Commonwealth of Virginia Emergency Operations Plan
Standard Hazard Mitigation Support Annex 3
(Volume II)

CHAPTER 3

Hazard Identification and Risk Assessment (HIRA)

Section 3.10:
Drought

2010

SECTION 3.10

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Section 3.10: Drought

Description

Little Creek Reservoir Toano, Virginia
2007
Source: www.drought.gov

Droughts are short-term or long-term water deficiencies that cause agricultural, environmental, and societal impacts. They can occur in any part of the state and can last for long periods of time. Agricultural drought is the most common, characterized by unusually dry conditions during the growing season, and can have significant economic effects on local agriculture. Meteorological drought is defined as an extended period (generally 6 months or more) when precipitation is less than 75 percent of normal during that period. Hydrologic drought is characterized by extremely low stream flow levels, and is caused by a prolonged meteorological drought.

Current drought conditions in Virginia have been tracked by a Drought Monitoring Task Force. The Task Force's status reports integrate information from various state and federal organizations to provide a complete picture of current and near-term drought conditions.[1]

Current drought conditions nationwide are tracked by the US Drought Monitor, a partnership between the National Drought Mitigation Center at the University of Nebraska-Lincoln, federal, and state environmental and climatologic organizations. The US Drought Monitor blends a variety of drought indicators to produce a weekly drought condition status map for the nation.[2]

Droughts are typically quantified based on indices that consider rainfall, temperature, stream flow, groundwater, and/or other factors. One of the most commonly-cited drought measures is the Palmer Drought Severity Index, first documented in a 1965 paper by Wayne Palmer, uses temperature and precipitation information for a location in a formula to quantify dryness. A Palmer index value of zero indicates normal conditions, with increasingly negative values indicating increasing drought severity. Other drought indices use different methods and formulas to quantify dryness, and may be more appropriate for specific applications. The US Drought

[1] Virginia's Department of Environmental Quality hosts these status reports, along with other information, on its website at: http://www.deq.virginia.gov/waterresources/drought.php
[2] US Drought Monitor available online at: http://www.drought.unl.edu/dm/monitor.html

Monitor uses a variety of drought indices, including the Palmer index, to produce an overall drought severity classification.

Extreme Heat

A heat wave is defined as prolonged periods of excessive heat, often combined with excessive humidity. Extreme heat is defined as temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks. A heat wave combined with a drought is a very dangerous situation.[3]

The main concern in periods of extreme heat is the potential public health impact, such as heat exhaustion or heat stroke. Individuals of particular concern include those living in residences without air-conditioning, or in areas where electric service is unavailable due to system-wide blackouts.

Accomack-Northampton PDC and the City of Chesapeake ranked extreme heat as a medium hazard. Thirteen other local plans ranked this hazard as low, and the remaining twelve did not include any discussion of extreme heat. Section 3.6 includes the overall rankings for the local plans. Due to the limited impacts to population and infrastructure, this hazard was not analyzed in detail as part of this plan.

Historic Occurrence

Table 3.10-1, based on available records from VDEM and the NWS National Weather Service, describes some of the major recorded droughts in Virginia's history.

Table 3.10- 1: Selected Droughts in Virginia's History

Year	Description
1607	An extended drought threatens Jamestown; many did not survive. (from Thomas Jefferson PDC)
1930's	The "dust bowl" years consisted of severe drought and heat throughout most of the United States, but especially in the Midwest, where climatologic factors combined with poor human management and planning, resulting in one of the worst natural disasters in national history. This period is also the drought of record for many other states, as well.
1962-1971	The cumulative stream flow deficit is the largest because of its duration; however, it was not as severe as the 1930's drought.
1985-1988	Severe drought in the entire southeast United States.
1993	Hot, dry weather affected 23 counties and was responsible for an estimated $75 million in crop damages.
1995	Suffolk City was declared was declared a Drought Disaster Area, with an estimated $13.3 million in crop damages.
1997	Drought conditions resulted in crop damages estimated at $73.8 million in Central, Eastern, and Northern Virginia.
1998	Drought conditions resulted in crop damages estimated at $66.5 million in the

