

# **Virginia Drought Assessment and Response Plan**

**Submitted by the Drought Response Technical Advisory  
Committee**

**March 28, 2003**

## Introduction

During the summer of 2002 Virginia experienced significant drought impacts due to precipitation deficits that dated to 1999 in most areas of the Commonwealth. While this drought did not reach the level of severity of the drought of record (1930-1932), increases in water demands when compared to the 1930's resulted in significant impacts to all sectors of Virginia's economy and society.

The intensity of these drought impacts peaked in late August 2002. Wildfire indices were at levels previously unrecorded in Virginia, the vast majority of Virginia agricultural counties had applied for Federal drought disaster designation, streamflows reached period of record lows, and thousands of individual private wells failed. During the third week of August several public water supply systems across the Commonwealth were on the brink of failure. Several large municipal systems, such as Charlottesville and Portsmouth, had less than sixty days of water supply capacity remaining in reservoirs. Several smaller rural systems that rely primarily on withdrawals from free-flowing streams, such as the towns of Farmville and Orange, had at most a few days of water supply available and were forced to severely curtail usage.

On August 30, 2002 Governor Warner took the unprecedented action of declaring a drought emergency in the majority of the Commonwealth by issuance of Executive Order #33. This executive order required the elimination of some non-essential water uses in large areas of the Commonwealth. In addition, this executive order named the Deputy Secretary of Natural Resources as the Commonwealth Drought Coordinator and charged him with the implementation of the water use restrictions. While these emergency actions were necessary in light of the drought impacts within the Commonwealth, they resulted in significant confusion and consternation among water users who were impacted.

On December 13, 2002 Governor Warner issued Executive Order #39, the Virginia Water Supply Initiative. This executive order requires the Commonwealth's Drought Coordinator to develop a formal drought assessment and response plan. In January 2003, the Deputy Secretary of Natural Resources invited a broad coalition of stakeholders to participate in a Drought Response Technical Advisory Committee chaired by the Virginia Department of Environmental Quality. This technical advisory committee was supported by the existing Virginia Drought Monitoring Task Force. Groups and agencies invited to participate or represented on the Drought Monitoring Task Force are listed below.

Mid-Atlantic Car Wash Association  
National Spa and Pool Institute  
Virginia Rural Water Association  
Virginia Agribusiness Council  
Virginia Green Industry Council  
Virginia Golf Course Superintendent's Association  
Virginia Association of Counties  
Virginia Section of the American Water Works Association  
Virginia Municipal League  
Virginia Sports Turf Manager's Association  
Virginia Hospitality and Travel Association  
Virginia Water Well Association

Virginia Manufacturer's Association  
Virginia Farm Bureau  
Southern Environmental Law Center  
Roanoke River Landowner's Association  
Virginia Irrigation Association  
City of Portsmouth  
Henrico County  
Town of Orange  
U.S. Navy  
U.S. Army Corp of Engineers  
Virginia Department of Environmental Quality  
Virginia Department of Emergency Management  
Virginia Department of Health  
Virginia Cooperative Extension Service  
Virginia Department of Game and Inland Fisheries  
Virginia Department of Agriculture and Consumer Services  
Virginia State Climatology Office  
Virginia Department of Forestry  
U.S. Geological Survey  
U.S. Department of Agriculture, Farm Services Agency  
National Oceanic and Atmospheric Administration, National Weather Service

The Drought Response Technical Advisory Group met three times in February and March and developed the following drought assessment and response plan for the consideration of the Commonwealth Drought Coordinator. There are several key concepts that must be kept in mind as this proposal is reviewed.

The development of droughts and the development of associated impacts is very complex. The coverage of monitoring points for most drought indicators (precipitation deficits, streamflows, ground water levels, and reservoir storage) is sparse. These two facts work together to preclude the development of a truly automated, objective drought monitoring system. This proposal includes a monitoring framework that relies heavily on the professional judgment of the Virginia Drought Monitoring Task Force in the determination of drought stages in the Commonwealth.

Due to the complexity of drought impacts on differing segments of society, the responses that are proposed at each drought stage are actions that should be considered. The Commonwealth Drought Coordinator will need to evaluate reported drought conditions and the impacts associated with those conditions and decide what actions are necessary. As an example, there will likely be circumstances in the future when actions currently proposed at the drought warning stage should be initiated somewhat earlier.

From a water supply standpoint, the impacts on a particular water supply may be as dependent on the reliability of that supply as it is on the severity of drought conditions at any point in time. As an example, water supply systems that rely on small order free-flowing streams and do not have storage may experience large impacts from relatively small drought events. This variability in reliability exists in all categories of water supplies; public waterworks, large self-supplied industrial and commercial supplies, and individual residential water supplies. Nothing that is proposed in this plan should be

viewed as limiting local government or public waterworks from taking more stringent action at any time to respond to local conditions.

## **Drought Monitoring**

The responsibility for monitoring drought conditions in the Commonwealth rests with the Virginia Drought Monitoring Task Force (DMTF), an interagency group of technical representatives from state and federal agencies responsible for monitoring natural resource conditions and the effects of drought on various segments of society. During periods of normal moisture conditions, the Virginia Department of Environmental Quality will monitor the NOAA U.S. Drought Monitor, and will produce information from this report specific to Virginia on a monthly basis. The Virginia drought map will be produced concurrent with the release of NOAA monthly and seasonal outlooks, which usually are released on the Thursday closest to the middle of the month. The DMTF will be activated with the first occurrence of *moderate drought* conditions (D1) in the Commonwealth or the occurrence of smaller scale moisture deficits that may fall beneath the level of resolution of the U.S. Drought Monitor. The DMTF will monitor the advance of drought conditions in the Commonwealth using the drought indicators listed on page 4 as other indicators such as the Standardized Precipitation Index, Palmer Drought Severity Index, Crop Moisture Index, Keetch-Byrum Drought Index, and NOAA monthly and seasonal precipitation outlooks. In addition, the DMTF will monitor the effect of advancing drought conditions on various sectors of society including agriculture, forestry, and recreation. The DMTF will produce a monthly report of current drought conditions and their effects, and will generally remain active until the NOAA U.S. Drought Monitor indicates that all drought impacts in the Commonwealth have subsided to an *unusually dry* level (D0). The DMTF may remain active after all drought impacts have subsided to an *unusually dry* level when small areas beneath the resolution of the U.S. Drought Monitor continue to experience drought impacts. The primary purpose of the drought monitoring system described below is to provide a framework for the DMTF to operate within when preparing recommendations for the declaration of various drought stages. Due to the complex nature of drought development, professional expertise must be applied to the wide range of drought monitoring data in order to develop defensible recommendations.

