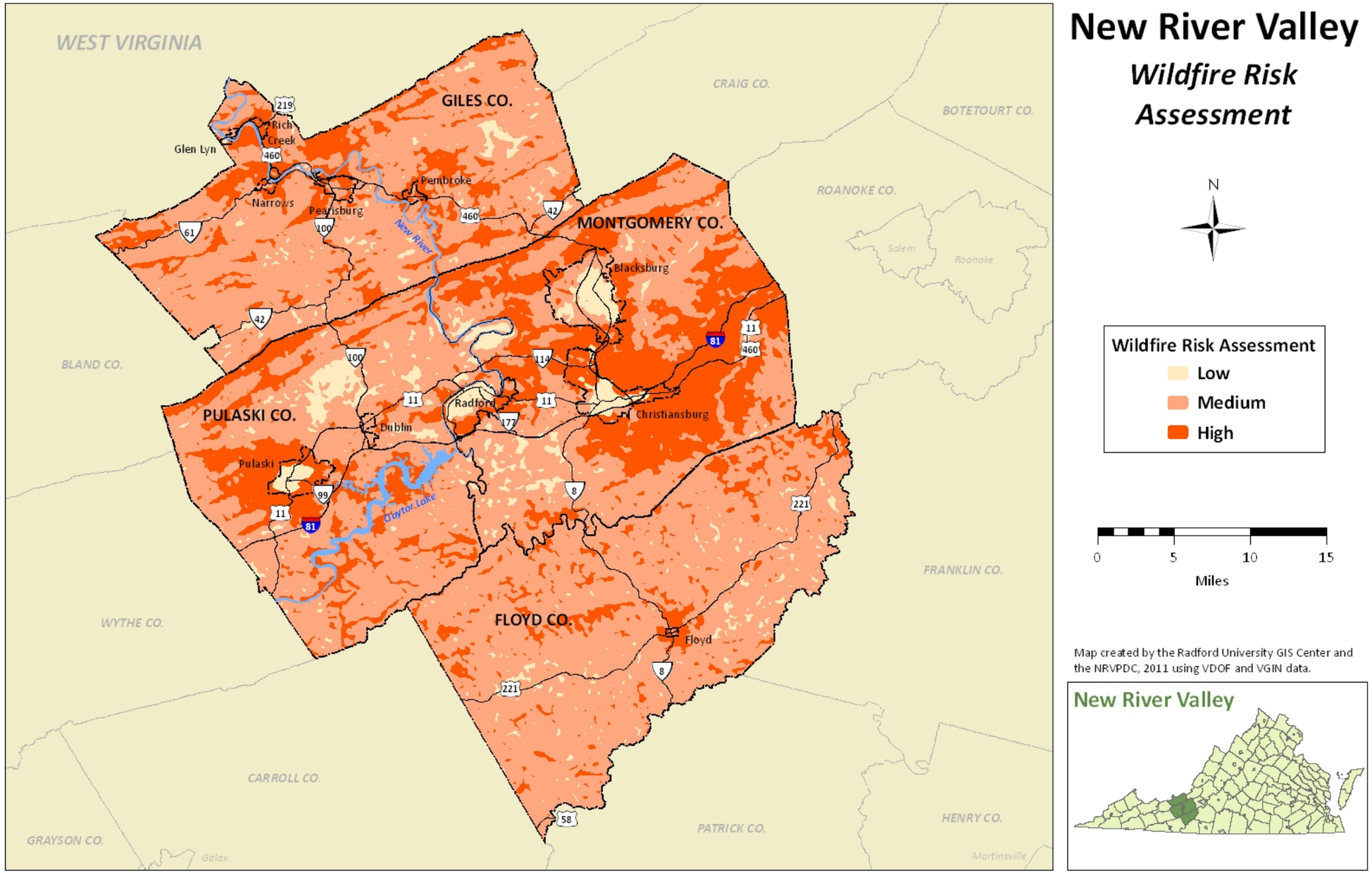
Slope can have an effect on wildfire in two regards, slope face and steepness. Slopes that face south receive more direct sunlight drying fuels and creating more favorable conditions for wildfires to ignite. Additionally, steeper slopes facilitate convective pre-heating for wildfires that can cause fires to advance uphill. Steeper slopes increase this pre-heating effect and thus increase the potential for wildfire ignition.

Human populations can also affect wildfire risk, as over 82% of wildfires in Virginia between 1995 and 2001 were started by humans. Despite this, urban areas were considered to have a much lower risk of wildfires than rural areas. To account for at least some of the human cause of wildfires, areas in close proximity to road corridors were ranked with a higher risk of wildfire due to the higher probability of human presence.

Map 34 below illustrates DOF's wildfire risk assessment for the New River Valley.

While considering the relative risk of all hazards possible in the New River Valley, the steering committee considered frequency of the event and severity, as well as the area affected by the hazard. Using these considerations, wildfire was ranked as a low risk in the region. The steering committee noted that relative to other hazards, wildfires are likely to occur, on average several occurring every year, though most have negligible to moderate impacts and occur in an isolated area.

Map 34. NRV Wildfire Risk Assessment



4.7.3 Special Hazard Areas

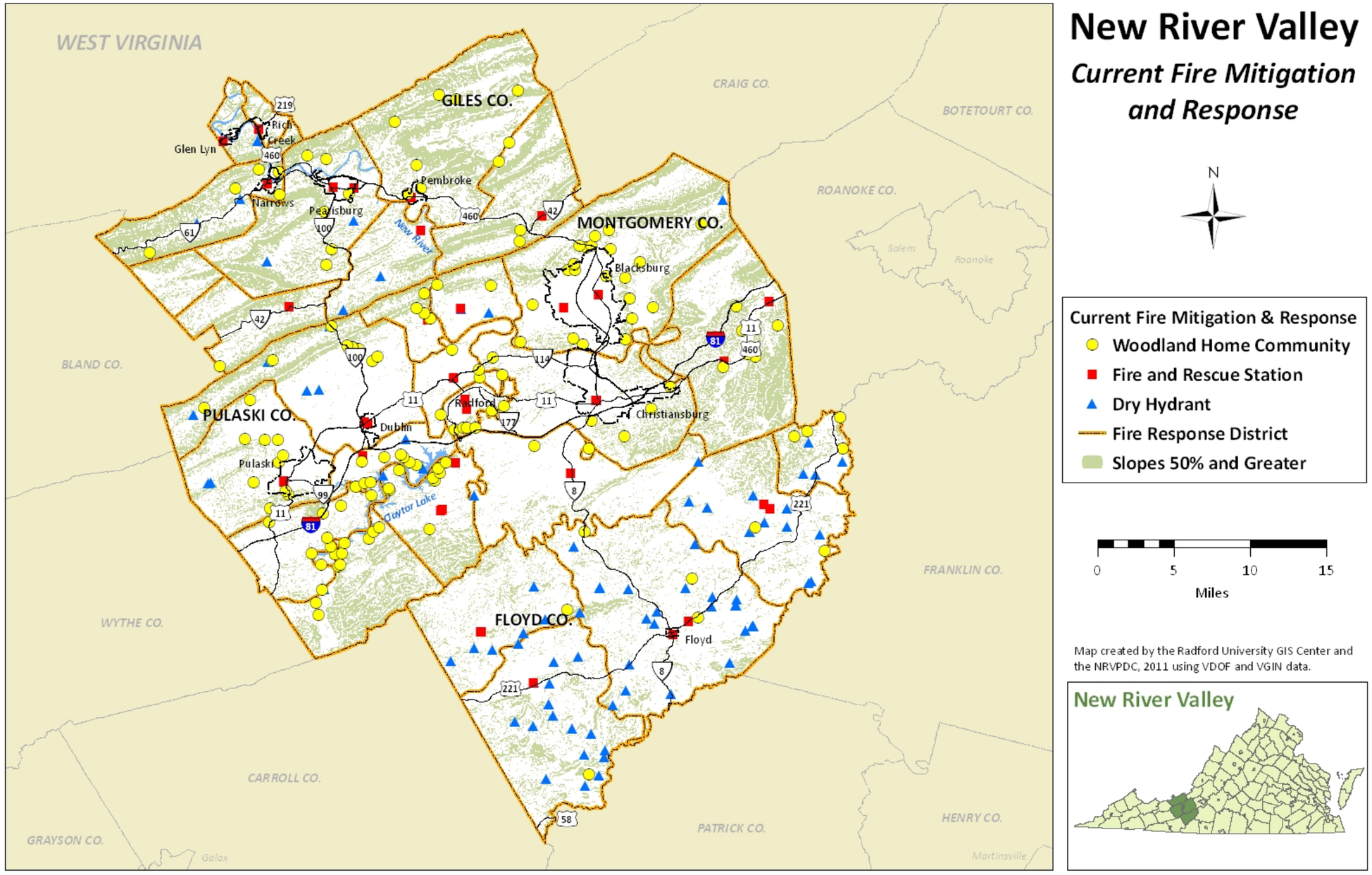
Several special hazard areas have been identified as well by DOF. The wildland-urban interface tends to be especially vulnerable to wildfire risks. DOF identified Woodland Home Communities where this interface could potentially put numerous homes and lives at risk during a wildfire. These communities are identified on Map 35 as part of the existing wildfire mitigation and response. In identifying the woodland home communities, DOF also prioritized these communities and their risk and has begun outreach efforts with those at the most risk of severe impacts from wildfires.

