Chapter 4 A Comparison of Water Supply and Water Use across the Commonwealth

The WSP Regulation requires the compilation of information for existing water sources, uses, and projections of future water demand. This Chapter provides a view of the water sources, uses, and projected demand in the Commonwealth based upon information collected from local and regional water supply plans.

Identification of Water Planning Areas and Basin Assignments

Forty-eight local and regional water supply plans were developed and submitted to DEQ by planning entities between 2008 and 2011[57]. Of the 48, ten local governments elected to develop individual (local) water supply planning programs: the Counties of Amelia, Charles City, King George, New Kent, and Stafford, the City of Richmond, and the Towns of Chincoteague, Hillsboro, Port Royal, and Warrenton. The remaining localities committed to regional water supply planning with the development of 38 regional plans (Figure 4-1). Water supply planning areas are designated along county, city, and town boundaries and the water use data collected in plans is presented and summarized along these boundaries.

[57] See Appendix A

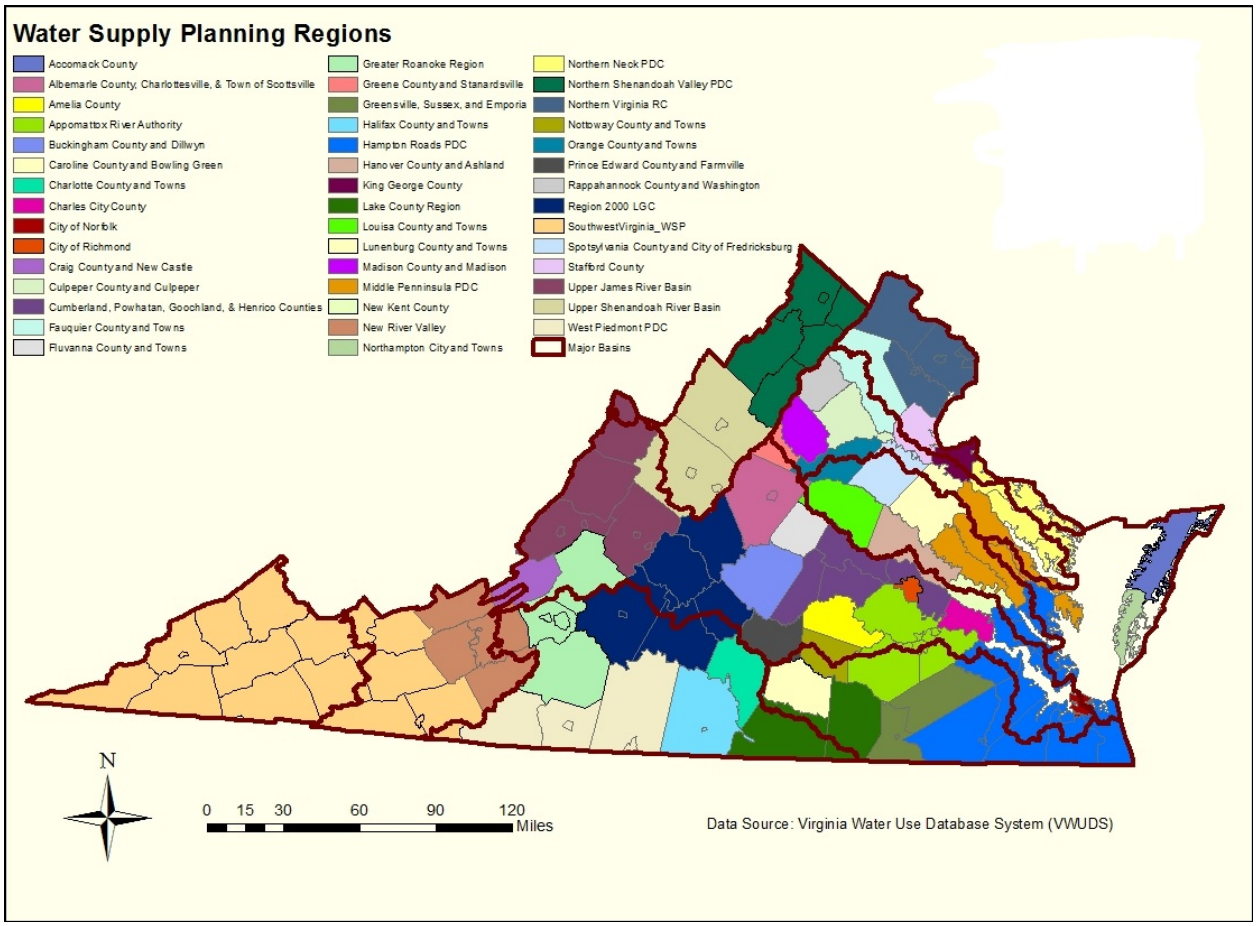

Figure 4-1: Local and Regional Water Supply Planning Areas in the Commonwealth

In Chapter 3, Figure 3-3 depicts the nine hydrologic (major basin) boundaries in the Commonwealth. Each basin includes a number of Hydrologic Unit Codes (HUC). In the State Plan, cumulative impact analysis, water use data from the local and regional plans is analyzed by the National Hydrography Database 8-digit Hydrologic Unit Code (HUC8) classification. There are 48 HUC8's in the Commonwealth.

Hydrologic units are drainage areas that are delineated so as to nest into a multi-level hierarchical drainage system. Aside from the surface waters that are collected within the boundary of a hydrologic unit, it may also accept water from one or more points outside of the unit's boundary. Hydrologic units may include associated surface areas whose drainages do not connect, thus resulting in multiple outlet points. This is usually the case with coastal units such as those containing multiple outlets to the Chesapeake Bay or Atlantic Ocean.

A HUC is a unique code assigned to hydrologic units in a hierarchical system initially created by the USGS. In 2006, new hydrologic unit delineation standards officially expanded the hierarchy from four to

six levels with HUCs 2 to 12 digits in length. A HUC8 is classified as a "sub-basin" level with average unit size of 703 square miles. The HUC8 classification is used in this State Plan as it is a convenient, reasonably-sized, and widely understood unit of watershed division for the purpose of reporting results that summarize resource availability, challenges, and strategies. The following Figure 4-2 depicts current water use by HUC8 in millions of gallons per day (MGD).