## **Drought Evaluation Regions**

For the purpose of implementation of this drought response plan the Commonwealth has been divided into thirteen drought evaluation regions. The regions were established based on a consideration of river basins, climatic divisions, physiographic provinces, major geomorphologic features, and service areas of major water supplies. Regional boundaries were chosen to correspond with local government boundaries to simplify the implementation of this plan. While the regional boundaries are somewhat arbitrary, they generally correspond to regions of the Commonwealth that possess similar climatic, ground water, streamflow and water supply conditions. Drought evaluation regions for the Commonwealth are listed below and displayed in Appendix A. Towns and independent cities are only listed when they are on the boundary of a drought evaluation region. Drought evaluation regions included all towns and independent cities located within the region.

**Big Sandy Drought Evaluation Region:** Lee, Wise, Buchanan, Dickenson, Scott, Russell, Tazewell, Washington and Smyth Counties.

**New River Drought Evaluation Region:** Grayson, Wythe, Bland, Carroll, Floyd, Pulaski, Giles, and Montgomery Counties.

**Roanoke River Drought Evaluation Region:** Patrick, Franklin, Roanoke, Henry, Bedford, Pittsylvania, Campbell, Halifax, Charlotte, and Mecklenburg Counties.

**Upper James Drought Evaluation Region:** Craig, Alleghany, Bath, Highland, Botetourt, and Rockbridge Counties.

**Middle James Drought Evaluation Region:** Amherst, Lynchburg, Nelson, Albemarle, Appomattox, Buckingham, Fluvanna, Prince Edward, Cumberland, Goochland, Amelia, Powhatan, Chesterfield, Petersburg, Hopewell, Colonial Heights, Henrico, and Hanover Counties.

**Shenandoah Drought Evaluation Region:** Augusta, Rockingham, Shenandoah, Frederick, Page, Warren, and Clarke Counties.

**Northern Virginia Drought Evaluation Region:** Fauquier, Loudoun, Prince William, Arlington, and Fairfax Counties.

**Northern Piedmont Drought Evaluation Region:** Greene, Madison, Rappahannock, Orange, Culpeper, Louisa, Spotsylvania, and Stafford Counties.

**Chowan Drought Evaluation Region:** Lunenburg, Nottoway, Brunswick, Dinwiddie, Greenville, Sussex, Prince George, Southampton and Surry Counties.

**Northern Coastal Plain Drought Evaluation Region:** Caroline, King George, King William, King and Queen, Essex, Richmond, Westmoreland, Gloucester, Mathews, Middlesex, Lancaster, and Northumberland Counties.

**York-James Drought Evaluation Region:** Hampton, Newport News, James City, York, Charles City, and New Kent Counties.

**Southeast Virginia Drought Evaluation Region:** Suffolk, Isle of Wight, Chesapeake, Virginia Beach, Portsmouth, and Norfolk.

**Eastern Shore Drought Evaluation Region:** Northampton and Accomack Counties.

## **Drought Indicators**

In order to monitor potential drought conditions in a uniform manner across the Commonwealth, Virginia will use four indicators to evaluate drought severity. The indicators are based on the amount of precipitation and the effect of the precipitation (or lack of precipitation) on the hydrologic system. These indicators include:

- Precipitation Deficits
- Streamflows
- Ground water levels
- Reservoir storage

Indicators will be evaluated by comparing current conditions to long term average conditions. This evaluation will be used to determine if current conditions are within a range of conditions commonly experienced or if significant drought conditions exist.

**Precipitation Deficits**

Precipitation deficits will be monitored by comparing current precipitation amounts with historical precipitation values as a percent of normal long-term average values. Comparisons will be made for each drought evaluation region using data compiled by the Office of the State Climatologist. Normal long-term average precipitation is defined as the mean precipitation for a thirty-year period of record for the area and time period being evaluated.

Precipitation amounts will be evaluated based on the water year (beginning October 1). Water years are a natural dividing point for water supply drought, as precipitation that falls in the first six months of a water year is analogous to putting money in the bank. Precipitation that occurs during this six month period has the potential to recharge ground water, which will sustain stream flows and support withdrawals from wells during the following six month period when moisture deficits naturally develop as evaporation and plant transpiration generally exceed precipitation. If a precipitation deficit outside of the normal range exists at the end of a water year, the precipitation records will carry forward until a normal condition is reached (i.e. if a precipitation deficit exists on October 1, precipitation records for the previous twelve months will be evaluated until the twelve month deficit is eliminated).

Because the significance of a precipitation deficit changes as the water year progresses, drought response stages will trigger at different percentages of normal depending upon the date of evaluation.

<b>Months Analyzed</b>	<b>Normal (% of Normal Precipitation)</b>	<b>Watch (% of Normal Precipitation)</b>	<b>Warning (% of Normal Precipitation)</b>	<b>Emergency (% of Normal Precipitation)</b>
October-December	>75.0	<75.0	<65.0	<55.0
October-January	>80.0	<80.0	<70.0	<60.0
October-February	>80.0	<80.0	<70.0	<60.0
October-March	>80.0	<80.0	<70.0	<60.0
October-April	>81.5	<81.5	<71.5	<61.5
October-May	>82.5	<82.5	<72.5	<62.5
October-June	>83.5	<83.5	<73.5	<63.5
October-July	>85.0	<85.0	<75.0	<65.0
October-August	>85.0	<85.0	<75.0	<65.0
October – September (and previous 12 months)	>85.0	<85.0	<75.0	<65.0

## **Streamflow**

Streamflow gages representing drought evaluation regions will be used to monitor streamflow responses to drought conditions. Representative daily flow values will be compared with historic flow statistics for the period of record. Representative daily streamflows above the 25th percentile for return flow frequency will be defined as normal conditions. Representative daily streamflows between the 10th and 25th percentile for return flow frequencies will be defined as drought watch conditions. Representative daily streamflows between the 5th and 10th percentile for return flow frequencies will be defined as drought warning conditions. Representative daily streamflows below the 5th percentile for return flow frequencies will be defined as drought emergency conditions. (A streamflow that represents the 25th percentile of return flow frequencies indicates that, for the period of record, 75% of streamflows have exceeded the current flow.) Gages were selected on the basis of the availability of real-time data, period of record, and relative location within the drought evaluation region. Typically, gages were selected that monitor moderately large drainage areas on streams without significant regulation. In drought evaluation areas where no appropriate stream gages exist, this indicator will not be utilized. Gages selected to monitor drought severity in each evaluation region are listed below and displayed in Appendix B.

