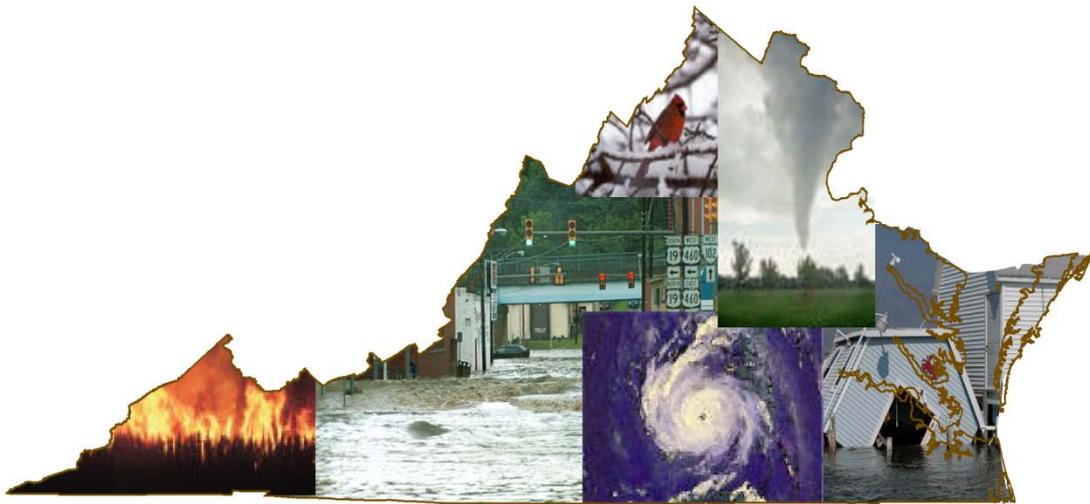


COMMONWEALTH OF VIRGINIA



Hazard Mitigation Plan



Chapter 3 Hazard Identification and Risk Assessment (HIRA)

Section 3.3 – Declared Disasters and NCEC Data



SECTION 3.3

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Section 3.3: Declared Disasters and NCDC Data

Disaster Declarations Background

Local and State governments share the responsibility for protecting their citizens and for helping them recover when a disaster strikes. In some cases, a disaster is beyond the capabilities of the state and local government to respond. In 1988, the Robert T. Stafford Disaster Relief and Emergency Assistance Act was enacted to support state and local governments and their citizens when disasters overwhelm them and exhaust their resources. This law, as amended, established a process for requesting and obtaining a Presidential disaster declaration, defines the type and scope of assistance available from the Federal government, and sets the conditions for obtaining that assistance.¹

A Presidential disaster declaration could result from a hurricane, earthquake, flood, tornado, major fire or other event which the President determines warrants supplemental federal aid. The event must be undoubtedly more than the state or local governments can handle alone. If declared, funding comes from the President's Disaster Relief Fund, which is managed by FEMA, and disaster aid programs of other participating federal agencies.

Presidential Disaster Declarations usually follows these steps:

- Local Governments are the first to respond, supplemented by neighboring communities through mutual aid agreements and volunteer agencies. If overwhelmed, turn to the state for assistance;
- The State responds with state resources, such as the Virginia Emergency Response Team, National Guard and other state agencies;
- A Rapid Needs Assessment (RNA) which focuses on lifesaving needs, imminent hazards, and critical lifelines is performed, usually within the first 24 hours of an event;
- An Initial Damage Assessment (IDA) is performed by the local government, which evaluates damages to residences, businesses, and public infrastructure (i.e., roads, bridges, public utilities, etc.)
- IDAs determine if there is sufficient damage to warrant a Joint Preliminary Damage Assessment (PDA) which consists of local, state, and federal staff verifying the IDAs to determine if enough damage exists to warrant federal recovery assistance;
- A Major Disaster Declaration is requested from the Governor to the FEMA Region III Administrator which evaluates the request and provides recommendations to the President based on the RNA and PDAs and the type of federal assistance requested;

¹ A Guide to the Disaster Declaration Process and Federal Disaster Assistance. FEMA March 4, 2008.





- A request for hazard mitigation assistance also accompanies the disaster declaration request;
- Depending on the nature of the disaster and the type of assistance being requested, a Presidential declaration could be approved within a couple of hours to a couple of weeks;
- A Presidential Declaration can also be approved prior to an event (i.e. hurricane) if it anticipated that the damage will be severe in order to pre-position resources;
- Federal funds for mitigation post-disaster are based on 15% of the Stafford Act disaster recovery assistance that is provided to the jurisdictions statewide.

Federally Declared Disasters in Virginia

Since the HIRA was developed for the 2010 plan in 2009, there have been 9 Presidential Disaster Declarations in Virginia. An important source for identifying hazards that can affect the Commonwealth is the record of federal disaster declarations. According to FEMA, there have been 47 major disaster declarations, 7 emergency declarations, and 7 fire management assistance declarations for Virginia dating back to 1957. Table 3.3-1 shows the Federal emergency and disaster declarations in Virginia from 1959 through 2012.

Tropical systems, flooding, and winter weather tend to have greater impacts and result in the most declarations in the Commonwealth; in 1996 and 2003 one of each of these hazards was declared in the state. Figure 3.3-1 shows the number of declared disasters, by jurisdiction, for Virginia. Fifteen jurisdictions have had 10 or more disasters during the time period 1969 to 2012.

Table 3.3-1: FEMA Disaster Declarations in Virginia since 1957

Disaster Number	Date of Declaration	Hazard Type/Name	Jurisdictions Declared
68	February 1957	Flood	NA
123	March 1962	Severe Storms, High Tides, Flooding	NA
149	March 1963	Flood	NA
274	August 1969	Hurricane Camille	27
339	June 1972	Tropical Storm Agnes	106
358	October 1972	Severe Storms & Flooding	3
359	October 1972	Severe Storms & Flooding	31
3018*	October 1976	Drought	38
525	January 1977	Ice Conditions	39
530	April 1977	Severe Storms & Flooding	16
3046*	July 1977	Drought	62





Commonwealth of Virginia Hazard Mitigation Plan

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Disaster Number	Date of Declaration	Hazard Type/Name	Jurisdictions Declared
543	November 1977	Severe Storms & Flooding	8
593	July 1979	Storms & Flash Flooding	1
606	September 1979	Severe Storms & Flooding	1
707	May 1984	Severe Storms & Flooding	3
755	November 1985	Severe Storms & Flooding	52
847	November 1989	Severe Storms, Mudslides, & Flooding	1
944	May 1992	Severe Storms & Flooding	28
3112*	March 1993	Severe Winter Storm	136
1007	December 1993	Severe Storms & Tornadoes	1
1014	March 1994	Severe Ice Storms, Flooding	72
1021	April 1994	Severe Winter Ice Storm	33
1059	July 1995	Severe Storms & Flooding	24
1086	January 1996	Blizzard of 1996 (severe storm)	127
1098	January 1996	Flooding -- Snow Melt	27
1135	September 1996	Hurricane Fran	55
1242	September 1998	Hurricane Bonnie	5
1290	September 1999	Tropical Storm Dennis	1
1293	September 1999	Hurricane Floyd -- Major Disaster	47
1318	February 2000	Winter Storms	109
1386	July 2001	Southwest VA Floods	10
3168*	September 2001	Terrorist Attack Emergency Declaration	1
1392	September 2001	Pentagon Attack	1
2394**	November 2001	Heard Mountain Fire Complex	2
2393**	November 2001	Shenandoah Gap Fire Complex	1
2390**	November 2001	Far Southwest Fire Complex	3
2397**	February 2002	Fultz Run Fire	1
1406	April 2002	Southwest VA Floods	10
1411	May 2002	Floods/Tornadoes	9
1458	April 2003	NOVA Snowstorm & SW VA Floods	22
1491	September 2003	Hurricane Isabel	100
1502	November 2003	SW Virginia Floods	6
1525	June 2004	Severe, Storms, Tornadoes, and Flooding	4
1544	September 2004	Severe Storms, Flooding And Tornadoes Associated with Tropical Depression Gaston	10
1570	October 2004	Severe Storms and Flooding from the remnants of Hurricane Jeanne	10





Disaster Number	Date of Declaration	Hazard Type/Name	Jurisdictions Declared
3240*	September 2005	Hurricane Katrina Evacuation	1
2637**	April 2006	Bull Mountain Fire	1
1655	July 2006	Severe Storms, Tornadoes, And Flooding	10
1661	September 2006	Tropical Depression Ernesto, Severe Storms and Flooding	22
1862	December 2009	Severe Storms and Flooding Associated with Tropical Depression Ida and a November Nor'easter	12
1874	February 2010	Severe December Winter Storm (Heavy snow, rain and high winds)	50
1905	April 2010	Severe February Winter Storms and Snowstorms	38
2860**	February 2011	Smith Fire	1
2861**	February 2011	Coffman Fire	1
3329*	August 2011	Hurricane Irene	30
4024	September 2011	August Hurricane Irene	48
4042	November 2011	August Earthquake	9
4045	November 2011	Remnants of September Tropical Storm Lee	8
4072	July 2012	June and July Severe Storms and Straight-line Winds (Derecho)	69
3359*	October 2012	Hurricane Sandy	134
4092	November 2012	October Hurricane Sandy	28

*FEMA Emergency Declarations

**FEMA Fire Management Assistance Declarations

A brief summary of selected declared disasters is highlighted below. Additional information on Virginia specific hazards can be found at VDEM website (www.vaemergency.com) for Virginia’s Weather History and Statistics.

- **Ash Wednesday Storm in 1962.** Damage was experienced throughout Virginia’s Tidewater region. Houses along the coast and bay region were damaged and flooded by high waves and 7 to 9 foot water rises. Virginia Beach’s concrete boardwalk and sea wall were damaged, and extensive shoreline erosion occurred. The City of Hampton had an estimated \$4 million in wind and flood damage. Two feet of snow fell from Charlottesville (21 inches), to Luray (24 inches), to Winchester (22 inches) setting new records.
- **Hurricane Camille in 1969.** This major storm made landfall out of the gulf as a category 5 Hurricane and weakened to a tropical depression before reaching Virginia. It rained more than 27 inches of rain in Nelson County and over ten inches in the area from Lynchburg to Charlottesville. Flooding and landslides, triggered by saturated soils, resulted in





catastrophic damage. More than 150 people died, another 100 were injured, and 113 bridges were washed out. At the time, damage was estimated at more than \$113 million.