[3] FEMA: Extreme Heat http://www.fema.gov/hazard/heat/heat_terms.shtm 3/20/06

Year	Description
	Eastern Piedmont and Northern Neck regions of Virginia.
1999	Drought conditions resulted in crop damages estimated at $83 million in Northern Virginia.
2000's	Throughout most of the early and mid 2000's the entire southeastern U.S. has been in varying levels of drought, including Virginia. In November 2002, 45 counties were approved for primary disaster designation by the US Secretary of Agriculture, while 36 requests were still pending. This dry period led to water conservation restrictions throughout the state and exacerbated water supply infrastructure problems, especially in rural communities.
October 2005	The Town of Big Stone Gap experienced a water shortage due to a combination of drought-like conditions and construction activities on a new dam for the Big Cherry Reservoir. A state of emergency was declared, and about $1.3 million in state funding was used to help offset the costs of local emergency water supply operations.
2007	Seventeen counties fell into severe drought status as over $10 million in crop damages occurred in Southwest Virginia.
June 2007	In the Town of Goshen, a pump failure caused water pressure to drop, and many older pipes (circa 1930), which were already in fragile condition, cracked and caused major leaks. The water system was forced to shut down for repairs. A state of emergency was declared, and water was shipped in and distributed with assistance from the National Guard, volunteer organizations, and church groups.

Risk Assessment

Probability

The future incidence of drought is highly unpredictable and may be localized, which makes it difficult to assess the probability of drought. Near-term conditions can be extrapolated from past trends. Some form of drought affects Virginia every year, and so the real challenge is to assess the exact timing, location, and severity of drought conditions. Any assessment of historical or future drought conditions must also define the measures of drought to be tracked, a non-trivial task.

No sources of information on long-term historic frequency of drought or future probability of drought were identified for inclusion in this plan. This may be a result of many different definitions resulting in spotty reporting. As a result, while the future probability of some type of drought may be estimated at 100%, the exact severity of future drought cannot be quantified at this time.

Impact and Vulnerability

Virginia has extensive agricultural operations throughout the state, many of which are vulnerable to shortages in rainfall. In 2002, about 10% of Virginia was harvested cropland, and about 30% of the state's land was held in farms.[4]

[4] Percentages calculated based on results of the 2002 Census of Agriculture conducted by the U.S. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS). Available online at: http://www.agcensus.usda.gov

Figure 3.10-1 illustrates the distribution of cropland in Virginia. Cropland is defined by the 2002 Census of Agriculture as land from which crops were harvested and hay was cut, and land used to grow short-rotation woody crops, land in orchards, citrus groves, Christmas trees, vineyards, nurseries, and greenhouses. The top five counties with the greatest percentage of cropland are listed in Table 3.10-2.

Table 3.10- 2: Percent Cropland by Jurisdiction for the Top Five Counties

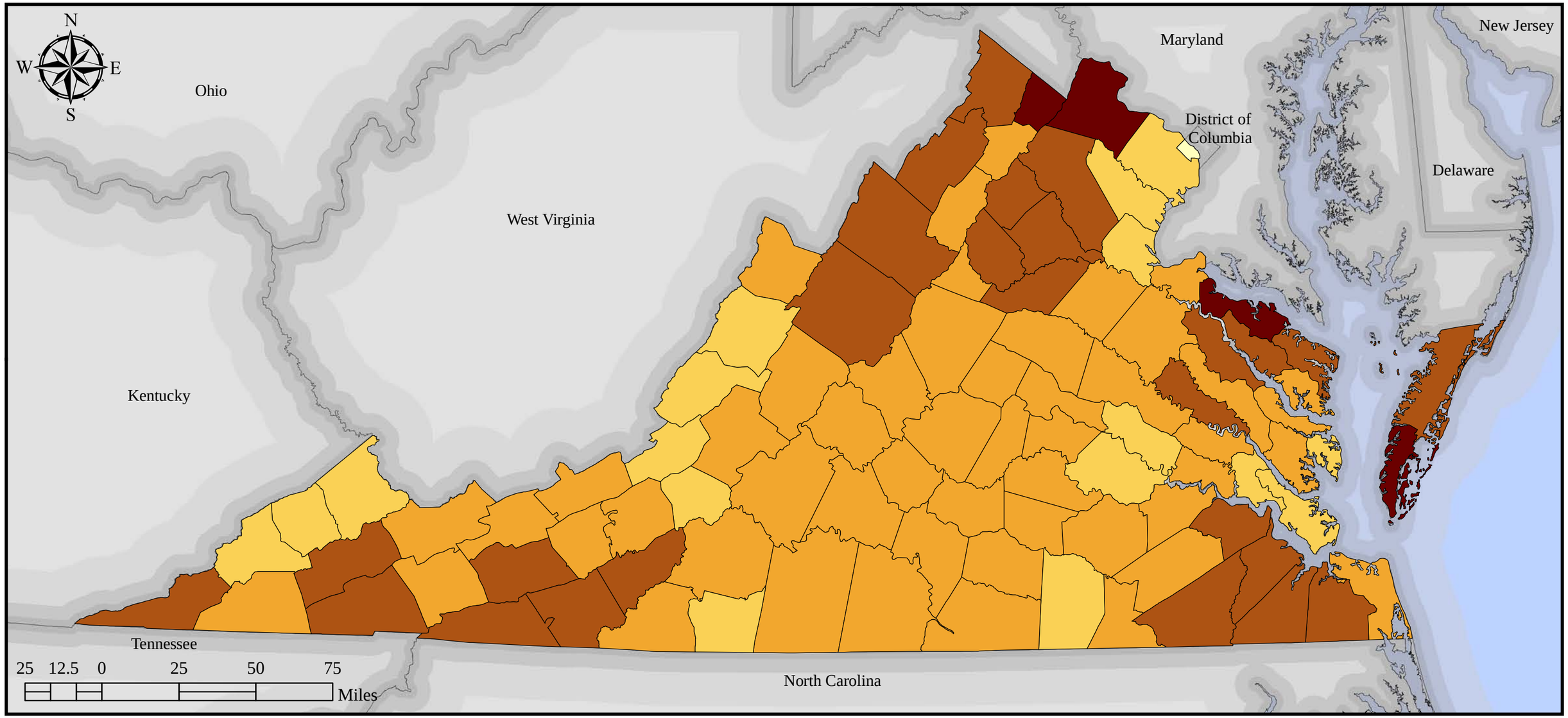
County	Percent Cropland
Clarke County	42.3%
Northampton County	31.7%
Westmoreland County	31.3%
Loudoun County	31.2%
Culpeper County	28.8%