4.7.4 Past or Existing Mitigation

The NRV benefits from many national and state forestry initiatives. These include the Virginia Forestry Smokey the Bear program, the Fire Risk Index, outdoor burn laws, dry hydrant programs, the Firewise program and geographic information system development. Dry hydrants are a non-pressurized pipe system installed in a stream, pond or lake to provide a suction source for water to a fire truck. The Firewise program enables the DOF to work with communities to assess wildfire risk and create plans to reduce them. Additionally, the US Forest Service's Federal Wildland Fire Policy emphasizes community initiatives including cross-training among structural and wildland (local, state and federal) firefighters. The U.S. Fire Administration and USDA's Rural Development program administer grant programs to help equip fire departments.

Map 35 below outlines some of these traditional mitigation techniques from fire and rescue districts to dry hydrant locations and areas with slopes greater than 50% than inhibit access for emergency response equipment.

Map 35. Current Fire Mitigation and Response



4.7.5 Mitigation Opportunities

A complete listing of NRV hazard mitigation goals, objectives, and strategies can be found in Chapter 5: Mitigation Strategy. Below are the goals, objectives, and strategies identified by the wildfire working group to specifically lessen the impacts of wildfire hazards in the region.

5. **Minimize wildfire losses in the "urban wildland interface" areas.**
    a. *Educate residents and landowners on possible wildfire mitigation techniques.*
        i. Educate the public about where building is occurring and the need to clear debris to prevent loss to wildfire.
        ii. Increase awareness of conditions that could enhance wildfire impacts.
        iii. Educate homeowners about the possibility of wildfires.
        iv. Conduct practice "tagging" exercises to educate homeowners about the realities of wildfire.
        v. Engage with landscaping companies to encourage and utilize Firewise techniques on customers' property.
    b. *Engage in mitigation and planning activities to minimize wildfire impacts.*
        i. Ensure that new wildland communities are built to Firewise standards through inclusion in subdivision ordinances, building permits, set-back ordinances and covenants.
        ii. Limit future development in areas with slopes greater than 50% that prevent access by fire equipment.
        iii. Work with insurance to improve incentives for homeowners engaging in Firewise activities.
        iv. Improve physical access to community for fire and rescue personnel and equipment.
        v. Encourage county-wide fire plans and Community Wildfire Protection Plans.
        vi. Search for funding to increase equipment and personnel to fight wildfires.
        vii. Enforce existing regulations that home numbers at the road are easily visible for first responders.
        viii. Improve 911 mapping systems for improved access by first responders.
        ix. Work with land and home owners with gates or locks to improve fire access.
        x. Encourage mitigation activities that prevent wildfire damage to structures, including creating a defensible space around a vulnerable structure, structural protection through ignition resistant construction activities, and hazardous fuels reduction activities.

4.8 Human-caused Hazards

There are three primary types of human-caused hazards; accidental, criminal and terrorist. Accidental human-caused hazards occur due to human error with no intent to do harm. Criminal acts are events carried out by humans with the intent to do harm to either persons or property. Terrorist activities are similar to criminal activities, but are defined by FEMA as the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives. Though these hazards tend to be more difficult to predict due to the unpredictable nature of human actions, it is still important to understand the risks associated with them and plan to mitigate their potential impacts.

This section will briefly discuss community assets and infrastructure that can be negatively impacted by human activities. This section will also include a brief discussion of vulnerable populations within the community that can be impacted by all of the discussed hazards in very unique ways.

4.8.1 History

The most memorable human-caused event in recent memory in the New River Valley was the April 16, 2007 shooting at Virginia Tech. During this incident, a lone gunman killed 32 students and staff members at the university. Since that time, the university has put in many new procedures and tools to prevent another tragedy at the same scale.

Both universities in the region have completed a hazard mitigation plan to earn the designation as "Disaster Resistant University." Both plans include sections regarding human-caused events focusing on structural fires, hazardous materials and acts of terrorism. For more information about these plans, please contact the Radford University Office of Emergency Preparedness at (540) 831-7155 or the Virginia Tech Office of Emergency Management at http://www.emergency.vt.edu/.

Outside this notable criminal act, very few major human-caused incidents have been noted in the region. The region does serve as a major transportation corridor via both the interstate highway system and railways. As a major corridor, accidents involving hazardous materials are not uncommon, but rarely cause interruptions to the daily life of the region's citizens. Records of these accidents or incidents are scattered and very difficult to compile, thus there is no good historical record.

There is no notable historical record of additional criminal or terrorist activities focused on this region.

4.8.2 Risk Assessment and Vulnerability

4.8.2.1 Hazardous Materials

Hazardous materials are routinely stored and transported throughout the New River Valley. For planning purposes these storage sites could be impacted by any of the three types of human-cause hazards; accidental, criminal or terrorist. Additionally, these sites could be impacted by a variety of natural hazards based on their location. The Environmental Protection Agency (EPA) requires reporting of hazardous chemical storage for compliance with the Emergency Planning

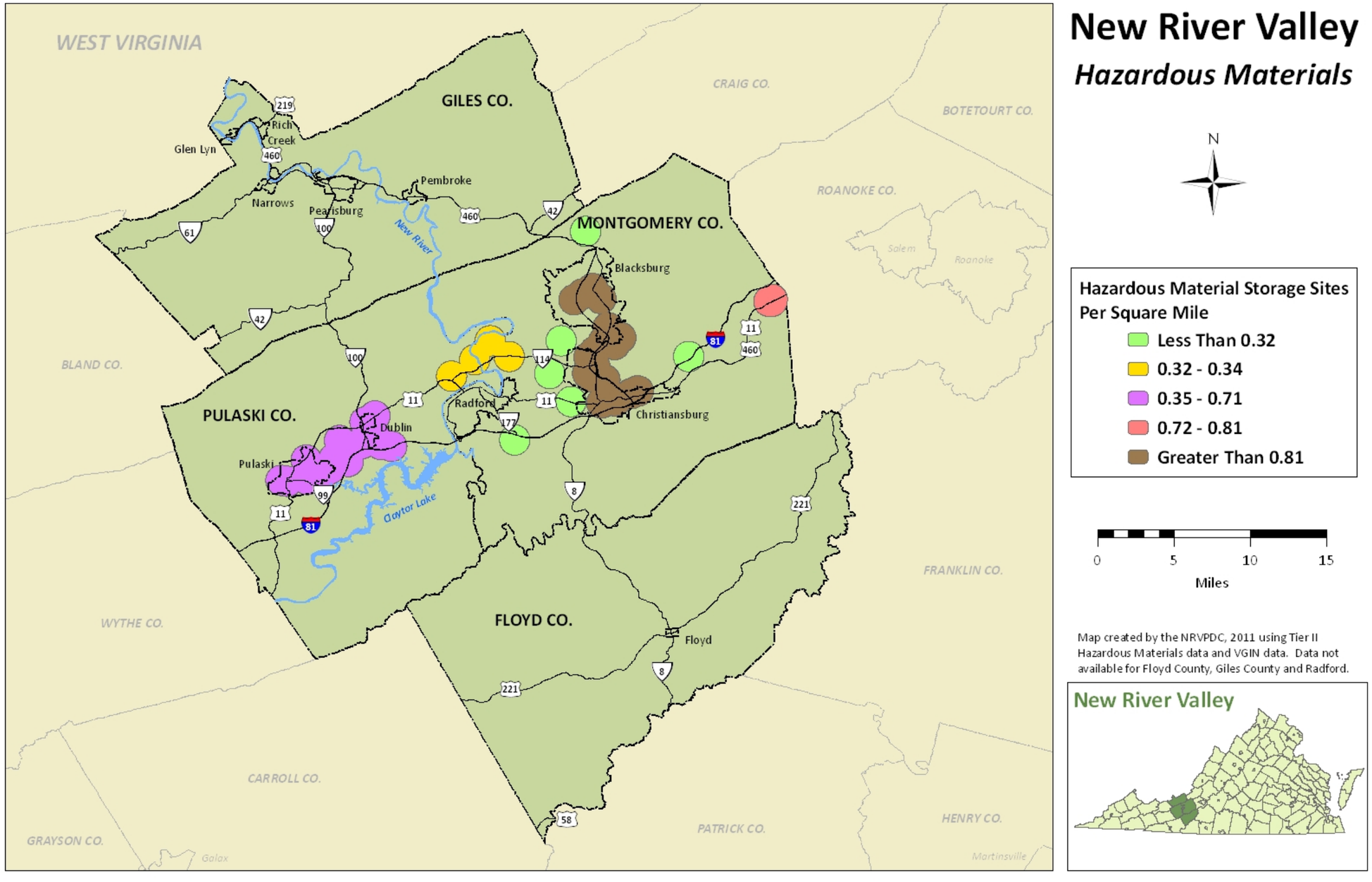
and Community Right-to-Know Act (EPCRA). Various facilities are required to report the hazardous chemicals used or stored in the workplace. Facilities that meet the thresholds below are required to report to annually to the Virginia Department of Environmental Quality, their Local Emergency Planning Committee, as well as the local fire department with jurisdiction for the storage facility. Facilities must report their hazardous materials storage if:

- They store either 500 pounds or the Threshold Planning Quantity (TPQ), whichever is lower, of Extremely Hazardous Substances (EHSs);
- For gasoline (all grades combined) at a retail gas station, they store 75,000 gallons (or approximately 283,900 liters), if the tank(s) was stored entirely underground and was in compliance at all times during the preceding calendar year with all applicable Underground Storage Tank (UST) requirements at 40 CFR part 280 or requirements of the State UST program approved by the agency under 40 CFR part 281;
- For diesel fuel (all grades combined) at a retail gas station, they store 100,000 gallons (or approximately 378,500 liters), if the tank(s) was stored entirely underground and the tank(s) was in compliance at all times during the preceding calendar year with all applicable UST requirements at 40 CFR part 280 or requirements of the State UST program approved by the agency under 40 CFR part 281;
- For all other hazardous chemicals, they store 10,000 pounds.

Map 36 below illustrates the density of facilities submitting Tier II reports in 2010. There is currently no data available for Giles or Floyd Counties. Typically these facilities include retail gas stations and public utility facilities, among others. The facilities were mapped using their listed addresses and then buffered by a mile to prevent specific location identification. Density was calculated by combining overlapping buffers and then calculating the number of facilities per square mile inside the buffered area. It will be important in future revisions of this plan to obtain better and more complete data from all jurisdictions on locations storing these types of hazardous materials.

Additional future analysis of the risks associated with hazardous materials storage should include an analysis of the risks posed to these sites by natural hazards.

Map 36. Hazardous Materials



4.8.2.2 Critical Facilities and Utilities

Critical facilities and critical utilities both play key roles in mitigating hazards. Critical facilities are those identified in the community that provide key services to residents and would have significant detrimental effects should they be destroyed or disrupted. Critical facilities are most likely to be affected by natural hazards, but some may be targeted for criminal or terrorist activities. The facilities identified throughout the region include emergency shelters, government buildings, hospitals, schools and emergency communications tower locations. Map 37 below depicts the locations of these facilities throughout the region. Additional facilities may be identified in the future and mitigation actions could be taken to ensure their proper functioning throughout the course of a given hazard event.

Critical utilities include those utilities that provide essential functions to maintain the health and safety of residents. These utilities primarily consist of water and sewer infrastructure and major gas and electrical transmission lines (Map 39). Additional data for the next plan update, especially for water and sewer infrastructure, could improve the analysis of these community assets. Utilities are most likely to be impacted by natural hazards such as high winds or ice, but some may also be the targets of criminal or terrorist activities.

Over the past 70 years, a nationwide system of collection, transmission, and distribution pipelines has been constructed to transport almost 100 percent of the natural gas and about 66 percent of the ton-miles of oil and refined petroleum products consumed in the United States. Many portions of the transmission pipelines were originally constructed in sparsely populated areas; subsequent growth has transformed some of these previously rural and sometimes remote areas into urban and suburban areas with housing subdivisions, shopping centers, and business parks.

The goal of the Pipelines and Informed Planning Alliance (PIPA) is to reduce risks and improve the safety of affected communities and transmission pipelines through implementation of recommended practices related to risk-informed land use near transmission pipelines. The PIPA recommended practices describe actions that can be taken by key stakeholders relative to proposed changes in land use or new development adjacent to existing transmission pipelines. Local governments, property developers/owners, transmission pipeline operators, and state real estate commissions have key roles to enhance pipeline safety and ensure the protection of people, the environment and the pipeline infrastructure.

To address increasing trends of excavation damage to pipelines and to fulfill the requirements of the Transportation Equity Act for the 21st Century, the US Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) undertook a study of damage prevention practices associated with existing one-call notification systems. In 1999, PHMSA published the landmark *Common Ground Study of One-call Systems and Damage Prevention Best Practices*. Building on the success of the Common Ground Study, PHMSA facilitated the founding of the Common Ground Alliance to provide stewardship to help ensure acceptance and implementation of the damage prevention best practices across the country.

To further address the impact of community growth on pipeline safety, and the requirements of the Pipeline Safety Improvement Act of 2002, the Transportation Research Board (TRB) of the National Academies conducted a comprehensive study of pipeline safety and land use practices

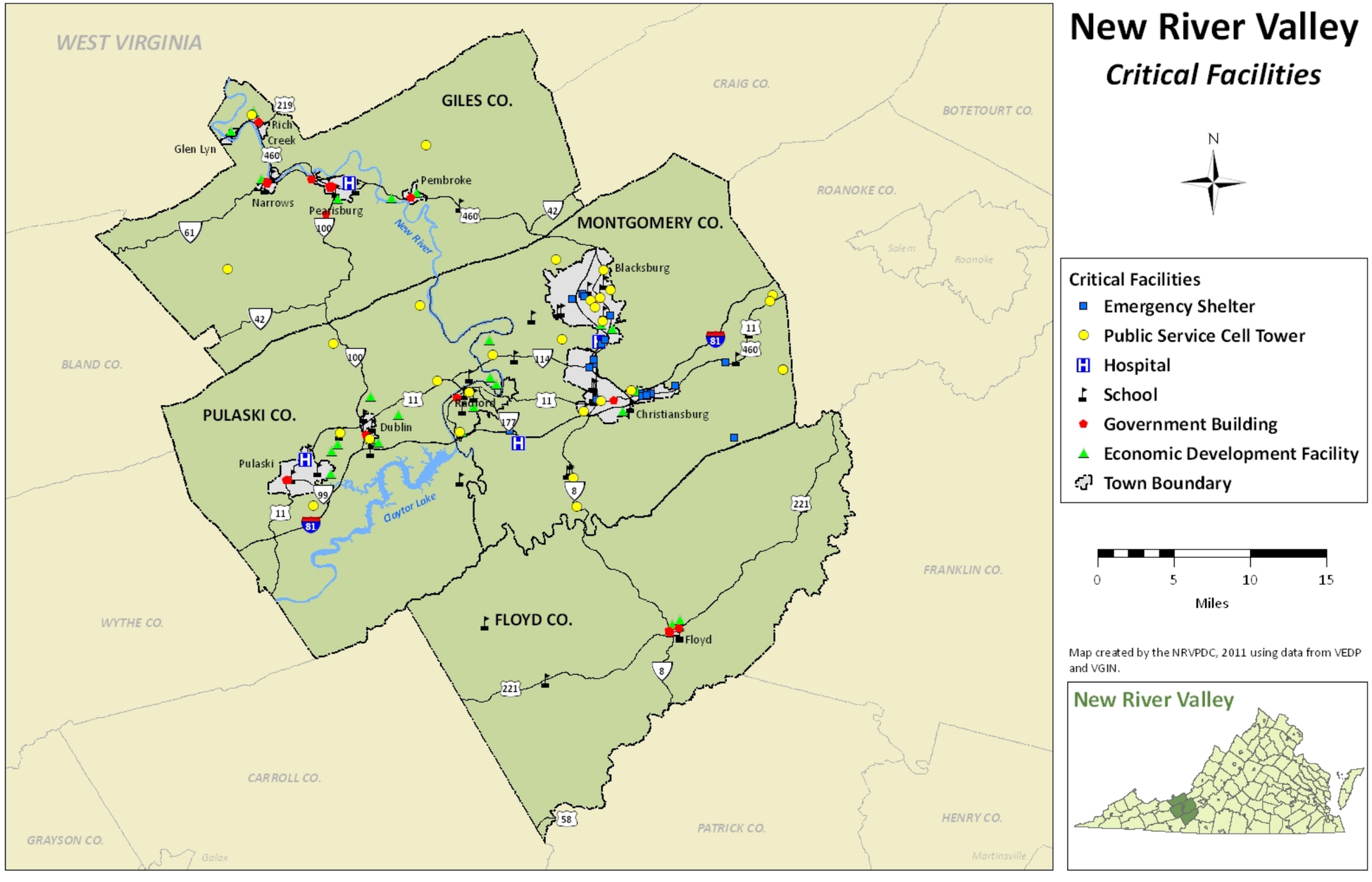
to better understand land use planning issues. The results, published in 2004 as TRB Special Report 281, "Transmission Pipelines and Land Use: A Risk-Informed Approach," included several recommendations for PHMSA. To address these recommendations, in August 2007 PHMSA facilitated the establishment of the PIPA.