- **Tropical Storm Agnes in 1972.** This event produced devastating flooding throughout the Mid-Atlantic States. Some areas of eastern Virginia received more than 15 inches of rainfall as the storm moved through. The Potomac and James Rivers experienced major flooding, which created 5 to 8 foot flood waters in many locations along the rivers. Richmond was impacted the most by these high water levels. Water supply and sewage treatment plants were inundated, as were electric and gas plants. Only one of the five bridges across the James River was open, while the downtown area was closed for several days, businesses and industries in the area suffered immense damage. Sixteen people lost their lives in the state and damage was estimated at \$222 million. These startling numbers resulted in 63 counties and 23 cities qualifying for disaster relief.
- **Tornado in 1973.** This F3 tornado is worth noting because it touched down in heavily populated areas of Northern Virginia and caused \$25 million in total damages. The tornado touched down in Prince William County and traveled through the cities of Fairfax and Falls Church before dissipating. Fairfax was hit hardest by this tornado; within a 6-mile damage path, a high school, two shopping centers, an apartment complex, and 226 homes were damaged or destroyed. 37 people were injured and the tornado resulted in \$14 million dollars.
- **Super Tornado Outbreak in 1974.** This was the worst tornado outbreak in U.S. history, generating the most tornadoes in a 24-hour period. Several states were struck with 148 observed tornadoes, killing 315 people and injuring thousands more. Eight of these tornadoes occurred in Virginia. Wind damage was reported in counties from Russell northward to Loudoun. Hundreds of homes and barns and many mobile homes were damaged or destroyed.
- **The Blizzard of 1983.** An unusually large area of the state was covered with more than 12 inches of snow, setting new records in many places. Richmond received 18 inches, while portions of northern Virginia had almost 30 inches. Strong winds that gusted over 25 mph created high snowdrifts and made clearing of roads a tough task. This storm cost the state more than \$9 million in snow removal.
- **Severe Weather Outbreak in 1984.** Severe weather pushed through the state on May 8th of this year, spawning tornadoes and producing significant downburst wind damage in central and eastern Virginia. A strong F3 tornado occurred in Hopewell and tracked into Charles City County as an F2. There was extensive home, mobile home, building, and tree damage from these cluster thunderstorms, imbedded tornadoes and windstorms; total damage costs exceeded \$50 million.
- **Election Day Flood in 1985.** Heavy rainfall from October 31 through November 6, 1985, caused record-breaking floods over a large region, including western and northern Virginia. Most of the rain fell on November 4 and 5 causing flash flooding. Heavy rainfall was indirectly related to Hurricane Juan. The Roanoke River rose seven feet in one hour and 18 feet in six hours, cresting at 23 feet on November 5. There were 22 deaths in Virginia as a





result of the flooding. FEMA declared 50 jurisdictions disaster areas. Approximately 1.7 million people were affected by the flooding; damages were estimated at \$800 million.

- **The Storm of the Century in 1993.** Affecting nearly the entire East Coast, this storm killed 200 people and generated several billion dollars in damage and snow removal. Although its effects in Virginia did not exceed the Ash Wednesday Storm in 1962, it affected more communities ranging from the Chesapeake Bay through central Virginia reaching into Southwest Virginia. Blizzard conditions in western Virginia dropped 2 to 3 feet of snow and produced snowdrifts up to 12 feet deep. Snow removal and clean-up costs were estimated at \$16 million for the state.
- **The Petersburg/Colonial Heights Tornado in 1993.** This tornado outbreak killed four people and injured 238. The strongest tornado touched down in Petersburg as an F4, with maximum winds estimated at 210 mph. The tornado jumped I-95 and smashed into a Wal-Mart causing the ceiling to collapse, three people died. Major damage occurred in the Old Towne section of Petersburg, destroying several stores and businesses in Colonial Heights. Other tornadoes hit the same day in the City of Newport News and the City of Chesapeake. During four hours, 18 tornadoes carved paths through southeast Virginia, setting a Commonwealth record. Total damages were estimated at \$52.5 million, making it Virginia's most costly tornado outbreak to date.
- **Ice Storm of 1994.** This winter storm coated portions of Virginia with 1 to 3 inches of ice from freezing rain and sleet. This led to the loss of approximately 10 to 20 percent of trees in some counties, which blocked roads and caused many people to be without power for a week. There were numerous automobile accidents and injuries from people falling on ice. Damages were estimated at \$61 million.
- **The Blizzard and flooding of Winter 1996.** Also known as the “Great Furlough Storm” due to Congressional impasse over the federal budget, the blizzard paralyzed the Interstate 95 corridor, and reached westward into the Appalachians where snow depths of more than 48 inches were recorded. Several local governments and schools were closed for more than a week. The blizzard was followed with another storm, which blanketed the entire state with at least one foot of snow. To compound things, heavy snowfall piled on top of this storm's accumulations in the next week, which kept snow pack on the ground for an extended period of time. This snow was eventually thawed by higher temperatures and heavy rain that fell after this thaw resulted in severe flooding. Total damage between the blizzard and subsequent flooding exceeded \$30 million.
- **Hurricane Fran in 1996.** This September 6 hurricane is notable not only for the \$350 million in damages, but because of its widespread effects, including a record number of people without power and closure of 78 primary and 853 secondary roads. Rainfall amounts between 8 and 20 inches fell over the mountains and Shenandoah Valley, leading to record-level flooding in many locations within this region. 100 people had to be rescued from the floodwaters and hundreds of homes and buildings were damaged by the floodwaters and high winds.
- **The Christmas Ice Storm in 1998.** This prolonged ice storm struck central and southeast Virginia in the days leading up to Christmas. Ice accumulations exceeded an inch, bringing





down many trees and power lines within this region. 400,000 people were without power on Christmas Eve, and some of these people did not get their power back for up to ten days. Property damage from this storm was estimated to be around \$20 million.

- **Wildfires of 1999.** The Purgatory Mountain Fire in Botetourt County, one of the largest fires of the year, burned 1,285 acres and cost more than \$166,000 to contain. A fire on Clinch Mountain in Southwest Virginia burned only 240 acres but containment costs exceeded \$97,000 due to the mountainous terrain and extreme drought conditions. A total of 1,749 fires burned 12,118 acres, considerably exceeding the five-year annual average of 1,320 fires and 6,081 acres.
- **Hurricane Floyd in 1999.** This large hurricane brought 10 to 20 inches of total rainfall over portions of southeast Virginia, with wind gusts up to 100 mph and storm surges approaching 7 feet along the coast. These three elements combined caused storm damages of approximately \$255 million. This disaster will long be remembered in the City of Franklin and Southampton and Isle of Wight Counties, as well as the other 44 Virginia jurisdictions included in the major disaster declaration. More than 8,900 homes, businesses and public facilities were either destroyed, significantly damaged, or sustained moderate impacts. In addition to direct property damage, lost business revenues were estimated at \$13.1 million, with the City of Franklin losing nearly \$2 million in tax revenues. Direct crop losses were estimated at \$17 million. FEMA reports allocating \$8.9 million for assistance to families and individuals, and \$19.8 million for public assistance.
- **Terrorist Attack in 2001.** American Airlines Flight 77 was hijacked and flown into the Pentagon in Arlington County, Virginia. The hijacking resulted in 150 fatalities when it crashed into the west side of the building. Combined with the attack on the World Trade Center and the impacts of the plane crash in Pennsylvania, this event changed terrorism policy in the United States and led to the creation of the Department of Homeland Security, where FEMA is now administered.
- **Southwest Virginia Flooding, 2001-2004.** A total of six federal disasters, primarily flooding and severe storms, have been declared in Southwest Virginia from 2001-2004 (Disasters 1386, 1406, 1411, 1458, 1502, 1525 and 1570). The worse hit counties were Tazewell (all 6 disasters), Buchanan (5 disasters), and Russell (4 disasters). Dickenson, Lee, Smyth, and Wise Counties were also declared in half of these disasters. Many of these disasters have storm tracks along the mountain valleys, producing excessive localized flooding. Catastrophic flooding has been experienced in rural settlements as well as in Bluefield, Hurley, Appalachia, Pennington Gap, Norton, Dante and Wise.
- **Hurricane Isabel in 2003.** Hurricane Isabel entered Virginia September 18 after making landfall along the North Carolina Outer Banks. The Commonwealth sustained tropical storm winds for 29 hours with some maximum winds approaching 100 mph. The hurricane produced storm surge of 5 to 8 feet along the coast and in the Chesapeake Bay with rainfall totals between 2 to 11 inches along its track. Twenty-one inches of rainfall was measured near Waynesboro Virginia. Damages due to wind, rain, and storm surge resulted in flooding, electrical outages, debris, transportation interruption, and damaged homes and businesses. At the height of the incident approximately 6,000 residents were housed in 134 shelters and curfews were imposed in many jurisdictions. Further damages occurred when a series of





thunderstorms and tornados came through many of the designated areas in the southeast portion of Virginia on September 23. There were a total of 36 confirmed deaths. More than 93,000 individuals, families and businesses registered for federal assistance. Residential impacts included 1,186 homes reported destroyed and 9,110 with major damage, 107,908 minor damage; losses estimated to exceed \$590 million. Of the 1,470 businesses involved, 77 were reported destroyed, 333 suffered major damage and 1,060 businesses suffered minor or casual damage, with losses exceeding \$84 million. Public assistance exceeded \$250 million and continues to increase. More than two-thirds of households and businesses within the Commonwealth were without power. Remote locations did not have power restored for three weeks.

- **Tropical Depression Gaston in 2004.** Downgraded from a hurricane, Tropical Depression Gaston moved into Virginia from the south during the morning of Monday, August 30, 2004. Although forecasts called for accumulations of 1”-3” in Central Virginia, the system stalled over the Richmond metropolitan area and brought as much as 14” of rain. In the cities of Richmond, Hopewell, Colonial Heights, and Petersburg and the counties of Charles City, Chesterfield, Dinwiddie, Henrico, Hanover, New Kent, Prince George, and King William homes, apartments, and businesses in low-lying areas were flooded and many streets were impassable due to severe damage, including I-95, I-64, and I-195. The Office of the Chief Medical Examiner confirmed nine deaths directly linked to Tropical Depression Gaston.
- **Tropical Depression Ernesto in 2006.** Downgraded from a hurricane, tropical depression Ernesto moved into Virginia on September 1. The system slowed over coastal and eastern Virginia, causing rainfall accumulations of up to 10” of rain in the cities of Hampton, Poquoson and Newport News. Serious flooding and shoreline damage occurred in Northern Neck with damages most significant in Northumberland, Lancaster and Westmoreland Counties. A public assistance disaster declaration provided aid to the Commonwealth and 25 local governments.
- **November Nor'easter and Tropical Depression Ida in 2009.** A combination of a Nor'easter and the remnants of Tropical Depression Ida led to significant rainfall which caused flooding and damage amounting to approximately \$388 million, \$25 million of which was in Norfolk alone. The areas affected were Hampton, Newport News, Norfolk, Virginia Beach, Chesapeake, Poquoson, Portsmouth, James, and York².
- **Severe December Winter Storm in 2009.** A nor'easter that formed over the Gulf of Mexico developed into a winter storm affecting much of the East Coast. The highest 1-day snowfall associated with this storm was 27 inches reported at the weather station in Buchanan Virginia.
- **Severe February Winter Storm in 2010.** A nor'easter developed into a winter storm that produced significant snowfall affecting northern Virginia. The highest 1-day snowfall

² Virginia Department of Emergency Management. Retrieved from www.vaemergency.gov/news/2009/sbaOfferDisasterAssist





associated with this storm was 34 inches reported at the weather station near Purcellville in Loudoun County.

- **Hurricane Irene in 2011.** Initially, Hurricane Irene was announced as an emergency declaration. After the Hurricane hit and damaged was assessed, this hurricane was declared a major disaster, resulting in federal funding. Hurricane Irene was a large tropical cyclone affecting the Caribbean and East Coast of the United States. The Commonwealth experienced the second highest number of power outages ever with 2.5 million citizens without power after the storm. Irene is ranked as the fifth costliest hurricane in United States history, costing approximately \$15.6 billion³.
- **Mineral Earthquake in 2011.** On August 23, 2011, a 5.8 magnitude earthquake occurred approximately 7 miles from Mineral, Virginia close to Louisa County. Hundreds of aftershocks were felt for several days. Some of these aftershocks were recorded at a 4.5 magnitude⁴. Louisa County received over \$6.6 million in individual assistance as well as \$1.6 million in low-interest loans to individuals and businesses through the Small Business Administration⁵.
- **Tropical Storm Lee in 2011.** Tropical Storm Lee caused heavy rain and flooding in Virginia on September 8th and 9th. Caroline, Essex, Fairfax, King and Queen, King George, Prince William, Westmoreland, and the city of Alexandria were approved for federal disaster assistance. The heavy rain caused significant damage to neighborhoods and businesses in Fairfax and Prince William Counties. Approximately 500 individual were displaced from their homes in Prince William County⁶.
- **Derecho in 2012.** Severe thunderstorms and straight-line winds exceeding 80 mph impacted Virginia on the evening of June 29th and the morning hours of July 1st. Fifteen storm-related deaths were reported⁷. A large portion of the Commonwealth lost power for several days, during a significant heat wave.

