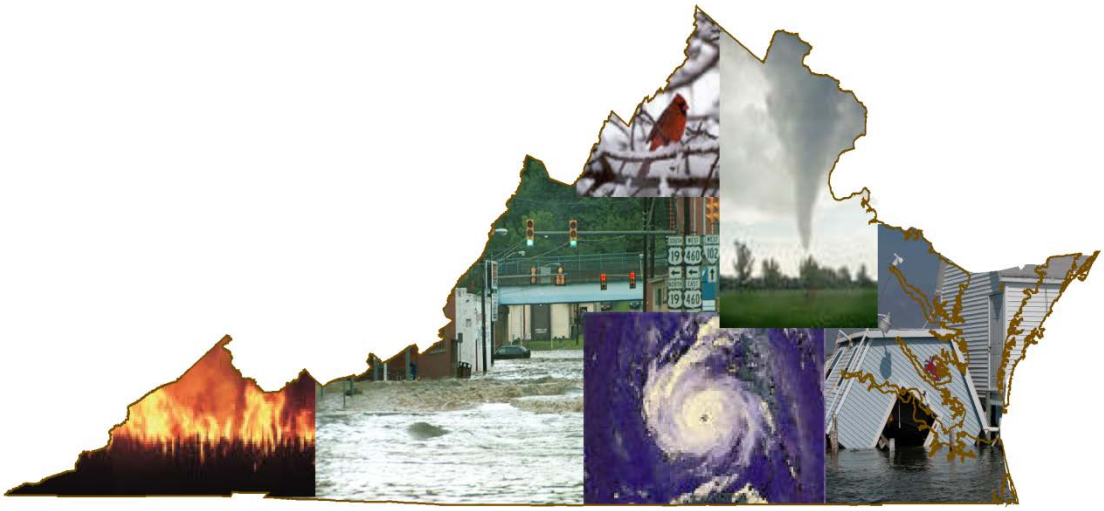
COMMONWEALTH OF VIRGINIA

Hazard Mitigation Plan



Chapter 3
Hazard Identification and Risk Assessment (HIRA)

Section 3.11 - Wildfire

SECTION 3.11

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Section 3.11: Wildfire

Description

Great Dismal Swamp Fire
2008
Source: Steve Earley and The Virginia-Pilot

A wildfire is an undesirable fire occurring in the natural environment and is a serious and growing hazard over much of the United States. Wildfires pose a great threat to life and property, particularly when they move from forest or rangeland into developed areas. An average of 5 million acres burn every year in the United States as a result of wildfires; causing millions of dollars in damage. Each year more than 100,000 wildfires occur in the United States, almost 90 percent of which are started by humans; the rest are caused by lightning. Weather is one of the most significant factors in determining the severity of wildfires. [1] Spring (March and April) and fall (October and November) are the main two seasons for wildfires in Virginia.

Wildfire is a unique hazard because its effects can be greatly altered by containment efforts during the event. According to the Virginia Department of Forestry (VDOF), there are three important factors that determine the formation of wildfire hazards: fuel, topography, and weather. These factors are generally most hazardous in the spring and fall, which are known as the wildfire seasons. Low relative humidity combined with windy conditions cause fuels on the forest floor to dry out quickly, increasing wildfire risk. Small diameter twigs and brush, leaf litter, conifer needles, and grasses have rapid fluctuations in moisture content, and can dry out in a matter of hours. This can heighten wildfire risk in a short period of time.

Drought is a hazard that also contributes to wildfire risk. Over long dry periods, even larger fuels such as medium to large diameter dead and dying woody debris can become dry and fuel large wildfires. Not only does this increase the risk of a wildfire igniting, but it also increases the spread, intensity, and overall danger of an event once it has occurred.

High intensity wildfire events have significant impacts on vegetation and groundcover that serves to stabilize the soil. Decreased soil stability greatly increases risk of localized landslides and flooding. These risks are greater in areas with steep topography. The effects can carry on for years in the forms of increased runoff and erosion.

[1] HAZUS-MH Risk Assessment and User Group Series How-to-Guide: Using HAZUS-MH for Risk Assessment (FEMA 433/August 2004)

Historic Occurrence

Wildfire occurrences have been documented across the Commonwealth. Seven jurisdictions have been included in Federally Declared Disasters; these include Buchanan County, Dickenson County, Scott County, Shenandoah County, Page County, Albemarle County and Nelson County. Nelson County also has the most (6) NCDC (National Climatic Data Center) wildfire events recorded in the state.

Table 3.11-1 is based on available records from Virginia Department of Forestry (VDOF) and includes the dates of significant wildfire in Virginia during the past century. The VDOF was created by the General Assembly in part to respond to the hundreds of thousands of acres of fires that burned annually throughout the Commonwealth.

Table 3.11-1: Historical Wildfire Events from Virginia Department of Forestry.