Approximately 130 stakeholder participants undertook the work to develop the PIPA recommended practices. The initial PIPA effort has resulted in recommended practices for local governments, property developers and owners, transmission pipeline operators, and real estate boards to be aware of and to implement as appropriate. PHMSA plans to continue working with stakeholders to ensure that a sound implementation strategy is developed and that the PIPA recommended practices are communicated to and understood by those that need to adopt them.[4]

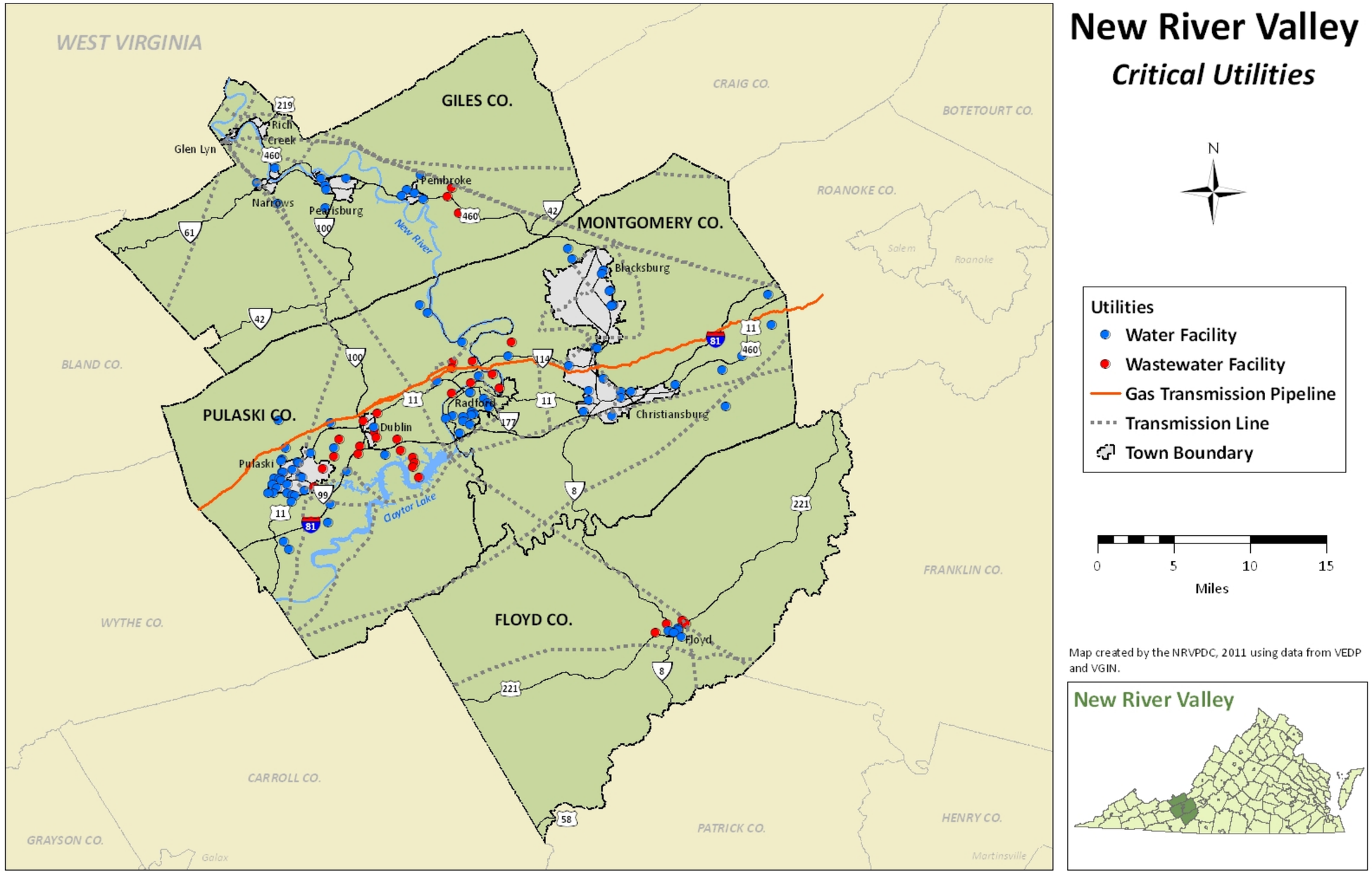
Broadband infrastructure is another critical utility that is essential in the proper functioning of numerous community services, including policy and fire, as well as hospitals. Every day, society becomes more reliant upon broadband access to provide critical services to the community, outside individual access to the internet. While there is no publicly available data indicating the location of major fiber transmission lines, this does provide an opportunity for emergency services staff and planners to partner with the private broadband providers to discuss mitigation in the event of natural or human-caused hazard events. Similar to other public utilities, especially water and sewer, it is critical to include broadband providers in planning discussions for future community growth and how to provide critical services to residents.

[4] *PIPA Report Final Draft, 7/21/10, available at:* www.pipelineinformedplanning.com.

Map 37. Critical Facilities



Map 38. Critical Utilities



4.8.2.3 Transportation Infrastructure

4.8.2.3.1 Evaluating Potential Hazards

The New River Valley has passenger and freight transportation modes inclusive of roadway, railway and aviation facilities. The region's transportation system is similar to that of many in Appalachia, featuring a variety of rolling topographical rural areas that integrate with a mixture of small urban communities. Typical hazards that may impact the existing transportation infrastructure are flooding, geologic failures, acts of terrorism and severe weather. The majority of the transportation network is located in predominately rural areas.

The region currently facilitates a mixture of passenger and freight traffic north-south by Interstate 81, US Route 11, US Route 221 and VA Primary Route 61 (roadway), Norfolk Southern's Crescent Corridor (railway), and the New River Valley Airport (airway-freight). East-west passenger and freight traffic is facilitated by US Route 460, US Route 8, VA Primary Route 114, VA Primary Route 42 and VA Primary Route 100 (roadway), Norfolk Southern's Heartland Corridor (railway), and the New River Valley Airport (airway-freight).

The future of these corridors includes a vast improvement schedule to advance the freight railway corridors and associated facilities. A passenger rail service as part of the TransDominion Express from Richmond, VA, to Bristol, NC, is also planned. Capacity improvements to Virginia Routes 114, 100 and 8 are planned.

The New River Valley also has mass public transportation fixed routes and on-demand services for several of the local communities. Currently fixed route services are provided in the Towns of Blacksburg, Christiansburg and Dublin. Currently, on-demand services are provided in the Towns of Pulaski, Dublin, Blacksburg, Christiansburg and City of Radford. There is also a multi-jurisdictional, fixed route that links Blacksburg and Christiansburg to Salem and Roanoke.

