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To: The Honorable Timothy M. Kaine
And Members of the General Assembly

From: David K. Paylor

Date: October 1, 2007

Subject: Annual Status of Virginia's Water Resources Report

In accordance with Chapter 3.2 of Title 62.1 of the *Code of Virginia*, the Department of Environmental Quality has completed its annual report on the status of the State's water resources, including ground water.

The Department of Environmental Quality is committed to ensuring that adequate and safe drinking water is available to all citizens of the Commonwealth and protecting the beneficial uses of our state waters. The primary objective of this report is to document the status of Commonwealth's waters and to document the Department's water supply and resource planning accomplishments.

This report is being made available at www.deq.virginia.gov/regulations/reports.html. If you need further information or would like a hard copy of this report, please contact Rick Linker, Assistant Director of Legislative and Legal Affairs at 804-698-4195.

STATUS OF VIRGINIA'S WATER RESOURCES

A Report on Virginia's Water Resources Management Activities for Calendar Year 2006

A Report to the Honorable Timothy M. Kaine, Governor and the General Assembly of Virginia

Virginia Department of Environmental Quality
Division of Water Resources Management

October 2007

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I. EXECUTIVE SUMMARY

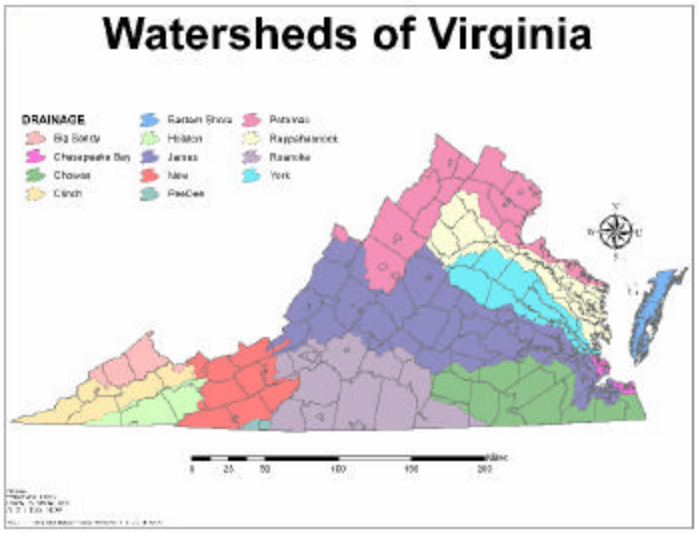
This annual report, submitted to the Governor and the Virginia General Assembly in accordance with Chapter 3.2 of Title 62.1 of the Code of Virginia, describes the status of the Commonwealth's surface and ground water resources, provides an overview of climate conditions and impacts on water supplies in the Commonwealth, and provides an update on the Commonwealth's Water Resources Management Program for Calendar Year 2006.

Virginia's current and future environmental quality, quality of life and economic growth depends on the availability of quality water resources. To assure that water resources are available for future generations, we must manage them wisely. With proper planning, our water resources are capable of serving multiple uses in a balanced manner. In the 21st century, sufficient water to meet our needs will not just happen, our resources must be continuously planned for so that they remain available to us and are protected from pollution and over use.

Virginia has an estimated 50,537 miles of streams and rivers and can be divided into twelve major watershed areas (**Figure 1**). Annual statewide rainfall averages almost 43 inches. The total combined flow of all freshwater streams in the state is estimated at about 25 billion gallons per day. The freshwater flow from Virginia's rivers into the Chesapeake Bay is approximately 9,727 million gallons per day. The 248 publicly owned lakes in the Commonwealth have a combined surface area of 162,230 acres. Additionally, many thousands of other small privately owned lakes and ponds are distributed throughout the state. Other significant water features of Virginia include approximately 236,900 acres of tidal and coastal wetlands, 808,000 acres of freshwater wetlands, 120 miles of Atlantic Ocean coastline, and more than 2,500 square miles of estuaries. A summary of Virginia's surface water resources is provided in **Appendix 1**.

Virginia's ground and surface water resources are actively managed by the Department of Environmental Quality's (DEQ) Division of Water Resources. This Division is comprised of the following programs: the Surface Water Investigations Program (SWI), the Ground Water Characterization Program (GWCP), the Ground Water Protection Program (GWP), the Water Supply Planning Program (WSP), and the Ground Water Withdrawal Permitting Program (GWWPP). Each of these program areas provides vital information needed to understand and effectively manage Virginia's water resources. Information from each of these program areas has been incorporated into this annual report.

Figure 1: Major Watershed Areas in Virginia



Sources: Watersheds – USGS; County Boundaries – DCR; All Other Data – VDGIF: VDGIF – Fish & Wildlife Information Services – LHFP, GISP 08/09/2007

The DEQ's Division of Water Resources and the U.S. Geological Survey (USGS) are the primary agencies responsible for collecting hydrologic data in Virginia. DEQ's data collection efforts are described in this annual report.

- Various surface water data is collected from 168 continuous-record stream gaging stations in the DEQ/USGS network.
- Various surface water data is also collected at more than 200 other miscellaneous measurement sites in the DEQ/USGS network.
- Various ground water data is collected from the 353 wells in the DEQ/USGS observation well network.
- Regional Ground Water Resources Reports are being developed based on regional and sub-regional ground water flow systems to document and describe the occurrence, movement, and availability of ground water.
- Water Well Completion Reports contain important information for characterizing ground water resources and for water supply planning. The bulk of this information is still in paper form and not readily accessible.
- A Geochemical Database of ambient water quality samples of water from 13,000 wells and springs throughout the State is under development.
- A geospatial database of springs throughout Virginia is being developed to locate and characterize these important sources of supply for municipalities, agriculture, and private landowners.
- In partnership with localities and the USGS, four new real-time ground water monitoring stations will be installed on existing wells in the Valley and Ridge region, and four will be installed in the Piedmont region.

The status of surface and ground water use for 2006 is described in this annual report. The following observations are made.

- In 2006, 86% of the total water used in Virginia came from streams or reservoirs.
- In 2006, public water supplies accounted for the greatest percentage (64%) of the total ground water and surface water used.
- Public water supplies in Virginia are 88% surface water sources and 12% ground water sources.
- In 2006, manufacturing was the second largest user with 32% of the total ground water and surface water used.
- The three largest water users by volume are the Honeywell Plant in Hopewell and the Potomac River and Occoquan facilities of the Fairfax County Water Authority.
- The annual report describes five year trends for the various categories of water use.
- The annual report describes the categories of 2006 water use for each of Virginia's major watersheds.

The annual report discusses how the state monitors drought conditions, impacts and outlook for 2006. The State's Drought Monitoring Task Force monitors the advance of drought conditions in the Commonwealth using "drought indicators" such as: precipitation deficits; streamflows; ground water levels; and reservoir storage as well as the Standardized Precipitation Index; Palmer Drought Severity Index; Crop Moisture Index, Keetch-Byrum Drought Index, and NOAA monthly and seasonal precipitation outlooks. DEQ maintains information about the current status of drought conditions and links to drought related web sites on the "drought monitoring" page of the Water Resources Management Website (http://www.deq.virginia.gov/waterresources/drought.php).

The 2006 activities of the DEQ's Division of Water Resources Programs are highlighted in this annual report, including:

Office of Water Supply Planning

- The Water Supply Planning Program requirements and deadlines are detailed. Individual program submissions are due beginning in 2008 and regional programs are due in 2011. Based on the current local activities it appears that the majority of Virginia's local governments will be pursuing regional approaches to their water supply planning efforts.
- The Water Supply Planning's Grant Program was established to assist in the cost of implementation. Over the course of the past three years, a total of 59 local government entities have submitted proposals for funding requests for a total of $2,545,067 through the Local and Regional Water Supply Planning Grants Program. The Local and Regional Water Supply Planning program has provided grants totaling $1,098,418 through this highly competitive process to partially fund efforts for development of water supply plans for a total of 37 local government entities.
- In FY 2008, DEQ awarded a total of $300,000 to thirteen local government authorities. All thirteen programs represent "regional" water supply plans assisting a total of 124 localities (17 Cities; 38 Counties; and 69 Towns).

Office of Ground Water Protection

- EPA granted final approval to Virginia's Wellhead Protection Program on May 26, 2005. Protection of ground water based public water supplies will be achieved through ongoing regulatory and non regulatory State programs and through voluntary participation by local governments with land use management authorities.

Office of Ground Water Permitting

- Virginia's two Ground Water Management Areas are desribed. Thirty years of water level observations in these Coastal Plain aquifers indicate a declining trend in water levels. Water levels are falling at a rate of about 2 feet per year in some aquifers.
- The GWWPP uses ground water flow models developed by the USGS to simulate the combined effects of all lawful withdrawals in order to evaluate resource availability for new or expanded uses.
- The most recent Total Permitted Simulation identifies four confined aquifers with areas where water levels are predicted to be below the regulatory threshold for permit issuance. Applications for ground water withdrawal permits that would result in additional impacts in those areas can not be permitted.

Surface Water Withdrawal Permitting

- The Office of Water Supply Planning provides technical analyses for all Virginia Water Protection Permits for surface water withdrawals.
- Water demand and instream flow impact analyses were conducted for a 15 billion gallon reservoir on Cobb Creek proposed to provide a reliable water supply to the counties of Cumberland, Powhatan, Henrico and Goochland. A proposal by the Rivanna Water and Sewer Authority to quadruple its useable water supply at the existing Ragged Mountain Reservoir was also evaluated.
- A series of amendments to the Virginia Water Protection Permit (VWPP) Regulation were developed to clarify and streamline the process for surface water withdrawals. With the aid of a broad coalition of stakeholders, DEQ eliminated some long standing ambiguity regarding what withdrawals are required to obtain a permit. In addition, major and minor

withdrawal categories were defined to streamline the application and review process for "minor" projects.

Managing Virginia's water resources is a complex and challenging task. The annual report identifies some of the individual program issues that are currently facing program staff and management.