Short-term droughts occurring in sync with the growing season may have a significant impact on agricultural productivity, but may have little impact on public drinking water supply.

Long-term hydrologic drought can impact public water supplies, forcing local governments to enact water conservation restrictions. The cost of such restrictions has not been analyzed in this plan, due to lack of data. Jurisdictions which have invested in water supply and distribution infrastructure are less vulnerable to drought.

In addition to the primary impacts of drought, there are also secondary impacts that can increase the potential for other hazards to occur. Extended periods of drought can increase the risk of wildfire occurrences. Wildfire occurrences can lead to an increase of burned woody debris that could increase the potential for landslides or mudflows.

Figure 3.10-1: Cropland in Virginia



Center for Geospatial Information Technology

VIRGINIA DEPARTMENT OF EMERGENCY MANAGEMENT

DATA SOURCES:

2002 Census of Agriculture
ESRI State Boundaries

LEGEND:

Percent Cropland

- N/A
- <10%
- 10% - 20%
- 20% - 30%
- >30%

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.

HAZARD IDENTIFICATION:

The 2002 Census of Agriculture was conducted by the National Agricultural Statistics Service (NASS) in the US Department of Agriculture (USDA).

Percent cropland in a jurisdiction is the area of cropland divided by jurisdictional area. Jurisdictional boundaries shown are the agricultural jurisdictional boundaries used in the 2002 Census of Agriculture; most cities are grouped with an adjacent county.

Risk

The risk associated with drought in Virginia has not been formally quantified, due to the difficulty in assessing the rate of incidence, and the lack of complete data on drought impacts. There is low risk of human injury/death due to drought in Virginia, and low risk of property damage. Droughts can typically occur in every part of the state. Risk should be considered uniformly across the Commonwealth.

Crop damages due to drought are uncertain, as agricultural productivity often varies with growing conditions from year to year. However, the NCDC Storm Events database does report a total of $375 million in crop damages due to drought in the 16 years from 1993 and 2008, or an annual average of about $23 million (all dollars expressed in inflation-adjusted 2007 dollars). Other than crops, the NCDC database does not report any property damages due to drought.

State Facility Risk

Risk associated with drought has not been quantified in terms of geographic extent for this revision; as a result, critical facility risk has not been calculated. The majority of drought related damages do not impact infrastructure.