The future of transit in the New River Valley may include fixed-route services in the City of Radford and connections between Montgomery and Pulaski Counties and the City of Radford. Additionally, Giles and Floyd Counties have expressed interest in exploring rural transit options in the near future. These communities have been identified by the Virginia Department of Rail and Public Transportation as having characteristics to support transit.

4.8.2.3.2 Identifying Critical Roadways

The primary roadway network for the region consists of one interstate which bi-sects the region from north-east to south-west. Interstate 81 provides access to the Towns of Pulaski, Dublin, Christiansburg and the City of Radford. This corridor has been identified as a mobility corridor that will incorporate roadway, railway and airway modes of transportation as part of Virginia's long range plan. This corridor predominately facilitates transportation for passenger and freight traffic between Tennessee and Washington, D.C.

I-81 serves as the region's only freeway which is defined by the Highway Capacity Manual as a divided highway with full control access and two or more lanes for the exclusive use of traffic in each direction. A freeway is the only facility that provides completely uninterrupted traffic flow. Freeways are unique in that there are no signalized or stop-controlled at-grade intersections, and access is limited to ramp locations. All other roadways are classified as rural or suburban 2-4 lane highways that generally have posted speed limits between 25 and 65 mph. These highways

generally have signalized intersections at widely spaced intervals, occurring at major junctions that are not grade separated.

Highway critical facilities that are essential to the health and welfare of the whole population and are especially important following hazard events include: I-81, U.S. 460, U.S. 11, U.S. 221, U.S. 219, Virginia 114, Virginia 100, Virginia 8, Virginia 177, Virginia 232, Virginia 99, Virginia 61 and Virginia 42. Each of these facilities provide connectivity to emergency operations, public works facilities, schools, other special needs populations, major employers, financial centers, businesses, high density residential, institutional, industrial areas, as well as historical and natural resource areas. Estimated vehicle capacities, otherwise known as average daily traffic (ADT), have been estimated and highlighted in Map 39. Estimates are based on the present roadway typical section operating at a level of service (LOS) E. A more detailed study should be considered along corridors of particular concern analyzing intersections, driveways, topography and other forms of delay for a more accurate capacity estimate.

The average year that critical roadway infrastructure was built in the NRV was 1968 and has an average value of $7,047,150.33. For the purpose of this plan, 95 critical bridges have been identified located along primary corridors and could cause substantial negative impacts following hazard events. The spans of these bridge structures range from 20 feet to nearly 1700 feet in length and provide crossings over waterways and railways and assist in navigating undulated terrain. The total estimated value of roadway bridges is nearly $670 million. It is recommended that 2,000 linear feet (LF) of temporary structure be kept on-hand by a regional authority to provide accessibility to primary corridors that could experience structure loss. Current research shows that there are numerous design alternatives that provide reliable alternatives to loss of structures in critical areas.

4.8.2.3.3 Identifying Critical Railways

The NRV is estimated to have over one million LF (nearly 200 miles) of active Class 1 freight rail track (multiple lines in parallel are accounted for separately), seven tunnels, and numerous bridge and culvert structures. Norfolk Southern is the area's railway operator. The Heartland (east-west) and Crescent (north-south) corridors cross in the center of the NRV. These alignments are major East Coast commodity shipment corridors that play a major role in the movement of goods on a national level. The total estimated value of railroad assets in the region exceeds $600 million. Nearly all railways follow valley bottoms alongside tributaries and steeply carved slopes. Flooding and slope failures are regular hazards for daily operations, but major damages have a ripple effect of delaying the movement of freight.

4.8.2.3.4 Identifying Critical Aviation

The NRV has two aviation facilities that accommodate a range of commodity shipments and private flights. The first is the NRV Airport in Dublin, constructed in 1962. The facility primarily serves general aviation, but is also an official U.S. Customs Service Port of Entry. The airport is estimated to have a net value of approximately $9 million.

The second airport, Virginia Tech Montgomery Executive Airport was constructed in 1929 and is located on the Virginia Tech campus. The original airport was constructed to accommodate the large aircraft of the time. The facility officially opened in 1931. The purpose of the airport has changed over time from training cadets in the 1940s to primarily serving the community and

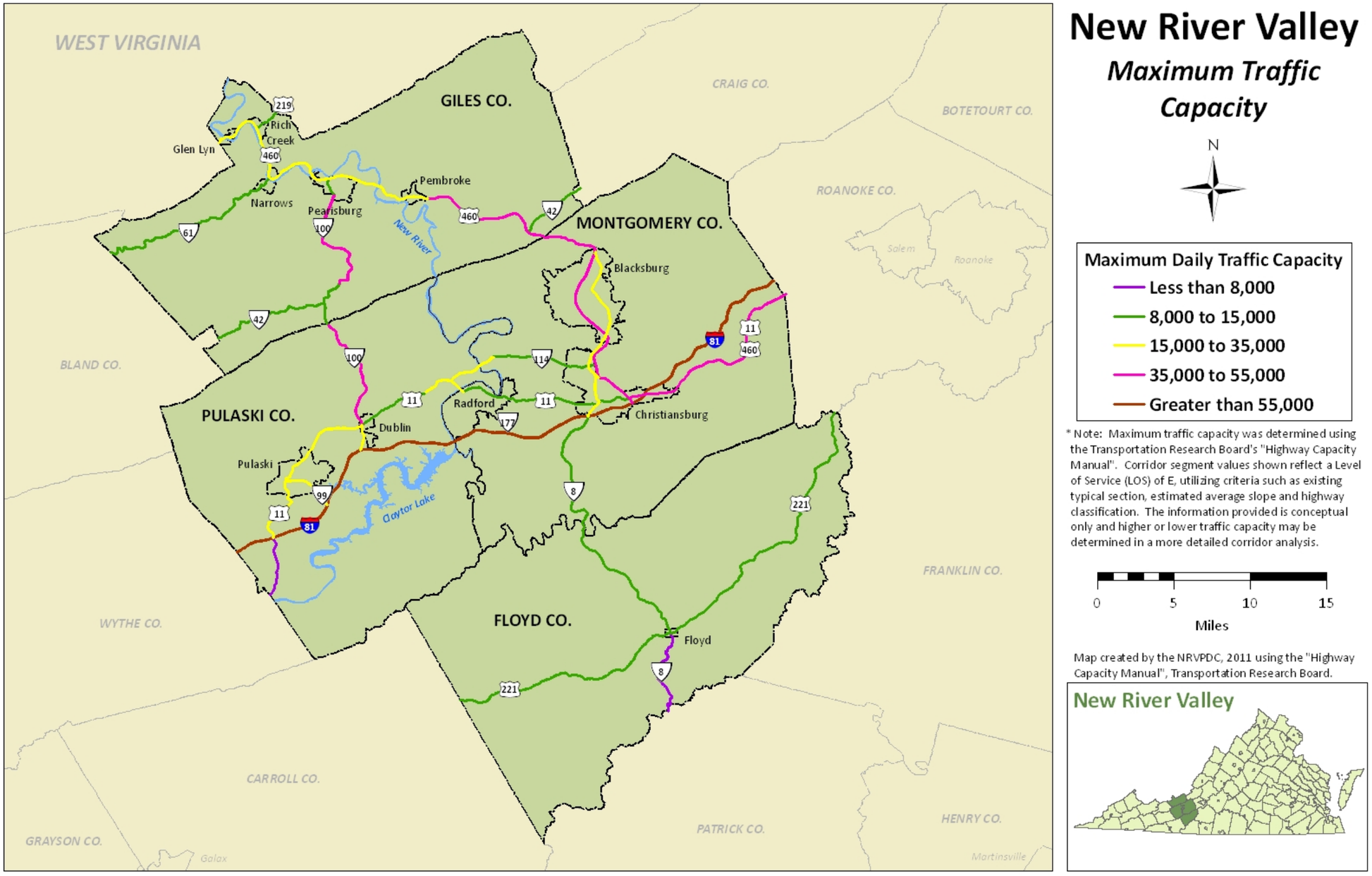
corporate jets. The Virginia Tech Executive Airport and associated assets are valued at nearly $20 million.

4.8.2.3.5 Identifying Critical Public Transportation Systems

The NRV currently has a mixture of fixed route, paratransit, senior services and on-demand transit services. Transit providers are often used to assist emergency response agencies to evacuate the elderly, low income and persons with disabilities. Currently services are offered within the Counties of Montgomery and Pulaski and the City of Radford. Giles and Floyd Counties currently do not provide transit services. Critical infrastructure for local transit providers includes vehicles, maintenance and office facilities, and local roadway networks. The estimated value for the region's public transportation assets is over $30 million.