**Big Sandy Drought Evaluation Region:** Clinch River at Cleveland, USGS Station 03524000

**New River Drought Evaluation Region:** Reed Creek at Graham Forge, USGS Station 03167000

**Roanoke River Drought Evaluation Region:** Goose Creek near Huddleston, USGS Station 02059500

**Upper James Drought Evaluation Region:** Cowpasture River near Clifton Forge, USGS Station 02016000

**Middle James Drought Evaluation Region:** Appomattox River at Farmville, USGS Station 02039500

**Shenandoah Drought Evaluation Region:** North Fork Shenandoah near Strasburg, USGS Station 01634000

**Northern Virginia Drought Evaluation Region:** Accotink Creek near Annandale, USGS Station 01654000

**Northern Piedmont Drought Evaluation Region:** Rapidan River near Culpeper, USGS Station 01667500

**Chowan Drought Evaluation Region:** Meherrin River near Lawrenceville, USGS Station 02051500

**Northern Coastal Plain Drought Evaluation Region:** Mattaponi River near Beulahville, USGS Station 01674500

**York-James Drought Evaluation Region:** Chickahominy River near Providence Forge, USGS Station 02042500

**Southeast Virginia Drought Evaluation Region:** No stream gages available to monitor.

**Eastern Shore Drought Evaluation Region:** No stream gages available to monitor.

### **Ground Water Levels**

Water table ground water monitoring wells representing drought evaluation regions will be used to monitor shallow ground water responses to drought conditions. In areas west of Route 95 it was assumed that wells completed in shallow fractured rock formations are indicative of water table conditions. Measured ground water levels will be compared with historic level statistics for the period of record. Measured ground water levels above the 25th percentile for all historic levels will be defined as normal conditions. Measured ground water levels between the 10th and 25th percentiles for all historic levels will be defined as drought watch conditions. Measured ground water levels between the 5th and 10th percentile for all historic levels will be defined as drought warning conditions. Measured ground water levels below the 5th percentile for all historic levels will be defined as drought emergency conditions. Monitoring wells were selected on the basis of period of record and relative location within the drought evaluation region. Monitoring wells selected to monitor drought severity in each evaluation region are listed below and displayed in Appendix C. In drought evaluation regions where no appropriate monitoring wells exist, the ground water indicator will not be used.

**Big Sandy Drought Evaluation Region:** No water table monitoring wells available to monitor.

**New River Drought Evaluation Region:** Christiansburg Observation Well, USGS Local Number 27F 2 SOW 019

**Roanoke River Drought Evaluation Region:** Roanoke-Nelson Observation Well, USGS Local Number 31G 1 SOW 008

**Upper James Drought Evaluation Region:** Glasgow Observation Well, USGS local Number 35K 1 SOW 063

**Middle James Drought Evaluation Region:** Buckingham Observation Well, USGS Local Number 41H 3; Virginia Maples Observation Well, USGS Local Number 53K 19 SOW 080

**Shenandoah Drought Evaluation Region:** McGaheysville Observation Well, USGS Local Number 41Q 1; Blandy Farm Observation Well, USGS Local Number 46W 175  
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**Northern Virginia Drought Evaluation Region:** Harper's Ferry Observation Well, USGS Local Number 49Y 1 SOW 022; Arlington Cemetery Observation Well, USGS Local Number 54V 3

**Northern Piedmont Drought Evaluation Region:** Gordonsville Observation Well, USGS Local Number 45P 1 SOW 030



**Chowan Drought Evaluation Region:** Slade Farm Observation Well, USGS Local Number 57E 13 SOW 094C

**Northern Coastal Plain Drought Evaluation Region:** George Washington Birthplace Observation Well, USGS Local Number 55P 9

**York-James Drought Evaluation Region:** Toano Observation Well, USGS Local Number 56H 31 SOW 135B

**Southeast Virginia Drought Evaluation Region:** Brinkley Observation Well, USGS Local Number 58B 13; Pungo Observation Well, USGS Local Number 62B 1 SOW 098A

**Eastern Shore Drought Evaluation Region:** P. C. Kellam Observation Well, USGS Local Number 63H 6 SOW 103A; Withams Observation Well, USGS Local Number 66M 19 SOW 110S

**Reservoir Storage**

Storage in major reservoirs will be used as a fourth drought indicator. Major reservoirs in Virginia support a wide variety of uses that include water supply storage, electric power generation, and flow augmentation to protect water quality. Water supply reservoirs will be evaluated based on the estimated days of available usable storage. Storage of greater than 120 days will represent normal conditions, storage of 90 to 120 days will represent watch conditions, storage of 60 to 90 days will represent warning conditions, and storage of less than 60 days will represent emergency conditions. Useable storage will be calculated as that storage above the level where advanced water treatment will be required.

Several large multi-purpose reservoirs will be evaluated as drought indicators. The criteria for consideration of drought stages are listed below for these reservoirs. Pool elevations of these reservoirs will be compared to benchmark elevations in relation to mean sea level (msl) or U.S. Army Corp of Engineers operating guide curves as indicated in the following table.

	NORMAL	DROUGHT WATCH	DROUGHT WARNING	DROUGHT EMERGENCY
Smith Mountain Lake	>793 feet msl	793 to 791.5 feet msl	791.5 to 790 feet msl	< 790 feet msl
Lake Moomaw	>1565 feet msl	1565 to 1562.5 feet msl	1562.5 to 1560 feet msl	< 1560 feet msl
Lake Anna	> 248 feet msl	248 to 246 feet msl	246 to 244 feet msl	< 244 feet msl
Kerr Reservoir	< 3 feet below the guide curve	3 to 6 feet below the guide curve	> 6 feet below the guide curve	< 288 feet msl

Reservoirs that will be used to monitor drought conditions are listed below. In drought evaluation regions where no appropriate reservoirs exist, this indicator will not be used.