Year	Acres Burned	Damages	Description
1917	305,000	$809,000	Earliest known records in Virginia; over 1,460 fires were reported with two fatalities
1927	27,863		An all time recorded low of 404 fires were reported for the state of Virginia.
1930	333,023		The year that the “great draught” occurred in Virginia. It was recorded that the year “will long be remembered in Virginia, not only for its yearlong fire season and unprecedented, disastrous summer fires, but also because it brought disaster to many farmers and stockmen. Coming as it did immediately following the crash in the fall of 1929, its economic effects were severely felt.” 2,554 fires were recorded across 58 counties.
1941-1943			An average of 2,970 wildfires burn 148,937 acres each of the three years.
1948	7,782		The Smokey Bear Campaign was implemented in 1944. This campaign is one of the most successful advertising campaigns in American history and resulted in the first year that Virginia recorded less than 10,000 acres burned.
1952	111,571		2,494 fires burned 111,571 acres. It was the last time 100,000+ acres were burned in a single year.
1963	44,823		“Everywhere” 3,300 fires burned 44,823 acres in a year.
1982	11,170		More than 10,000 acres in eastern Virginia were destroyed by numerous spring wildfires.
1987	20,393		A dry summer and fall caused extreme fire conditions throughout the state. Governor Wilder considered cancelling fall hunting season as fires burned in southwest Virginia until a frontal system reduced the fire risk.
1995	9,240	$1,258,541	On April 9, dry conditions, gusty winds, and deadwood resulted in 66 acres of forest burned in Buckingham County, 150 acres of forest burned in Franklin County requiring 65 residents to be evacuated, and 24 acres of forest burned in Pittsylvania County, all on the same day. Damage was estimated at about $50,000.

Year	Acres Burned	Damages	Description
1998	6,480	$1,519,453	Dry conditions and rough terrain led to more than 2,000 acres being burned in one wildfire which occurred in the George Washington and Thomas Jefferson National Forest near Deerfield in Augusta County.
1999	15,663	$3,588,947	1,753 fires burned 15,663 acres. More than 400 acres on Afton Mountain burned on April 2, causing more than $2,000 in property damages. An overheated combine working in a wheat field during dry conditions on July 9 in White Post, Clarke County started a fire that burnt 67 acres, including 60 acres of wheat and the combine which resulted in $6,700 and $92,000 in damages respectively. The Cumulative Severity Index rated Northern Virginia at 628 by the end of July. (1-800 rating for fire danger).
2001	19,476	$13,205,274	This is the only year on record that required significant out-of-state resources, which included 12 USFS crews, 6 Florida Division of Forestry engines, and 1 Florida Division of Forestry plane and pilot. This is also the only year that wildfire funding assistance was received from FEMA. Similar to 1930, drought was a major cause of the large acreage that was burned.
2006	13,763	$12,465,881	Due to gusty winds and dry fuels, the Bull Mountain Fire in Patrick County burned more than 4,000 acres, including some vehicles and outbuildings.
2008	26,541	$12,706,576	Acres burned and damages summarized from January 1 to November 20, 2008. February 10, 2008 saw the largest single day outbreak of wildfire in Virginia's recorded history. A strong dry cold front came through the Commonwealth bringing exceptionally high winds which lasted for more than 12 hours. The VDOF responded to 354 wildfires which ultimately burned 16,112 acres.
2009	8,779	$6.1 million	Acres burned and damages summarized from July 1, 2008 through June 30, 2009. Of the $6.1 million in damages, $5 million was timber damage and $1.1 million was property damage.
2010	5,071	$5 million	Acres burned and damages summarized from July 1, 2009 through June 30, 2010. Of the $5 million in damages, $4 million was timber damage and just under $1 million was property damage.
2011	22,022	$15.7 million	Acres burned and damages summarized from July 1, 2010 through June 30, 2011. Of the $15.7 million in damages, $11 million was timber damage and $4.7 million was property damage. FEMA fire management assistance was given for the Smith and Coffman Fires which occurred in 2011.