Provisional 2009 numbers show that nearly 173,000 people live in the New River Valley. Population varies throughout the year because of the two universities in the region. The Town of Blacksburg is home to the Commonwealth's largest institution, Virginia Tech, which has an enrollment of nearly 30,000 students and consists of nearly 75% of the community's overall population each year. The City of Radford is home to Radford University which has an enrollment of nearly 9,000 students that more than doubles the community population. The Town of Dublin is home to the New River Community College which has an enrollment of nearly 3,000 commuter students that more than doubles the community's population any given day of the week. Each of these facilities has varying impacts on the local transportation system. For the purpose of this plan it is important to take into account the additional 40,000 persons that live in the NRV 75% of the year.

Map 39. NRV Maximum Traffic Capacity



4.8.2.4 Risk Assessment

Vulnerability is based on service losses as well as the interruption of service. For the purpose of mitigation planning these transportation assets are critical to emergency operations and accessibility.

In the NRV, there are a total of 95 identified roadway bridges on primary roads with a total linear length of 36,958 feet and an average length of 389 feet. The total estimated value of all identified bridges is $669,479,281 with an average value of $7,047,150 and on average built in 1968. Public transportation assets in the region have a total estimated value of $32 million. There are 11,367 LF of aviation infrastructure in the NRV with a total estimated value of $29,000,000.

Railways are an important component of the transportation infrastructure in the NRV. There is approximately 1,053,250 LF of railway in the region, with 1,030,000 feet of mainline track. The total estimated value of railway infrastructure in the NRV is $643,400,000 with the average structure's value being $17,872,222. There are 25 railway bridges in the region with lengths over 100 feet, the average being 280 feet. There is a total of 2,030 feet of bridges of less than 100 feet. Eight tunnels serve the NRV railway system, with an average length of 1,776 feet.

The following tables provide detailed 2010 data from VDOT about specific and critical transportation assets and their estimated value. Map 40 provides a basic illustration of the transportation infrastructure in the region.

Table 4-29. Floyd County Roadway Bridges

Route	Structure Number	Over	Year Built	Length*	Lanes	Width*	ADT**	Estimated Value
8	1001	Dodds Creek	1936	64.94	2	28.86	1807	$749,817.45
8	1002	Dodds Creek	1976	122.02	2	41.98	6788	$2,049,087.90
8	1003	W Fork Little River	1976	137.10	2	41.98	6788	$2,302,469.73
221	1017	W Fork Little River	1939	96.10	2	26.57	3436	$1,021,316.43
221	1019	Dodd Creek	1938	97.48	2	29.99	3436	$1,169,401.04
221	1021	Pine Creek	1938	112.47	2	26.29	2675	$1,182,894.13
221	1022	Little River	1998	320.78	2	37.72	8051	$4,839,988.99
221	1023	Beaverdam Creek	1936	127.92	2	26.57	2675	$1,359,431.42
221	1025	Big Run	1936	64.94	2	32.47	2152	$843,544.63
221	1026	Pine Branch	1936	112.83	2	32.47	2152	$1,465,552.28

* in Linear Feet
** ADT = Average Daily Traffic

Table 4-30. Giles County Roadway Bridges

Route	Structure Number	Over	Year Built	Length (LF)	Lanes	Width (LF)	ADT	Estimated Value
42	1012	Sinking Creek	1941	84.95	2	30.83	1286	$1,047,696.03
61	1023	Dry Branch @ Narrows	1998	30.83	2	28.86	4586	$355,973.94
61	1037	New River & Rte 460	1952	1266.74	2	46.00	4356	$23,307,942.40
61	1078	Wolf Creek @ Narrows	1963	221.07	2	37.39	2411	$3,306,529.69
61	1079	Wolf Creek	1969	440.83	2	27.22	538	$4,800,484.15
61	1080	Wolf Creek	1969	252.89	2	27.22	538	$2,753,849.16
100	1015	Big Walker Creek	1987	182.04	2	45.92	4262	$3,343,710.72
100	1017	Walker Creek	1977	246.00	2	41.98	2216	$4,131,225.60
100	1042	Walker Creek	1990	362.77	4	87.90	3897	$12,755,503.31
100	1050	Walker Creek @ Bane	1977	246.00	2	41.98	2216	$4,131,225.60
219	1929	Rich Creek	1931	98.07	2	24.93	8979	$977,895.53
219	6215	Rich Creek	1930	129.89	2	47.56	8979	$2,470,989.31
460	1001	NS Rwy/Prvt Ent Celnse	1978	170.89	2	41.98	6304	$2,869,824.72
460	1002	New River & N&W Railway	1978	1317.58	2	41.98	6304	$22,126,844.31

Route	Structure Number	Over	Year Built	Length (LF)	Lanes	Width (LF)	ADT	Estimated Value
460	1010	New River/ Rt640/Ns Rwy.	2001	1300.00	2	48.87	6304	$25,413,440.00
460	1011	NS Rwy/Prv Ent To Plant	2001	1285.00	2	48.87	6304	$25,120,208.00
460	1019	East River	1986	276.83	2	40.02	4614	$4,431,083.72
460	1020	New River	1986	1653.45	2	41.66	4614	$27,550,411.96
460	1021	Rich Creek	1973	118.08	4	92.82	6826	$4,384,263.17
460	1075	Sinking Creek	1977	216.81	2	41.98	4990	$3,640,986.83
460	1076	Stream	1932	5.90	4	85.00	12609	$200,736.00
460	1077	Sinking Creek	1961	220.09	2	33.13	4990	$2,916,430.11
460	1081	East River	1969	274.86	2	46.25	4614	$5,084,764.11
460	1082	New River	1969	1649.51	2	37.06	4614	$24,455,005.11
460	1083	New River/Ns Railway	1974	1272.64	2	38.05	5904	$19,368,562.69
460	1084	New River/Ns Railway	1974	1272.64	2	38.05	5904	$19,368,562.69
460	1085	Rte 460 Bus	1981	212.87	2	41.66	5904	$3,546,958.41
460	1086	Rt 460 Bus	1981	212.87	2	41.66	5904	$3,546,958.41

Table 4-31. Montgomery County Roadway Bridges

Route	Structure Number	Over	Year Built	Length (LF)	Lanes	Width (LF)	ADT	Estimated Value
8	1007	Mill Creek	1990	21.98	3	51.82	7359	$455,553.69
8	1902	Little River & Rte 716	1984	312.91	2	41.98	7359	$5,254,918.96
11	1002	S Fork Roanoke River	1981	211.89	2	41.66	4044	$3,530,562.61
11	1006	S Fork Roanoke River	1926	143.99	2	24.93	3782	$1,435,773.03
11	1027	S Fork Roanoke River	1950	202.05	2	32.14	4044	$2,597,852.36
11	1028	S. Fork Roanoke River	1950	261.09	2	32.14	4044	$3,356,965.07
11	1029	South Fork Roanoke River	1950	259.78	2	32.14	4044	$3,340,095.90
11	1031	S Fork Roanoke River	1952	173.84	2	33.13	3782	$2,303,588.61
81	2004	NS Railway & Rte 641	1970	173.84	2	41.98	22672	$2,919,399.42
81	2005	NS Rwy, Den Hill Rd/641	1970	165.97	2	41.98	19500	$2,787,200.20
81	2006	NS Railway & Roanoke Rv	1970	345.06	3	56.09	22728	$7,741,400.37
81	2007	NS Railway & Roanoke Rv	1970	326.03	2	43.95	19500	$5,731,903.39

Route	Structure Number	Over	Year Built	Length (LF)	Lanes	Width (LF)	ADT	Estimated Value
81	2900	New River, Ns Rwy, Rt605	1965	1657.71	2	41.98	14500	$27,838,952.24
81	2901	New River, Ns Rwy, Rt605	1965	1599.66	2	41.98	19455	$26,863,983.00
114	1045	New River	1990	1036.81	2	45.92	7942	$19,044,089.34
114	1046	NS Railway	1990	147.93	2	45.92	7471	$2,717,141.50
114	1092	Rte. 460 Bypass	2003	194.83	4	111.52	13324	$8,691,065.86
177	1062	Rte I 81	1965	306.02	2	35.10	5274	$4,296,087.32
177	1065	Rte I 81	1965	306.02	2	35.10	5274	$4,296,087.32
232	1044	Rte. I-81	1965	293.89	2	46.90	6647	$5,513,809.10
460	1032	Toms Creek	1978	18.04	4	85.00	12437	$613,360.00
460	1067	Rte 723	1969	98.07	2	42.64	15989	$1,672,716.03
460	1068	Rte 723	1969	98.07	2	42.64	15989	$1,672,716.03
460	1074	Jennelle Rd./Rt642	2002	360.80	2	42.64	17734	$6,153,804.80
460	1075	Rte. 642/ Jennelle Rd.	2002	450.02	2	42.64	17734	$7,675,472.90
460	1086	Ramp C 460 W Bus	2002	369.00	2	42.64	15989	$6,293,664.00