Ground Water Characterization Program

- Additional investigation is needed in the Coastal Plain to better define the cone of depression in the Piney Point aquifer in James City and New Kent Counties and the area in Southampton County where simulated water levels in the Potomac aquifer are dropping below the critical surface of the aquifer.
- There is a need to investigate the existence and extent of deep ground water systems for industrial and municipal ground water supply in the Piedmont and Blue Ridge.
- There is a need to collect quality structural geologic data associated with existing wells with high yields in the Piedmont and Blue Ridge areas in order to identify other potential locations with high ground water yields.

Water Supply Planning Program

- State grant funds are significantly below locally identified needs and as a result, many worthy planning efforts have gone unfunded and not moved forward.
- By November 2, 2008, each local government will have to notify DEQ whether its first water supply program submission will be an individual local program or a regional program.
- Technical capabilities need to be developed so that the State Water Resources Plan can serve its identified function of identifying the water resource management consequences of the combined statewide water demand and the water resource development alternatives contained in local and regional water supply plans.
- The acquisition of new capacity data from surface water withdrawals excluded from permits may demonstrate that significantly less water is available for new and expanded uses in certain watersheds than has been previously understood.

Ground Water Permitting Program

- Since 2000, the total withdrawal amount allowed by all active permits has increased by more than 50%.
- Existing requests for new or expanded uses propose 6,000,000 gallons per day of withdrawal in areas of the Coastal Plain currently shown to be at or beyond the limits of the resource to sustain existing demands.
- As many as 37 permits will expire in the next two years and some are not expected to meet regulatory criteria required for reissuance at their current permitted amounts.
- The Ground Water Withdrawal Regulations require evaluation and potential revisions to assure that all resource management issues are addressed. Some potential revisions may require additional legislative authorizations.
- The implementation of new USGS models over the next year will require changes to existing procedures and may have regulatory implications.

II. Status of Hydrologic Data Gathering in 2006

The DEQ and the USGS are the primary agencies responsible for collecting hydrologic data in Virginia. The two agencies have worked cooperatively since 1925, except for a period between 1957 and 1967 when they operated independently. Individually, the agencies carry out their own agendas in the collection of hydrologic data. Together, they provide a comprehensive picture of hydrologic conditions in the Commonwealth. The Office of Surface Water Investigations (SWI) is the primary data collection arm of the Water Resources Division.

II.A. Surface Water

To collect systematic hydrologic data on surface water levels, flow volumes, and other streamflow data, the SWI operates 73 continuous-record real time stream gaging stations. Data from these stations are uploaded to the USGS website using satellite technology. In addition surface water data is collected at more than 100 other miscellaneous measurement sites. The continuous-record gages are located primarily on larger, free-flowing hydrologically significant streams whereas 58 of the DEQ miscellaneous measurement sites are largely in support of the TMDL program. The USGS operates 95 continuous-record gages and more than 100 miscellaneous measurement sites in Virginia. The USGS also collects information from 5 stage and reservoir stations and 4 tidal gauges. The USGS collects water quality data at 13 continuous-record gaging stations. Discrete water quality samples are collected from 29 sites throughout the Commonwealth. The USGS also operates 13 gages that provide stage (surface level height) data for lakes and reservoirs. The flow, lake level, water quality, and miscellaneous measurement data are published in *"Water Resources Data, Virginia - Volume 1: Surface water and surface-water-quality records"*, an annual report cooperatively prepared by the DEQ and the USGS. The gages farthest downstream in each major river basin are used to summarize or index the hydrologic condition of the Commonwealth for any given water year. Water years run from October 1 through September 30.

II.B. Ground Water

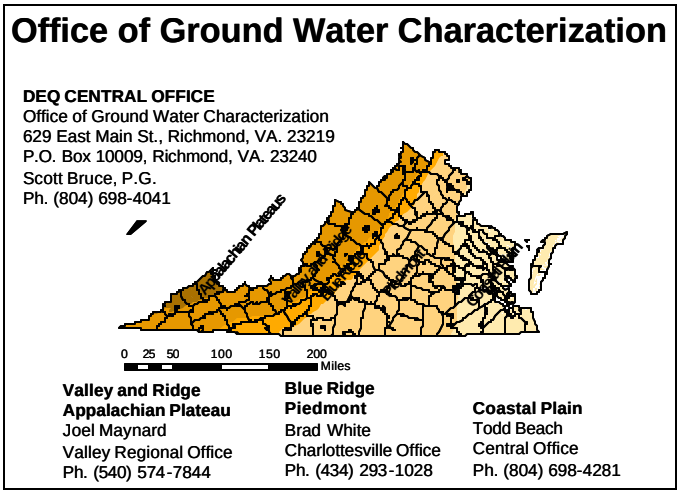
The DEQ collects data on ground water levels at 240 wells. Of these wells 41 have been converted to real time monitoring with measurements captured once every 15 minutes and uploaded using satellite technology; 163 are read quarterly by steel tape; and 36 are read yearly by steel tape. The USGS collects ground water levels data at 218 wells, with water quality data being collected at 18 of those wells. These data are published in *"Water Resources Data, Virginia - Volume 2: Ground water and ground-water-quality records"*, which is cooperatively prepared annually by the DEQ and the USGS. The ground water levels data collected by the DEQ contributes to a long-term Coastal Plain ground water modeling project with the USGS. DEQ continues to cooperate with the USGS on a multi-year effort to update and revise existing ground water flow models to better manage the ground water resources of the Virginia Coastal Plain. The revised models are expected to be implemented next year.

II.C. Ground Water Characterization Program Description and Overview

DEQ established the Office of Ground Water Characterization (OGWC) in response to negative impacts experienced by many localities, businesses, and domestic well users during the drought of 2002 and to assist localities in the collection and interpretation of ground water data necessary to support the development of local water supply plans. The office has been fully staffed since February 2006 by three regional staff members assigned to the Coastal Plain, the Piedmont-Blue Ridge, and the Valley-Plateau (**Figure 2**).

The organizational objective of the Office of Ground Water Characterization is to protect Virginia's environment and promote the health and well being of its citizens by collecting, evaluating, and interpreting technical information necessary to manage ground water resources of the Commonwealth. The OGWC staff works to assure that necessary information is available to support resource management decisions and water supply planning activities, assess ground water availability, facilitate drought monitoring, and provide technical support for the expansion or creation of ground water management areas.

Figure 2: Office of Ground Water Characterization Contacts



Initial efforts in 2006, included cooperation with other state and federal agencies involved with ground water related activities to compile historical water well construction, withdrawal data, and water quality data into a GIS database as well as developing procedures to automate the acquisition of new data. Long range goals include expansion of the State Observation Well Network west of the fall line and in Virginia's Northern Neck peninsula and publication of regional ground water resources reports.

II.C.1. Regional Ground Water Reports

During the late 1970s and early 1980s, State Water Control Board (SWCB) geologists compiled 18 Ground Water Resources Reports to document the availability, utilization rates, and water quality of ground water resources within selected counties and political sub-regions of Virginia. To this day, these ground water resource reports are the only readily available published source of information pertaining to the occurrence, movement, and availability of ground water for a large number of the investigated areas. Although the majority of these historical reports are out-of-print, the reports will be made available online on the OGWC web-site which is currently under development.

In addition to these reports, the OGWC is compiling recent and historical ground water and geologic data from multiple databases and water resource investigations into three regional reports intended to document the occurrence, movement, and availability of ground water within the state of Virginia. The regional report format for inventorying ground water resources will address those portions of the state that were previously uninvestigated by the SWCB and will present Virginia ground water resources based on regional and sub-regional ground water flow systems rather than by political boundaries. These reports will document and describe the geologic controls on the occurrence, movement, and availability of ground water in Virginia, and will summarize current ground water withdrawal rates and trends. These reports will be made available to the public via the OGWC web site, and are intended to be of greatest use to state and local planners, consultants, and interested citizens.

II.C.2. Statewide Well Construction Database

Well construction data is one of the basic "building blocks" required to analyze ground water conditions. Over the years, water well information has been collected by different state and federal agencies for a variety of purposes. These agencies include the Virginia Division of Mineral Resources, Virginia Division of Water Resources, Virginia SWCB, Virginia Department of Health, Virginia DEQ and the USGS. Well construction data has been collected in different formats, for different

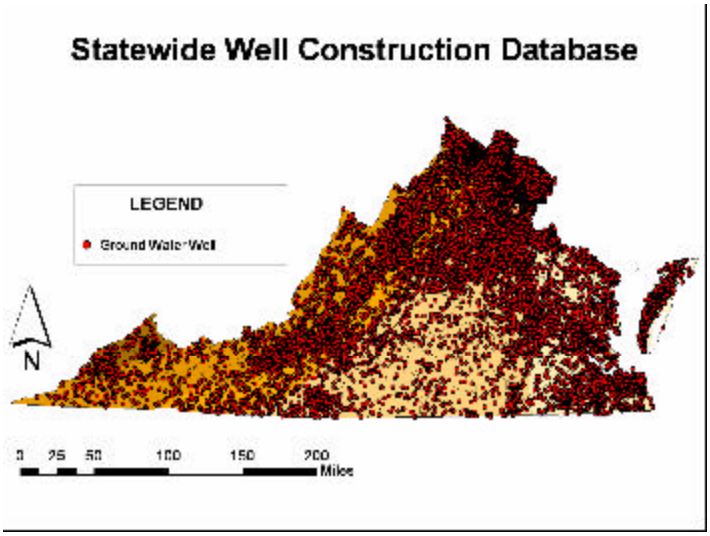
purposes, with different degrees of accuracy regarding physical well location.

OGWC has begun the effort of compiling all available historic well construction records into a GIS database. The current coverage of wells incorporated into the Statewide Well Construction Database is displayed in **Figure 3**.

VDH currently collects well construction records for all private wells and public water supply wells and is the largest single source of well construction information in the Commonwealth. OGWC is currently working with VDH in an attempt to standardize requirements for locating private wells. It is hoped that VDH's revised Private Well Construction Regulations will require global positioning system locations for all well construction records.

An effort is underway by the Virginia Water Well Association and a firm called Groundwater Dynamics to distribute electronic groundwater well completion software called "AquiPort" to drillers around the state. DEQ and VDH participated in the development of the software and are supportive of electronic submittal of water well completion reports and the distribution of this software to drillers and local governments.