Critical Facility Risk

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Jurisdictional Risk

The hazard ranking for drought is based on parameters reported in the NCDC Storm Events database. No geographic extent data was available for drought probability estimation; each jurisdiction was assigned a value of low (1) for ranking purposes. Annualized injuries and deaths and property damages were also given a low ranking for the state as a result of the limited events in the NCDC storm events database. The parameters in the drought risk assessment are illustrated in Figure 3.10-2, along with the total ranking. The reporting of drought occurrence, and of drought-related crop damages, is shown to be generally higher in Northern and South-Central parts of the state. The following jurisdictions have been assigned a high ranking for drought:

- Augusta County
- Bedford County
- Fairfax County
- Pittsylvania County
- Prince William County
- City of Waynesboro

Thirty-four other jurisdictions, some of which neighbor these “high” jurisdictions, were rated “medium-high” for drought.

Local 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.

Twenty-four of the twenty-seven local plans provided a general description of drought and its impact on their region. Seven plans used the 2000 U.S. Census data for the percent of people on public and private wells. Multiple plans included past regional water supply problems. Three local plans also discussed the types of crops and farmland in their regions. Six local plans provided annualized loss values based on the NCDC storm events database; this is the same data that was used for the statewide analysis. Table 3.10-3 shows the annualized loss values from the local plans. Local plans discussed the inability to calculate loss due to the lack of detailed record keeping of historical events, probability, and drought not having a physical impact on structures in terms of damage to structures.

Table 3.10- 3: Local plan drought annualized loss.

PDC/Jurisdiction	Local Plan Annualized Loss
Northern Virginia RC	$2,207,000
Rappahannock-Rapidan RC	$2,251,736
Commonwealth RC (Virginia's Heartland)	$2,567,066
Southside Hampton Roads	$2,215,839
Southampton County	*Negligible (< $1,000)*
City of Franklin	*Negligible (< $1,000)*

Comparison with Local Ranking

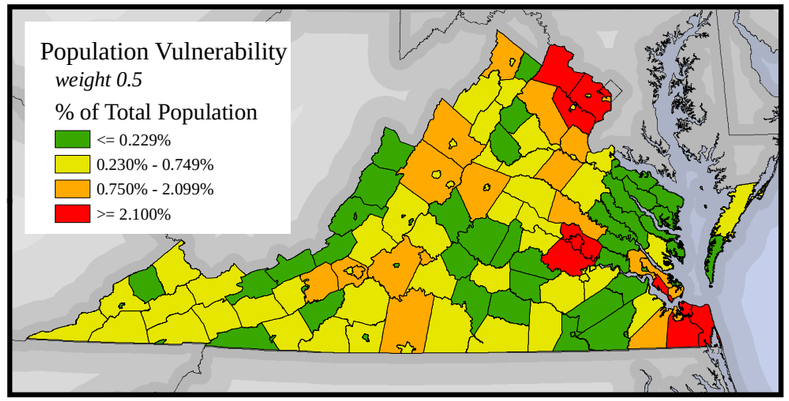
Four of the twenty-seven regional and local plans ranked drought as a high hazard, one ranked as medium-high, eight ranked as medium, and twelve ranked as low.

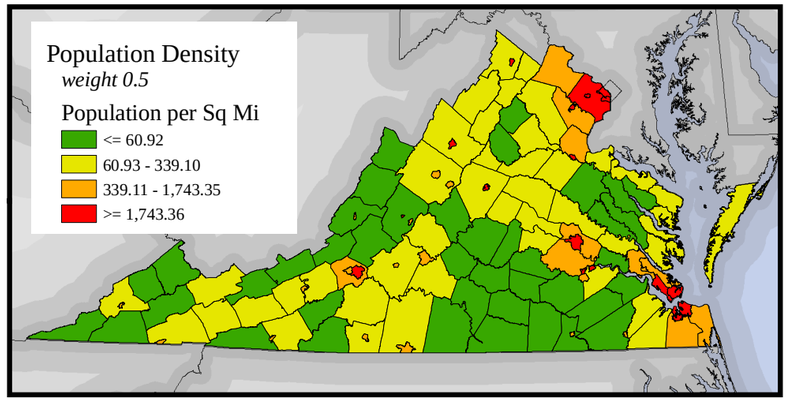
The local plan ranking average was medium-low for drought (section 3.6). The 2010 statewide analysis has ranked drought as medium risk. Section 3.6 (Table 3.6-2) includes the complete ranking of all the local plans.