**Big Sandy Drought Evaluation Region:** Big Cherry Water Supply Reservoir

**New River Drought Evaluation Region:** No reservoirs will be monitored.

**Roanoke River Drought Evaluation Region:** Smith Mountain Lake, Kerr Reservoir

**Upper James Drought Evaluation Region:** Lake Moomaw

**Middle James Drought Evaluation Region:** Lake Moomaw, Charlottesville Water Supply Reservoir System

**Shenandoah Drought Evaluation Region:** Switzer Water Supply Reservoir

**Northern Virginia Drought Evaluation Region:** Occoquan Water Supply Reservoir, Lake Manassas Water Supply Reservoir

**Northern Piedmont Drought Evaluation Region:** Lake Anna, Spotsylvania Water Supply Reservoir System

**Chowan Drought Evaluation Region:** Emporia Water Supply Reservoir

**Northern Coastal Plain Drought Evaluation Region:** Gloucester Water Supply Reservoir

**York-James Drought Evaluation Region:** Newport News Water Supply Reservoir System

**Southeastern Virginia Drought Evaluation Region:** Kerr Reservoir, Portsmouth Water Supply Reservoir System

**Eastern Shore Drought Evaluation Region:** No reservoirs will be monitored.

### **Other Indicators**

The DMTF will evaluate all other available drought information during deliberations related to the development of drought stage recommendations. Other drought indicators that will be considered include the Standardized Precipitation Index, Palmer Drought Severity Index, Crop Moisture Index, and NOAA monthly and seasonal precipitation outlooks.

When streamflows or ground water levels at the selected monitoring sites previously listed indicate drought conditions, the DMTF will monitor other stream gages and ground water monitoring wells that are available.

The DMTF will evaluate the Cumulative Severity Index developed by the Virginia Department of Forestry (VDOF) and the Keech-Byrum Drought Index to determine the potential impact of drought on forests and the potential for wildfire starts. In addition, the DMTF will consider the number of wildfire starts and the number of acres of forest burned as supplied by the VDOF as indicators of drought impacts on forestry. The DMTF will evaluate information compiled by the Virginia Agricultural Statistics Service to assess the impacts of drought on agricultural interests in the state. The DMTF will also rely on the input of local agricultural extension agents through the Virginia Cooperative Extension Service to document actual drought impacts through the Commonwealth. In addition, the DMTF will evaluate the number of requests for federal

drought disaster designation as reported by the Virginia Department of Agriculture and Consumer Services.

The DMTF will consider operating conditions at public waterworks in the determination of drought recommendations. The Virginia Department of Health (VDH) monitors the conditions of many public waterworks in the Commonwealth on a monthly basis. At a minimum, individual public waterworks typically contact the VDH when they experience water supply problems that are due to drought. VDH will continue to provide support to these waterworks and will continue monthly reporting of water supply problems. These monthly reports will be used as an additional indicator of drought severity in the Commonwealth. In addition, the DMTF will consider the number of private well replacement permits issued by the VDH as an indication of drought impacts to persons served by this type of system.

### **Declaration of Drought Stages**

The DMTF will use the four drought indicators; precipitation deficits, streamflows, ground water levels, and reservoir levels; as the initial indicators to be considered when making a recommendation concerning the declaration of a particular drought stage. When two indicators exceed the threshold for stage determination, the DMTF will evaluate all other drought information and provide a recommendation to the Virginia Drought Coordinator. This recommendation may be to declare a specific drought stage or the recommendation may include an explanation of why the particular drought stage should not be declared at that time. Conversely, the DMTF may recommend the declaration of a particular drought stage prior to the exceedance of threshold levels for two of the four indicators. Recommendations for declaration of specific drought stages will generally be based on the drought evaluation regions previously described. It is likely that conditions may exist where the DMTF may recommend the declaration of a specific drought stage for a portion of a drought evaluation region. Recommendations for declaration of a portion of a drought evaluation region may be based on differing climatic conditions within the area or differences in the ability of specific waterworks to reliably provide water during drought conditions.

As an example, when two of the four drought indicators indicate drought warning conditions, the DMTF will evaluate all other drought information available and, if the majority of information warrants declaration, recommend the declaration of a drought warning in the drought evaluation region where these conditions exist. In all cases, the final decision regarding the declaration of a particular drought stage will be at the discretion of the Virginia Drought Coordinator. Any local government may declare local drought emergencies, adopt emergency ordinances to address those local emergencies and implement those ordinances prior to the declaration of a Drought Emergency by the Governor of Virginia.

The DMTF will use the following general descriptions of four drought stages when making recommendations to the Virginia Drought Coordinator concerning drought declarations in the Commonwealth. These descriptions should not be viewed as absolute requirements for drought designation, but as a mechanism to be used by the DMTF to reach consensus on the appropriate drought recommendations.

### **Normal Conditions**

No more than one indicator outside of the normal range:

- Precipitation exceeds the percent of normal precipitation for the time period in precipitation table
- Streamflows are above the 25th percentile
- Ground water levels are above the 25th percentile for all historic levels
- Water Supply Reservoirs exceed 120 days of useable storage or appropriate criteria for non-water supply reservoirs

### **Drought Watch**

At least 2 indicators meet the following conditions:

- Precipitation levels are at or below the percent of normal precipitation for the time period in precipitation table
- Streamflows fall between the 10th and 25th percentile
- Ground water levels fall between the 10th and 25th percentile for all historic levels
- Water Supply Reservoirs contain between 90 and 120 days of useable storage or appropriate criteria for non-water supply reservoirs

### **Drought Warning**

At least 2 indicators meet the following conditions:

- Precipitation levels are at or below the percent of normal precipitation for the time period in precipitation table
- Streamflows fall between the 5th and 10th percentile
- Measured ground water levels fall between the 5th and 10th percentile for all historic levels
- Reservoirs contain between 60 and 90 days of useable storage or appropriate criteria for non-water supply reservoirs

### **Drought Emergency**

At least 2 indicators meet the following conditions:

- Precipitation levels are at or below the percent of normal precipitation for the time period in precipitation table
- Streamflows are at or below the 5th percentile
- Measured ground water levels fall are at or below the 5th percentile for all historic levels
- Reservoirs contain 60 days or less of useable storage or appropriate criteria for non-water supply reservoirs

## **Responses to Drought in Virginia**

The impacts of drought on society are broad reaching and complex. In addition, the nature of a particular drought event is dependent on the time of year, the long-term duration of precipitation deficits, the immediate impacts of short-term precipitation deficits within a period of general precipitation deficits, and many other interrelated factors. In short, every significant drought has a particular signature and the impacts of no two droughts will be identical. Due to the complex nature of droughts, responses to individual drought events must be tailored to the impacts that are being propagated. The specific response activities that are delineated below for the three drought stages should

be viewed as activities that will generally be initiated and not as required activities that are “written in stone”.