Figure 3: Statewide Well Construction Database



II.C.3. Statewide Geochemical Database

The OGWC is compiling a master database of ambient water quality samples from wells and springs throughout the State. Ambient water quality data comprising this database originates from a number of Federal and State databases and includes major ion geochemistry and field parameters for approximately 13,000 geo-referenced wells and springs. When combined with location data, ambient water quality samples from wells and springs provide valuable information about the background concentrations of naturally occurring constituents and field parameters of ground water flow systems. In addition to their value in delineating natural ground water flow systems, it is anticipated that these data will be used by municipalities, consultants, and state and federal agencies for a wide variety of applications such as determining the extent and magnitude of elevated concentrations of undesirable constituents to optimize well placement to ensure high quality drinking water for private residences and municipalities.

II.C.4. Statewide Spring Database

An initiative is underway by OGWC to locate, characterize, and publish a database of springs throughout Virginia with an emphasis on the predominantly carbonate terrains of western Virginia. Springs are important water resources for municipalities, agriculture, and private landowners. Locations and discharge measurements of springs is an important component of any hydro-geologic analysis and is increasingly sought after by resource managers. No comprehensive analysis of springs has been undertaken by the state of Virginia since 1930.

The OGWC is in the process of creating a statewide spring database. Spring locations are largely unmapped in most parts of the region and limited information is fragmented between DEQ, DCR, USGS, and Virginia Division of Mineral Resources (VDMR) about the location, discharge, and basic water quality of such waters. A comprehensive

database of this basic information is necessary to develop an understanding of regional water resources in complex terrains such as the carbonate aquifers of western Virginia. This geospatial database will also have value to other programs in DEQ such as Pollution Reports Program (PREP) and the Petroleum Storage Tank Program that deal with subsurface contaminant transport. Working agreements, standardized forms and definitions are being developed by OGWC that will be used by field personnel in sister agencies such as DCR, and VDMR in order to multiply the rate of identification and entry of new springs into a central database that includes spring locations, morphology, discharge, and basic geo-chemistry.

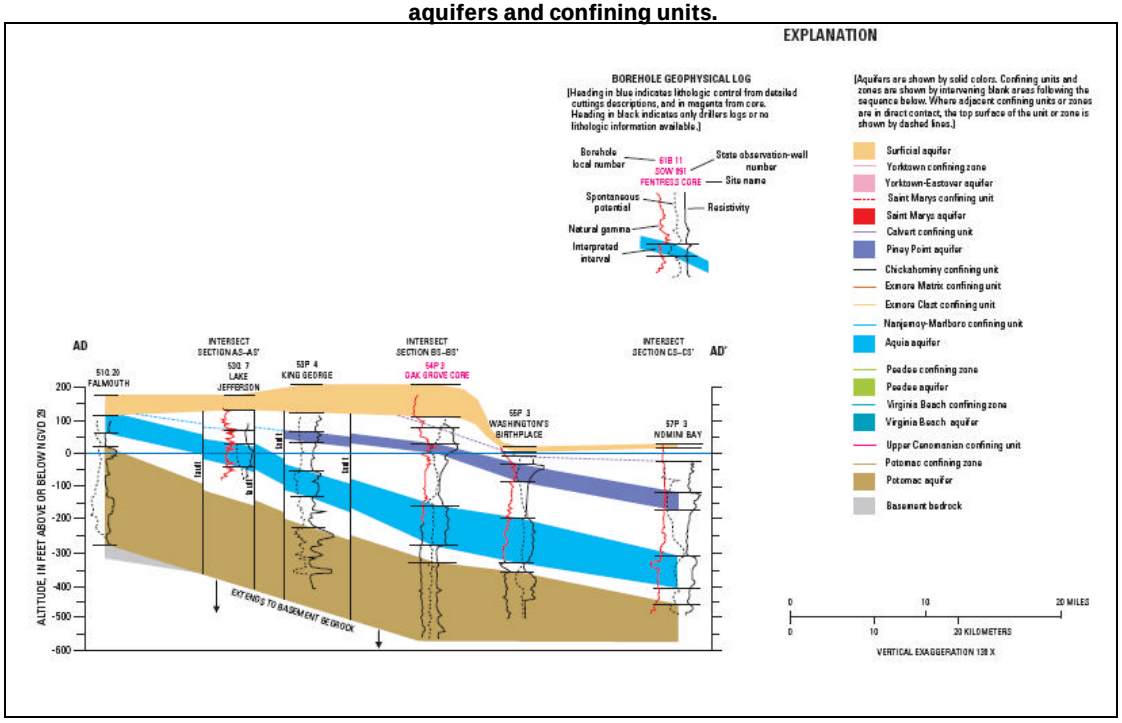
OGWC geologists are equipped with global positioning systems that are used to located springs with sub-meter horizontal accuracy. After locating the spring with the GPS unit, spring morphology is catalogued, and a discharge measurement is taken if possible using a variety of flow-meters, flumes, and volumetric devices. Basic geochemistry parameters such as pH, conductivity, total dissolved solids, temperature, dissolved oxygen, and salinity are also collected during an OGWC geologist site visit.

II.C.5. Geophysical Logging Program

The OGWC operates, in cooperation with the USGS, a geophysical logging truck that staff geologists use to evaluate individual wells throughout the Commonwealth. The truck is equipped with instruments that analyze various geophysical properties of the geologic formations that a well penetrates. In addition instruments are available that measure water flow through discrete intervals of a well and measure the size and shape of the borehole. The truck also has tools on-board that will produce oriented imagery of the borehole.

Geophysical equipment is used differently in the various regions due to the various types of geology in which wells are constructed. In the ground water management area of the Coastal Plain, where nearly horizontal unconsolidated units produce discrete water-bearing and confining units each unit tends to produce a distinctive geophysical signal that helps to define the occurrence of aquifers over great distances (**Figure 4**).

Figure 4: Example of two dimensional cross section through the multi-aquifer system using bore hole geophysical logs to correlate aquifers and confining units.



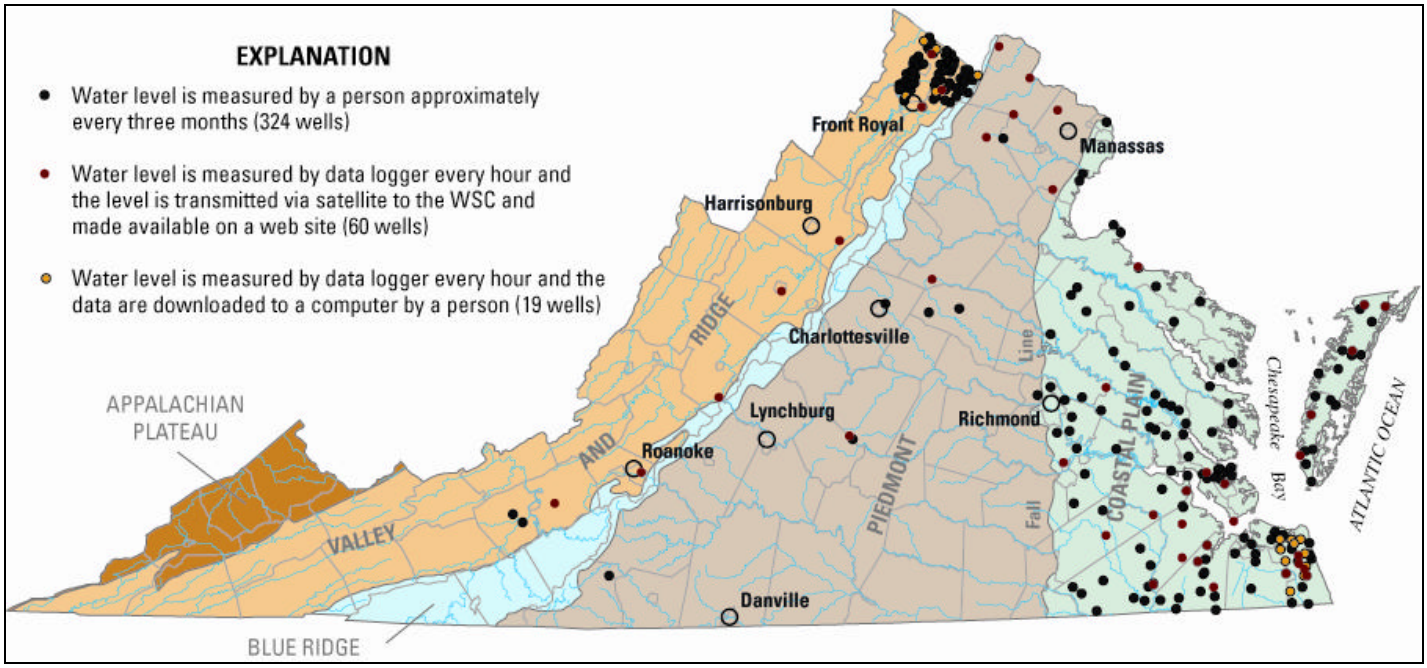
Source: USGS Professional Paper 1731

In the fractured "hard-rock" terrains of Piedmont, Blue-Ridge, Valley, Ridge, and Plateau wells are characterized using imaging tools, tools to measure flow within the well, bore-hole cameras, and caliper instruments to measure the size and shape of the borehole. Unlike the Coastal Plain where water flows around grains of aquifer material, ground water in central and western Virginia flows through fractures, bedding planes, folds, faults, and voids. Instruments that can image the bore-hole aid the geologist in mapping these components of the regional ground water flow system.

II.C.6. State Observation Well Program

Ground water data collected from wells in the current state observation network is described in Section II.B. **Figure 5** illustrates the current coverage of all water level observation wells maintained by DEQ and USGS throughout Virginia.

Figure 5: Current status and distribution of the DEQ/USGS Ground Water Observation Well Ne twork.