Table 4-32. Pulaski County Roadway Bridges

Route	Structure Number	Over	Year Built	Length (LF)	Lanes	Width (LF)	ADT	Estimated Value
11	1904	New River & Ns Railway	2005	1494.70	3	55.76	13562	$33,337,699.58
11	1905	New River & Ns Railway	2002	1494.70	3	55.76	13562	$33,337,699.58
81	2000	Rtes 100 & 11	1959	194.83	3	44.94	17071	$3,501,988.30
81	2001	Rtes 100 & 11	1959	194.83	3	44.94	14500	$3,501,988.30
81	2002	Rt99/Count Pulaski Dr.	1960	246.98	3	45.92	17774	$4,536,602.11
81	2003	Rt99/Count Pulaski Dr.	1960	225.99	2	43.95	14500	$3,973,120.15
81	2004	Peak Creek	1960	371.95	2	42.64	17774	$6,344,013.31
81	2005	Peak Creek	1960	371.95	2	42.64	14500	$6,344,013.31
81	2006	New River Trail St. Park	1960	175.81	2	43.95	17774	$3,090,845.29
81	2007	New River Trail S. P.	1960	175.81	2	43.95	14500	$3,090,845.29
81	2024	Rte 644_Miller Lane	1965	123.98	2	43.95	17774	$2,179,737.91
81	2025	Rte 644_Miller Lane	1965	123.98	2	43.95	14500	$2,179,737.91

Route	Structure Number	Over	Year Built	Length (LF)	Lanes	Width (LF)	ADT	Estimated Value
81	2026	Rte 611_Newbern Rd.	1965	129.89	2	43.95	17774	$2,283,534.95
81	2027	Rte 611_Newbern Rd.	1965	125.95	2	43.95	14500	$2,214,336.92
81	2028	Rte 100	1965	253.87	2	42.31	19215	$4,296,732.83
81	2029	Rte 100	1965	247.97	2	42.31	14500	$4,196,808.81
81	2030	Rte 799	1965	136.12	2	43.95	19455	$2,393,098.50
81	2031	Rte 799	1965	130.87	2	43.95	14500	$2,300,834.46
99	1009	Branch Peak Creek	1960	5.90	4	85.00	6892	$200,736.00
100	1015	Back Creek	1936	127.92	2	30.83	2506	$1,577,611.78
100	1016	Little Walker Creek	2001	275.00	5	89.22	5012	$9,813,760.00
100	1018	Back Creek	1974	140.06	2	41.98	2506	$2,352,044.44
100	1022	Rte 11 @ Dublin	1950	88.89	2	39.03	2756	$1,387,790.57
100	1024	Ns Railway & Rte 689	1952	195.82	2	38.05	8943	$2,980,162.87
100	1041	Rte 11 @ Dublin	1966	86.92	3	46.90	2881	$1,630,758.27
100	1042	Ns Railway & Rte 689	1966	193.85	2	36.41	8943	$2,823,047.19

Table 4-33. City of Radford Roadway Bridges

Route	Structure Number	Over	Year Built	Length (LF)	Lanes	Width (LF)	ADT	Estimated Value
Univ Blvd	NA	Ns Railway	NA	450.00	4	62.00	NA	$11,160,000.00
11	NA	New River & Railway	NA	1505.00	3	55.00	NA	$33,110,000.00
11	NA	New River & Railway	NA	1525.00	3	55.00	NA	$33,550,000.00
11	NA	Tributary	NA	180.00	2	50.00	4600	$3,600,000.00
11	NA	Tributary	NA	150.00	2	50.00	4600	$3,000,000.00

Table 4-34. NRV Aviation Infrastructure

Asset Description	Yr Built	Length (LF)	Strips	Width (LF)	ADT	Estimated Value
NRV Airport, Dublin, VA	1962	6201	1	150	10044	$9,000,000.00
Virginia Tech Airport, Blacksburg, VA	1929	5166	2	100	16780	$20,000,000.00

Table 4-35. NRV Railway Infrastructure

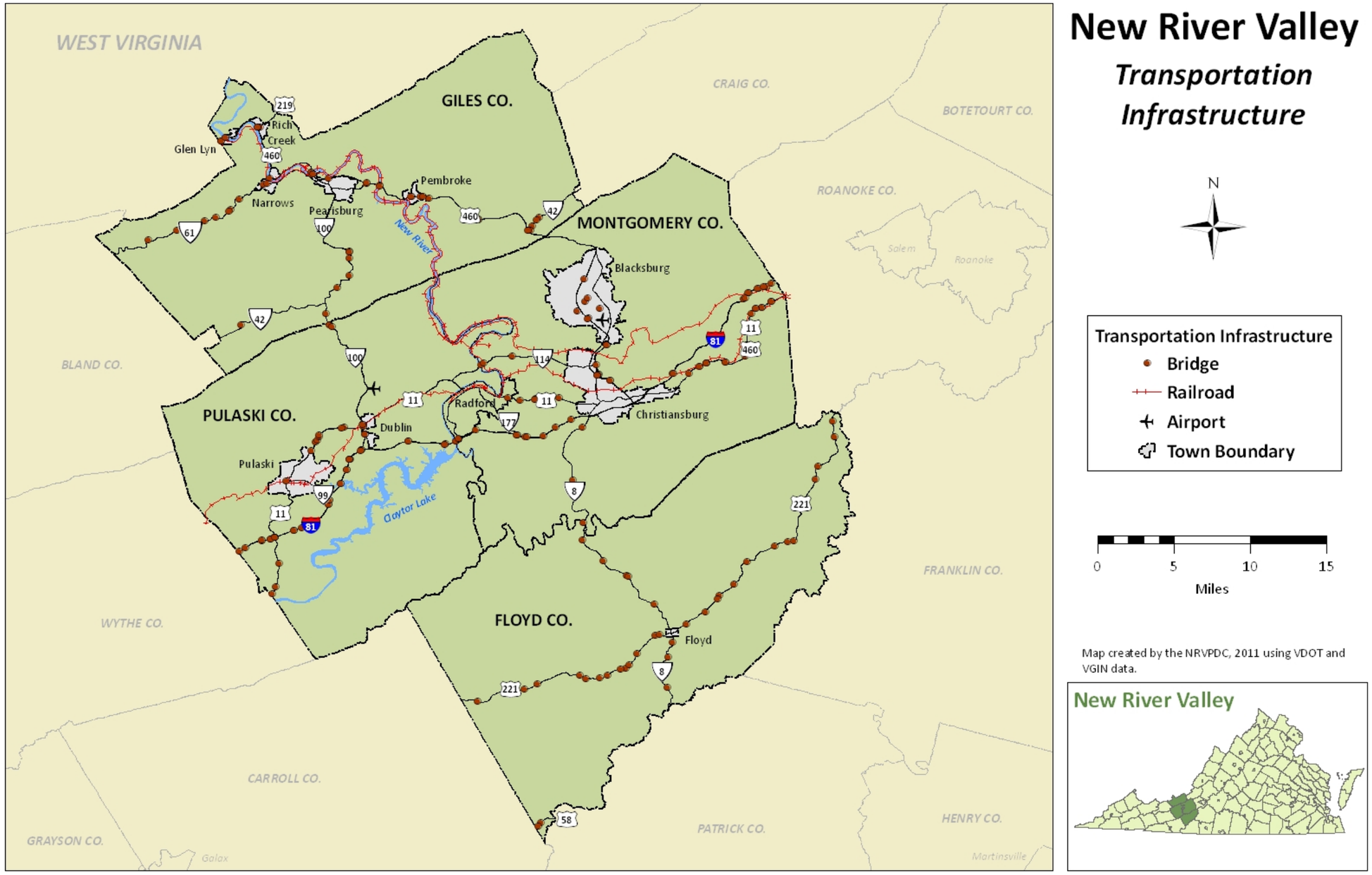
Asset Description	Length (LF)	Lines	Estimated Value
Estimated Norfolk Southern Doublestack Mainline Track	665000	1-3	$232,750,000.00
Estimated Norfolk Southern Mainline Track	365000	1-2	$127,750,000.00
Norfolk Southern Cowan Tunnel	3650	1	$18,250,000.00
Norfolk Southern Tunnel (Giles Co.)	575	1	$2,875,000.00
Norfolk Southern Tunnel (Giles Co. 2)	1285	1	$6,425,000.00
Norfolk Southern Tunnel (Giles Co. 3)	1700	1	$8,500,000.00
Norfolk Southern Tunnel (Montgomery Co./Prices Fork Rd.)	500	1	$2,500,000.00
Norfolk Southern Tunnel (Montgomery Co. Merrimac)	4850	1	$24,250,000.00
Norfolk Southern Tunnel (Montgomery Co.)	750	2	$7,500,000.00
Norfolk Southern Tunnel (Montgomery Co./N Fork Rd.)	900	1	$4,500,000.00
Norfolk Southern Estimated Total of Bridges 100 ft. or less	2030	1	$40,600,000.00
Norfolk Southern Bridge (Giles Co. West of Narrows)	225	2	$9,000,000.00
Norfolk Southern Bridge (Giles Co. Narrows/New River)	1300	1	$26,000,000.00
Norfolk Southern Bridge (Giles Co. Ripplemead/New River)	650	1	$13,000,000.00
Norfolk Southern Bridge (Giles Co.)	325	2	$13,000,000.00
Norfolk Southern Bridge (Giles Co./Pembroke)	135	1	$2,700,000.00
Norfolk Southern Bridge (Pulaski Co. West of RAAP)	150	1	$3,000,000.00
Norfolk Southern Bridge (Pulaski Co. South of Gatewood Reservoir)	215	1	$4,300,000.00
Norfolk Southern Bridge (Pulaski Co. East of Hogan Lake)	125	1	$2,500,000.00
Norfolk Southern Bridge (Pulaski Co. East of Hogan Lake 2)	180	1	$3,600,000.00
Norfolk Southern Bridge (Pulaski Co. West of Town)	175	1	$3,500,000.00
Norfolk Southern Bridge (Pulaski Co. West of Town 2)	200	1	$4,000,000.00
Norfolk Southern Bridge (Pulaski Co. West of Town 2)	180	1	$3,600,000.00
Norfolk Southern Bridge (Town of Pulaski)	140	1	$2,800,000.00
Norfolk Southern Bridge (Town of Pulaski 2)	150	1	$3,000,000.00