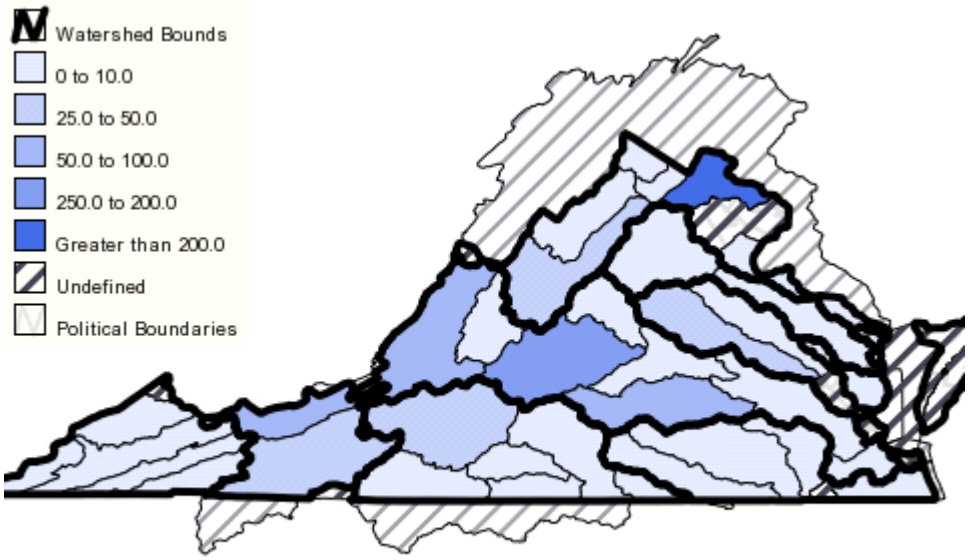

Figure 4-2 Current Water Use (MGD) in Virginia by HUC8

Water Source and Use Data Collection

Water users are sorted into four categories: community water systems, large and small self-supplied users, and agriculture. These are abbreviated CWS, SSU_LG, SSU_SM, and AG respectively and can use surface water or groundwater as sources. A CWS is a private or public waterworks that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents and is regulated by the VDH Waterworks Regulation.[58] Self-supplied users are defined as any person making a withdrawal of surface water or groundwater (e.g. a river, stream, lake, aquifer, or reservoir fed by any such waterbody) for his own use. Self-supplied users do not receive water from a community water system. SSU_LG are defined as those users of more than 300,000 gallons per month of surface water or groundwater for nonagricultural uses, including, but not limited to commercial (includes golf course irrigation), manufacturing, mining, and power. SSU_SM are defined as those users supplied by individual wells withdrawing less than 300,000 gallons of water per month. AG water use

[58] 12 VAC 5-590

data is collected for those agricultural operations withdrawing more than 300,000 gallons of water per month.

The data collected for the four category types in the local and regional water supply plans was obtained by local governments and planning entities through existing, readily available sources. Sources commonly used include local water purveyors, Virginia Department of Health Office of Drinking Water (VDH-ODW), and DEQ. As described in Chapter 2, Virginia's Collaborative Water Management Framework, DEQ collects water withdrawal data on an annual basis through the Virginia Water Withdrawal Reporting Regulation (VWWR). DEQ withdrawal data is stored in an online database, the Virginia Water Use Data System (VWUDS). The VDH-ODW collects monthly the raw water pumped and/or treated and the total water produced for CWS regulated under the VDH Waterworks Regulation. Data is stored at the local VDH-ODW field offices across the Commonwealth.

Through the water supply planning process, some planning entities determined that water source and use information was not always readily available for all users in a particular locality. Agriculture and golf course water use were two areas often lacking readily available data. When specific agricultural users were unknown in a locality or region, the United States Department of Agriculture's National Agricultural Statistics Service Census of Agriculture (NASS Census) data was often summarized in the plans. The NASS Census is confidential as required by law, collecting data from farm and ranch operations. NASS Census data is reported by county for total acres irrigated and total number of livestock. The plans using NASS Census used the data to estimate livestock and crop irrigation water use. The estimates based on the NASS Census are for all users in an entire county, not just the users of greater than 300,000 gallons per month. The amount of use derived from surface water versus groundwater is unknown. Although the data is not a best fit for what is required by the WSP Regulation, it does provide a basis for projections of future demand for the agricultural sector in a particular county and aids DEQ in understanding which counties reported the greatest number of irrigated acres.

The threshold for agricultural data outlined in the WSP Regulation differs from the threshold in the VWWR. The VWWR requires crop irrigation data for those withdrawing more than one million gallons in any single month. The WSP Regulation requires agricultural data (crop irrigation and all other agricultural uses) for those withdrawing more than 300,000 gallons per month. Therefore, it is possible the amount used for agricultural irrigation was underestimated by those planning entities using agricultural irrigation data collected by DEQ (VWWR) in the local and regional water supply plans. DEQ recognizes the need for compliance and is targeting nonreporters, including agriculture and golf course facilities, to increase the amount of data available for water supply planning.

Existing Water Sources

As reported in the local and regional water supply plans, approximately 800 surface water withdrawals (reservoir, stream, and spring sources) and 2,900 groundwater well withdrawals (excluding private groundwater wells) are used statewide (Figure 4-3). The number of groundwater sources for the SSU_SM use type is unknown and, therefore, is not included in Figure 4-3. As estimated for the year 2010 in the water supply plans, over 1.6 million people in the Commonwealth use private groundwater wells for residential water supply. Detailed source information is provided for each individual basin in Appendix B, Major Basin Summaries.