The OGWC has designated a limited amount of existing funding to expand Virginia's real-time state observation network (SOW) that is operated in cooperation with the USGS Virginia Water Science Center (http://waterdata.usgs.gov/va/nwis/current/?type=gw). Most existing real time wells are located in the Coastal Plain region of eastern Virginia (45 out of 61). Eight real-time research stations are located in the Piedmont region and eight are located west of the Blue Ridge Mountains (figure 5). Considerable effort is underway to establish a higher density of real-time monitoring wells west of I-95. This year, four new real-time stations will be established in existing wells in the Valley and Ridge region, and four will be established in existing wells in the Piedmont region.

One use of information obtained from observation well networks is the development of a conceptual regional hydrogeologic framework. DEQ's effort in this regard has been concentrated in the Coastal Plain for the last several decades and has been a cooperative undertaking with the USGS. This cooperative effort between DEQ and the USGS has resulted in the publication of an award winning scientific report. Professional Paper #1731, *The Virginia Coastal Plain Hydrogeologic Framework*, coauthored by E. Randolph McFarland (USGS) and T. Scott Bruce (DEQ) was published this year. The

paper was recently made available online at http://pubs.usgs.gov/pp/2006/1731/pp1731_download.htm and a limited number of copies are expected to be published in late 2007. The paper received the USGS's 2006 David A. Aronson Award. The Aronson Award is presented annually in the Northeastern Region USGS for the report that best exemplifies the qualities of timeliness, scientific content, organization, and clarity of expression. The award is presented to a Water Science Center in recognition that the planning, writing, and reviewing of a report involve the cooperative effort of many people. This report presents the results of a multi-year study completed in cooperation with the DEQ, the USGS and the Hampton Roads Planning District Commission. The report presents an in-depth synthesis and new region-wide interpretation of information from the Chesapeake Bay impact crater studies and from other recent studies. In so doing, it provides a timely revision of the hydrogeologic framework for the Virginia Coastal Plain that was developed during the USGS Regional Aquifer-System Analysis (RASA) program in the early 1980's.

The OGWC is moving forward with an initiative to refine the hydrogeologic framework of the Northern Neck and install a series of Research Stations, each comprised of several State Observation Wells (SOWs), in the Northern Neck Counties. This initiative will utilize several existing deep borings on the Northern Neck peninsula in conjunction with the recently completed deep core hole at Surprise Hill in Northumberland County to develop a more accurate and detailed hydrogeologic framework for the Northern Neck Peninsula than what is currently available. The deep boring at Surprise Hill was completed in April 2007 with funding provided through a cooperative agreement between DEQ, the USGS, and the Northern Neck Planning District Commission (PDC). This boring provided a more complete geologic cross section of the Northern Neck peninsula and SOWs will be designed and installed to monitor water levels in the aquifers identified at that location. Current plans are to develop a series of small contracts, (ideally awarded to small local drilling contractors in order to reduce costs), to install the monitoring wells at the Surprise Hill site during FY07-08.

II.C.7. Public Outreach and Data Dissemination

OGWC has given numerous presentations to state agencies, local governments, planning districts, schools, trade organizations and non-governmental organizations concerning a wide range of ground water related issues. Providing educational outreach to members of the Commonwealth is seen as one of the most important opportunities in gaining awareness of the wide range of viewpoints and issues affecting the region.

An alpha version of the Virginia water well construction and geochemical database has been distributed upon request to numerous localities and consultants contracted by localities for water supply planning efforts, and to consultants contracted by private industry for pinpointing and investigating potential well sites for prospective industries. In order to more readily disseminate ground water related information, OGWC is in the process of developing a web-site that will be used to house and provide access to ground water reports and databases.

III. Status of Water Use in 2006

The most recent water use report by the USGS, titled *"Estimated Use of Water in the United States in 2000"* estimated that 75 percent of Virginia's population is served by public water supply systems and 25 percent is supplied through private wells. Surface water sources supply 88 percent of the public water, and ground water sources supply the remaining 12 percent. The 2000 publication is the latest in print. The publication is updated and re-compiled every five years. Data collection for the USGS report, *"Estimated Use of Water in the United States in 2005"* is in progress and the report will be published later this year.

III.A. 2006 Water Use

The Virginia Water Withdrawal Reporting Regulation (9 VAC 25-200-10 et seq.) requires that individuals or facilities that withdraw water at volumes greater than 10,000 gallons per day (gpd) (one million gallons per month for crop irrigators) must measure and report annually to DEQ the monthly volume of water withdrawn. The Virginia Water Use Data System (VWUDS) database contains withdrawal data collected since 1982 under this regulation. The information presented below represents reported water withdrawals by category as set forth by the water withdrawal reporting regulation. The Type of Water Use Categories identified in the VWUDS database include: Agriculture; Commercial; Irrigation; Manufacturing; Mining; Other; Power Fossil; Hydropower; Power Nuclear; and Public Water Supply. Withdrawals of less than 10,000 gpd are exempt from the reporting requirements and are not included in this report. Overall, reported 2006 water use decreased slightly over that reported in 2005.

III.A.1. 2006 Water Use - Category of Use

Figure 6 shows the water usage in 2006 by categories of use. It shows that in 2006, public water supplies accounted for the greatest percentage (64%) of the total ground water and surface water use in Virginia. Manufacturing use in 2006 remained significant as well with 32% of the total ground water and surface water use.

Figure 6: % of Total Water Use by Category for 2006

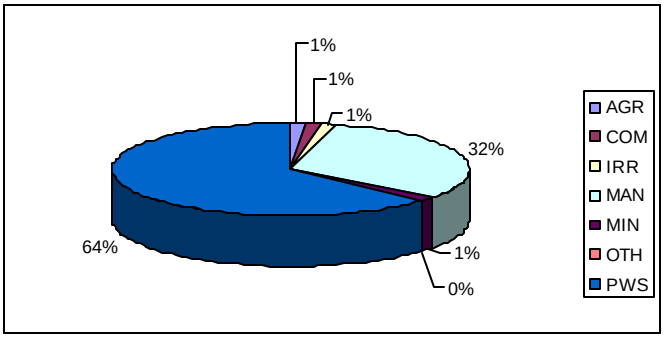


Table 1 lists the top 20 individual non-power generating water users, ranked by the amount of their 2006 reported withdrawals. **Appendix 2** includes a list of the top 50 water users including use by power generating facilities in 2006.

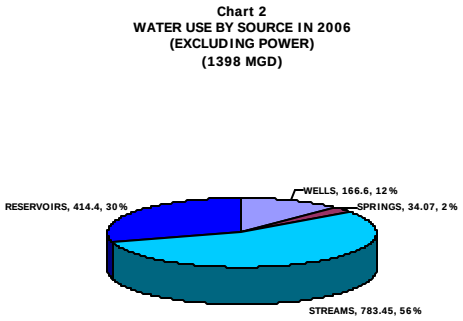
Table 1: Top Water Users in 2006 (Non-Power Generation)

OWNER NAME	CATEGORY	SYSTEM	LOCALITY	MGD
HONEYWELL INTERNATIONAL INC	MAN	HOPWELL PLANT	CITY OF HOPEWELL	120.48
FAIRFAX COUNTY WATER AUTHORITY	PWS	POTOMAC RIVER	FAIRFAX COUNTY	85.74
FAIRFAX COUNTY WATER AUTHORITY	PWS	OCCOQUAN	PRINCE WILLIAM COUNTY	71.01
RICHMOND, CITY	PWS	RICHMOND, CITY	CITY OF RICHMOND	70.87
NORFOLK, CITY	PWS	NORFOLK	CITY OF SUFFOLK	62.63
CINERGY SOLUTIONS OF NARROWS	MAN	CELCO PLANT	GILES COUNTY	60.30
GIANT YORKTOWN INC	MAN	YORKTOWN REFINERY	YORK COUNTY	59.95
MEADWESTVACO CORPORATION	MAN	COVINGTON PLANT	ALLEGHANY COUNTY	39.36
INTERNATIONAL PAPER CORP	MAN	FRANKLIN PLANT	ISLE OF WIGHT COUNTY	35.75
APPOMATTOX RIVER WATER AUTHORITY	PWS	LAKE CHESDIN	CHESTERFIELD COUNTY	30.61
DUPONT E I DE NEMOURS & CO	MAN	SPRUANCE PLANT	CHESTERFIELD COUNTY	28.82
NEWPORT NEWS, CITY	PWS	NEWPORT NEWS	CITY OF NEWPORT NEWS	27.61
HENRICO COUNTY	PWS	HENRICO COUNTY WTP	HENRICO COUNTY	25.98
NEWPORT NEWS, CITY	PWS	NEWPORT NEWS	NEW KENT COUNTY	25.02
VIRGINIA BEACH, CITY	PWS	VIRGINIA BEACH	CITY OF VIRGINIA BEACH	23.67
NEWPORT NEWS, CITY	PWS	NEWPORT NEWS	YORK COUNTY	21.77
VIRGINIA AMERICAN WATER CO	PWS	HOPEWELL DISTRICT	CITY OF HOPEWELL	20.36
HONEYWELL NYLON LLC	MAN	CHESTERFIELD PLANT	CHESTERFIELD COUNTY	19.37
PORTSMOUTH, CITY	PWS	PORTSMOUTH	CITY OF SUFFOLK	18.29
ST LAURENT PAPER PRODUCTS CORP	MAN	WEST POINT PLANT	KING WILLIAM COUNTY	17.81
TOTAL				865.40

Abbreviations Legend: MAN= MANUFACTURING, PWS= PUBLIC WATER SUPPLY

The relative contribution of surface and ground water sources to 2006 non-power generation withdrawals is illustrated in **Figure 7** which shows that large water demands are primarily met by surface water sources. Users of ground water sources outnumber surface water users; however, the amount of ground water withdrawn from aquifers is less than is withdrawn from streams and reservoirs.