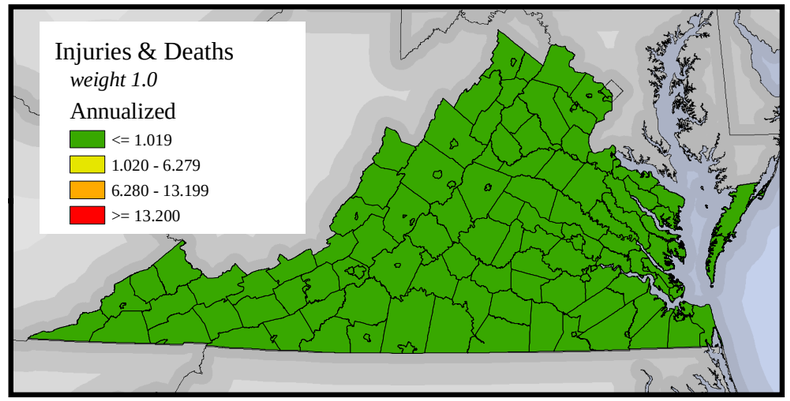
Changes in Development

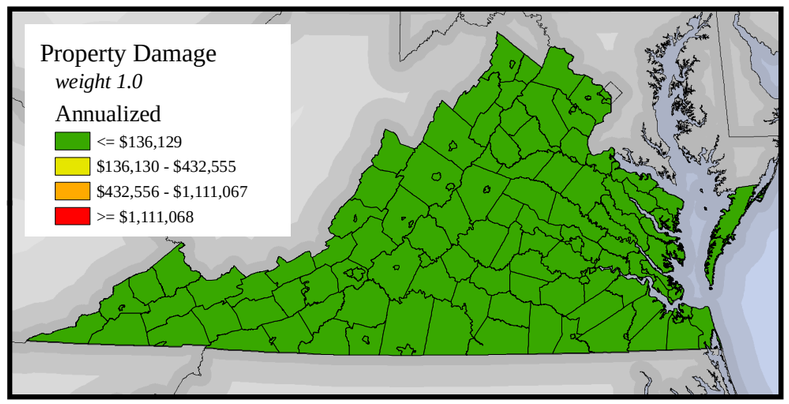
The majority of local plans did not specifically address changes in development for each hazard or the effects of changes in development on loss estimates. In most cases overall development patterns were discussed in general. Seventeen of the twenty-seven local plans cite their comprehensive plans for current and future land use changes (section 3.2). The majority of the damages due to drought are not related to infrastructure. Communities with large amounts of agricultural land have some water supply related mitigation action items.

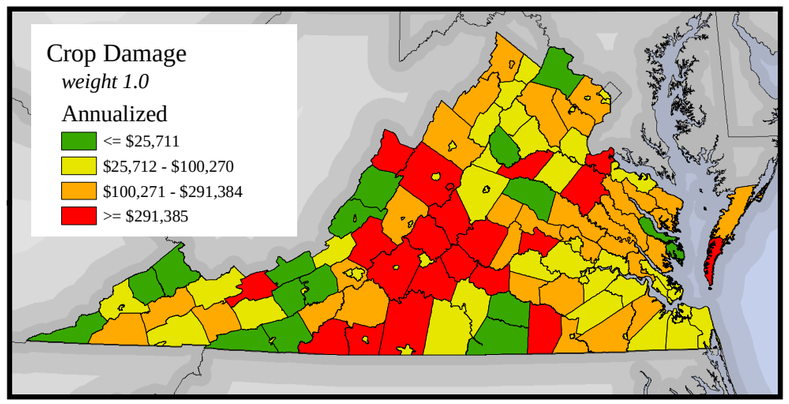
Figure 3.10-2: Drought Hazard Ranking Parameters and Risk Map