Drought watch responses are generally responses that are intended to increase awareness, in the public and private sector, to climatic conditions that are likely to precede the occurrence of a significant drought event. During this drought stage the primary activities that are suggested are to prepare for the onset of a drought event. It is unlikely that significant water use reductions will occur at this stage although it is possible that the increased public awareness of water conservation activities may reduce water use up to 5%.

Drought warning responses are generally responses that are required when the onset of a significant drought event is imminent. Water conservation and contingency plans that have been prepared during a drought watch stage would begin to be implemented. From the perspective of the Commonwealth, water conservation activities at this stage would generally be voluntary. Voluntary water conservation activities generally result in reductions in water use of 5-10%.

Drought emergency responses are generally responses that are required during the height of a significant drought event. During these times, it is likely that some water supplies will not supply the amount of water needed by all users and non-essential uses of water should be eliminated. Mandatory water conservation requirements contained in water conservation and contingency plans should be initiated at this stage. Mandatory water conservation activities generally result in water use reductions of 10-15%.

While actions on the State level are important for the purpose of alerting localities and citizens of the advance of drought impacts, actions by local governments, individual water suppliers, and individual citizens are much more important and effective in actually addressing the impacts of drought. Water sources used by public waterworks and self-supplied water users vary considerably across the Commonwealth. Water conservation requirements for water users whose only source of water supply is a free-flowing stream with no significant storage will likely be different than requirements for a water user who relies entirely on a reservoir system for water supply. The development of a drought water conservation and contingency plan that takes into account the nature of a particular water source and the nature of the end use of water withdrawn is necessary to assure that proper water conservation activities are instituted at the proper times. In general, water supplies that rely on sources with significant storage (reservoir and ground water based systems) will realize greater benefits of water conservation activities initiated early in a drought cycle when compared to supplies that rely solely on free-flowing streams. It is likely that individual private well users, especially those who rely on shallow water table wells, will receive the largest benefit from their early individual initiation of water conservation activities.

The following responses will generally be made upon declaration of individual drought stages.

#### **Drought Watch**

- The Virginia Drought Coordinator will declare a statewide or regional Drought Watch and will issue a press release indicating the reasons for the declaration.
- The Virginia Drought Coordinator will notify all local governments within the drought watch area of drought watch status.

- The Virginia Drought Coordinator will report the drought watch declaration to the Governor's Cabinet and request the assistance of all state agencies in the implementation of the drought response plan.
- The VDH will inform all public waterworks within the drought watch area of drought watch status.
- The Virginia Cooperative Extension Service will cooperate with all state agencies owning or controlling impoundments and/or river access to identify sources that may be used by livestock producers for emergency livestock watering during declared drought emergencies. VCE will inform livestock producers of these opportunities and will provide contact information necessary to access these sources.
- The DMTF will continue to monitor statewide moisture conditions and provide monthly reports of drought conditions to the Virginia Drought Coordinator who will update the Governor's Cabinet.
- The DMTF will make monthly reports of drought conditions available to media outlets within the drought watch area.
- The Virginia Drought Coordinator will encourage all public waterworks and self-supplied water users who withdraw more than 10,000 gallons per day to develop or review existing drought water conservation and contingency plans.
- All DMTF agencies will include water conservation information on their websites and will distribute water conservation information as broadly as possible.
- All executive branch agencies and institutions will review existing drought water conservation and contingency plans or develop new plans with the goal of reducing water usage by 15% during declared drought emergencies.
- VDH will continue monitoring problems incurred by public waterworks on a monthly basis.
- VDH will encourage all public waterworks to aggressively pursue leak detection and repair programs.
- Local governments and public waterworks may impose water use restrictions consistent with local water supply conditions at any time.

### **Drought Warning**

- The Virginia Drought Coordinator will declare a statewide or regional Drought Warning and will issue a press release indicating the reasons for the declaration.
- The Virginia Drought Coordinator will notify all local governments within the drought warning area of drought warning status.
- The Virginia Drought Coordinator will advise the Governor and his Cabinet regarding the necessity of authorizing the Departments of State Police, Transportation and Motor Vehicles to grant temporary overweight/overwidth/registration/license exemptions to carriers transporting essential emergency relief supplies into and through the Commonwealth in order to support disaster response and recovery.
- The VDH will inform all public waterworks within the drought warning area of drought warning status.
- The Virginia Department of Agriculture and Consumer Services will cooperate with the Virginia Association of Counties, the Virginia Municipal League, Virginia Cooperative Extension, the Virginia Farm Bureau Federation and the Virginia Agribusiness Council in notifying agricultural communities, agriculture

interest groups and local governments within the drought warning area of the potential for federal agricultural drought disaster designation. VDACS will also work with VACO, VML, VCE, VFBB and VAC in communicating the appropriate procedure for local governments to use in applying to the Governor for federal disaster designation.

- The DMTF will continue to monitor statewide moisture conditions and provide monthly reports of drought conditions to the Virginia Drought Coordinator. Significant changes in drought conditions will be reported biweekly.
- The Virginia Drought Coordinator will update the Governor's Cabinet concerning drought conditions on a biweekly basis.
- The Governor's Press Office will encourage media outlets within the drought warning area to publicize updates of drought conditions by developing biweekly press releases.
- All local governments will be encouraged to review existing local ordinances requiring mandatory non-essential water use restrictions or adopt such ordinances consistent with the mandatory non-essential water use restrictions listed below.
- All public waterworks and self-supplied water users who withdraw more than 10,000 gallons per day will initiate voluntary water conservation requirements contained in drought water conservation and contingency plans.
- All public waterworks and self-supplied water users who withdraw more than 10,000 gallons per day that have not developed drought water conservation and contingency plans will be encouraged to voluntarily reduce or eliminate non-essential uses of water including the elimination of non-essential flushing of water lines.
- All persons who utilize any source of water for outdoor irrigation will assure that the minimum amount of water is utilized in the most efficient manner practical.
- All self-supplied users who withdraw less than 10,000 gallons per day, including private well users, will be encouraged to voluntarily reduce or eliminate non-essential uses of water.
- All executive branch agencies and institutions will initiate the reduction or elimination of non-essential uses of water with the goal of reducing total water usage by 5-10%.
- VDH will continue monitoring problems incurred by public waterworks on a monthly basis.
- Local governments and public waterworks may impose water use restrictions consistent with local water supply conditions at any time.