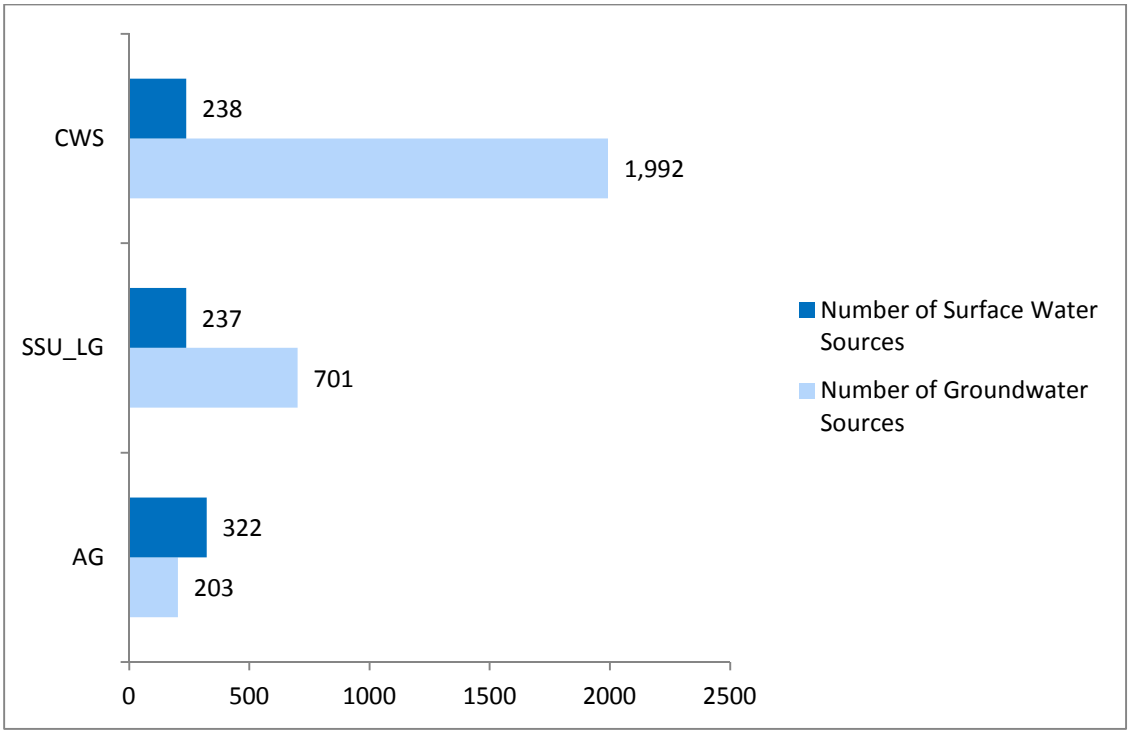

Figure 4-3: Statewide Source Type by User Type

The cumulative impact analysis in the State Plan predicts a net increase of over 30% in mean daily water supply demand over the planning period to 2040, which is consistent with the projected population increase within the Commonwealth. This increase in projected demand provides for special concern when dealing with groundwater withdrawals occurring in the Coastal Plain of Virginia and the associated GWMA, since groundwater resources are already oversubscribed, not sustainable for the long term at current use, and are contributing to increased land subsidence and saltwater intrusion potential. Therefore, localities will need to conduct a more in-depth alternative water sources analysis to allow for reduction of groundwater while still meeting their projected needs for water supply.

Nontraditional water sources, such as water reclamation and reuse, desalination, and interconnection are not commonly used by localities in the Commonwealth. However, there are a few localities taking advantage of these options. More information may be found in Appendix B, Major Basin Summaries.

Water withdrawn in the Commonwealth may be used by a withdrawing user or transferred to another user. The transfer of water within and between river basins is a demand management practice that can address water supply and/or water quality needs by moving water from a basin or sub-basin with surplus supply to a basin or sub-basin with a supply deficit. Most often this practice of transferring water across sub-basin boundaries within a major river basin - intrabasin transfers - occurs within a single county, but such transfers can occur across county lines. Intrabasin water transfers occur throughout the Commonwealth, primarily between CWS. Specific intrabasin transfer information is provided in Appendix B, Major Basin Summaries.

Water movement that occurs when water is withdrawn from one major basin and transferred to a user in another major basin is called an interbasin transfer. The interbasin transfer of water is less common in Virginia, but does take place. Specific interbasin transfer information is provided in Appendix B, Major Basin Summaries.

Current Trends in Off-stream Water Use

The categories of water withdrawals reported pursuant to the VWWR Regulation include agriculture, commercial, irrigation, manufacturing, mining, fossil fuel power, hydropower, nuclear power, and public water supply. The VWWR Regulation public water supply category correlates to the WSP Regulation's CWS category. The VWWR Regulation agriculture and crop irrigation categories are combined to represent the WSP Regulation's AG category. All remaining VWWR categories (commercial includes golf course irrigation), manufacturing, mining, fossil fuel power, hydropower, and nuclear power) are combined to represent the WSP Regulation category of SSU_LG.

The water use reported in the water supply plans exceeds the withdrawals reported to the VWWR in all three corresponding use categories by millions of gallons per day (MGD), as depicted in Figure 4-4. Data provided in the plans includes information for those users not currently required to report under the VWWR Regulation, such as CWS using less than 300,000 gallons per month, SSU_SM (< 300,000 gallons per month), and AG irrigation withdrawals of less than one million gallons per month. Although data collected by the VWWR Regulation is not as comprehensive as the data provided in the water supply plans, it does provide a historical reference for CWS, SSU_LG, and AG water use.