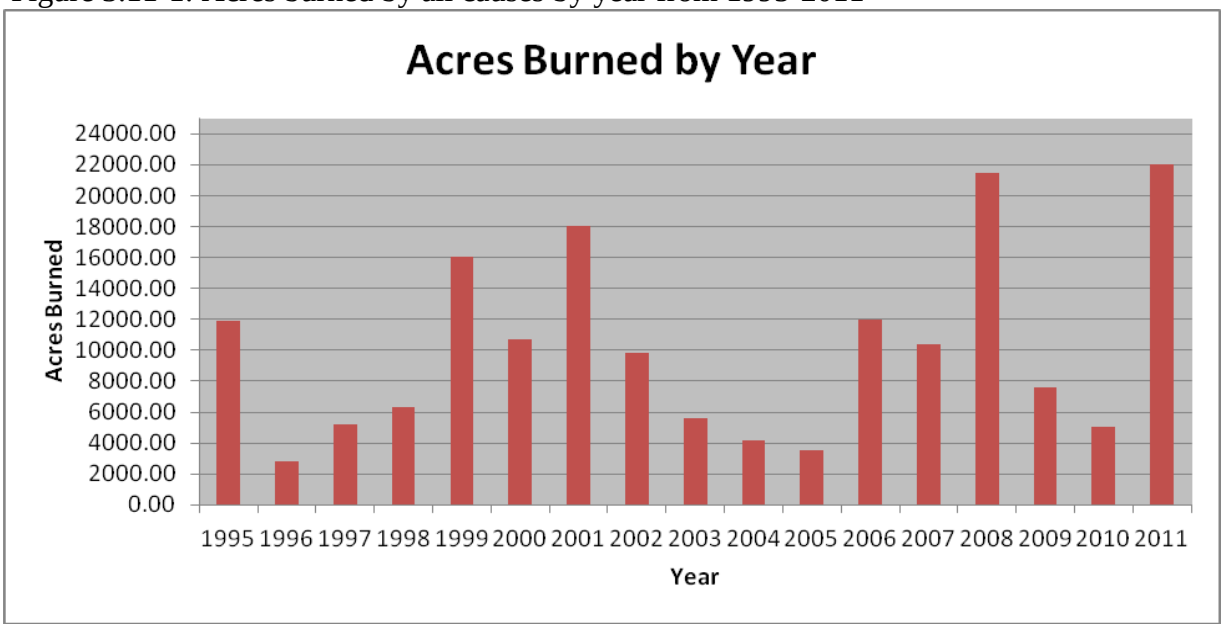
Human activities are the leading cause of wildfire incidents in Virginia (as seen in Table 3.11-2). Debris burning and the intentional setting of fires were responsible for the greatest number of reported wildfire incidents and acres burned during years 1995-2006. As suburban residential development continues to expand, it is reasonable to expect an increase in human/wildland interactions, resulting in more wildfires.

Table 3.11-2: Wildfire Incidents and Acres Burned in Virginia (1995-2011)

General Cause	Incidents	Total Acreage Burned	% Total Incidents	% Total Acres Burned
Lightning	646	17,060.20	3.33	9.86
Campfire	257	6,191.85	1.33	3.58
Smoking	1,192	5,125.70	6.15	2.96
Debris Burning	6,682	39,099.95	34.46	22.59
Incendiary	3,197	44,450.10	16.49	25.68
Equipment Use	1,760	12,736.80	9.08	7.36
Railroad	468	3,013.65	2.41	1.74
Children	1,123	2,136.25	5.79	1.23
Miscellaneous	3,698	40,433.90	19.07	23.36
Other/Unknown	366	2,842.45	1.89	1.64
Total	**19,389**	**173,090.85**		

Figure 3.11-1 illustrates the total number of acres burned from 1995 – 2011. The years 2008 and 2011 have the highest total acreage burned.

Figure 3.11-1: Acres burned by all causes by year from 1995-2011



Risk Assessment

Probability

Future wildfire incidents are difficult to predict, as the factors influencing wildfire generation vary greatly with changing weather conditions, and with human activities. There is currently no quantitative estimate of future wildfire probability for specific regions of the state. While a VDOF Wildfire Risk Assessment does indicate the relative propensity for wildfires across the state, this assessment does not assign exact probabilities of occurrence. Based on the VDOF available data from 1995 – 2011, the Commonwealth experiences an average of 1,141 fires per year, affecting an average of 10,181 acres annually.

Probability for wildfire cannot be deduced into specific return periods or recurrence intervals as it can be for other hazards. As a result, analysis for wildfire was based on the VDOF Wildfire Risk Assessment dataset (Figure 3.11-1).

Impact & Vulnerability

Vulnerability to wildfire is influenced by a variety of factors, such land cover conditions, weather, and the effectiveness of land management techniques. Highly urbanized areas are less vulnerable to wildfire, but suburban neighborhoods located at the "urban/wildland interface" are very vulnerable to wildfire. Individual buildings may be more or less vulnerable to damage from wildfire based on factors such as the clear distance around the structure, and the structure's construction materials.

The primary impacts of most wildfires are timber loss and environmental damage, although the threat to nearby buildings is always present. In the wake of a wildfire, secondary impacts may also include landslides and mudslides caused by the loss of groundcover which played a key role in stabilizing soil.

The VDOF thoroughly tracks the number of acres burned and estimated damages for each incident in the Commonwealth. Timing and coordination resulted in limitations in using this data as part of the ranking methodology. Future revisions of this plan will include this data, with modifications to fit within the ranking framework. Modifications would include further refinement of the VDOF data to distinguish timber damages from structural damages would provide a better understanding of the specific impacts of wildfire. See potential mitigation action items for further information on how this data could be incorporated in the next revision.