### **Drought Emergency**

- The Governor will declare a statewide or regional Drought Emergency by executive order and will issue a press release indicating the reasons for the declaration.
- The Virginia Drought Coordinator will notify all local governments within the drought emergency area of drought emergency status.
- The VDH will inform all public waterworks within the drought emergency area of drought emergency status.
- The DMTF will continue to monitor statewide moisture conditions and provide monthly reports of drought conditions to the Virginia Drought Coordinator. Significant changes in drought conditions will be reported weekly.

- The Virginia Drought Coordinator will update the Governor's Cabinet concerning drought conditions on a weekly basis.
- The Governor's Press Office will encourage media outlets within the drought emergency area to publicize updates of drought conditions by developing weekly press releases.
- All public waterworks and self-supplied water users who withdraw more than 10,000 gallons per day will initiate mandatory water conservation requirements contained in drought water conservation and contingency plans that include the mandatory non-essential water use restrictions listed on page 16.
- All public waterworks and self-supplied water users who withdraw more than 10,000 gallons per day that have not developed drought water conservation and contingency plans initiate the mandatory non-essential water use restrictions listed below including the elimination of non-essential flushing of water lines.
- All self-supplied users, who withdraw less than 10,000 gallons per day, including private well users, will initiate the mandatory non-essential water use restrictions listed below.
- All executive branch agencies and institutions will implement drought water conservation and contingency plans with the goal of reducing water usage by 15% that include the mandatory non-essential water use restrictions listed on page 16.
- Local governments and public waterworks may impose water use restrictions more stringent than the mandatory non-essential water use restrictions listed below consistent with local water supply conditions at any time.
- For the duration of the declared drought emergency the Director of the Department of Environmental Quality shall be authorized to allocate ground water and surface water resources and to restrict any withdrawals based upon the adequacy of the resource to meet the necessary beneficial uses as set forth in §62.1-44.36 of the Code of Virginia. Such allocations may apply to any withdrawer and shall over-ride any existing authorizations to use or withdraw surface water or ground water.
- For the duration of the declared drought emergency the State Forester shall be authorized to declare open burning bans in wild fire susceptible areas of the Commonwealth.
- For the duration of the declared drought emergency the Departments of State Police, Transportation and Motor Vehicles shall be authorized to grant temporary overweight/overwidth/registration/license exemptions to carriers transporting essential emergency relief supplies into and through the Commonwealth in order to support the disaster response and recovery.
- Volume I, Virginia Emergency Operations Plan (COVEOP) Basic Plan, July 1997 as amended shall be implemented by agencies of the state and local government along with other appropriate state agency plans.
- The Virginia Emergency Operations Center (VEOC) and State Emergency Response Team (SERT) will be activated to coordinate state operations in support of affected localities and the Commonwealth, to include issuing mission assignments to agencies designated in the COVEOP and others that may be identified by the State Coordinator of Emergency Management, in consultation with the Secretary of Public Safety, which are needed to provide for the preservation of life, protection of property and implementation of recovery activities.



- Local governments of the Commonwealth will be authorized to adopt local ordinances to enforce the mandatory non-essential water use restrictions listed below and to establish, collect, and retain fines for violations of these restrictions. Nothing contained in this drought response plan should be construed to limit the powers of local government to adopt and enforce local emergency ordinances as necessary to protect the public welfare, safety and health.

## **Mandatory Non-essential Water Use Restrictions**

The following non-essential water uses will be prohibited during periods of declared drought emergencies. Please note the exceptions that follow each prohibited use. These prohibitions and exceptions will apply to uses from all sources of water and will only be effective when the Governor of Virginia declares a Drought Emergency through the issuance of an executive order. Water use restrictions shall not apply to the agricultural production of food or fiber, the maintenance of livestock including poultry, nor the commercial production of plant materials so long as best management practices are applied to assure the minimum amount of water is utilized.

### **Unrestricted irrigation of lawns is prohibited.**

- Newly sodded and seeded areas may be irrigated to establish cover on bare ground at the minimum rate necessary for no more than a period of 60 days. . Irrigation rates may not exceed one inch of applied water in any 7 day period.
- Gardens, bedding plants, trees, shrubs and other landscape materials may be watered with hand held containers, hand held hoses equipped with an automatic shutoff device, sprinklers or other automated watering devices at the minimum rate necessary but in no case more frequently than twice per week. Irrigation should not occur during the heat of the day.
- All allowed lawn irrigation must be applied in a manner to assure that no runoff, puddling or excessive watering occurs.
- Irrigation systems may be tested after installation, routine maintenance or repair for no more than ten minutes per zone.

### **Unrestricted irrigation of golf courses is prohibited.**

- Tees and greens may be irrigated between the hours of 9:00 p.m. and 10:00 a.m. at the minimum rate necessary.
- Localized dry areas may be irrigated with a hand held container or hand held hose equipped with an automatic shutoff device at the minimum rate necessary.
- Greens may be cooled by syringing or by the application of water with a hand held hose equipped with an automatic shutoff device at the minimum rate necessary.
- Fairways may be irrigated between the hours of 9:00 p.m. and 10:00 a.m. at the minimum rate necessary not to exceed one inch of applied water in any ten-day period.
- Fairways, tees and greens may be irrigated during necessary overseeding or resodding operations in September and October at the minimum rate necessary. Irrigation rates during this restoration period may not exceed one inch of applied water in any seven-day period.

- Newly constructed fairways, tees and greens and areas that are re-established by sprigging or sodding may be irrigated at the minimum rate necessary not to exceed one inch of applied water in any seven-day period for a total period that does not exceed 60 days.
- Fairways, tees and greens may be irrigated without regard to the restrictions listed above so long as:
  - The only water sources utilized are water features whose primary purpose is stormwater management,
  - Any water features utilized do not impound permanent streams,
  - During declared Drought Emergencies these water features receive no recharge from other water sources such as ground water wells, surface water intakes, or sources of public water supply, and,
  - All irrigation occurs between 9:00 p.m. and 10:00 a.m.
- All allowed golf course irrigation must be applied in a manner to assure that no runoff, puddling or excessive watering occurs.
- Rough areas may not be irrigated.