Figure 7: % of Total Water Use by Source in 2006



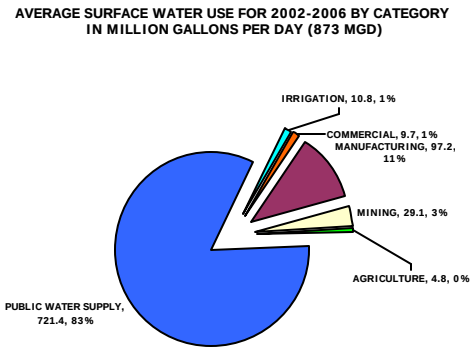
III.A.2 Average Water Withdrawals

The following charts provide information on the average surface water withdrawals and ground water withdrawals by category in million gallons per day (mgd) for the reporting period of 2002 through 2006.

III. A.2.a Average Surface Water Withdrawals

Figure 8 shows the average surface water withdrawals by category in mgd for 2002-2006. Use categories included public water supply (721.4 mgd); manufacturing (97.2 mgd); mining (29.1 mgd); irrigation (10.8 mgd); commercial (9.7 mgd); and agriculture (4.8 mgd) for a total usage of surface water of 873 mgd for the period.

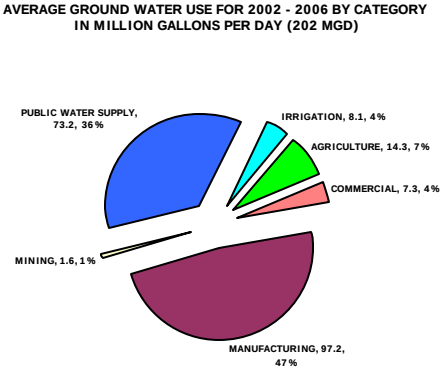
Figure 8: Average Surface Water Use for 2002 – 2006 by Category in Million Gallons per Day



III. A.2.b Average Ground Water Withdrawals

Figure 9 shows the average ground water withdrawals by category in mgd for the reporting period. Use categories, ranked by use, included: manufacturing (97.2 mgd); public water supply (73.2 mgd); agricultural (14.3 mgd); irrigation (8.1 mgd); commercial (7.3 mgd); and mining (1.6 mgd).

Figure 9: Average Ground Water Use for 2002 – 2006 by Category in Million Gallons per Day

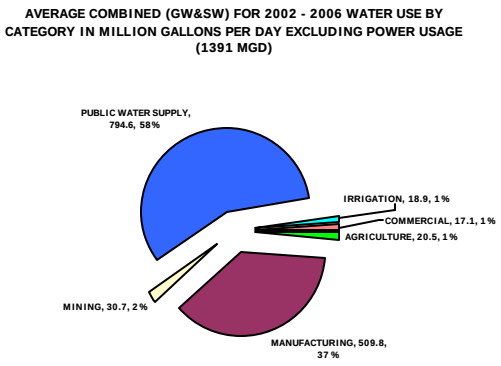


III. A.2.c Average Surface & Ground Water Withdrawals – Excluding Power Generation

Figure 10 serves to illustrate the average water use by category to include both ground water and surface water withdrawals in mgd, excluding power generation. For the period of 2002 through 2006, the average combined ground water and surface water use included the following

categories: public water supply (794.6 mgd); manufacturing (509.8 mgd); mining (30.7 mgd); irrigation (18.9 mgd); agriculture (20.5 mgd); and commercial (17.1 mgd).

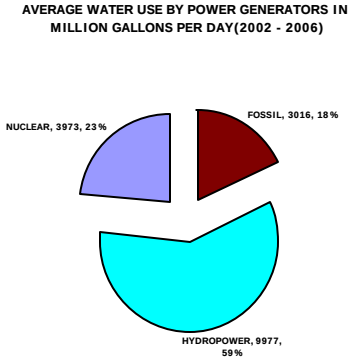
Figure 10: Average Combined (GW&SW) for 2002 – 2006 Water Use by Category in Million Gallons per day excluding Power Usage



III. A.2.d Power Generation Water Withdrawals

In addition to the use categories illustrated above, power generation accounted for an additional average use of 16,966 mgd from 2002 through 2006. **Figure 11** shows the average nuclear and fossil power usage compared to hydroelectrical usage. For the reporting period, hydropower represented 59% of the average water use by power generators, with nuclear power generation accounting for 23% and fossil power generation 18%.

Figure 11: Average Water Use by Power Generators in Million Gallons per Day (2002 – 2006)



III.B. Recent Trends in Virginia Water Use

A summary of the water withdrawal data from the VWUDS for the years 2002 through 2006 is presented in **Table 2**. The data are aggregated by category of use and by source water type. This time period is used to illustrate the changes in reported water use of both ground water and surface water resources during significant dry and wet rainfall years. Virginia experienced record drought in 2001-2002 and record rainfall in 2003-2004. The chart illustrates that reported ground water use by commercial, public water supplies, and irrigation peaked during the 2002 drought. Ground water use by manufacturing reached its lowest point of the last five years during 2006 and was at its highest point during 2003 and 2005. The use of surface water by public water supplies reached its lowest point in 2003; was at a reported high in 2002 and has been at a fairly constant level of usage during the past two years. Surface water withdrawals by power generating facilities are not included in this table as approximately 90-95% of their withdrawal is returned to the source. Newer power plants, however, usually use cooling towers that consume more water than the older plants. Ground water is not a significant source for power generation.

Table 2: Virginia Water Use Summary (2002-2006) in Million Gallons per Day (MGD)

	Category	2002	2003	2004	2005	2006
Ground Water	AGR	13.8	16.7	15.5	14.5	16.2
	COM	9.7	6.3	7.6	6.7	6.5
	MAN	94.0	100.9	98.9	100.2	92.2
	MIN	0.9	1.7	0.7	2.5	2.0
	PWS	75.6	68.0	73.5	73.2	75.9
	IRR	11.2	10.3	7.1	4.3	7.8
	TOTAL (GW)	205.2	203.9	203.3	201.4	200.6
Surface Water	AGR	4.5	5.2	3.9	5.7	6.7
	COM	10.7	5.2	8.3	10.7	13.9
	MAN	436.7	398.8	407.6	424.6	395.0
	MIN	31.2	29.0	38.0	27.3	20.1
	PWS	756.3	662.9	690.5	748.5	748.6
	IRR	14.0	5.6	6.0	14.9	13.7
	TOTAL (SW)	1,253.4	1,106.7	1,154.3	1,231.7	1,198.0

Abbreviations Legend: AGR= AGRICULTURE, COM= COMMERCIAL, MAN= MANUFACTURING, MIN= MINING, PWS= PUBLIC WATER SUPPLY, IRR= IRRIGATION

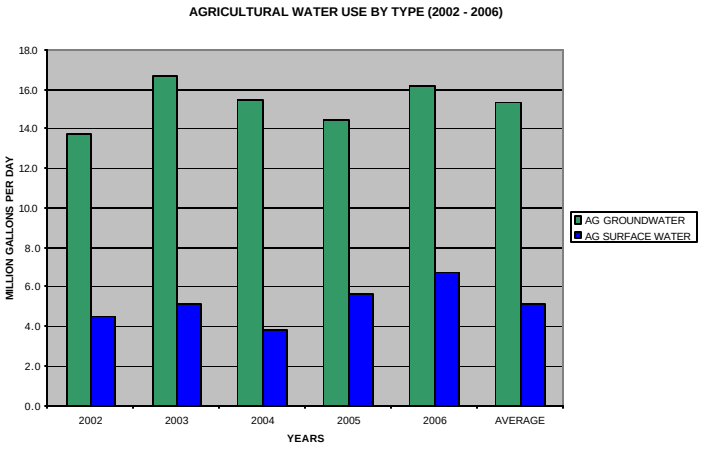
III.B.1 Categories of Water Use (2002 – 2006)

The next series of bar and pie charts have been included to illustrate the water use for individual categories over the last 5 years (2002 – 2006).

III.B.1.a Agricultural Water Use

Agricultural (**Figure 12**) withdrawals include operations such as commodity farms, fish farms and hatcheries. Ground water withdrawals accounted for the majority of agricultural water use over the period of 2002 through 2006. Ground water use averaged approximately 15 mgd while surface water use for agriculture averaged approximately 5 mgd. For 2006 agricultural use of ground water was reported at just over 16 mgd, while use of surface water was reported at approximately 6 mgd.

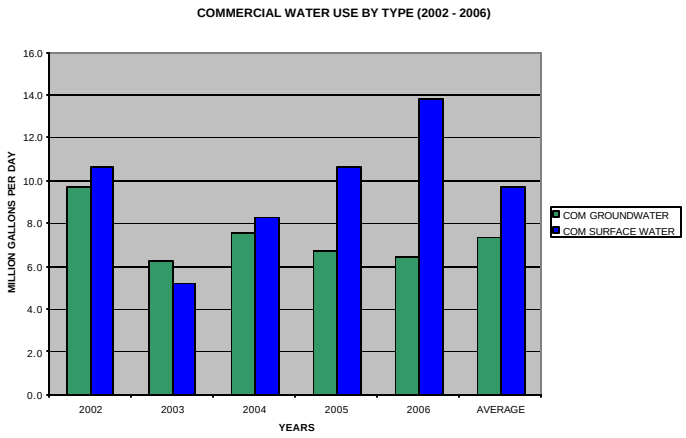
Figure 12: Agricultural Water Use by Type (2002 – 2006)



III.B.1.b Commercial Water Use

Commercial (**Figure 13**) withdrawals include operations such as golf courses, local and federal installations, hotels and laundromats. Commercial use of surface water exceeded the commercial use of ground water for the majority of the period of 2002 through 2006 with the exception of 2003 when ground water accounted for a majority of the use.