Risk

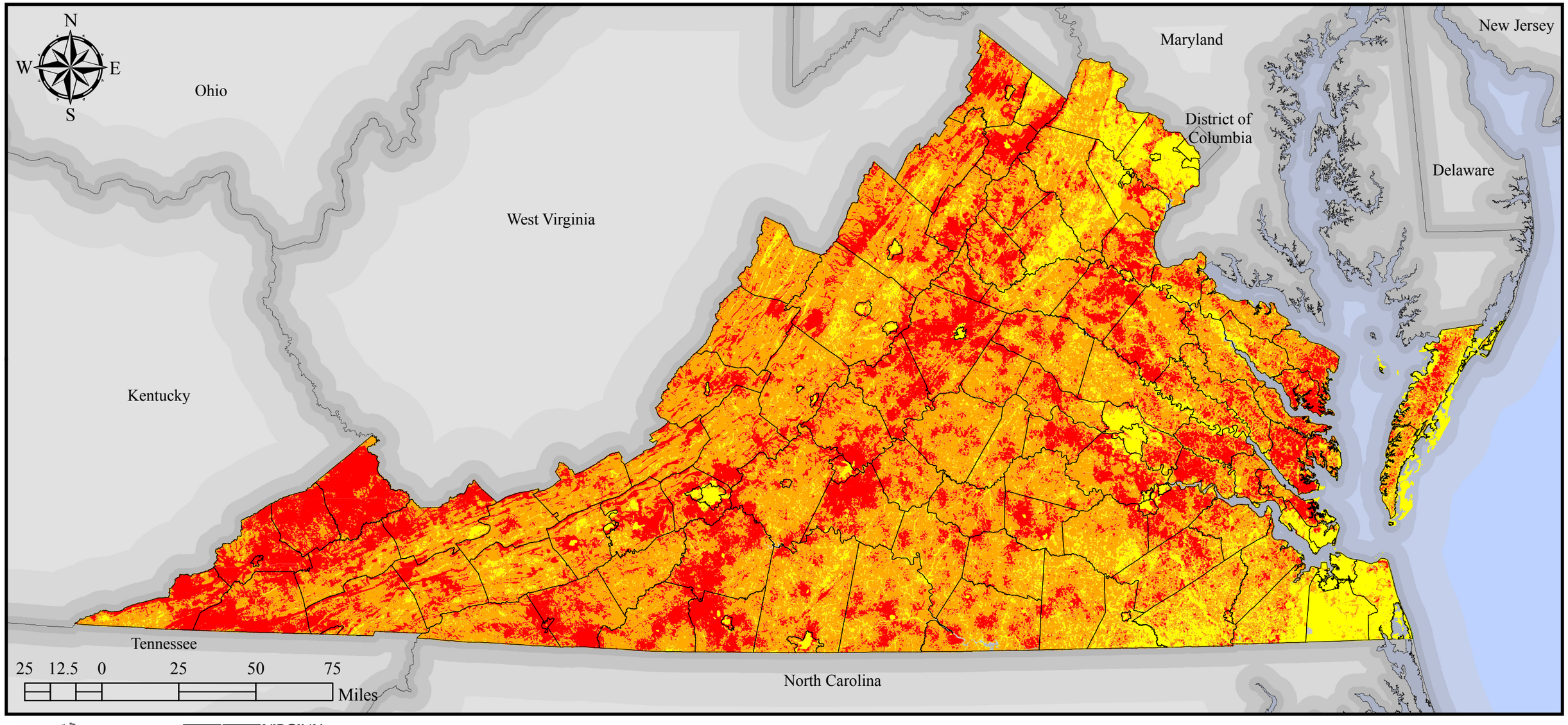
The risk associated with wildfire in Virginia has not been formally quantified, due to the lack of precise information on probability and impact. In 2002 and 2003, VDOF conducted a wildfire risk assessment based on GIS data layers and expert judgment.

The VDOF examined which factors influence the occurrence and advancement of wildfires, and investigated how these factors could be represented in a GIS model. VDOF determined that the following inputs were important in modeling wildfire risk:

Density of Historical Wildfires	Population Density
Land Cover (fuel)	Distance to Roads
Percent Slope	Railroad Buffer
Slope Orientation/Aspect	Road Density and Developed Areas

These model parameters were combined to estimate the overall wildfire risk, although due to regional differences, the modeling process was conducted independently in each of the three physiographic regions (mountain, piedmont, and coastal plain). The final results were merged, and the wildfire risks were classified and scored as: 1 (low), 2 (moderate), and 3 (high). Figure 3.11-1 shows the VDOF Wildfire Risk Assessment Layer; this dataset was used for the analysis in this plan. It should be noted that risk of wildfire, in this plan, is focused on risk in terms of damages to infrastructure and population. The risk of fires starting or spreading is different and not discussed in detail in this plan.

Figure 3.11-2: VDOF Statewide Wildfire Risk Assessment



Center for Geospatial Information Technology

VIRGINIA DEPARTMENT OF EMERGENCY MANAGEMENT

DATA SOURCES:

VDOF Wildfire Risk Assessment
VGIN Jurisdictional Boundaries
ESRI State Boundaries

LEGEND:

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

HAZARD IDENTIFICATION:

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

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

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

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.

State Facility Risk

In order to determine what facilities were at risk for wildfire, the state facilities were intersected with the VDOF wildfire risk assessment layer. The results of this analysis indicate approximately 23% of state facility location and 10% of the total building value are located in high wildfire risk zones, 12% in moderate risk and 78% in low risk zones. The lack of wildfire probabilities and detailed infrastructure data led to the inability to calculate potential losses due to wildfire. Building material and sprinkler system attributes in the VAPs database were used to categorize state facilities.