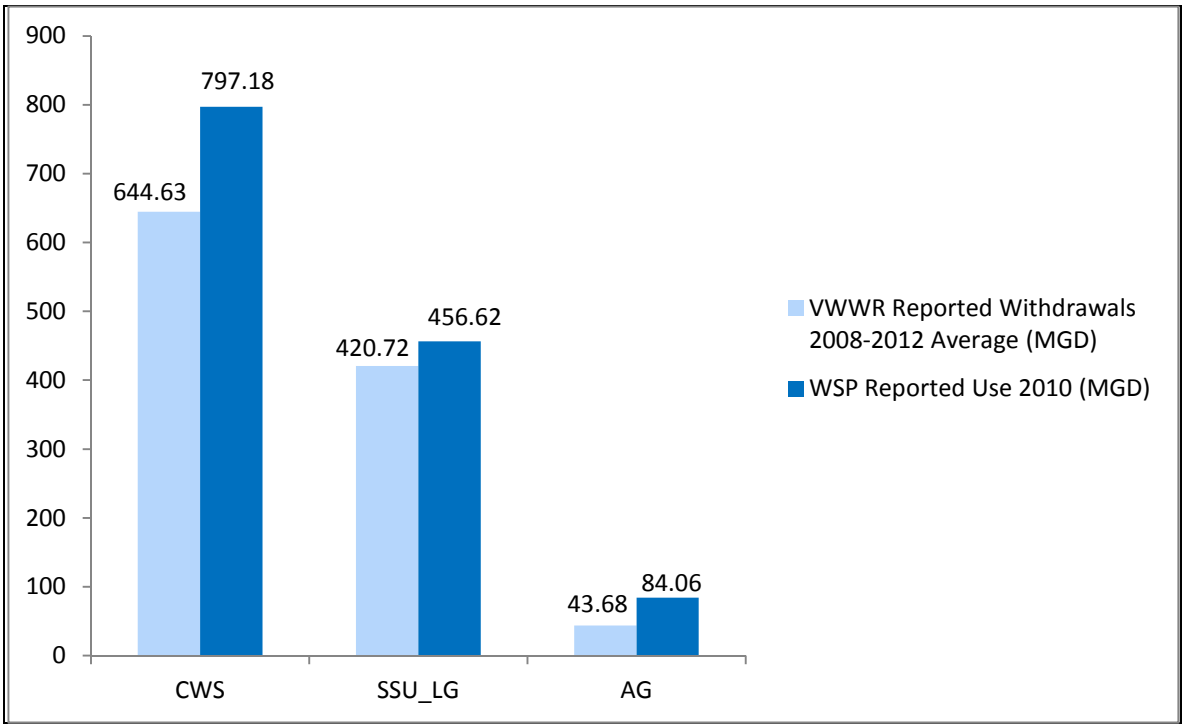

Figure 4-4: Statewide Water Withdrawal (VWWR) and Use (WSP) Comparison

It should be noted that a portion of the water reported as withdrawn by CWS and SSU_LG users with Virginia Pollutant Discharge Elimination System (VPDES) discharges is nonconsumptive, as some of the water is returned to the stream. Water diverted for hydropower use is essentially non-consumptive. These withdrawals are exempt from the VWWR Regulation and are generally not reported to the DEQ. A significant portion of water diverted for uses related to fossil fuel and nuclear power generation is also non-consumptive. For these reasons, the following summary of total statewide water withdrawals and use does not include water withdrawn for non-consumptive power cooling.

Figure 4-5 summarizes water withdrawals in Virginia as reported to the VWWR, averaged for the five-year time period of 2008 through 2012. The amount withdrawn was predominantly from surface water sources and totaled 1,109 MGD, with 931 MGD from surface water and 178 MGD from groundwater.

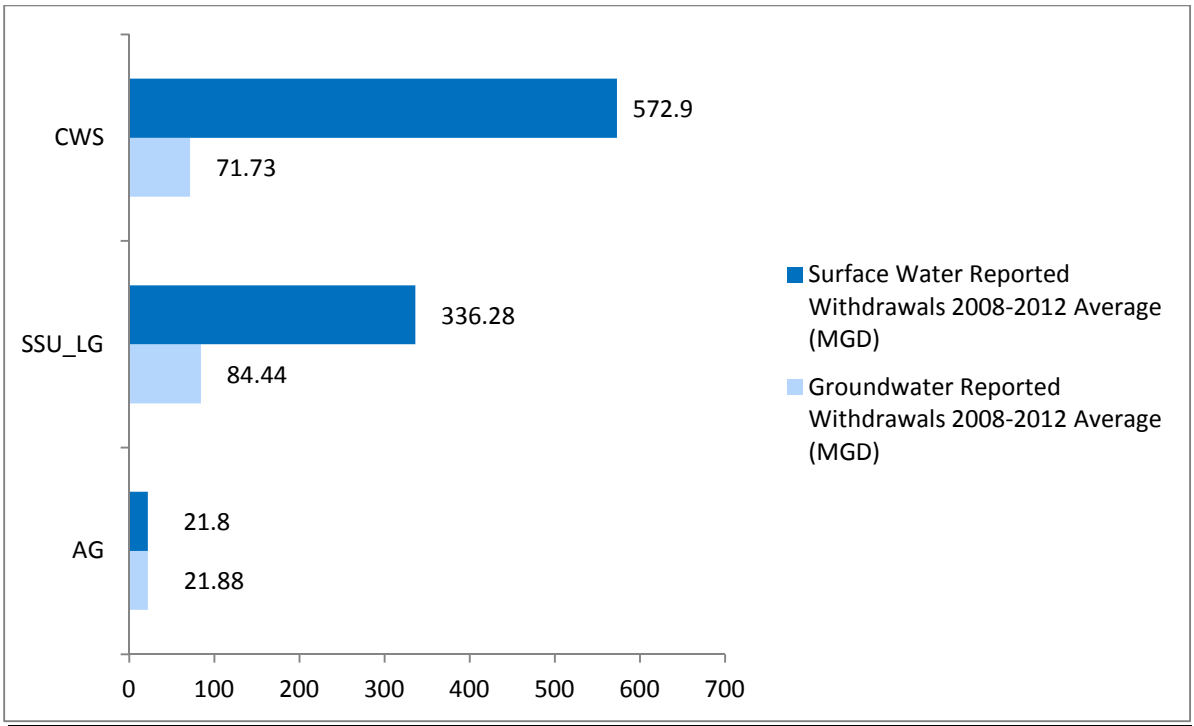

Figure 4-5: Statewide VWWR Average Reported Water Withdrawals by Source and Type

Water use reported in the local and regional water supply plans, excluding non-consumptive power cooling use, was predominantly from surface water sources. The total estimated water use was approximately 1,476 MGD, with 1,096 MGD from surface water and 380 MGD from groundwater (Figure 4-6). CWS, SSU_LG, and AG used more surface water than groundwater. SSU_SM uses solely groundwater. Statewide, totaling all use types and excluding non-consumptive power cooling, 74% of the 2010 water use was from surface water sources and 26% came from groundwater sources.