³ Lixion, Avila and John Cangialosi. “Hurricane Irene Tropical Cyclone Report.” National Hurricane Center. http://www.nhc.noaa.gov/data/tcr/AL092011_Irene.pdf

⁴ Department of GeoSciences at Virginia Tech. <http://www.geol.vt.edu/outreach/vtso/2011/0823-louisa/>

⁵ Virginia Department of Emergency Management. “Governor McDonnell Asks for Additional Earthquake Recovery Assistance for Homeowners and Local Governments”. <http://www.vaemergency.com/news/news-releases/2011/Additional-earthquake-assistance>

⁶ Virginia Department of Emergency Management. “FEMA Approves Federal Disaster Assistance for Local and State Governments Following Tropical Storm Lee”. <http://www.vaemergency.gov/news/news-releases/2011/FEMA-Approves-Fed-Disaster-Assistance-for-Local-State-Governments-Tropical-Storm-Lee>

⁷ Virginia Department of Emergency Management. “Situation Report #19.” <http://virginiaderecho.tumblr.com/>





Federal Disaster Data Compilation

Federally Declared Disaster data from the 2004 hazard mitigation plan was used as the starting point to update the records. Once the data from the new sources was compiled and all available missing data was filled in using FEMA’s Declared Disasters webpage (<http://www.fema.gov/disasters>), the data was ready to be processed into HIRA categories. Descriptions of the disasters can vary quite dramatically and as a result they needed to be grouped into broad hazard type categories for comparison. Table 3.3-2 shows how the declared disaster categories were grouped into the HIRA hazard categories.

Table 3.3-2: FEMA disasters declarations to align with the HIRA hazards

HIRA Category	General Categories Included
Drought	Drought
Flood	Flood Flood / Tornado Hurricane Thunderstorm / Flood Thunderstorm / Flood / Landslide Winter Storm / Flood
High Wind	Hurricane Thunderstorm / Flood Thunderstorm / Flood / Landslide Thunderstorm / Tornado / Flood Thunderstorm / Tornado Tropical Storm
Tornado	Flood / Tornado Thunderstorm / Tornado / Flood Thunderstorm / Tornado
Winter Storm	Winter Storm Winter Storm / Flood
Wildfire	Wildfire
Landslide	Thunderstorm / Flood / Landslide
Dam	NA

It should also be noted that since many of these disaster declarations have multiple events and cover large areas, there is the possibility that a municipality has received funding for a disaster that did not occur in that particular municipality. For example, an event that included severe storms, flooding, and tornados, could have only had a tornado in one county, while the disaster assistance was provided to multiple counties. Without going through each disaster individually, there is no simple method to separate these events. To be able to visualize the number of different disaster types that have impacted Virginia the maps showing the individual federally declared disasters have been double counted when different hazards have occurred during a





single event. For example, the storm in July 2006 (disaster number 1655) was classified by FEMA as “Severe Storms, Tornado, and Flooding”. To be able to show these as separate events each designated county was given a score of one for each of the event types for this one declared disaster. Each declared disaster is represented from the assigned FEMA categories. This may result in some types of categories not being represented to its fullest account. One exception to this is the landslide events that resulted from Hurricane Camille in 1969 (disaster number 274) and the Severe Storm and Flooding in 1995 (disaster number 1059) that impacted Nelson and Madison counties, respectively.

The total number of declared disasters (Figure 3.3-1) does not double count these events. If one was to sum up the total number of individual hazard events each county was given and compared it to the total number of declared disasters they would not be equal, for reason discussed above. In addition, for communities declared for disasters, contiguous communities can also be added.

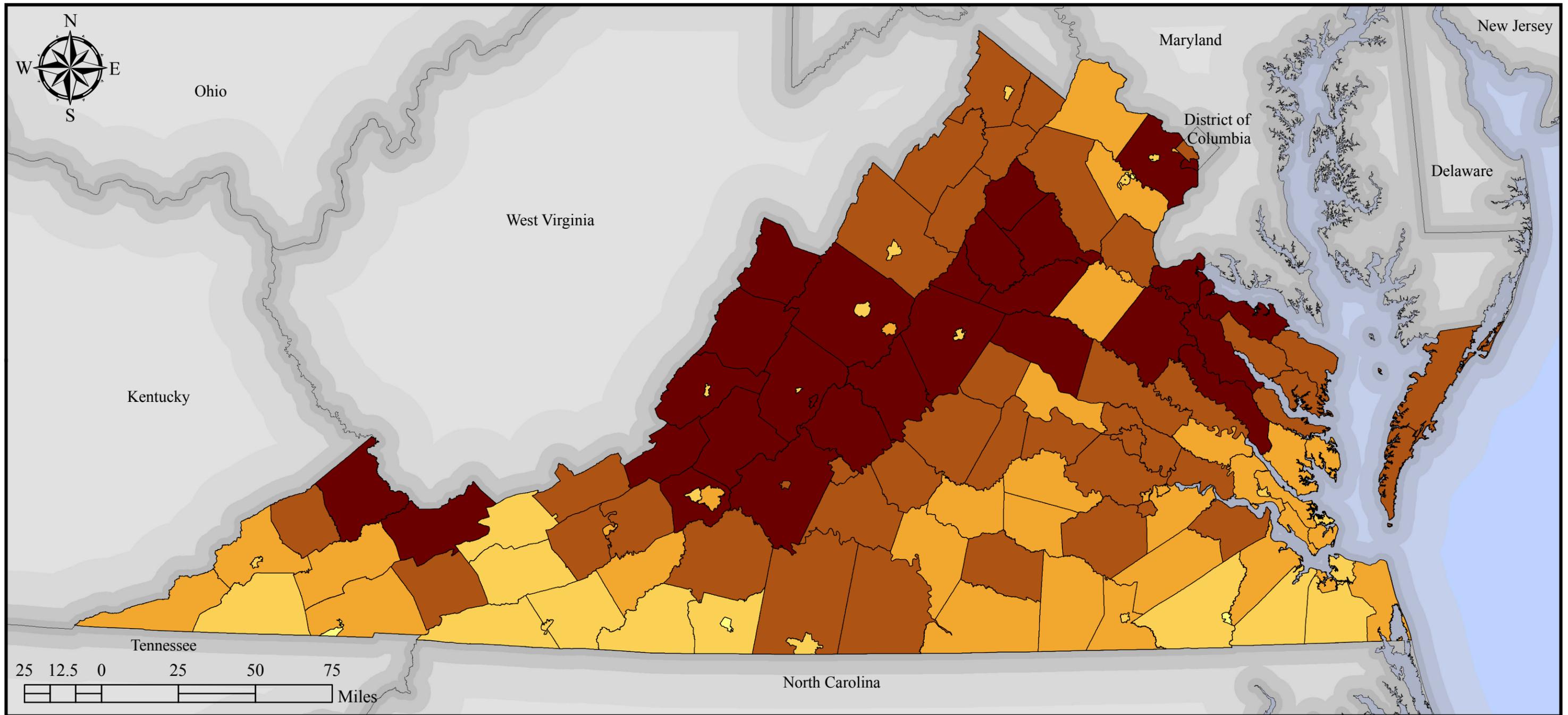
Figures 3.3-2 through 3.3-9 show the number of declared disasters, by jurisdiction, for the individual Hazard HIRA Categories. Flood, High Wind and Winter Weather represent the majority of Federally Declared Disasters in Virginia. Landslide, Land Subsidence (karst), and Flooding due to Impoundment Failure are hazards that have been considered in this plan, but do not have any federally declared disasters directly associated with them.

The following jurisdictions have experienced 14 or more declared disasters from 1957 through July 2012:

- Alexandria City
- Alleghany County
- Amherst County
- Augusta County
- Bath County
- Bedford County
- Buchanan County
- Greene County
- King George County
- Nelson County
- Rockbridge County



Figure 3.3-1: Total Federal Declared Disasters



DATA SOURCES:

FEMA & VDEM Declared Disasters
 VGIN Jurisdictional Boundaries
 ESRI State Boundaries

LEGEND:

Number of Declared Disasters (1964 - 2012)

- 2 - 4
- 5 - 7
- 8 - 9
- 10 - 12
- 13 - 16

DATA IDENTIFICATION:

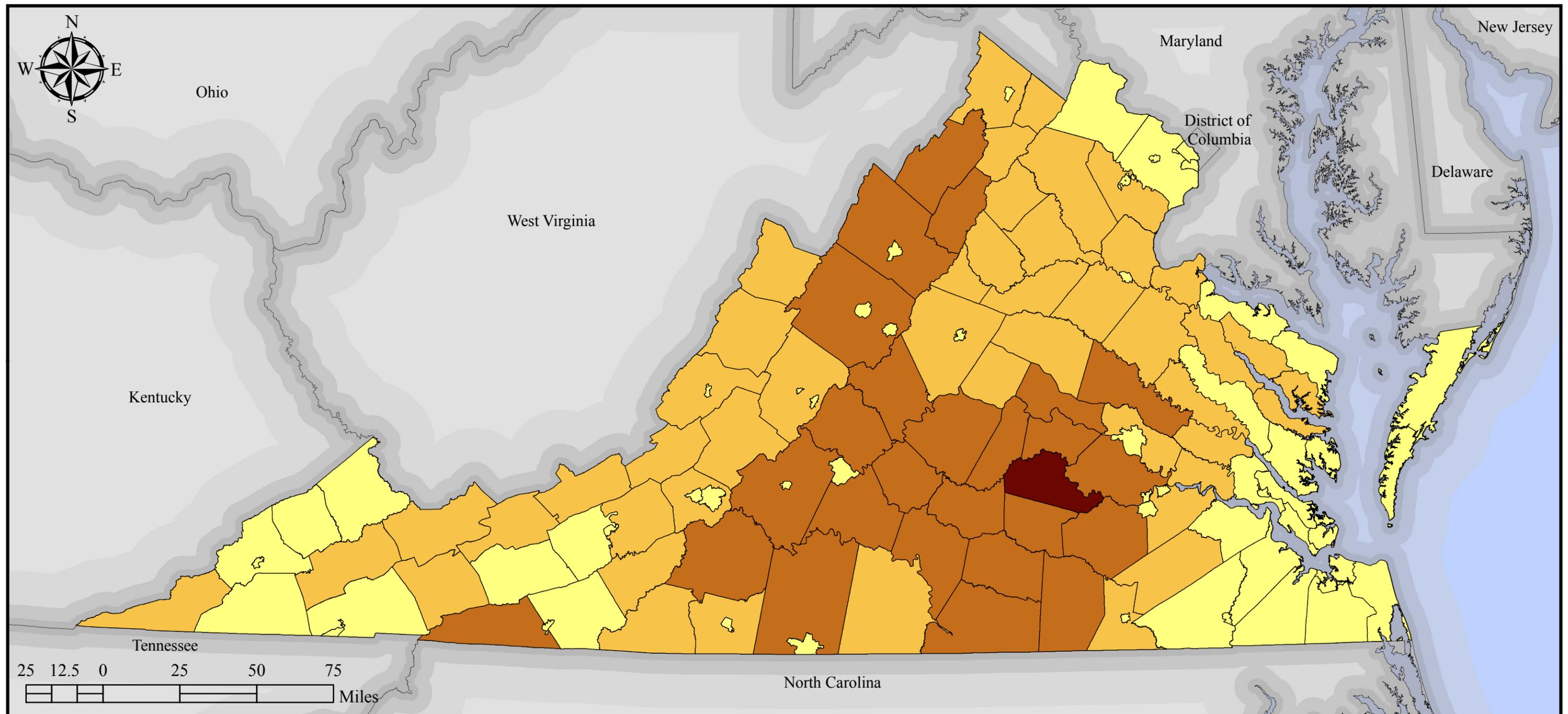
A declared federal disaster is any disaster in which Federal funding was allocated to a jurisdiction in the wake of a disaster incident. The sources and types of funding are not taken into account for this map.