**Unrestricted irrigation of athletic fields is prohibited.**

- Athletic fields may be irrigated between the hours of 9:00 p.m. and 10:00 a.m. at a rate not to exceed one inch per application or more than a total of one inch in multiple applications during any ten-day period. All irrigation water must fall on playing surfaces with no outlying areas receiving irrigation water directly from irrigation heads.
- Localized dry areas that show signs of drought stress and wilt (curled leaves, foot-printing, purpling) may be syringed by the application of water for a cumulative time not to exceed fifteen minutes during any twenty four hour period. Syringing may be accomplished with an automated irrigation system or with a hand held hose equipped with an automatic shutoff device at the minimum rate necessary.
- Athletic fields may be irrigated between the hours of 9:00 p.m. and 10:00 a.m. during necessary overseeding, sprigging or resodding operations at the minimum rate necessary for a period that does not exceed 60 days. Irrigation rates during this restoration period may not exceed one inch of applied water in any seven-day period. Syringing is permitted during signs of drought stress and wilt (curled leaves, foot-printing, purpling).
- All allowed athletic field irrigation must be applied in a manner to assure that no runoff, puddling or excessive watering occurs.
- Irrigation is prohibited on athletic fields that are not scheduled for use within the next 120-day period.
- Water may be used for the daily maintenance of pitching mounds, home plate areas and base areas with the use of hand held containers or hand held hoses equipped with an automatic shutoff device at the minimum rate necessary.
- Skinned infield areas may utilize water to control dust and improve playing surface conditions utilizing hand held containers or hand held hoses equipped with an automatic shutoff device at the minimum rate necessary no earlier than two hours prior to official game time.

**Washing paved surfaces such as streets, roads, sidewalks, driveways, garages, parking areas, tennis courts, and patios is prohibited.**

- Driveways and roadways may be pre-washed in preparation for recoating and sealing.
- Tennis courts composed of clay or similar materials may be wetted by means of a hand-held hose equipped with an automatic shutoff device at the minimum rate necessary for maintenance. Automatic wetting systems may be used between the hours of 9:00 p.m. and 10:00 a.m. at the minimum rate necessary.
- Public eating and drinking areas may be washed using the minimum amount of water required to assure sanitation and public health.
- Water may be used at the minimum rate necessary to maintain effective dust control during the construction of highways and roads.

**Use of water for washing or cleaning of mobile equipment including automobiles, trucks, trailers and boats is prohibited.**

- Mobile equipment may be washed using hand held containers or hand held hoses equipped with automatic shutoff devices provided that no mobile equipment is washed more than once per calendar month and the minimum amount of water is utilized.
- Construction, emergency or public transportation vehicles may be washed as necessary to preserve the proper functioning and safe operation of the vehicle.
- Mobile equipment may be washed at car washes that utilize reclaimed water as part of the wash process or reduce water consumption by at least 10% when compared to a similar period when water use restrictions were not in effect.
- Automobile dealers may wash cars that are in inventory no more than once per week utilizing hand held containers and hoses equipped with automatic shutoff devices, automated equipment that utilizes reclaimed water as part of the wash process, or automated equipment where water consumption is reduced by at least 10% when compared to a similar period when water use restrictions were not in effect.
- Automobile rental agencies may wash cars no more than once per week utilizing hand held containers and hoses equipped with automatic shutoff devices, automated equipment that utilizes reclaimed water as part of the wash process, or automated equipment where water consumption is reduced by at least 10% when compared to a similar period when water use restrictions were not in effect.
- Marine engines may be flushed with water for a period that does not exceed 5 minutes after each use.

**Use of water for the operation of ornamental fountains, artificial waterfalls, misting machines, and reflecting pools is prohibited.**

- Fountains and other means of aeration necessary to support aquatic life are permitted.

**Use of water to fill and top off outdoor swimming pools is prohibited.**

- Newly built or repaired pools may be filled to protect their structural integrity.
- Outdoor pools operated by commercial ventures, community associations, recreation associations, and similar institutions open to the public may be refilled as long as:
  - Levels are maintained at mid-skimmer depth or lower,
  - Any visible leaks are immediately repaired,
  - Backwashing occurs only when necessary to assure proper filter operation,

- Deck areas are washed no more than once per calendar month (except where chemical spills or other health hazards occur),
- All water features (other than slides) that increase losses due to evaporation are eliminated, and
- Slides are turned off when the pool is not in operation.
- Swimming pools operated by health care facilities used in relation to patient care and rehabilitation may be filled or topped off.
- Indoor pools may be filled or topped off.
- Residential swimming pools may be filled only to protect structural integrity, public welfare, safety and health and may not be filled to allow the continued operation of such pools.

**Water may be served in restaurants, clubs, or eating-places only at the request of customers.**

**All residential, business and industrial water users; whether supplied by public water supplies, self-supplied sources, or private water wells; who do not normally utilize water for any of the listed prohibited uses are requested to voluntarily reduce water consumption by at least 10%. This reduction may be the result of elimination of other non-essential water uses, application of water conservation practices, or reduction in essential water uses.**