Table 3.11-3 shows the facilities at risk for wildfire damage broken down by the fire risk zone in which they are located. Table 3.11-5 is further divided into building construction and sprinkler system. Wood is the most susceptible construction material to wildfire, but only 2.3% of these buildings have some type of sprinkler system. On the other side of the spectrum are fire resistive and modified fire resistive buildings, of which 53.8% have some type of sprinkler system.

Table 3.11-3: State facilities in Wildfire Risk Zones

Wildfire Risk Zone	Number of State Facilities	Building Value at Risk
Low	5,063	$17,682,884,666
Moderate	4,902	$2,771,851,098
High	3,028	$2,174,633,110
Total	**12,993**	**$22,629,368,874**

The results of this analysis indicate 3,028 buildings are at a high risk for wildfires and a total of 118 different state agencies are within this high risk zone. The top five agencies by building value have been listed below in Table 3.11-4. The agencies listed represent 22% of the buildings and 36% of total building value that is within a high risk zone.

Table 3.11-4: Top Five Agencies in a High Hazard Zone by Building Value

Agency	Number of Buildings	Building Value
Central Virginia Training Center	87	$289,477,157
UVA at Wise	47	$198,070,031
Sussex I State Prison	23	$124,057,147
Lawrenceville Correctional Center	14	$88,868,459
Department of Conservation & Recreation	497	$87,750,452
Total	**668**	**$788,223,246**

Table 3.11-5: Building material and sprinkler systems in wildfire risk zones

Wildfire Risk Zone	Wood			Brick/Masonry/Noncombustible			Steel		
	Sprinkler System	Partial Suppression	No Suppression	Sprinkler System	Partial Suppression	No Suppression	Sprinkler System	Partial Suppression	No Suppression
Low	32	0	799	689	66	1,912	34	0	815
Moderate	21	0	1,210	320	7	1,292	31	0	1,655
High	11	1	755	286	1	786	19	0	956
Total	**64**	**1**	**2,764**	**1,295**	**74**	**3,990**	**84**	**0**	**3,426**

Wildfire Risk Zone	Modified Fire Resistive			Fire Resistive		
	Sprinkler System	Partial Suppression	No Suppression	Sprinkler System	Partial Suppression	No Suppression
Low	107	7	119	333	4	146
Moderate	21	0	59	110	0	176
High	13	0	37	101	1	61
Total	**141**	**7**	**215**	**544**	**5**	**383**

Critical Facility Risk

The lack of wildfire probabilities and detailed critical facility data led to the inability to calculate potential losses due to wildfire. Risk for critical facilities was calculated in the same fashion as mentioned above for state facilities. Table 3.11-6 shows the breakdown of wildfire risk zones by critical facility type. The results of this analysis indicate approximately 18% of critical facilities are located in high wildfire risk zones, 32% in moderate risk and 50% in low risk zones. Emergency response and education services represent the majority of critical facilities in high wildfire risk zones.

Table 3.11-6: Critical facilities in Wildfire Risk Zones

Wildfire Risk Zone	Law Enforcement	Transportation	Public Health	Emergency Response	Education	Total
Low	321	29	585	1,201	1,706	**3,842**
Medium	213	23	269	1,087	874	**2,466**
High	128	4	221	551	461	**1,365**
Total	**662**	**56**	**1,075**	**2,839**	**3,041**	**7,673**

Wildfire Risk to Energy Pipelines

Wildfires can damage pipelines as a result of extreme heat or flame. In addition, other above ground facilities associated with operating the pipeline could be damaged, requiring the pipeline to be shut down. For example, a 2011 wildfire in Raton, New Mexico burned gaskets in Raton Natural Gas Company's pipeline valves[2].

Jurisdictional Risk

Wildfire hazard ranking is based on NCDC Storm Events database, VDOF data, and population parameters as described in the Ranking Section (section 3.5). The parameters in the risk assessment are illustrated in Figure 3.11-2, along with the total ranking. The geographic extent score for a given jurisdiction is based on the percent of the jurisdiction that falls within the "high" risk area as defined by VDOF. The majority of the Commonwealth is in the low and medium categories. There are relatively few records in NCDC for wildfire events; as a result, the lowest ranking score (1) was assigned to the majority of the annualized data for events, damages, and deaths and injuries to be able to compare wildfire to the other hazards. The ranking methodology is described in section 3.5.

According to NCDC crop and property damage data, the Commonwealth can expect approximately $377,009 in annualized damages per year for wildfire related events. Annualized damages have been calculated by taking the total damages per jurisdiction and dividing by the period of record as as adjusting for inflation.

[2] KRQE News 13. "Raton wildfire won't cut gas after all." June 15, 2011. http://www.krqe.com/dpp/weather/wildfires/raton-wildfire-cutting-off-gas-service

According to VDOF, the Commonwealth can expect annualized damages in an approximate amount of $7,189,330. That number was calculated using wildfire damages from 1999 through 2008. One of the reasons for the difference in the two annualized loss estimates is a result of the VDOF data including all types of damages (such as timber, structures, and personal property) while the NCDC data only documents damages to property and crops. Additionally, the VDOF database is a much more complete record of all wildfires in Virginia, while NCDC is known to be an underestimate of the true quantity of events and damages – not just for wildfire, but for all event types. The difference also highlights the fact that wildfire is a predominant hazard in Virginia but seems to be mostly limited to highly forested and rural areas.