The period of record for this map spans 1964 through 2012. Occurrences include total number of disaster declarations by jurisdiction.

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.

Figure 3.3-2: Drought Federal Declared Disasters



DATA SOURCES:

FEMA & VDEM Declared Disasters
 VGIN Jurisdictional Boundaries
 ESRI State Boundaries

LEGEND:

Number of Declared Disasters (1964- 2012)

- No Declared Disasters
- 1
- 2
- 3

DATA IDENTIFICATION:

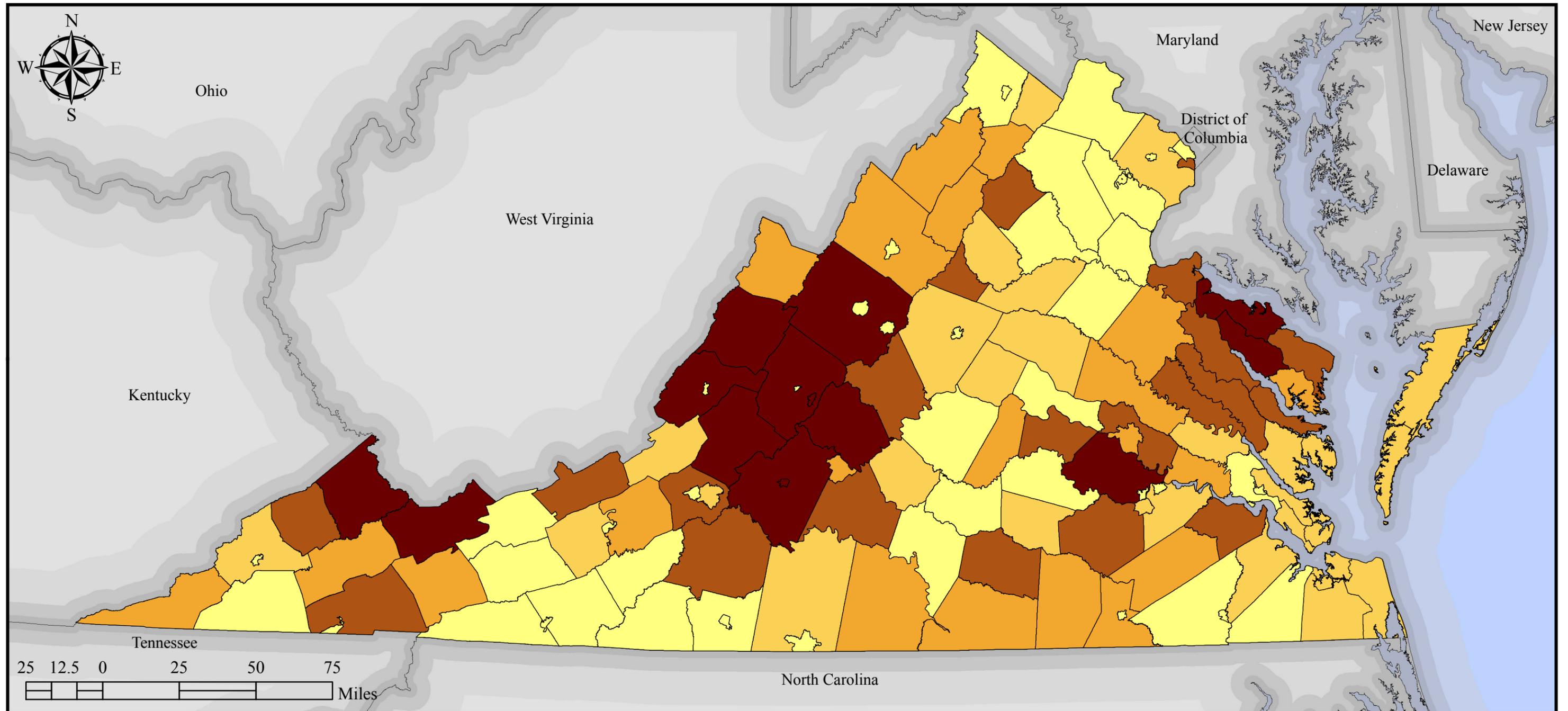
A declared federal disaster is any disaster in which Federal funding was allocated to a jurisdiction in the wake of a disaster incident. The sources and types of funding are not taken into account for this map.

The period of record for this map spans 1964 through 2012. Occurrences include total number of drought related disaster declarations by jurisdiction.

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.

Figure 3.3-3: Flood Federal Declared Disasters



DATA SOURCES:

FEMA & VDEM Declared Disasters
 VGIN Jurisdictional Boundaries
 ESRI State Boundaries

LEGEND:

Number of Declared Disasters (1964- 2012)

- 0 - 4
- 5
- 6
- 7
- 8 - 11

DATA IDENTIFICATION:

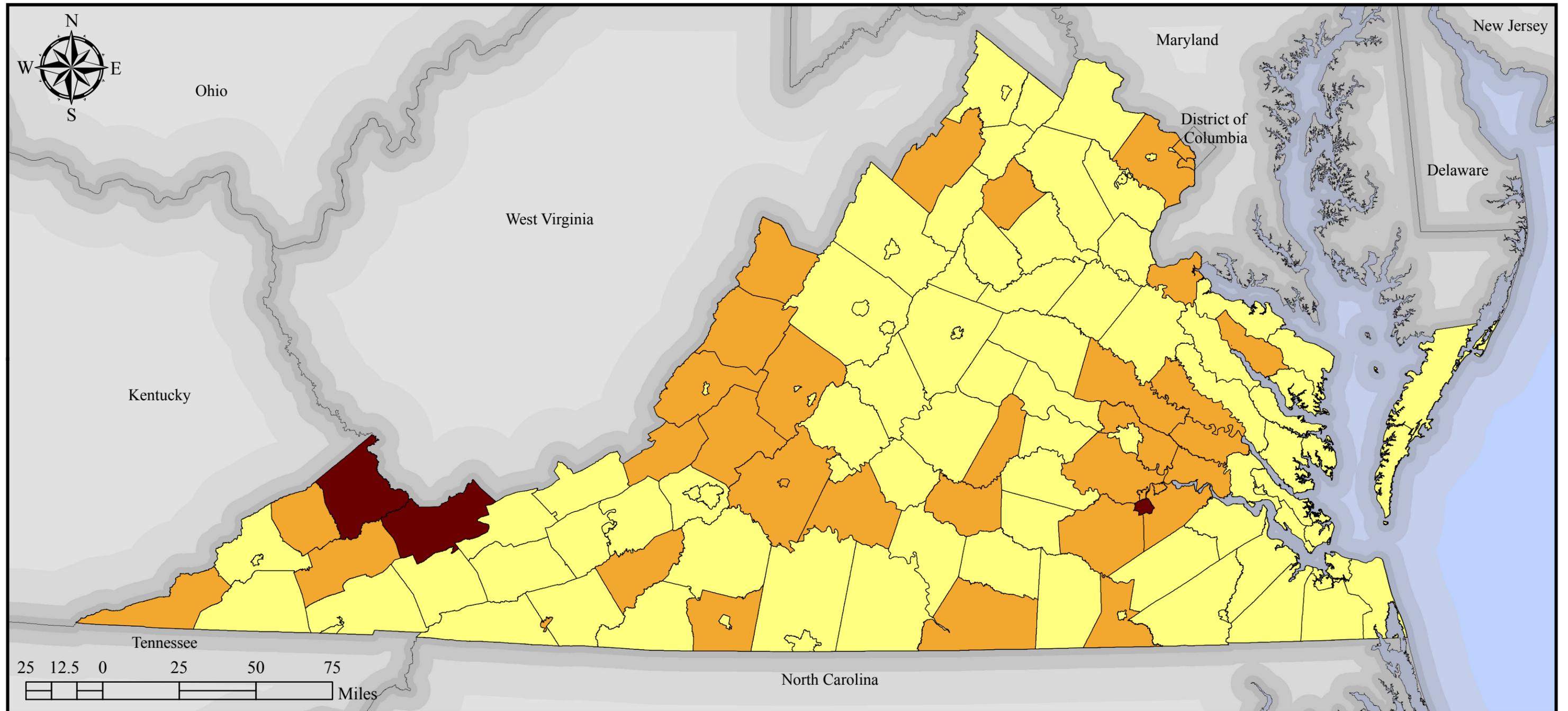
A declared federal disaster is any disaster in which Federal funding was allocated to a jurisdiction in the wake of a disaster incident. The sources and types of funding are not taken into account for this map.

The period of record for this map spans 1964 through 2012. Occurrences include total number of flood related disaster declarations by jurisdiction.

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.