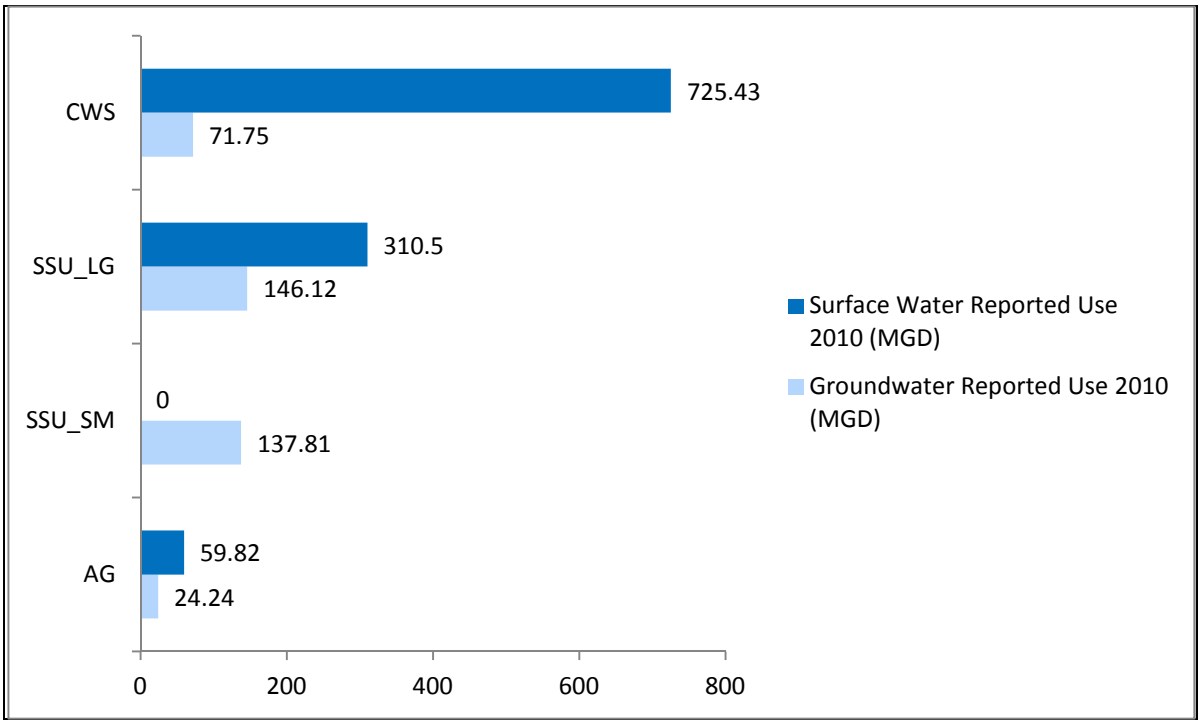

Figure 4-6: Statewide WSP Reported Water Use by Source and Type[59]

As shown in Figure 4-7, CWS used an estimated 54% of the total 2010 reported water use in the Commonwealth, followed by SSU_LG (31%), SSU_SM (9%), and AG with 6%.

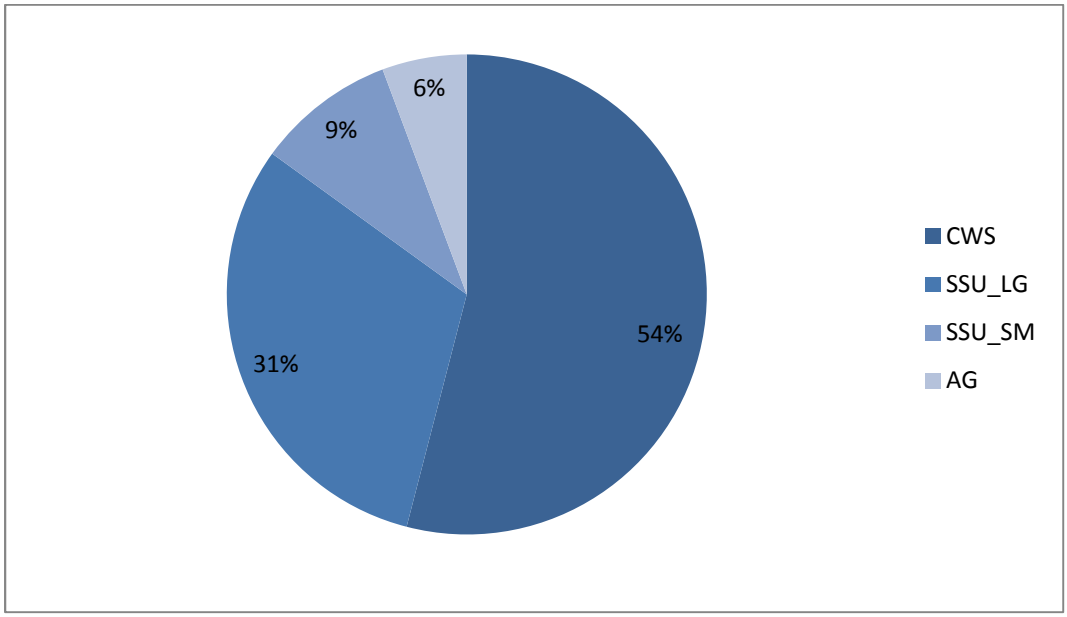

Figure 4-7: Statewide Percentage of WSP 2010 Reported Use by User Type

[59] Source: Local and Regional Water Supply Plans

The following tables provide an analysis of water use, excluding non-consumptive power cooling, for each of the four use category types as reported in the local and regional water supply plans. Water use is ranked from largest to smallest for each of the nine major basins.

The water use of CWS was approximately 797 MGD in 2010 (Table 4-1). The Potomac-Shenandoah River Basin reported the highest CWS use in the Commonwealth.

Basin	Reported CWS Use 2010 (MGD)
Potomac-Shenandoah	280.87
James	271.27
Roanoke	94.58
Albemarle-Chowan	36.57
Tennessee-Big Sandy	33.54
New	32.09
York	31.65
Rappahannock	13.54
Chesapeake Bay-Small Coastal	3.07
TOTAL	**797.18**

Table 4-1: Statewide WSP 2010 Reported CWS Use by Major Basin

The water use of SSU_LG (excluding non-consumptive power cooling) totaled approximately 457 MGD in 2010 (Table 4-2). The James River Basin reported the highest SSU_LG use in the Commonwealth.