### **Water Rationing**

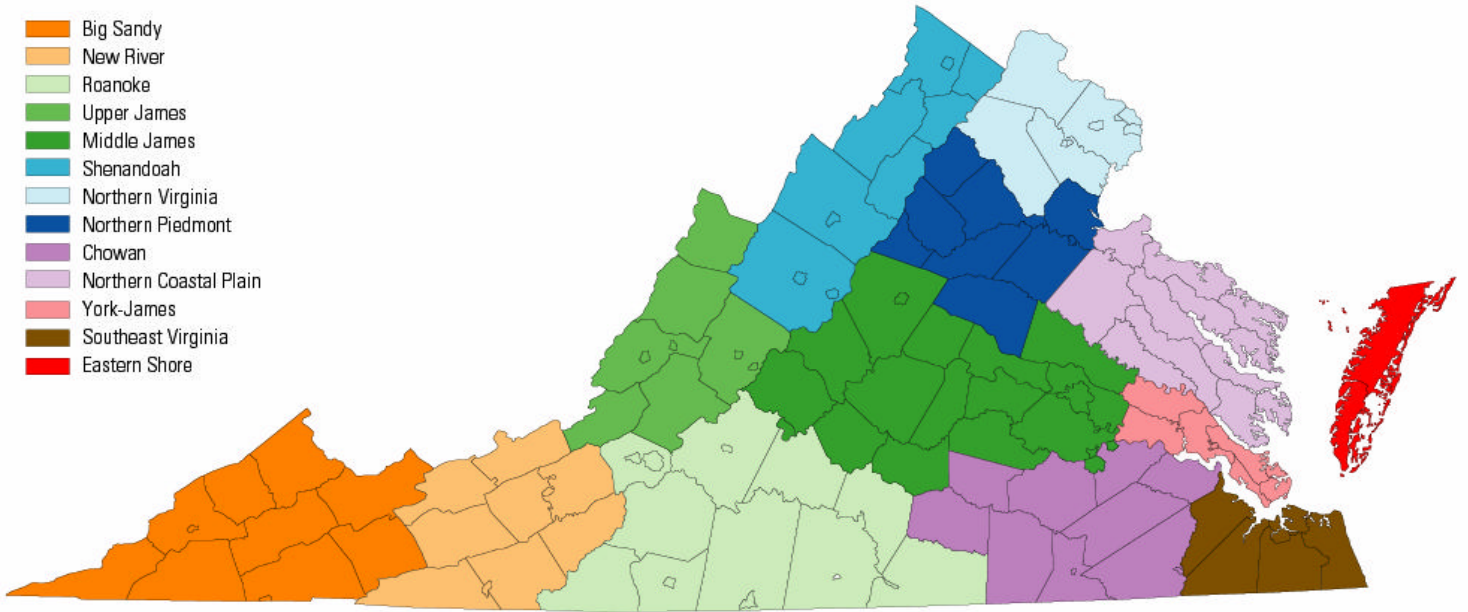
In some cases, the mandatory non-essential water use restrictions may not be sufficient to protect the supplies of an individual public waterworks. When an individual waterworks' sources are so depleted as to threaten public health and safety, it may become necessary to ration water within that system in order to assure that water is available to support essential uses. Rationing water is a more severe measure than merely banning nonessential uses of water. Under rationing, each customer is allotted a given amount of water, based on a method of allotment developed by the waterworks or local government. Generally it will be based on a percentage of previous usage or on a specific daily quantity per household. Rationing is more likely to have some effect on welfare than mandatory non-essential use restrictions, because industrial and commercial water uses may be curtailed or eliminated to assure an adequate supply is available for human consumptive uses.

The decision to ration water will typically be made by the local government or waterworks operator. The Virginia Drought Coordinator will work closely with any entity where water rationing is required to assure that all available State resources are effectively used to support these highly stressed water supply systems. The Virginia Department of Emergency Management (VDEM) is the first point of contact for waterworks or local governments who decide to ration water. VDEM will coordinate the Commonwealth's response and assistance to such entities.

# Appendix A

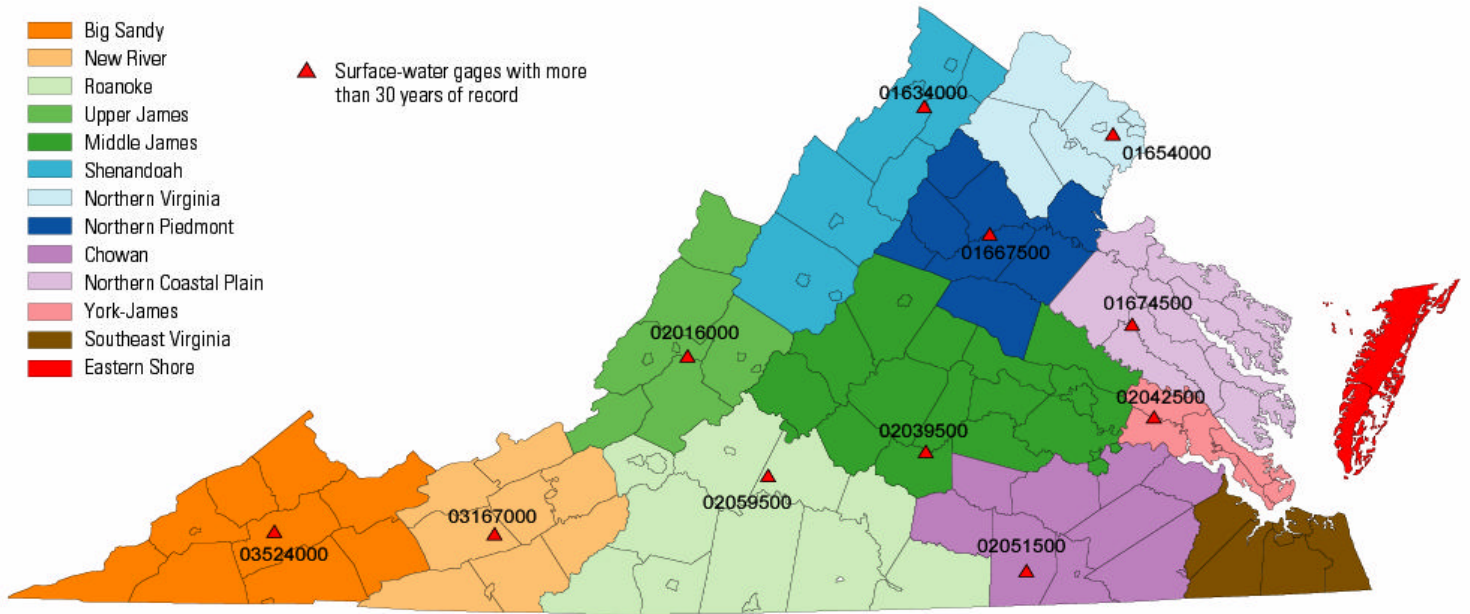
## State of Virginia Drought Evaluation Regions

- Big Sandy
- New River
- Roanoke
- Upper James
- Middle James
- Shenandoah
- Northern Virginia
- Northern Piedmont
- Chowan
- Northern Coastal Plain
- York-James
- Southeast Virginia
- Eastern Shore



# Appendix B

## State of Virginia Drought Evaluation Regions Surface-Water Drought Response Network



# Appendix C

## State of Virginia Drought Evaluation Regions Ground-Water Drought Response Network