Figure 3.3-5: Tornado Federal Declared Disasters



DATA SOURCES:

FEMA & VDEM Declared Disasters
 VGIN Jurisdictional Boundaries
 ESRI State Boundaries

LEGEND:

Number of Declared Disasters (1964- 2012)

- No Declared Disasters
- 1
- 2

DATA IDENTIFICATION:

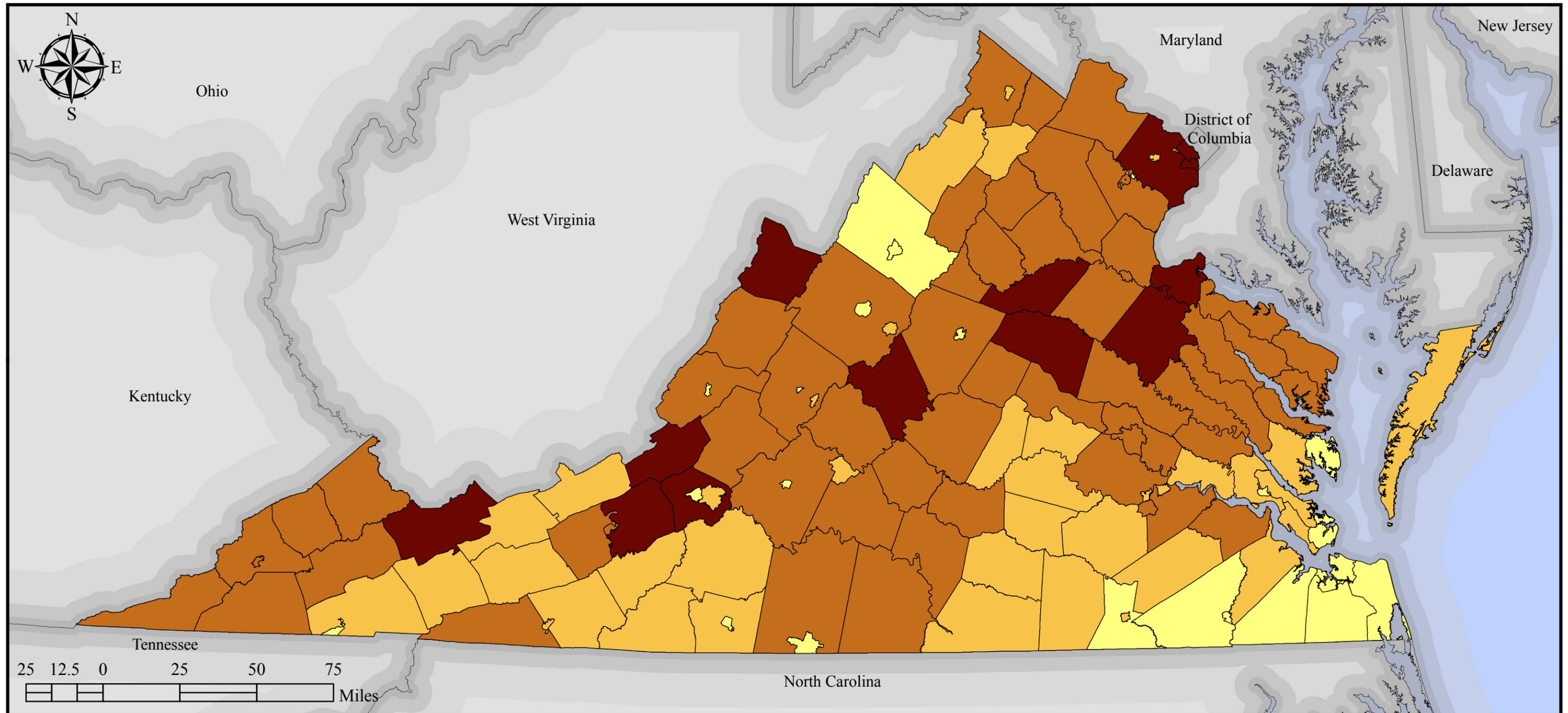
A declared federal disaster is any disaster in which Federal funding was allocated to a jurisdiction in the wake of a disaster incident. The sources and types of funding are not taken into account for this map.

The period of record for this map spans 1964 through 2012. Occurrences include total number of tornado related disaster declarations by jurisdiction.

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.

Figure 3.3-6: Winter Storm Federal Declared Disasters



DATA SOURCES:

FEMA & VDEM Declared Disasters
 VGIN Jurisdictional Boundaries
 ESRI State Boundaries

LEGEND:

Number of Declared Disasters (1964- 2012)

- 1 - 2
- 3
- 4 - 5
- 6 - 7

DATA IDENTIFICATION:

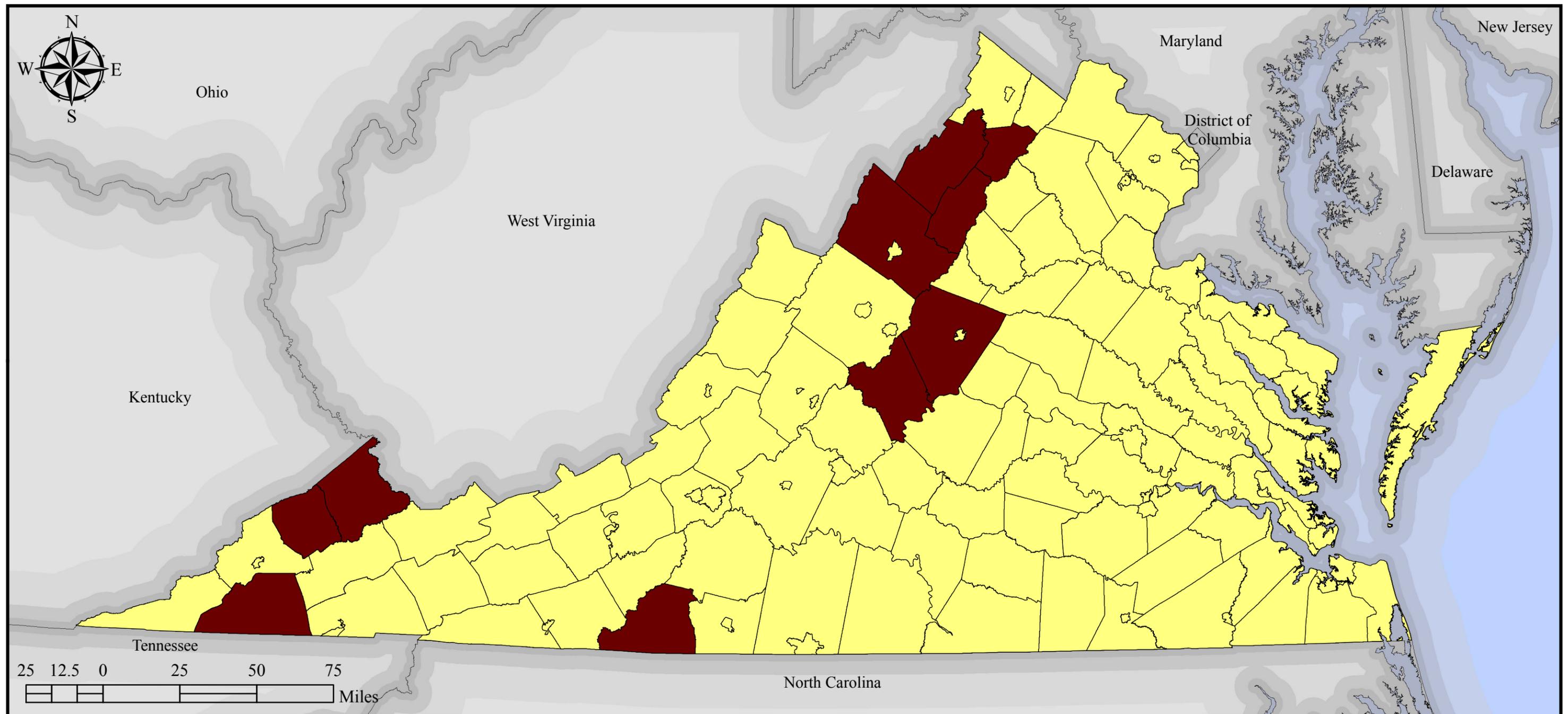
A declared federal disaster is any disaster in which Federal funding was allocated to a jurisdiction in the wake of a disaster incident. The sources and types of funding are not taken into account for this map.

The period of record for this map spans 1964 through 2012. Occurrences include total number of winter storm related disaster declarations by jurisdiction.

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.

Figure 3.3-7: Wildfire Federal Declared Disasters



DATA SOURCES:

FEMA & VDEM Declared Disasters
 VGIN Jurisdictional Boundaries
 ESRI State Boundaries

LEGEND:

Number of Declared Disasters (1964-2012)

	No Declared Disasters
	1

DATA IDENTIFICATION:

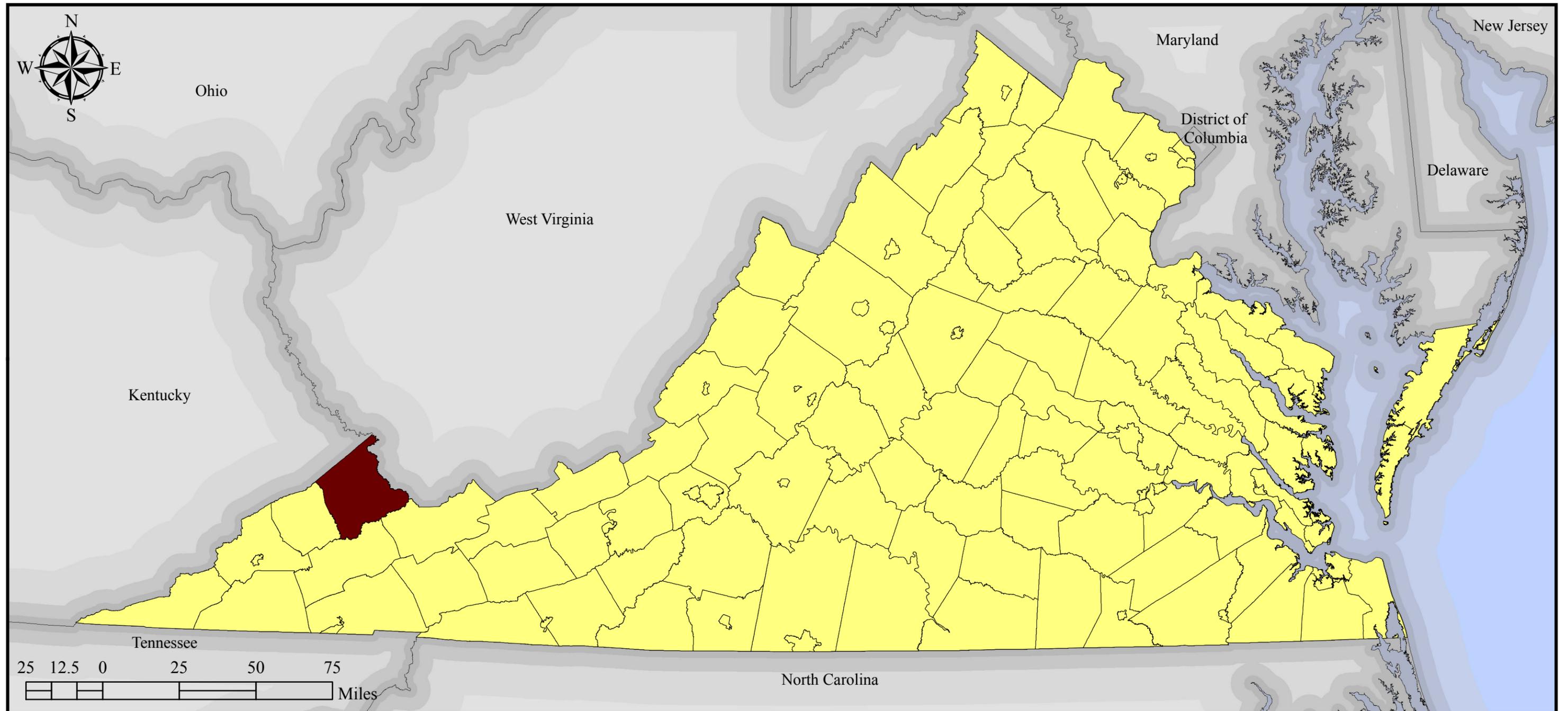
A declared federal disaster is any disaster in which Federal funding was allocated to a jurisdiction in the wake of a disaster incident. The sources and types of funding are not taken into account for this map.

The period of record for this map spans 1964 through 2012. Occurrences include total number of wildfire related disaster declarations by jurisdiction.

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.