Basin	Reported SSU_LG Use 2010 (MGD)
James	236.9
York	54.41
Albemarle-Chowan	48.97
New	39.51
Potomac-Shenandoah	34.4
Roanoke	25.41
Tennessee-Big Sandy	7.27
Chesapeake Bay-Small Coastal	5.64
Rappahannock	4.11
TOTAL	**456.62**

Table 4-2: Statewide WSP 2010 Reported SSU_LG Use by Major Basin

The water use of AG totaled approximately 84 MGD in 2010 (Table 4-3). The highest reported AG use occurred in the James River Basin.

Basin	Reported AG Use 2010 (MGD)
James	24.64
Roanoke	17.56
New	10.63
Potomac-Shenandoah	10.32
Tennessee-Big Sandy	5.71
Chesapeake Bay-Small Coastal	5.55
York	5.55
Albemarle-Chowan	3.09
Rappahannock	1.01
TOTAL	**84.06**

Table 4-3: Statewide WSP 2010 Reported AG Use by Major Basin

In 2010, approximately 138 MGD of groundwater was used for SSU_SM private residential supply statewide (Table 4-4). The James River Basin reported the highest SSU_SM residential use in the Commonwealth. The residential population served by private wells was estimated in the plans by taking the total population of a locality and subtracting the population served by CWS. The resulting population number was multiplied by a gallons per day (gpd) factor to determine the amount used on an annual average. The gpd factor varied depending on what was chosen by the planning entity and commonly measured between 75 and 100 gpd.

Basin	Reported SSU_SM Groundwater Use 2010 (MGD)
James	34.12
Potomac-Shenandoah	31.26
Roanoke	21.7
York	14.63
Rappahannock	10.33
Chesapeake Bay-Small Coastal	7.77
Albemarle-Chowan	7.38
New	6.55
Tennessee-Big Sandy	4.07
TOTAL	**137.81**

Table 4-4: Statewide WSP 2010 Reported SSU_SM Residential Groundwater Use by Major Basin

As noted above, non-consumptive power cooling use is excluded from the tables and figures. Table 4-5 reveals the amount of water used in each basin for non-consumptive power cooling. The 2010 statewide total was approximately 6,567 MGD, and the James River Basin reported the highest amount of non-consumptive water use for power cooling.

Basin	Non-Consumptive Power Cooling Use 2010 (MGD)
James	3,391.5
York	2,882.9
New	289.1
Roanoke	3.0
Chesapeake Bay-Small Coastal	0
Albemarle-Chowan	0
Potomac-Shenandoah	0
Rappahannock	0
Tennessee-Big Sandy	0
TOTAL	**6,566.5**

Table 4-5: Statewide WSP 2010 Reported Non-Consumptive Power Cooling Use by Major Basin

Projections of Future Off-stream Water Demand

The projected population by decade for the Commonwealth (2000 through 2040) is displayed in Figure 4-8. Population data is obtained from the Virginia Employment Commission's population estimates, which rely on data produced by the United States Census Bureau. The overall population is projected to increase through the year 2040. By the year 2040 the estimated population is projected to reach approximately 10,455,075, an approximate 32% increase, from 2010 to 2040.

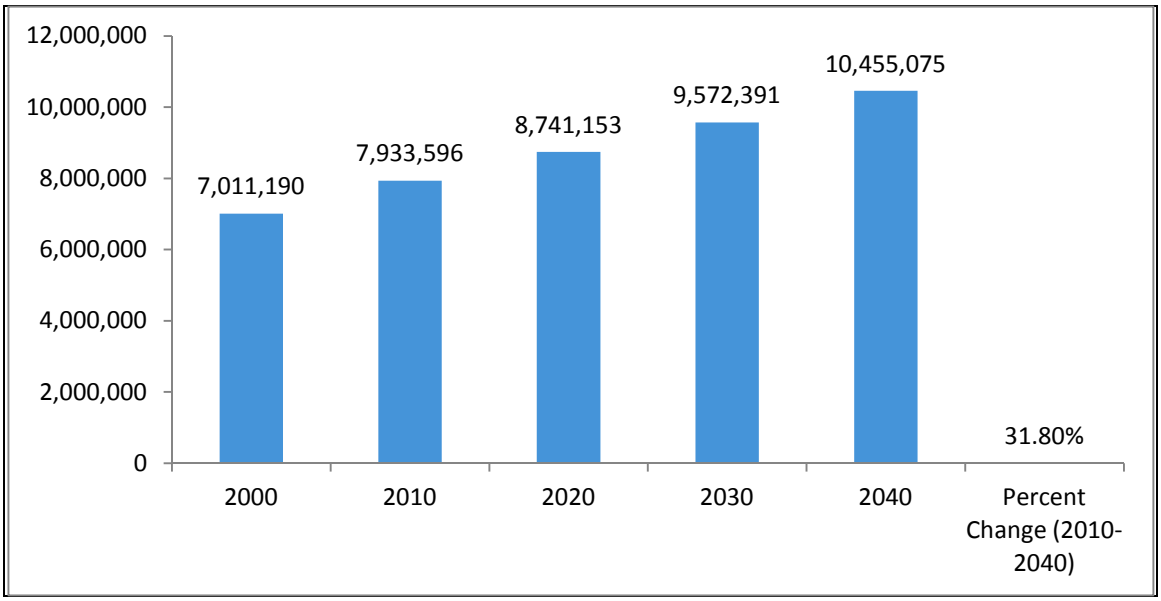

Figure 4-8: Statewide Projected Population by Decade (2000–2040)

The Commonwealth's projected water demand through the year 2040 is summarized in Figure 4-9. The total projected water demand as reported in the local and regional water supply plans is estimated to increase from 1,476 MGD to 1,935 MGD in 2040, or approximately 32% during the 30-year timeframe. Projections were derived using various methods selected by the planning entities, as outlined in each individual water supply plan. The methodologies applied, although varied, were reasonable and found to be consistent with the requirements of the WSP Regulation. Projections by major basin are described in Appendix B, Major Basin Summaries.

By 2040, an increase of approximately 450 MGD of water will be needed. This estimated 32% increase from 2010 is consistent with the percentage increase of population for the same time period.