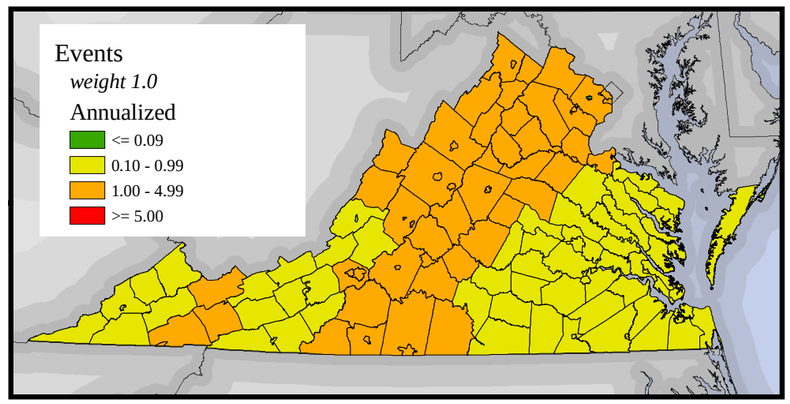


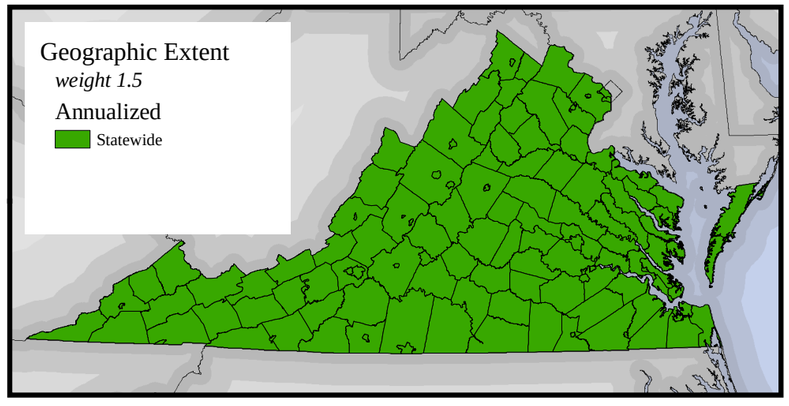


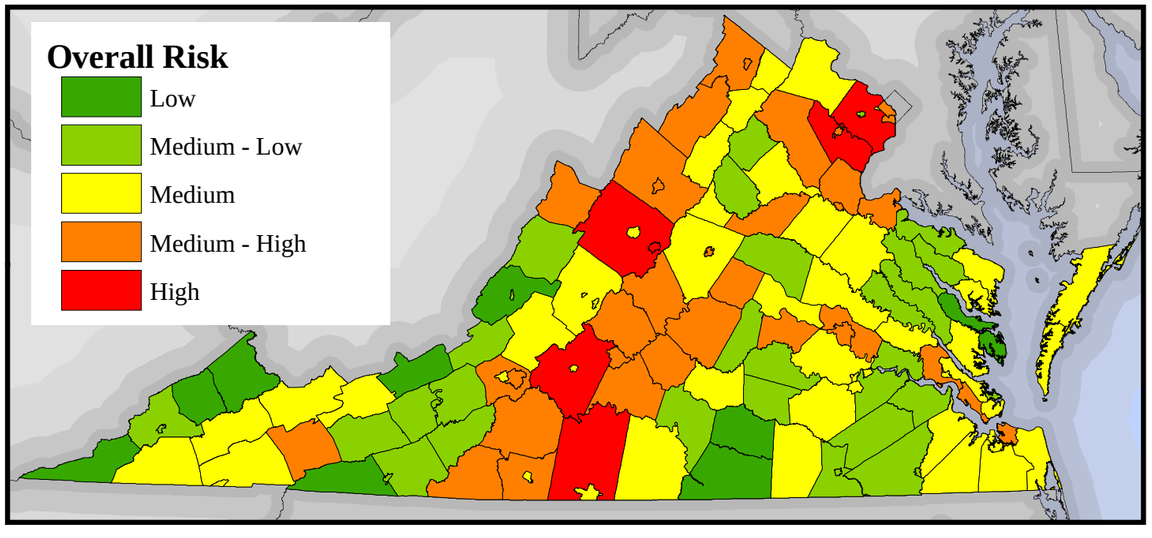












HAZARD RANKING:

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 Jurisdicational Boundaries
ESRI State Boundaries

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

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Table 3.10-4: EMAP Analysis

Subject	Detrimental Impacts
Health and Safety of Public	Local water supply distributions can be severely impacted if primary source of water for the area is compromised.
Health and Safety of Response Personnel	Limited impacts for response personnel unless water supply is compromised.
Continuity of Operations	Unlikely to execute Continuity of Operations Plan
Property, Facilities, and Infrastructure	Localized areas may experience moderate impacts from downed water utilities, property and infrastructure damages are expected to be minimal.
Delivery of Services	The ability to supply water to needed areas can be impacted if the water supply is low, or the utility line is damaged.
The Environment	Droughts can result in a lack of water, causing animals to relocate to possibly more populated areas. Drought can also increase the vulnerability to wildfire, and flooding if persistent heavy rains occur.
Economic and Financial Condition	Local economy could face moderate impacts for the duration of the drought, dependent on the abundance of a local water supply.
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_