Figure 3.3-8: Landslide Federal Declared Disasters



DATA SOURCES:

- FEMA & VDEM Declared Disasters
- VGIN Jurisdictional Boundaries
- ESRI State Boundaries

LEGEND:

- Number of Declared Disasters (1964- 2012)
- 1
 - Flood Disaster resulted in Landsliding
 - No Disaster Declaration

DATA IDENTIFICATION:

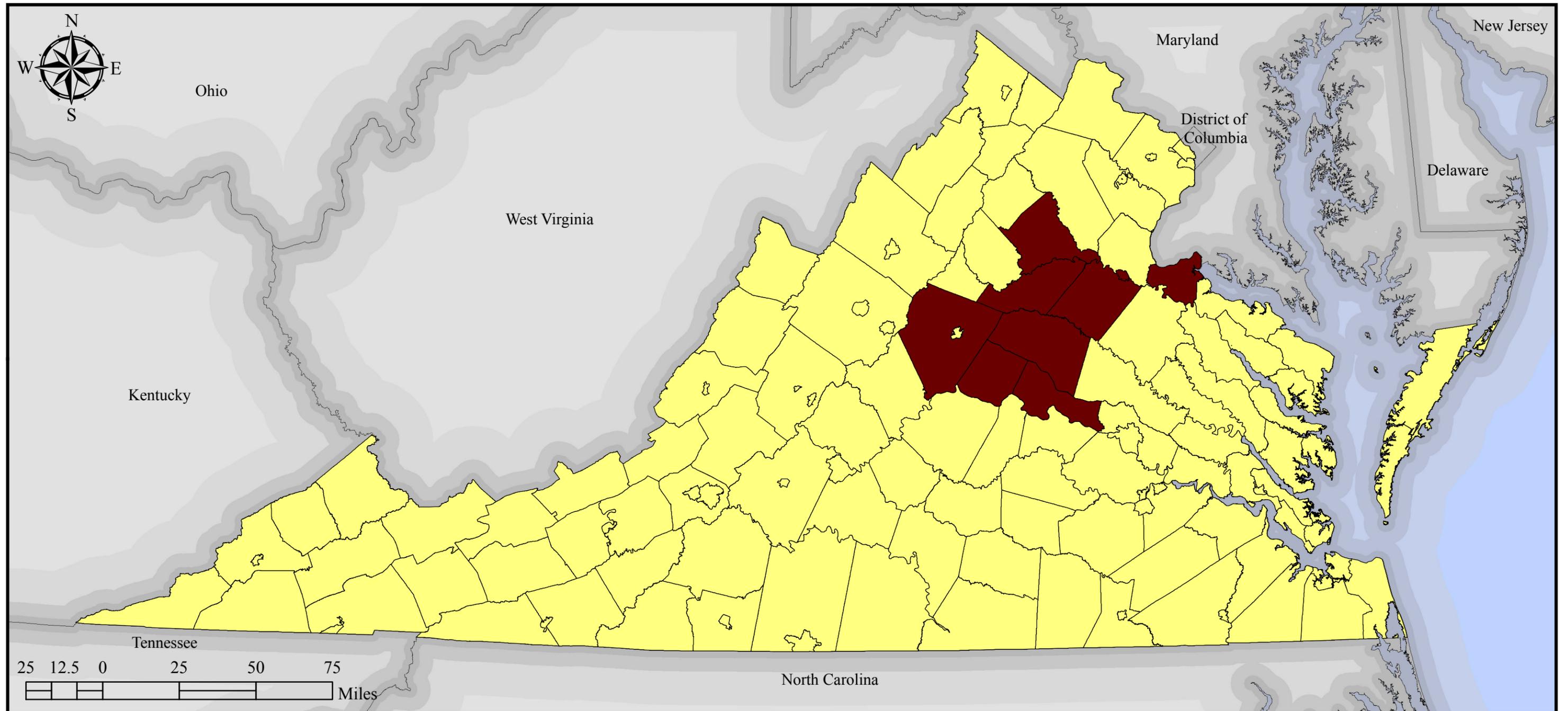
A declared federal disaster is any disaster in which Federal funding was allocated to a jurisdiction in the wake of a disaster incident. The sources and types of funding are not taken into account for this map.

The period of record for this map spans 1964 - 2012. Occurrences include total number of landslide disaster declarations and landslides that were a result of a flooding declared disaster.

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.

Figure 3.3-9: Earthquake Federal Declared Disasters



DATA SOURCES:

FEMA & VDEM Declared Disasters
 VGIN Jurisdictional Boundaries
 ESRI State Boundaries

LEGEND:

Number of Declared Disasters (1964- 2012)

	No Declared Disasters
	1

DATA IDENTIFICATION:

A declared federal disaster is any disaster in which Federal funding was allocated to a jurisdiction in the wake of a disaster incident. The sources and types of funding are not taken into account for this map.

The period of record for this map spans 1964 through 2012. Occurrences include total number of earthquake related disaster declarations by jurisdiction.

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.

National Climatic Data Center (NCDC)

NCDC Storm Data Background

National Climatic Data Center (NCDC) *Storm Data* is published by the National Oceanic and Atmospheric Administration (NOAA), part of the U.S. Department of Commerce. The storm events database contains information on storms and weather phenomena that have caused loss of life, injuries, significant property damage, and/or disruption to commerce. Efforts are made to collect the best available information, but because of time and resource constraints, information may be unverified by the National Weather Service (NWS). The NWS does not guarantee the accuracy or validity of the information. Although the historical records in the database often vary widely in their level of detail, the NWS does have a set of guidelines used in the preparation of event descriptions.⁸

CGIT received an export of the Storm Data database records from NOAA's National Climatic Data Center. This NCDC database provides information about significant events from 1951 to 2011. Records for the majority of weather events were reported starting in 1993, with the exception of tornado (reports date to 1950), thunderstorm winds (reports date to 1959), and hail (reports date to 1959). Before the NCDC Storm Events data could be used for analysis, though, some additional processes were required.

For the purposes of this HIRA, the county/city in which the event occurred was of primary interest, and the NCDC has provided this data in two methods:

- a) County/City Name – Event listed as individual record for each county or city in which it occurred
- b) Zone – Event listed by the zone or multiple zones, which contain multiple counties and cities. Some individual rows in NCDC data could include every county and city in Virginia

It should be noted that NCDC is known to have spotty recording of geological hazards (i.e. earthquake, landslide, karst). In the absence of better data it was decided to proceed with the records available in NCDC for these events, in all cases NCDC records for these events are severe under-representations of what has happened in Virginia's past. Efforts were made to contact the correct state representative for these hazards to see if better data sources of historical accounts were available. To date no comprehensive digital databases exist for these hazards.

⁸ National Water Service Instruction 10-1605. Operations and Services Performance: Storm Data Preparation Guide. August 17, 2007. Available at: <http://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf>



NCDC Normalizing Data

To be able to accurately count the number of events occurring in a single county, the zonal data records were expanded into a set of individual city/county records, based on NCDC zone definitions. For example, if there were three political jurisdictions in a given zone, a record in the database for a winter storm covering that zone would be replaced with three records for that storm, corresponding to each of the political jurisdictions. During this process, the damages and injuries associated with a storm event in a certain zone were divided evenly among the political jurisdictions in that zone. Table 3.3-3 below is the normalized sum of all the jurisdictions, by hazard, for the NCDC parameters of interest. In this table, the damages, injuries, and deaths due to each hazard type have not been annualized to account for their varying periods of record. Each event in this table represents a storm event affecting a single jurisdiction.

Injuries and fatalities, once normalized, were combined into a single number. While there is no good method to equate injuries with fatalities, FEMA's cost-benefit analysis documentation has suggested that the cost of a fatality is 176 times the cost of an injury. Therefore, fatalities have been multiplied by a factor of 176 and added to the injuries for each jurisdiction. Table 3.3-3 above shows the normalized total of injuries and deaths by hazard type.

General time statistics were generated to determine how the different hazards were represented in the NCDC data. This consisted of developing percentile (tabular and graphical) and histograms of events versus date for each hazard type. For all events except for high wind, the percentile graph was relatively linear. This suggests that reporting has remained roughly equal over the entire period of record, and all records should be counted. However, the high wind period of record showed very few events between 1955 and 1989, and a linear trend after that. Therefore, since a longer period of record is only necessary when the data has been reported consistently, high wind was only evaluated using the period of record from 1989 to 2011 for the annualized data analysis.





Table 3.3-3: Total of jurisdictional analysis of NCDC results

Hazard Type	Timeframe	Years of Record	Number of Events	Property Damage*	Crop Damage*	Injuries	Deaths	Injuries + Deaths*176
Drought	1993-2011	19	1,096	\$0	\$580,539,797	0	2	352
Flood	1993-2011	19	3,625	\$705,058,502	\$134,359,286	17	51	8,993
Non-Rotational Wind	1955-2011 (use 1989 -2011)	23	11,952	\$1,113,324,052	\$129,040,924	352	143	25,520
Tornado	1951-2011	61	811	\$834,608,122	\$2,432,356	914	36	7250
Wildfire	1995-2011	17	53	\$4,731,559	\$2,241,392	8	0	8
Winter Storm	1993-2011	19	7,129	\$74,230,048	\$1,809,559	90	25	4,490
Landslide	1993-2011	18	7	\$239,586	\$0	0	1	176
Totals			24,673	\$2,732,191,869	\$850,423,314	1,381	258	46,789

*Damages are expressed in year 2011 dollars





Once the zonal records were replaced with individual jurisdictional records, the NCDC database was used to calculate a variety of summary statistics on a jurisdictional basis. For example, the total number of each type of storm events, and the total damages associated with a storm event, were summarized on a statewide and jurisdictional basis. Statistics were generated for the dates of events in each HIRA category, percentile (tabular and graphical) and a histogram of events versus date. For all events except for high wind, the percentile graph was relatively linear. This suggests that reporting has remained roughly equal over the entire period of record, and all records should be counted. However, the high wind period of record showed very few events between 1955 and 1989, and a linear trend after that. Therefore, since a longer period of record is only useful when the data has been reported consistently, high wind will only be evaluated on the period from 1989 to 2011 for the annualized data analysis.

NCDC Inflation Computation

The damages entered into the NCDC Storm Events database portray how much damage was incurred in the year of the event. Due to inflation and the changing value of money, the values of damages incurred have been adjusted so that they reflect their worth in 2011. This process was done by obtaining information from the Bureau of Labor Statistics, which provides a yearly index of Consumer Prices. Each value was multiplied by the index of its year of occurrence and subsequently divided by the index value in 2011, the target year. The year 2011 was chosen because it was the most recent full year available in the index values list at the time of this writing, but the values could have been adjusted to any other year without changing the relative ranking of each hazard.

NCDC Annualizing Data

After the data was normalized, inflation accounted, and summary statistics calculated, the data was annualized in order to be able to compare the results on a common system (i.e. ranking the hazards). In general, this was completed by taking the parameter of interest and dividing by the length of record for each hazard. The annualized value should only be utilized as an estimate of what can be expected in a given year. Deaths/injuries, property and crop damage, and events were all annualized in this fashion, on a per-jurisdiction basis. The NCDC formatted data that was used in the analysis is available through VDEM. High wind events before 1989 have not been included as they would skew the record due to reasons described under normalizing the data.





NCDC Data Compilation

As the NCDC Storm Events database uses very detailed event categories, the reported storm events were summarized in simplified classifications to correspond to the major hazard types considered in this plan. Table 3.3-4 shows how the NCDC categories were grouped into the HIRA hazard categories. Section 3.5 on ranking methodologies also explains how the NCDC data was used in ranking the hazards against each other.





Table 3.3-4: NCDC categories to align with hazards addressed in the HIRA.