Figure 3.11-2 shows the relative wildfire rankings for each jurisdiction. The following jurisdictions have been assigned a "high" ranking for wildfire:

- Clarke County
- Albemarle County
- Warren County
- Roanoke County

In addition, twenty-six other jurisdictions were assigned a rank of "medium-high" for this hazard.

Local Plan Risk Assessment

Local plans were reviewed for spatial data sources used, historical occurrences, hazard probabilities, vulnerability, loss estimations, and land use and development trends. When available, this information supplements the text and figures of each of the sections in this revision.

All of the local plans provided a general description of the hazard. Some of the local plans intersected the VDOF wildfire risk assessment GIS later with critical facilities and/or parcels to determine the percentage of structures at risk. Eight of the twenty-five local plans provided annualized loss estimates based on VDOF wildfire statistics. The annualized loss values from these plans have been compared to the statewide analysis in Table 3.11-7 below. The loss values used for the statewide analysis are from the NCDC storm events database. The VDOF dataset provides a more complete record of past wildfires and damages to the Commonwealth. Timing and coordination resulted in limitations in using this data as part of the statewide ranking methodology. The completeness of the VDOF data, as compared to the NCDC data, is evident in comparing the local results for Commonwealth RC ($228,726) to the statewide results ($2,952). This is consistent with the differences between NCDC and VDOF discussed in Jurisdictional Risk for the statewide annualized loss totals. It should be noted that the NCDC damages are for only crop and property while the VDOF loss includes all damages caused by the incident.

Table 3.11-7: Comparison of local plan and statewide annualized loss

PDC/Jurisdiction	Annualized Wildfire Loss	
	Local Plan*	2013 State Plan**
Commonwealth RC (Virginia's Heartland)	$228,726	$2,952
Richmond-Crater	$152,941	$0
Thomas Jefferson PDC	$53,400	$14,207
Rappahannock-Rapidan RC	$42,523	$0
Northern Virginia RC	$13,915	$0
Southside Hampton Roads PDC	$11,758	$0
Southampton County	$9,558	$0
City of Franklin	Negligible (< $1,000)	$0

*Local plan loss estimates based on VDOF historical wildfire incidents, but the number of years used to annualize the losses varies according to specific local plan methodologies.
**Statewide loss values based on NCDC events from 1995-2011.

Comparison with Local Ranking

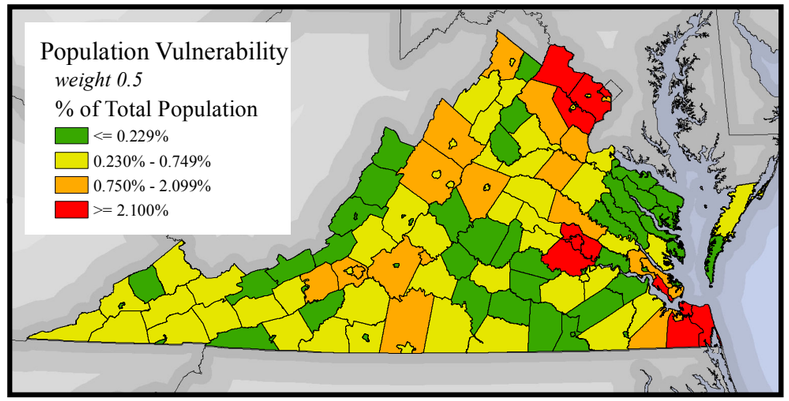
The Cumberland Plateau, George Washington, Lenowisco, Lower Peninsula, and Roanoke Valley-Alleghany plans ranked wildfire as a medium-high hazard.

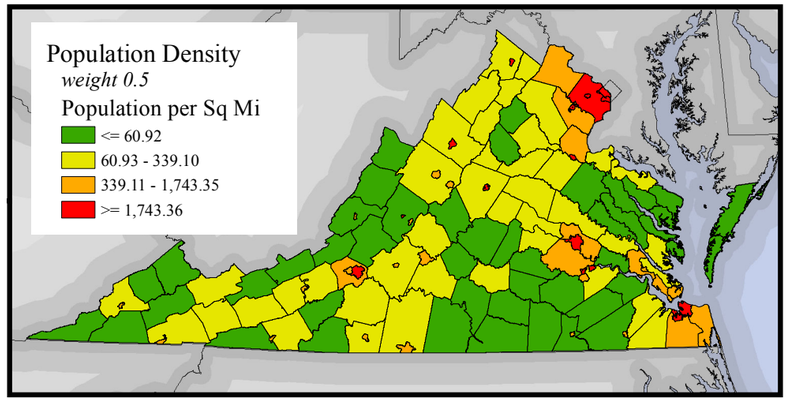
Overall, none of the twenty-five regional and local plans ranked wildfire as a high hazard, five ranked as medium-high, twelve ranked as medium, two ranked as medium-low, and six ranked wildfire as a low hazard. The average ranking of the local plans for wildfire was medium. The 2013 statewide analysis has also ranked wildfire as medium. Section 3.6 (Table 3.6-2) includes the complete ranking of all the local plans.