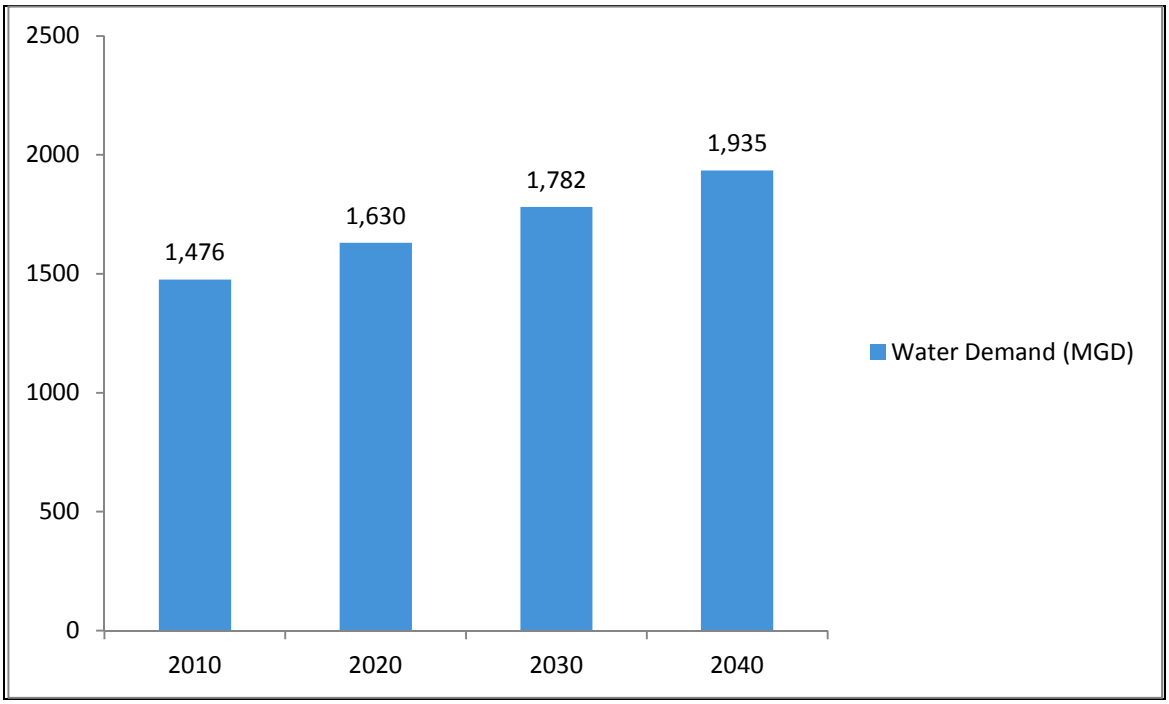

Figure 4-9: Statewide Projected Water Demand (2010 – 2040)

As viewed in Table 4-6, CWS show the largest percent change increase (38.7%) in water demand over the 30-year planning period, followed by SSU_SM (29.6%), SSU_LG (23.9 %) and AG (9. %).

User Type	Reported Use 2010 (MGD)	Projected Use 2020 (MGD)	Projected Use 2030 (MGD)	Projected Use 2040 (MGD)	Percent Change (2010-2040)
CWS	797.18	897.48	997.9	1,098.07	37.7%
SSU_LG	456.62	493.02	529.4	565.8	23.9%
SSU_SM	137.81	151.43	165.1	178.63	29.6%
AG	84.06	86.71	89.4	92.03	9.5%

Table 4-6: Statewide Projected Water Demand by User Type (2010-2040)

In 2040, the percentage of demand by user type shows an increase for CWS as compared to the percentage of current use. In 2040, CWS percentage of demand is estimated at 57%, an increase of 3% from the percentage of current use. SSU_LG follows with 29% of 2040 demand, a decrease of 2% when compared to the SSU_LG percentage of current use. The percentage of SSU_SM demand is projected to remain steady at 9% and the percentage of AG demands is projected to decrease to 5% of the total statewide demand (Figure 4-10).

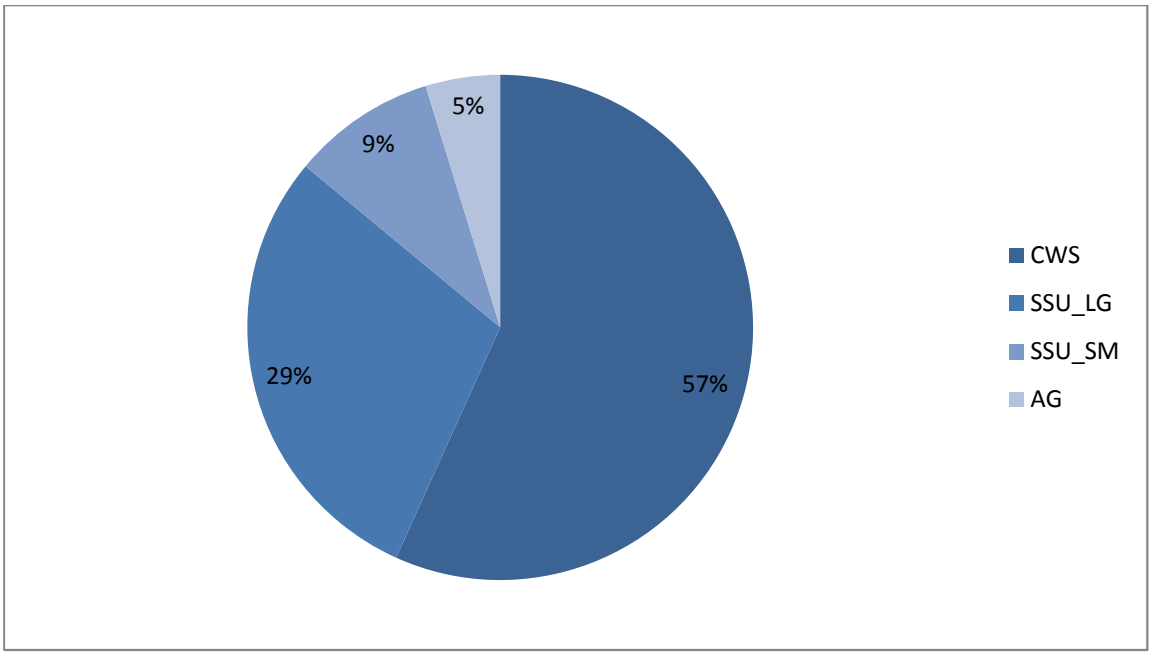

Figure 4-10: Statewide Percentage of 2040 Projected Demand by User Type

In 2040, 77% of the total projected water demand is estimated to come from surface water, an increase of 3% as compared to the percentage of 2010 reported use. The percentage of total 2040 water demand derived from groundwater sources is estimated at 23% which is a decrease of 3% when compared to the 2010 reported use. (Figure 4-11).