HIRA Category	NCDC Categories Included
Drought	Drought Drought / Excessive Heat
Flood	Flooding Flash Flood River Flood Minor Flooding Urban / Small Stream Flooding Coastal Flood Tidal Flooding Storm Surge
High Wind	Wind Strong / High / Gusty Wind Thunderstorm Wind Dry Microburst Wet Microburst High Wind and Seas Hurricane Tropical Storm
Tornado	Tornado Waterspout Funnel Cloud Land spout
Winter Storm	Blizzard Snow Heavy Snow Ice Ice Storm Snow / Sleet / Rain Winter Storm Winter Weather Winter Weather Mix Freezing Rain
Wildfire	Wild / Forest Fire
Landslide	Mudslide Rockslide Landslide Debris Flow

Figure 3.3-10 shows the number of NCDC hazard events, by jurisdiction, for the Commonwealth. High wind and winter storm events make up more than 70% of the events for the jurisdictions listed below. The following jurisdictions have 300 or more NCDC recorded events for drought, flood, high wind, landslide, tornado, wildfire, and winter storm.





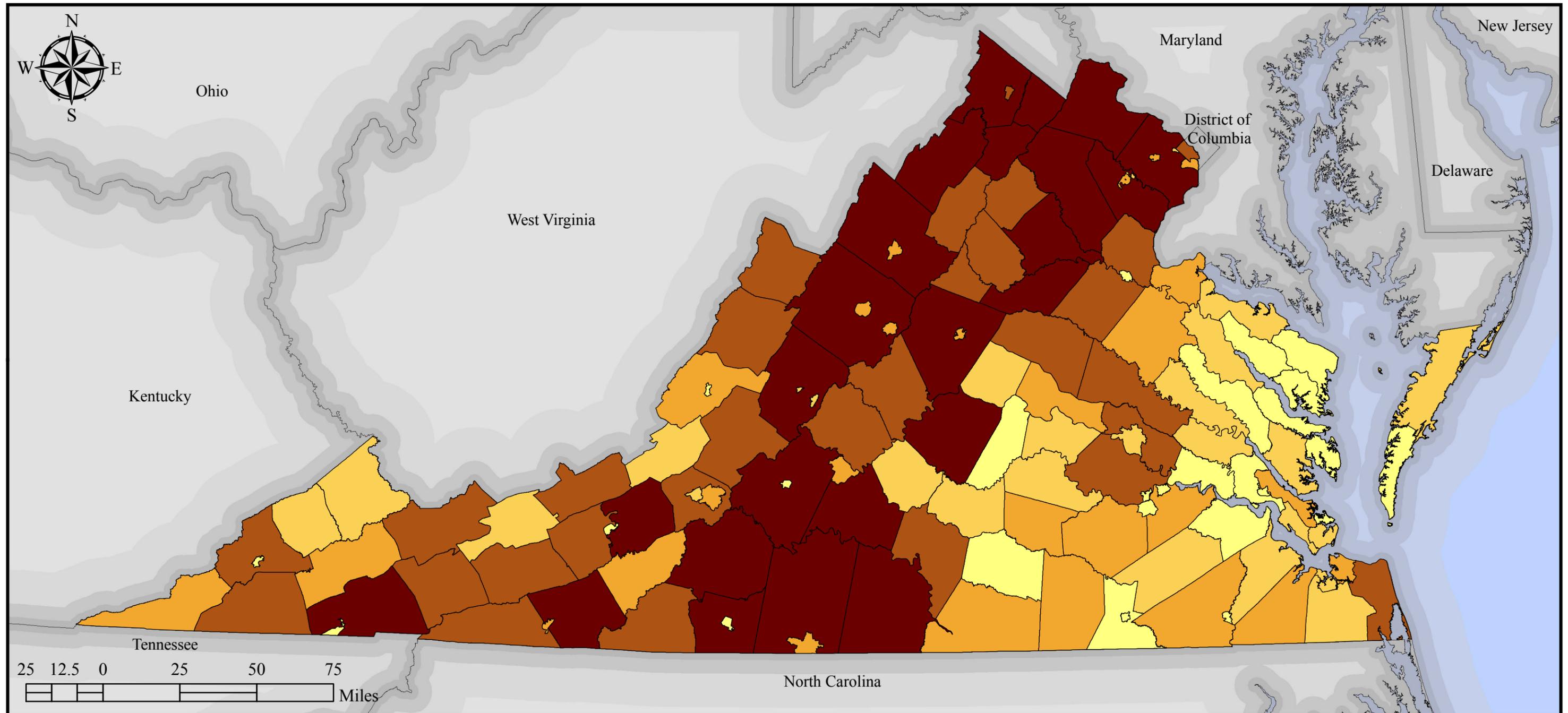
- Albemarle County
- Augusta County
- Bedford County
- Campbell County
- Carroll County
- Clarke County
- Culpeper County
- Fairfax County
- Fauquier County
- Franklin County
- Frederick County
- Halifax County
- Henrico County
- Henry County
- Loudoun County
- Madison County
- Nelson County
- Orange County
- Page County
- Patrick County
- Pittsylvania County
- Prince William County
- Pulaski County
- Rappahannock County
- Roanoke County
- Rockbridge County
- Rockingham County
- Shenandoah County
- Spotsylvania County
- Stafford County
- Tazewell County
- Warren County

Figures 3.3-11 through 3.3-17 show the number of NCDC recorded events, by jurisdiction, for the individual Hazard HIRA Categories. Unlike the federally declared disasters, the individual hazard maps do not double count events. To be consistent with the NCDC data, only the dominate hazard type is shown, as is described in the above sections and Table 3.3-4.

High wind and winter weather represent the majority of the documented weather related events in Virginia. Land subsidence (karst), earthquake, and flooding due to impoundment failure are hazards that have been considered for the Commonwealth but currently do not have NCDC events associated with them.



Figure 3.3-10: Total NCDC Events



DATA SOURCES:

NCDC Storm Events Database
 VGIN Jurisdictional Boundaries
 ESRI State Boundaries

LEGEND:

Number of Occurrences through 2011

- 57 - 117
- 118 - 144
- 145 - 181
- 182 - 241
- 242 - 560

DATA IDENTIFICATION:

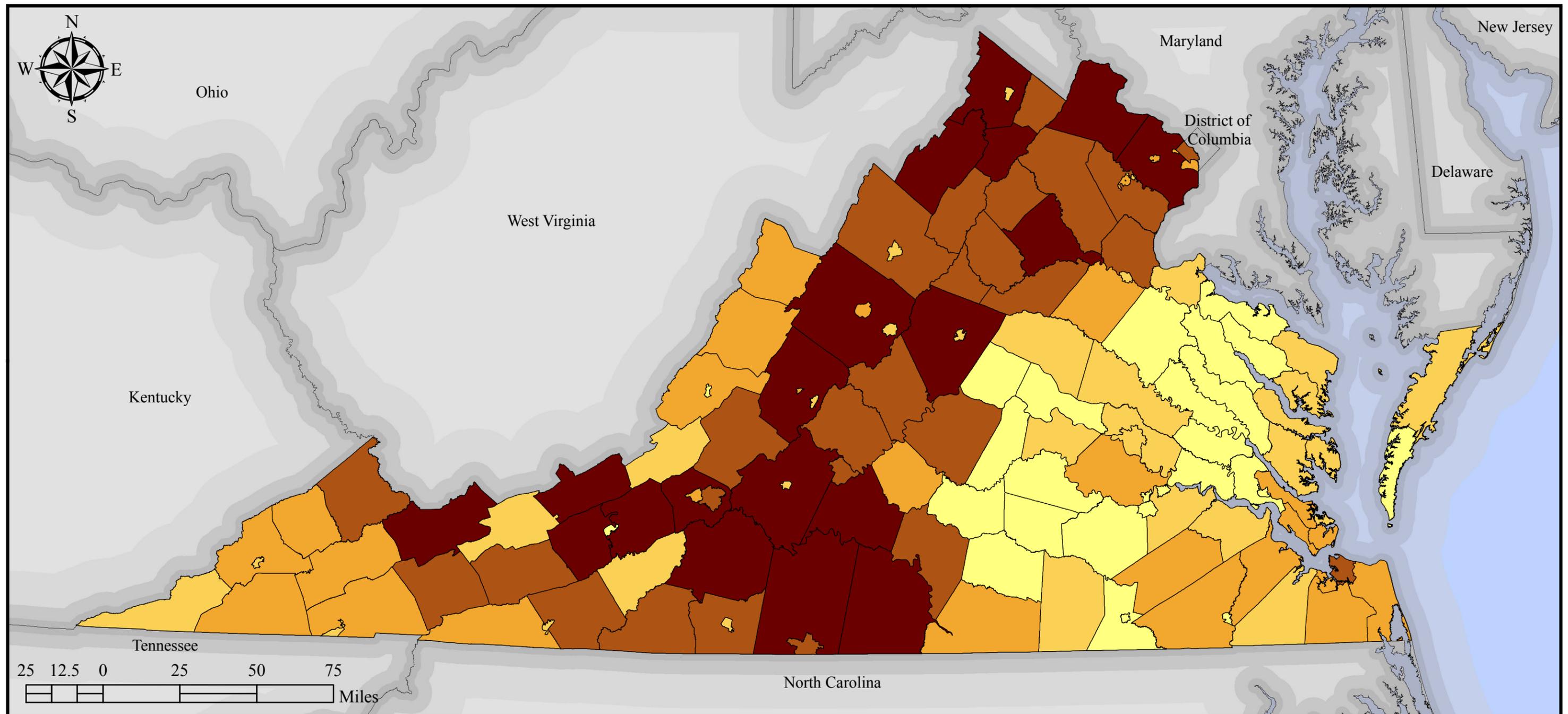
This map represents the HIRA related hazard events, as recorded by NCDC, on a jurisdictional basis. Events include drought, flood, non-rotational winds, tornado, winter weather, wildfire, and landslide.

The NCDC period of record for this map varies based on each hazard type. See table 3.3-3 for hazard specific dates.

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.