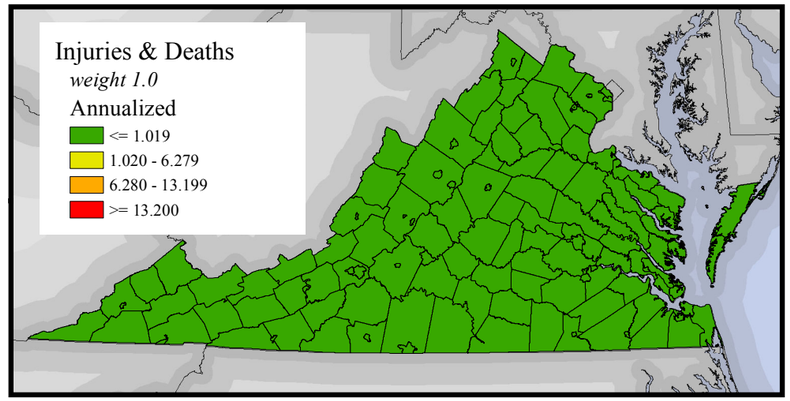
Changes in Development

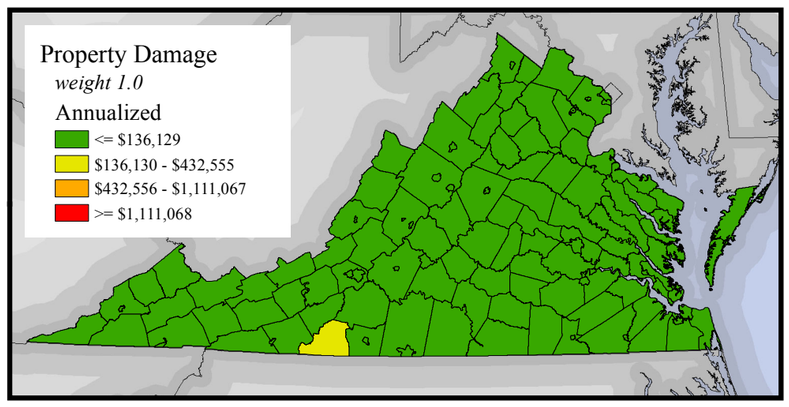
The majority of local plans did not specifically address changes in development for each hazard or the effects of changes in development on loss estimates. In most cases overall development patterns were discussed in general. Sixteen of the twenty-five local plans cite their comprehensive plans for current and future land use changes (section 3.2).

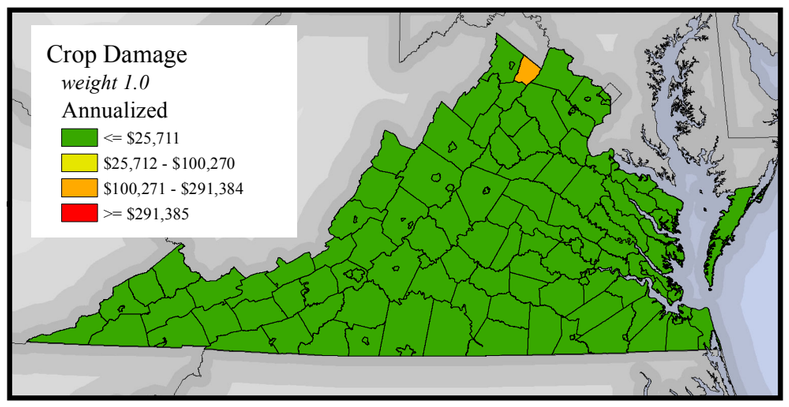
Figure 3.11-3: Wildfire Hazard Ranking Parameters and Risk Map