Figure 13: Commercial Water Use by Type (2002 – 2006)

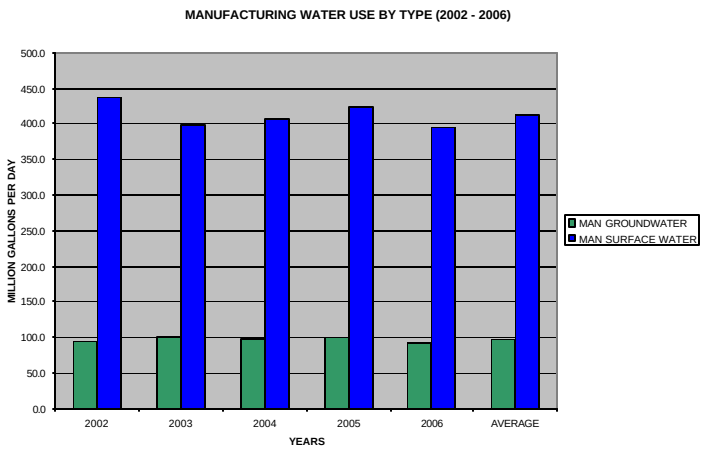


For this period of use (2002 – 2006) commercial use of groundwater has fluctuated from a low of approximately 6.0 mgd in 2003 to a high of approximately 10.0 mgd in 2002. Commercial use of surface water for this same period also hit its lowest use in 2003 (approximately 5.0 mgd) with its highest use coming in 2006 (approximately 14.0 mgd). Data for 2006 indicates commercial use of ground water at a rate of approximately 7.0 mgd and a rate of surface water use of approximately 14.0 mgd. Average commercial water use for the period was approximately 7.0 mgd for groundwater and approximately 10.0 for surface water.

III.B.1.c Manufacturing Water Use

Manufacturing (**Figure 14**) withdrawals include operations such as paper mills, food processors, drug companies, furniture, and concrete companies. The major source of water for manufacturing has consistently been surface water. Ground water use for the period of 2002 - 2006 averaged slightly less than 100 mgd, while surface water use averaged just over 410 mgd.

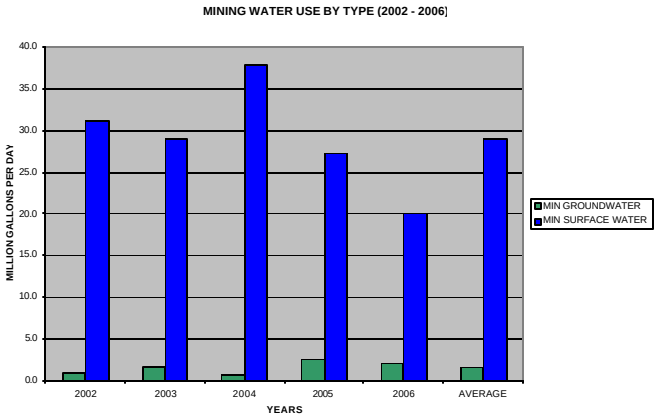
Figure 14: Manufacturing Water Use by Type (2002 – 2006)



III.B.1.d Mining Water Use

Mining (**Figure 15**) withdrawals include operations such as sand, rock and coal companies. Mining withdrawals of ground water normally fall below 2 mgd, except for a high of approximately 2.5 mgd in 2005, while withdrawals of surface water have averaged approximately 29 mgd for the period of 2002 through 2006. Data for 2004 indicates that mining operations accounted for approximately 1 mgd of ground water and a high for the period of in excess of 37 mgd for surface water use. Data for 2006 indicates mining operations withdrew approximately 2 mgd of ground water and approximately 20 mgd of surface water.

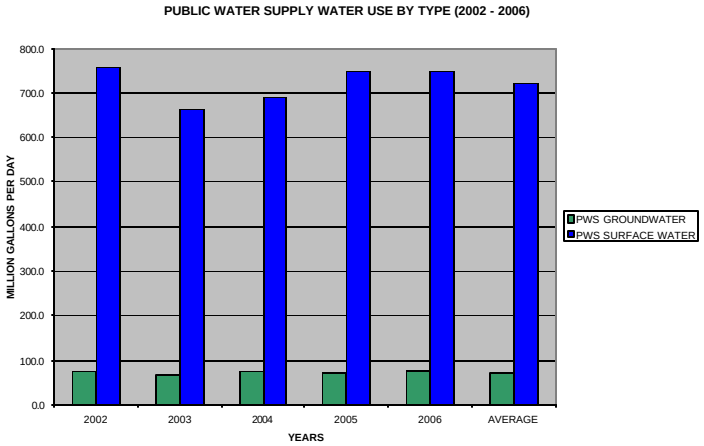
Figure 15: Mining Water Use by Type (2002 -2005)



III.B.1.e Public Water Supply Water Use

Public water supply (**Figure 16**) includes municipal and private water purveyors. Use of ground water sources for public water supply averaged less than 74 mgd for the period of 2002 through 2006. Use of surface water sources for public water supply in this 5 year period has averaged over 720 mgd, with highs in excess of 700 mgd being reported for every year except for 2003 and 2004. Data for 2006 indicates that ground water use for public water supplies averaged less than 76 mgd, while surface water use for public water supplies approached 750 mgd.

Figure 16: Public Water Supply Water Use by Type (2002 – 2006)

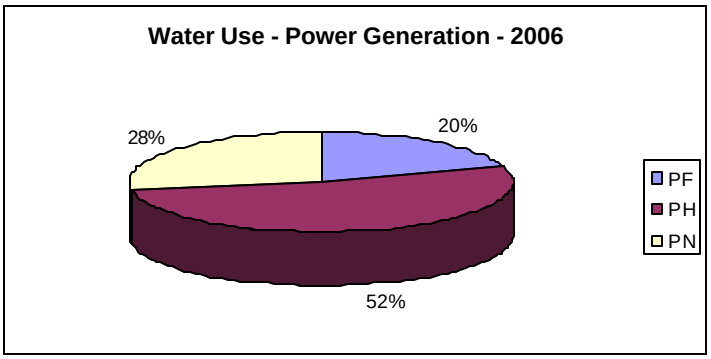


III.B.2 Power Generation Water Use - 2006

Virginia's Power generation facilities reported the use of a total of approximately 15,000 mgd from surface water sources. The majority of the use of surface water for power generation occurred in the Roanoke River Watershed for 2006.

In 2006, just over half of the total amount of surface water used to generate power was used in hydropower facilities. See **Figure 17** for breakdown of use by type of facility.

Figure 17: Water Use for Power Generation - 2006



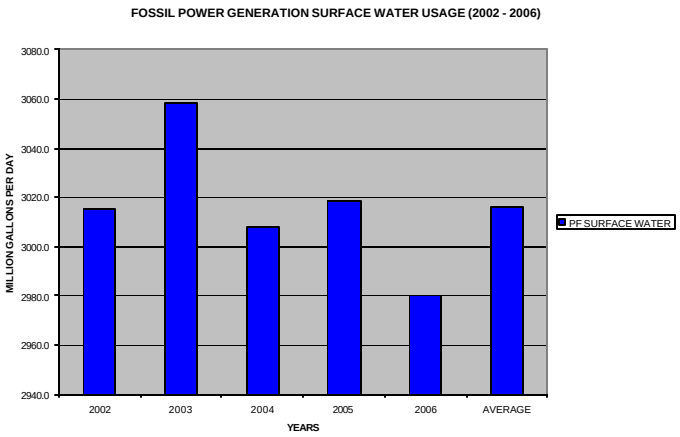
III.B.3 Power Generation Water Use (2002 – 2006)

Power generators (**Figures 18 - 20**) use surface water sources to cool the generators or pass through the turbines to produce the electric power.

III.B.3.a Fossil Power Generation

Figure 18 provides information on the use of surface water for fossil power generation. During this period (2002 – 2006) use of surface water for fossil power generation has averaged at or in excess

Figure 18: Fossil Power Generation – Surface Water Usage (2002 – 2006)

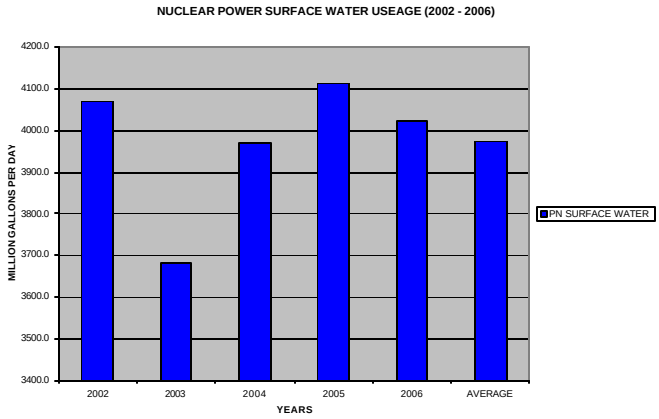


of 3,000 mgd. Data for 2006 indicates a use of just less than 3,000 mgd of surface water for fossil power generation.

III.B.3.b Nuclear Power Generation

Figure 19 illustrates the extent of use of surface water for the generation of nuclear power. Use of surface water in this category for the period of 2002 through 2006 has gone from a low of just over 3,680 mgd in 2003 to a high in excess of 4,100 mgd in 2005 of surface water for the generation of nuclear power.

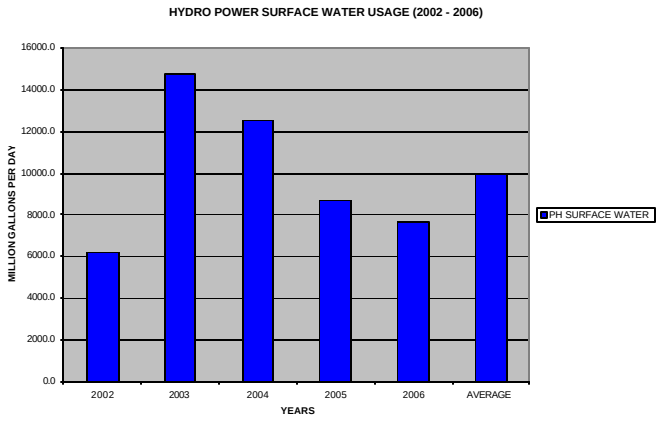
Figure 19: Nuclear Power – Surface Water Usage (2002 – 2006)



III.B.3.c Hydro Power Generation

Figure 20 provides an illustration of the variations in use of surface water for the generation of hydro power over the period of record. Use of surface

Figure 20: Hydro Power – Surface Water Usage (2002 – 2006)



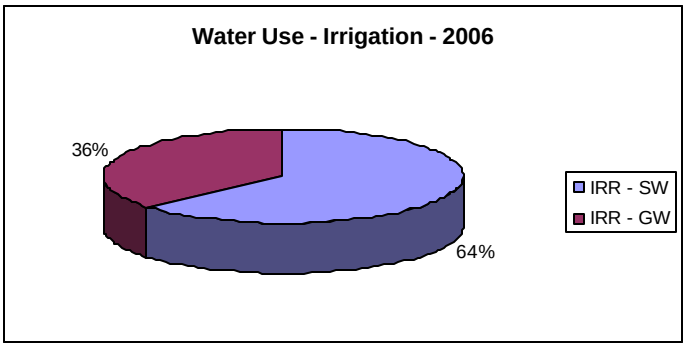
water in this category has fluctuated greatly over the period with a high of approximately 15,000 mgd in 2003 to a low of just over 6,000 mgd in 2002. Use in 2006 was slightly less than 8,000 mgd. Average use for the period was approximately 10,000 mgd.