Figure 3.3-12: NCDC Significant Flood Events



DATA SOURCES:

NCDC Storm Events Database
 VGIN Jurisdictional Boundaries
 ESRI State Boundaries

LEGEND:

Number of Occurrences (1993-2011)

- 2 - 8
- 9 - 15
- 16 - 28
- 29 - 53
- 54 - 142

DATA IDENTIFICATION:

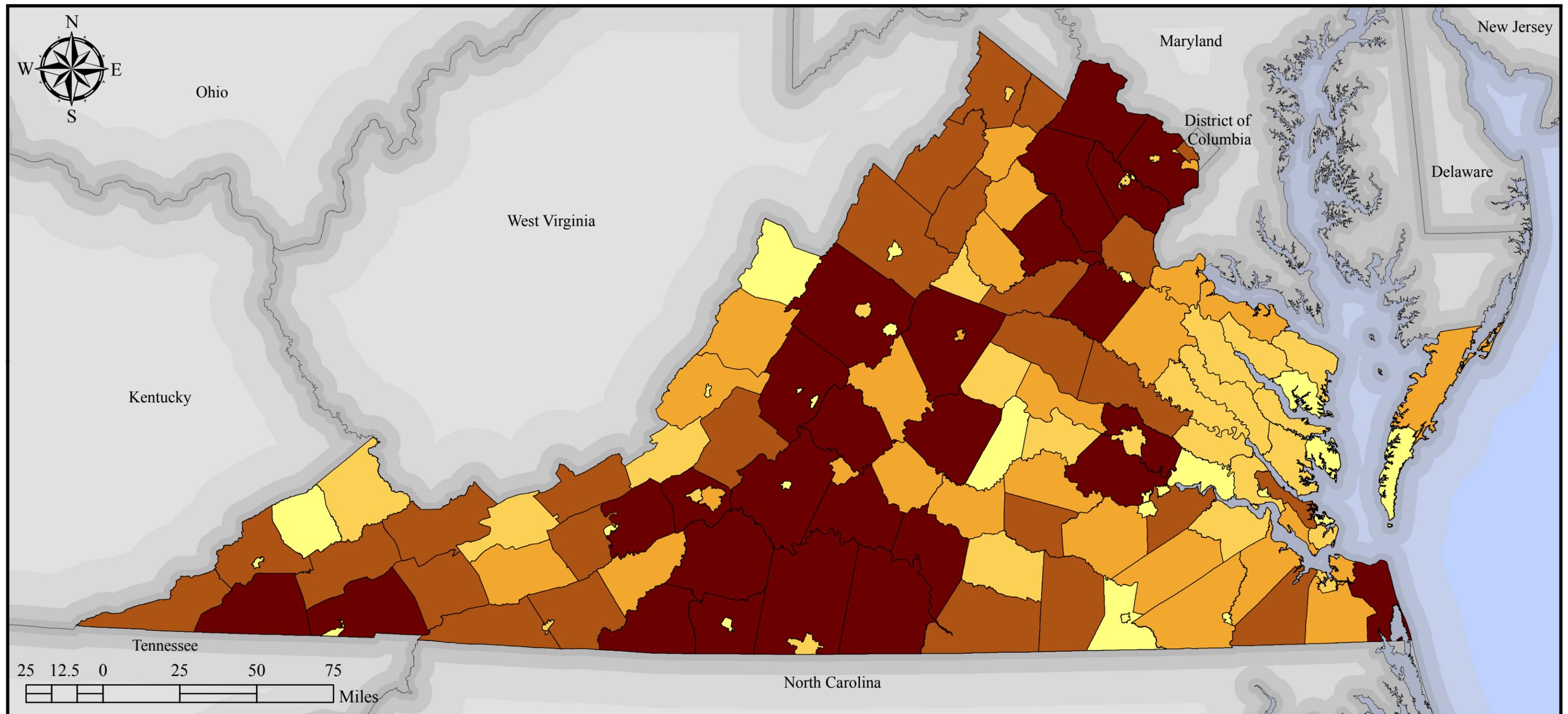
This map represents the HIRA related flood events, as recorded by NCDC, on a jurisdictional basis.

The NCDC period of record for this map varies based on each hazard type. See table 3.3-3 for hazard specific dates.

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.

Figure 3.3-13: NCDC Significant Non-Rotational Wind Events



DATA SOURCES:

NCDC Storm Events Database
 VGIN Jurisdictional Boundaries
 ESRI State Boundaries

LEGEND:

Number of Occurrences (1989-2011)

- 15 - 46
- 47 - 64
- 65 - 87
- 88 - 123
- 124 - 336

DATA IDENTIFICATION:

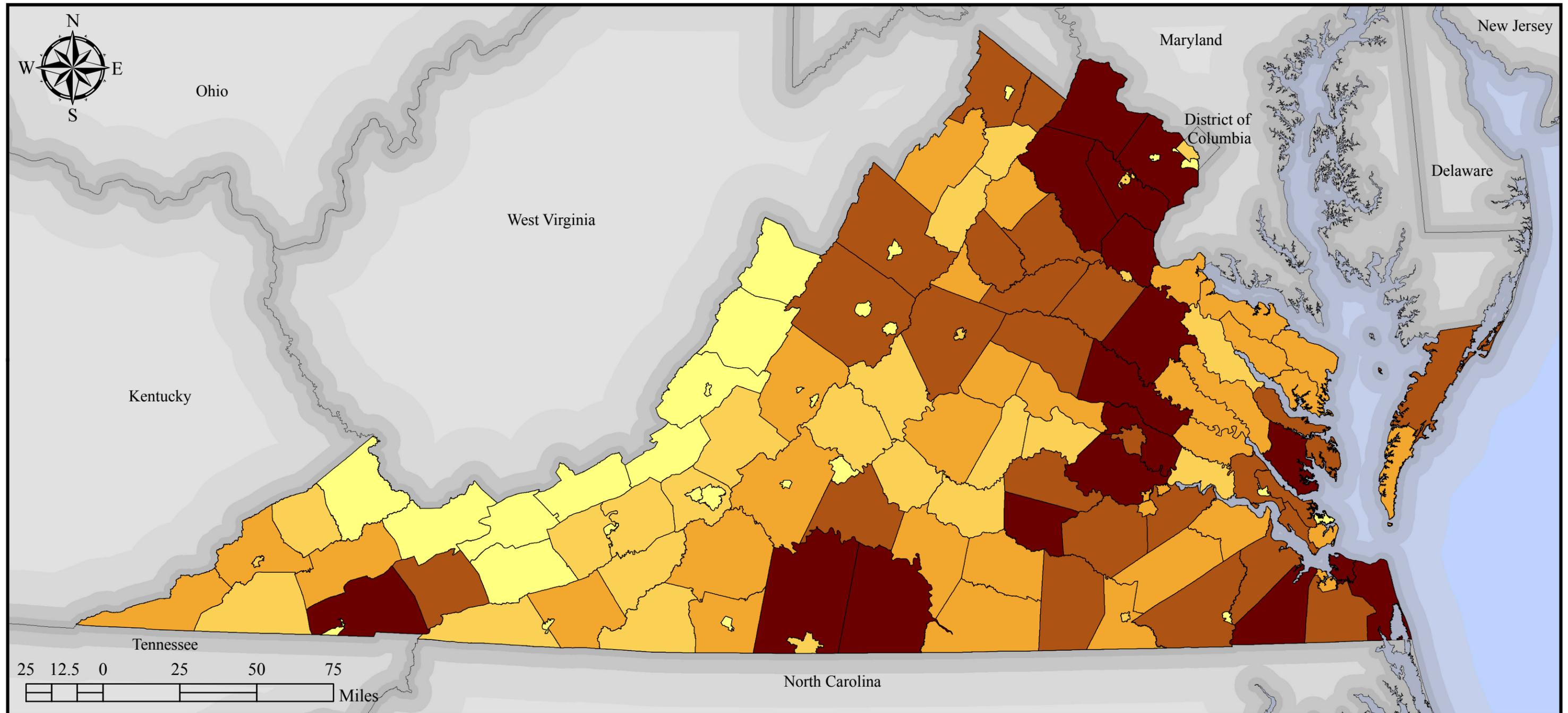
This map represents the HIRA related non-rotational wind events, as recorded by NCDC, on a jurisdictional basis.

The NCDC period of record for this map varies based on each hazard type. See table 3.3-3 for hazard specific dates.

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.

Figure 3.3-14: NCDC Significant Tornado Events



DATA SOURCES:

NCDC Storm Events Database
 VGIN Jurisdictional Boundaries
 ESRI State Boundaries

LEGEND:

Number of Occurrences (1951-2011)

- 0 - 1
- 2 - 3
- 4 - 7
- 8 - 12
- 13 - 27

DATA IDENTIFICATION:

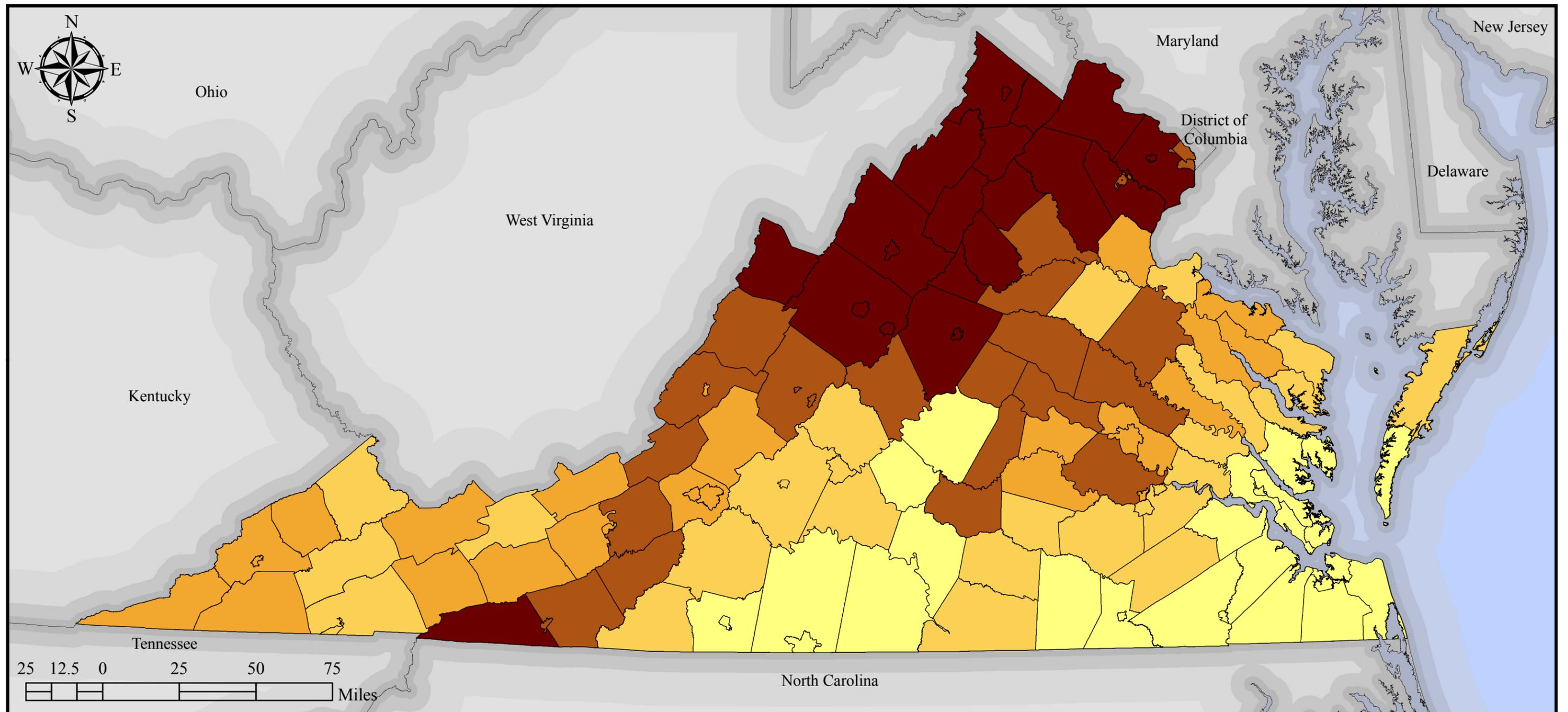
This map represents the HIRA related tornado events, as recorded by NCDC, on a jurisdictional basis.

The NCDC period of record for this map varies based on each hazard type. See table 3.3-3 for hazard specific dates.

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.

Figure 3.3-15: NCDC Significant Winter Weather Events



DATA SOURCES:

NCDC Storm Events Database
 VGIN Jurisdictional Boundaries
 ESRI State Boundaries

LEGEND:

Number of Occurrences (1993-2011)

- 23 - 35
- 36 - 45
- 46 - 52
- 53 - 73
- 74 - 118

DATA IDENTIFICATION:

This map represents the HIRA related winter weather events, as recorded by NCDC, on a jurisdictional basis.

The NCDC period of record for this map varies based on each hazard type. See table 3.3-3 for hazard specific dates.

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.