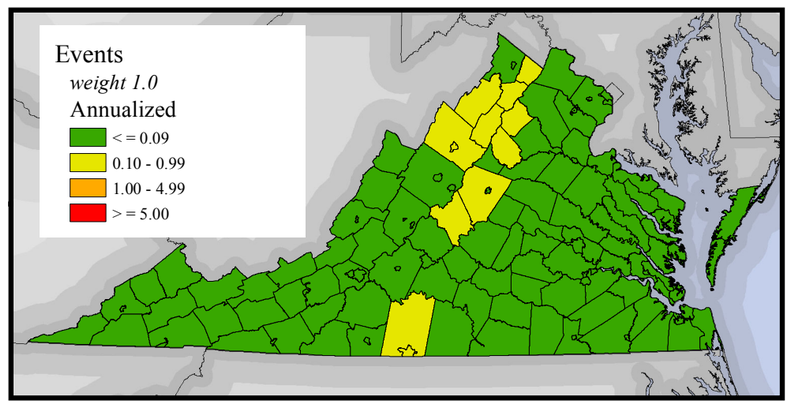


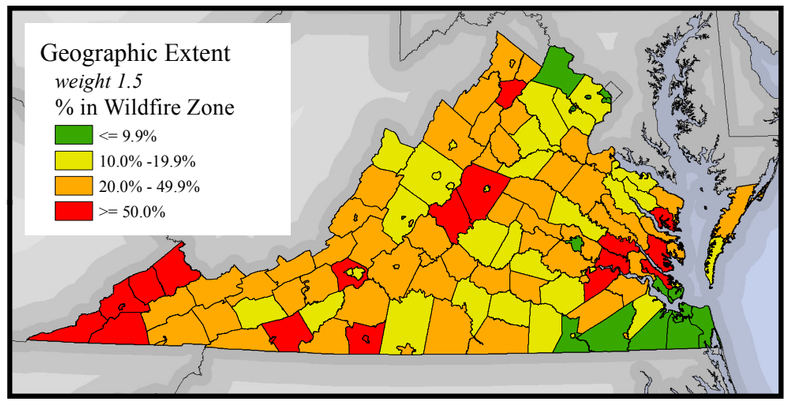


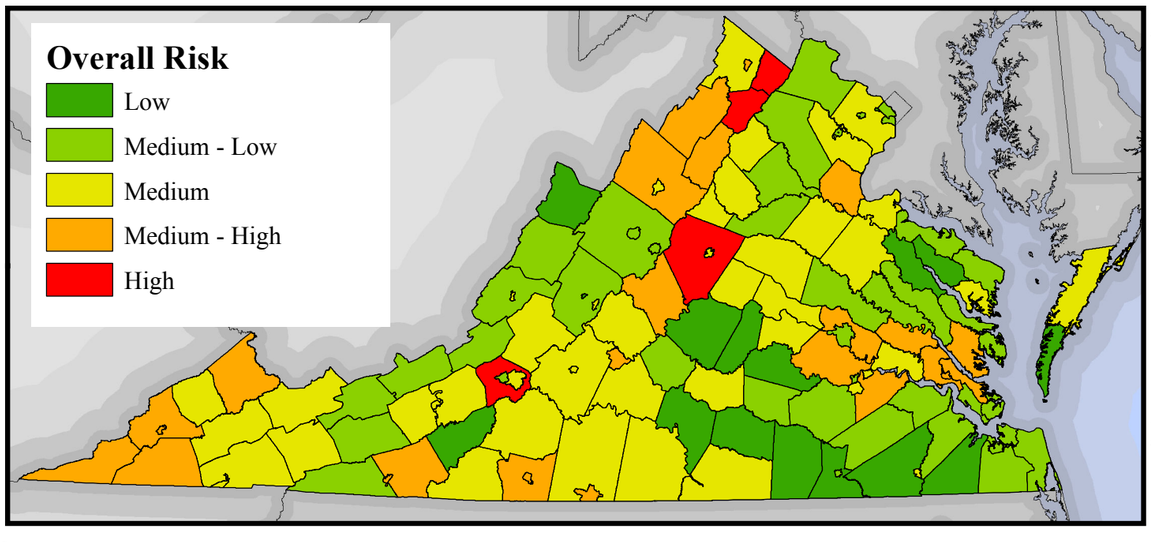












HAZARD RANKING:

A number of factors have been considered in this risk assessment to be able to compare between jurisdictions and hazards. The factors have been added together to come up with the overall total ranking for each hazard.
Some factors were weighted based on imput from the HIRA sub-committee.
Section 3.5 explains each of the factors in detail.

Factors & Weighting Include:
- Population Vulnerability & Density 0.5 weighting
- Injuries & Deaths 1.0 weighting
- Crop & Property Damage 1.0 weighting
- Annualized Events 1.0 weighting
- Geographic Extent 1.5 weighting

DATA SOURCES:

CGIT Ranking Methodology
VGIN Jurisdictional Boundaries
ESRI State Boundaries

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

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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.

Table 3.11-8: EMAP Analysis

Subject	Detrimental Impacts
Health and Safety of Public	Localized impacts are expected to be severe for the event area, and moderate for the outlying areas including smoke inhalation.
Health and Safety of Response Personnel	Localized impacts could be serious as local responders are working within the impacted area, if they live within the impacted area then they may be displaced for an extended period of time.
Continuity of Operations	Damage to facilities/personnel in the area of the event may require temporary relocation of some operations.
Property, Facilities, and Infrastructure	Depending on the magnitude of the event, localized impact to facilities, residential properties, and infrastructure in the area of the event could be severe.
Delivery of Services	Localized disruption of roads, facilities, communications and/or utilities caused by the event may postpone the delivery of some services.
The Environment	Localized impacts expected to be severe for the impacted areas, soil stability impacted, area likely to be vulnerable to landslides. Possible smoke and HAZMAT remediation needed.
Economic and Financial Condition	Local economic and financial conditions may be impacted for a long period of time depending on duration and geographical area of the event, as well as investigations around the cause of the fire.
Public Confidence in the Jurisdiction's Governance	Ability to respond and recover may be questioned and challenged if planning, response, and recovery time is not sufficient

***Table was modeled from the Missouri State Hazard Mitigation Plan*