III.B.4 Irrigation Water Use - 2006

A total of approximately 21.4 mgd was reported for irrigation use for 2006. The majority of the water

used for irrigation used surface water sources, see **Figure 21**.

Figure 21: Water Use for Irrigation - 2006

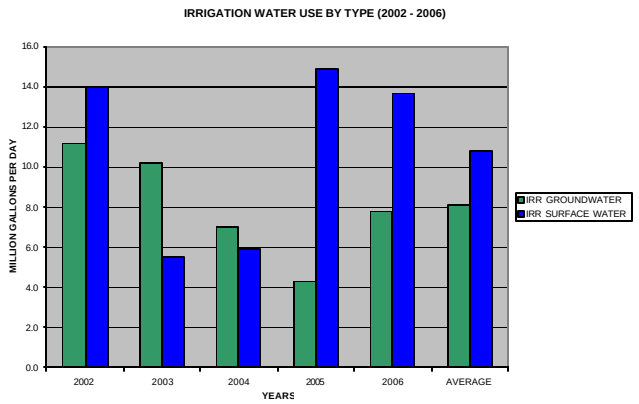


The majority of irrigation water use in 2006 occurred in the Eastern Shore Watershed, with 25% being used from ground water sources and 10% coming from surface water sources.

III.B.5 Irrigation Water Use (2002 – 2006)

Irrigation (**Figure 22**) withdrawals are used to promote growth in such crops as tobacco, corn and soybeans for example. Over the reporting period the use of ground water for irrigation averaged approximately 8 mgd, while the use of surface water for irrigation averaged approximately 11 mgd. The records show that in 2003 the use of ground water exceeded that of surface water by just over 4 mgd. Ground water use in this category has gone from a low of approximately 4 mgd in 2005 to a high of approximately 11 mgd in 2002. Surface water use in this category has gone from a high in excess of 14 mgd in 2005 to a low of approximately 6 mgd in 2003. Irrigation withdrawals for 2006 included approximately 8 mgd of ground water and approximately 14 mgd of surface water.

Figure 22: Irrigation Water Use by Type (2002 – 2006)



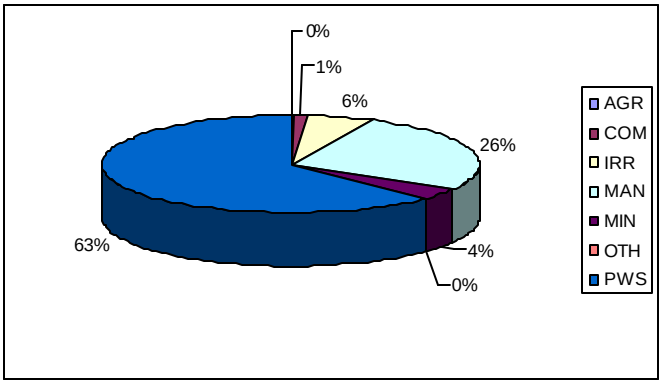
III.C. 2006 Categories of Water Use by Watershed Areas

The following series of figures examines the categories of water use for 2006 for each of Virginia's watershed areas.

III. C.1. Chowan Watershed Water Use

During the 2006 reporting period, 66% of the water used in the Chowan Watershed was from ground water sources. The percentages of use for each of the categories of water use in the basin are included in **Figure 23**. The majority of the water use in the basin (63%) was used for public water supplies. Manufacturing accounted for 26% of water use for 2006.

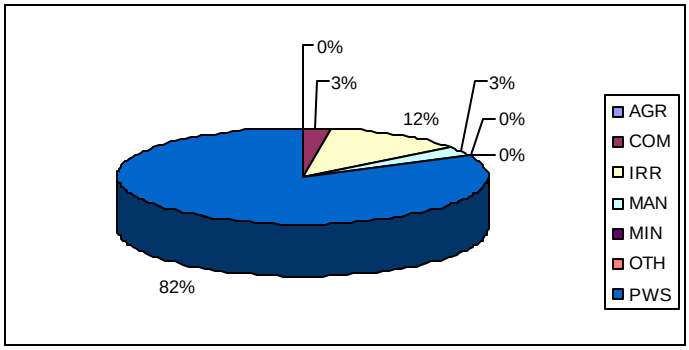
Figure 23: Chowan Watershed Categories of Water Use



III. C.2. Chesapeake Bay Coastal Watershed Water Use

During the 2006 reporting period, 85% of the water used in the Chesapeake Bay Coastal Watershed was from surface water sources. The percentages of use for each of the categories of water use in the basin are included in **Figure 24**. The majority of the water use in the basin (82%) was used for public water supply.

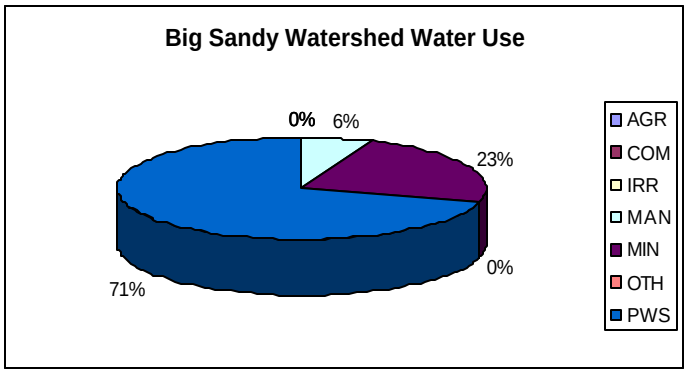
Figure 24: Chesapeake Bay Coastal Watershed Water Use by Category



III. C.3. Big Sandy Watershed Water Use

During the 2006 reporting period, 97% of the water used in the Big Sandy Watershed was from surface water sources. The percentages of use for each of the categories of water use in the basin are included in **Figure 25**. The majority of the water use in the basin (71%) was used for public water supply, with another 23% used for commercial purposes.

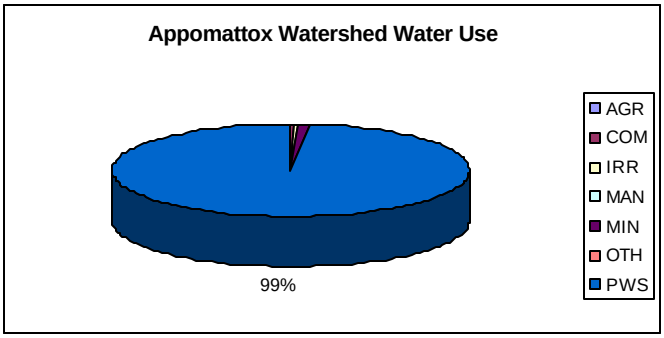
Figure 25: Big Sandy Watershed Categories of Water Use



III. C.4. Appomattox River Watershed Water Use

During the 2006 reporting period, 99% of the water used in the Appomattox River Watershed was from surface water sources. The percentages of use for each of the categories of water use in the basin are included in **Figure 26**. The majority of the water use in the basin (99%) was used for public water supply.

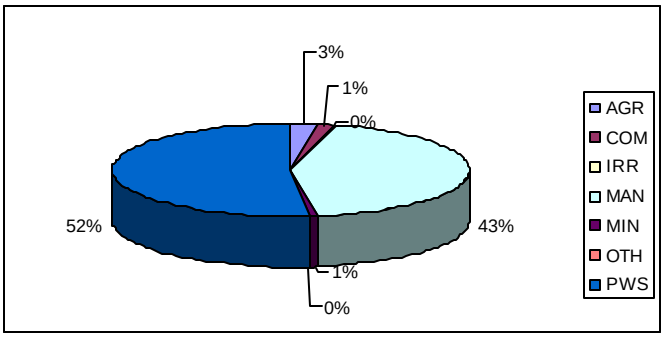
Figure 26: Appomattox River Watershed Categories of Water Use



III. C.5. James River Watershed Water Use

During the 2006 reporting period, 93% of the water used in the James River Watershed was from surface water sources. The percentages of use for each of the categories of water use in the basin are included in **Figure 27**. The majority of the water use in the basin (52%) was used for public water supply, with another 43% being used for manufacturing.

Figure 27: James River Watershed Categories of Water Use

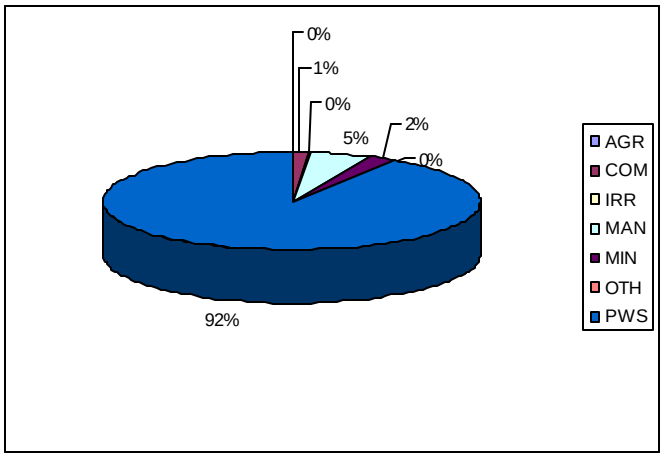


III. C.6. Roanoke River Watershed Water Use

During the 2006 reporting period, 89% of the water used in the Roanoke River Watershed was from

surface water sources. The percentages of use for each of the categories of water use in the basin are included in **Figure 28**. The majority of the water use in the basin (92%) was used for public water supply.