Asset Description	Length (LF)	Lines	Estimated Value
Norfolk Southern Bridge (Town of Pulaski 3)	150	1	$3,000,000.00
Norfolk Southern Bridge (City of Radford)	960	1	$19,200,000.00
Norfolk Southern Bridge (Montgomery Co./East of Christiansburg)	120	1	$2,400,000.00
Norfolk Southern Bridge (Montgomery Co./East of Christiansburg 2)	200	1	$4,000,000.00
Norfolk Southern Bridge (Montgomery Co./N Fork Road)	215	1	$4,300,000.00
Norfolk Southern Bridge (Montgomery Co./North of Elliston)	150	1	$3,000,000.00
Norfolk Southern Bridge (Montgomery Co./North of Elliston 2)	125	1	$2,500,000.00
Norfolk Southern Bridge (Montgomery Co./North of Elliston 3)	125	1	$2,500,000.00
Norfolk Southern Bridge (Montgomery Co./West of Elliston)	415	2	$16,600,000.00
Norfolk Southern Bridge (Montgomery Co./West of Elliston 2)	185	2	$7,400,000.00
Norfolk Southern Bridge (Montgomery Co./Elliston)	215	2	$8,600,000.00

Table 4-36. NRV Public Transportation Assets

Asset Description	ADT	Estimated Value
Blacksburg Transit Vehicles and Facilities	3,000,000	$27,500,000.00
Community Transit Vehicles and Facilities	100,000	$1,750,000.00
Pulaski Area Transit Vehicles and Facilities	65,000	$1,750,000.00
Smart Way Vehicles	75,000	$1,000,000.00

Map 40. Transportation Infrastructure



4.8.2.5 Vulnerable Populations

For the purposes of this plan, vulnerable populations are generally defined as persons with either short-term or long-term disabilities and elderly persons. These populations may be particularly susceptible to the impacts of hazard events and have very specific needs in the event of a hazard event. To begin evaluating those specific needs, the NRVPDC attended and led a facilitated discussion with the region's Disability Services Board (DSB). The DSB provides input to state and local agencies on service needs and priorities of persons with physical and sensory disabilities, to provide information and resource referral to local governments regarding the Americans with Disabilities Act and to provide such other assistance and advice to local governments as may be requested. The DSB is comprised of individuals representing businesses, consumers, each locality and liaisons. A primary activity of the DSB is to conduct a region-wide needs assessment focused on the disabled population, from transportation and housing to services.

During this facilitated discussion, the group identified numerous needs of these communities and how those needs could be addressed. The two main themes emerging from this discussion were that communication is a critically unaddressed issue, as well as the need for access to resources and supplies during a hazard event.

Communication during a hazard event, whether natural or human-caused, is critical in the mitigation of negative impacts in vulnerable populations. This communication must be two-way, both from the authorities to the population in a way that they can access the information, as well as from the population to the authorities to express their needs. As the group identified this need, it became evident that there is a fine line to be balanced between identifying vulnerable populations and not violating their right to privacy. To prevent many of the potentially negative impacts of hazard events, it is critical for government agencies and service providers to conduct outreach and provide persons within these populations the opportunity to self-identify themselves. Maintaining a database of these individuals should assist authorities in providing the necessary assistance to those who want it. A self-maintained database of the location and needs of permanently disabled or elderly persons should be adequate, but additional staff support at either a government agency or other service provider may be necessary to keep track of the self-reported individuals with short-term disabilities or needs.

Communication during a hazard event is also critical to ensure that vulnerable populations are aware of the situation and what they need to do to maintain their personal safety. Typically, notifications are sent to the general public through crawlers on TV screens or announcements on radio stations. The crawlers are not sufficient for the visually impaired or those with cognitive disabilities that limit their ability to read the information provided. This communication also needs to be in multiple forms, beyond TV, radio and the internet to be sure that the necessary information is reaching all the concerned individuals. Some alternative communications methods, especially for critical situations, include door-to-door notifications as well as working with church groups to get information distributed. Reverse 911 with an option to receive a text message would enable a good portion of these vulnerable populations to receive notifications.

Access to resources and supplies can be critical for vulnerable populations during a hazard event. Many times these individuals rely on specific medical devices and/or medications that may be difficult to access or transport in emergency situations. It is important for both emergency

sheltering authorities and individuals to identify where to obtain necessary equipment and/or medications prior to an emergency or to identify a storage location if the resource can be stored for periods of time. The group emphasized the need to individuals with disabilities to create and maintain their own personalized "To Go" kit, and possibly a back-up kit, with all necessary medications and equipment. A suggested strategy to further this idea was to propose training sessions at agencies and service providers for individuals on how to create and maintain their own kit. One idea for ensuring that all necessary equipment and medications are available to disabled populations is to shelter these individuals directly in hospitals or other care facilities during emergency events.

In addition to these resources, access to transportation is critical for many in the disabled population. For evacuation situations, it is necessary that all regional authorities know what accessible vehicles are available and where they are to provide a means for evacuation for disabled populations. The group identified the need to establish community locations for evacuation pick-up that are available for disabled persons and would facilitate their timely egress from a potentially dangerous situation.

A primary strategy identified to help address these identified needs was to increase outreach by government agencies and other service providers to these vulnerable populations that may not be currently receiving aid or assistance. Providing a workshop with clients at agencies and working directly with clients will create an awareness of how to respond in time and promote readiness within the vulnerable populations.

4.8.2.5.1 Mitigation Opportunities

A complete listing of NRV hazard mitigation goals, objectives, and strategies can be found in Chapter 5: Mitigation Strategy. Because so little information is available on human-caused hazards and is a relatively new hazard being considered, the Steering Committee developed a mitigation goal. The Steering Committee elected to delay developing specific objectives and strategies until the next revision of this plan.

1. **Develop information on man-made hazards that impact human health and quality of life, e.g., air, water and soil quality in the NRV.**