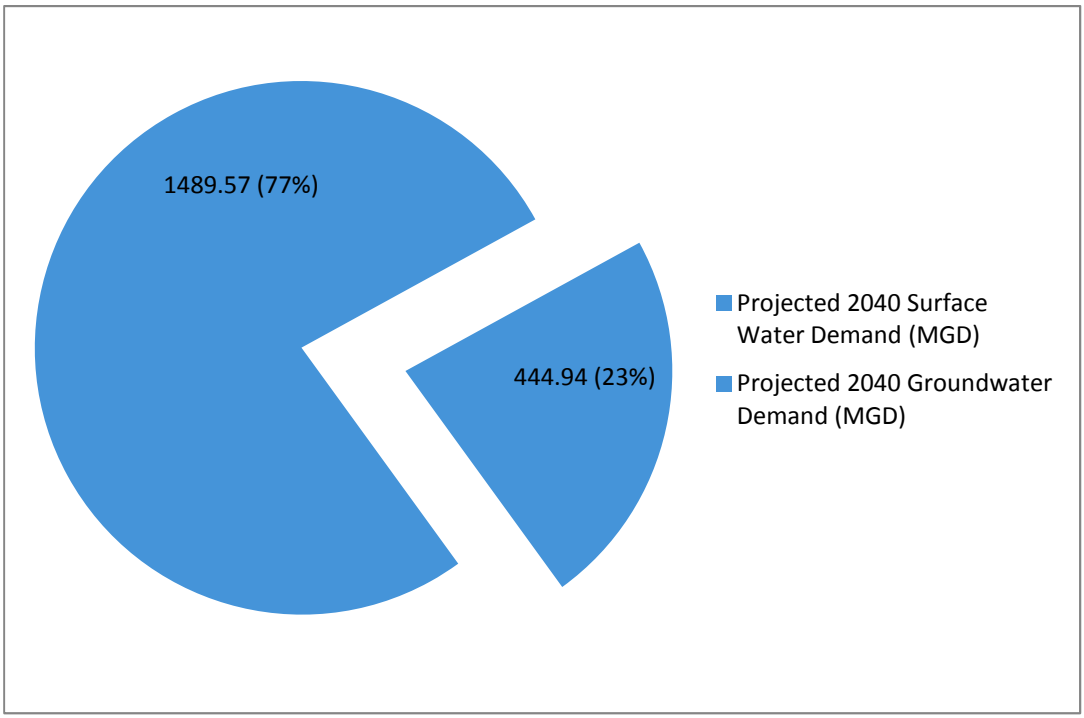

Figure 4-11: Statewide 2040 Projected Demand by Source Type

As shown in Figure 4-12, the total amount of surface water use is estimated to increase from approximately 1,096 MGD to 1,490 MGD in 2040. Groundwater use is estimated to increase from approximately 380 MGD to 445 MGD in 2040.

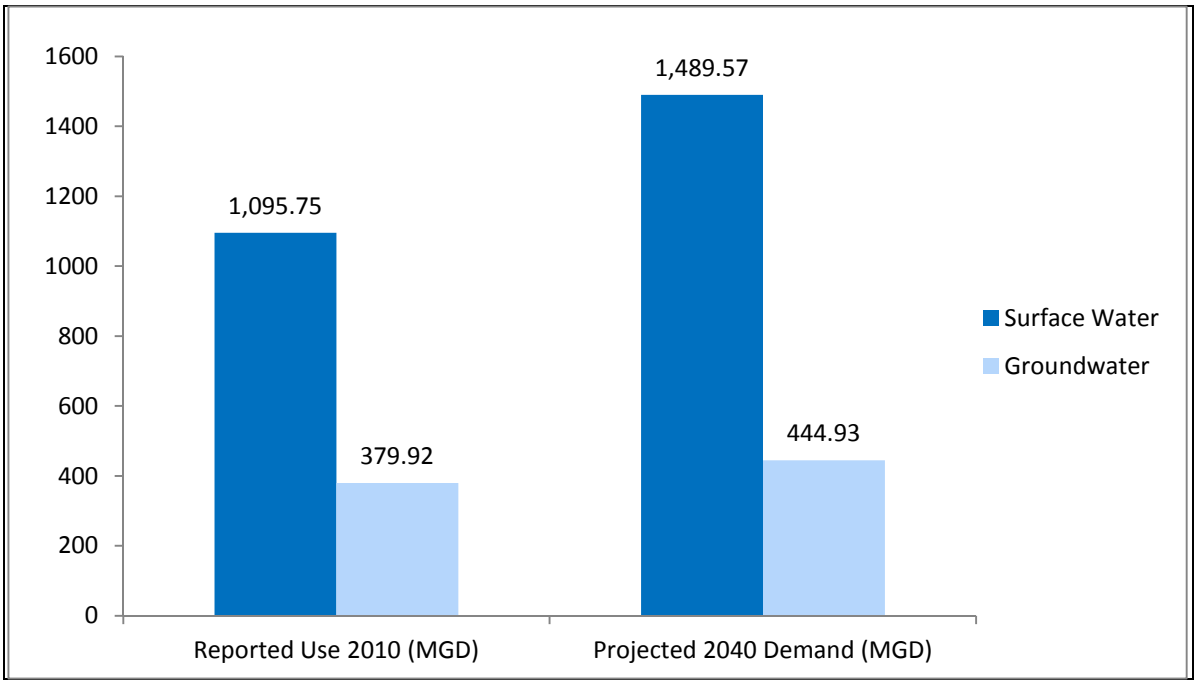

Figure 4-12: Statewide 2010 Reported Use and 2040 Projected Demand by Source Type