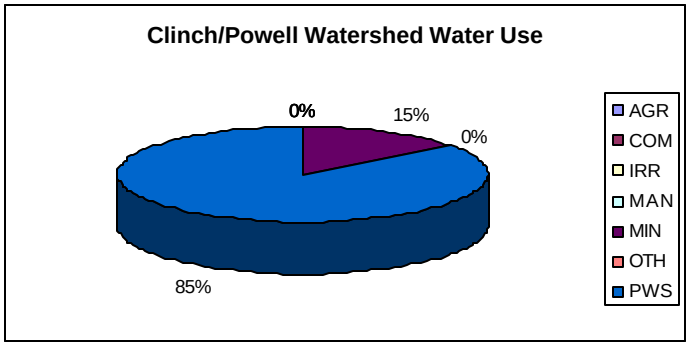
Figure 28: Roanoke River Basin Watershed Categories of Water Use



III. C.7. Clinch/Powell River Watershed Water Use

During the 2006 reporting period, 91% of the water used in the Clinch/Powell River Watershed was from surface water sources. The percentages of use for each of the categories of water use in the basin are included in **Figure 29**. The majority of the water use in the basin (85%) was used for public water supply.

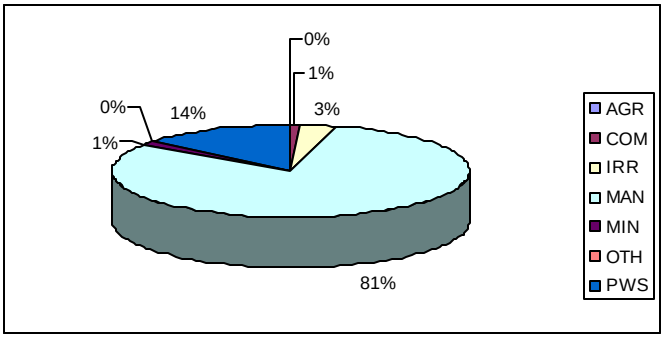
Figure 29: Clinch/Powell River Watershed Categories of Water Use



III.C.8. York River Watershed Water Use

During the 2006 reporting period, 79% of the water used in the York River Watershed was from surface water sources. The percentages of use for each of the categories of water use in the basin are included in **Figure 30**. The majority of the water use in the basin (81%) was used for manufacturing, with an additional 14% used for public water supply.

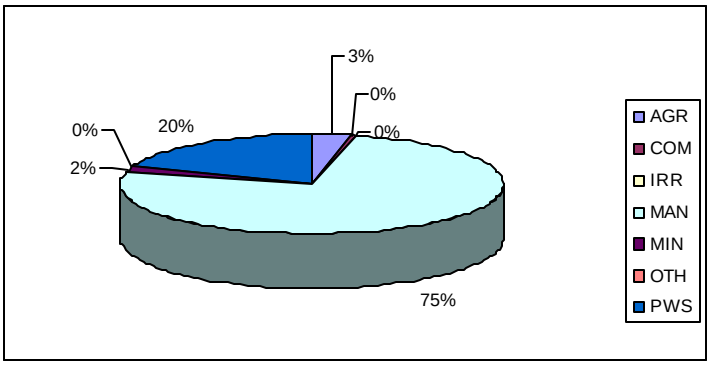
Figure 30: York River Watershed Categories of Water Use



III. C.9. New River Watershed Water Use

During the 2006 reporting period, 84% of the water used in the New River Watershed was from surface water sources. The percentages of use for each of the categories of water use in the basin are included in **Figure 31**. The majority of the water use in the basin (75%) was used for manufacturing, with an additional 20% used for public water supply.

Figure 31: New River Watershed Categories of Water Use

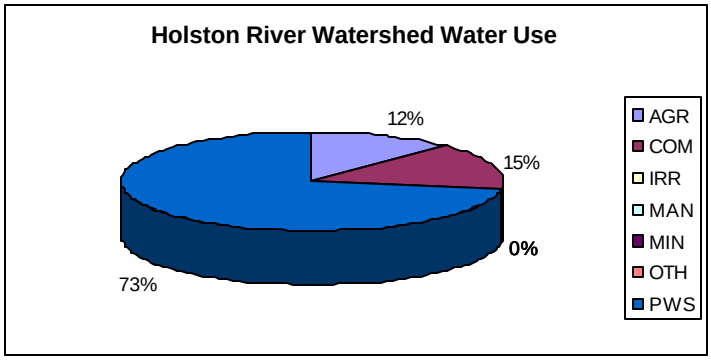


III. C.10. Holston River Watershed Water Use

During the 2006 reporting period, 71% of the water used in the New River Watershed was from surface water sources. The percentages of use for each of the categories of water use in the basin are included

in **Figure 32**. The majority of the water use in the basin (73%) was used for public water supply, with an additional 15% used for commercial and 12% for agricultural uses.

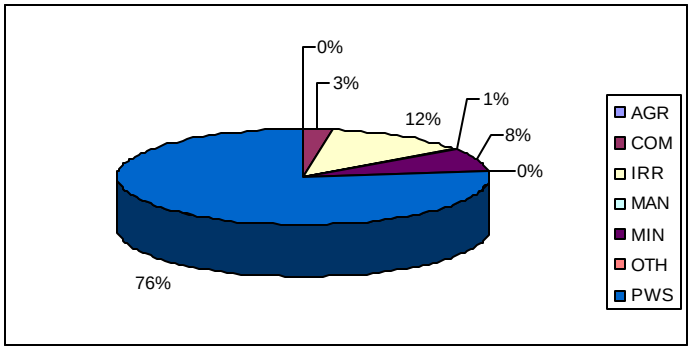
Figure 32: Holston River Watershed Categories of Water Use



III. C.11. Rappahannock River Watershed Water Use

During the 2006 reporting period, 84% of the water used in the Rappahannock River Watershed was from surface water sources. The percentages of use for each of the categories of water use in the basin are included in **Figure 33**. The majority of the water use in the basin (76%) was used for public water supply, with an additional 12% used for irrigation.

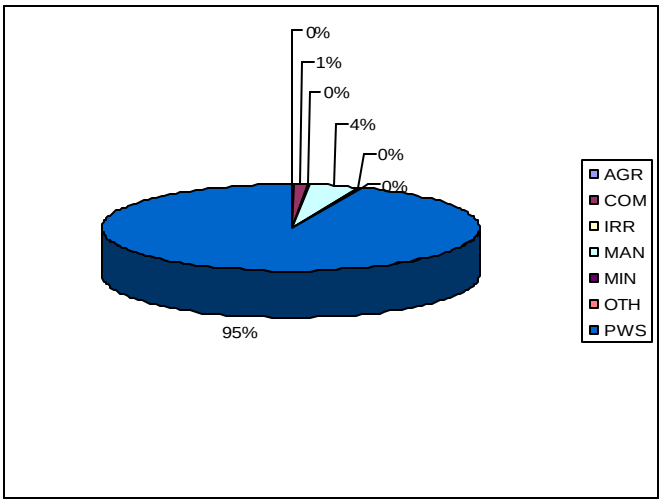
Figure 33: Rappahannock River Watershed Categories of Water Use



III. C.l2. Potomac River Watershed Water Use

During the 2006 reporting period, 90% of the water used in the Potomac River Watershed was from surface water sources. The percentages of use for each of the categories of water use in the basin are included in **Figure 34**. The majority of the water use in the basin (95%) was used for public water supply.

Figure 34: Potomac River Watershed Categories of Water Use



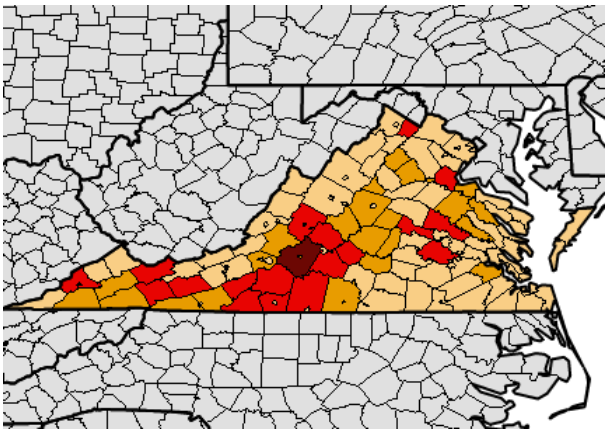
IV. Climatological Conditions

This section of the annual report provides an overview of the climatological conditions affecting the status and condition of Virginia's Water Resources.

IV.A 2006 Statewide Drought Conditions

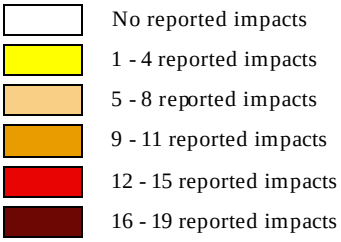
Significant precipitation deficits have been experienced periodically across the Commonwealth during the reporting period and for 2006. These significant precipitation deficits have resulted in a number of short-term drought impacts in many areas of the State. **Figure 35** illustrates the number and distribution of short-term drought impacts experienced throughout the Commonwealth in 2006. The 24 drought impacts reported in 2006 occurred primarily in the categories of agriculture (e.g., damage to crop quality, reduced crop yields) and water/energy (e.g., lower water levels in reservoirs, lakes and ponds, reduced streamflow).

Figure 35: Drought Impacts – 2006



SOURCE: Drought Impact Reporter – National Drought Mitigation Center – State of Virginia Data

Legend



IV.B. 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. To address continuing concerns over both the long term and short term impacts of drought conditions throughout the Commonwealth, a "Virginia Drought Assessment and Response Plan" has been developed and implemented. During periods of normal moisture conditions, the DEQ monitors the NOAA U.S. Drought Monitor, and produces information from this report specific to Virginia on a monthly basis. The Virginia drought map is produced concurrent with the release of the NOAA monthly and seasonal outlooks.

IV.B.1. Drought Monitoring Task Force

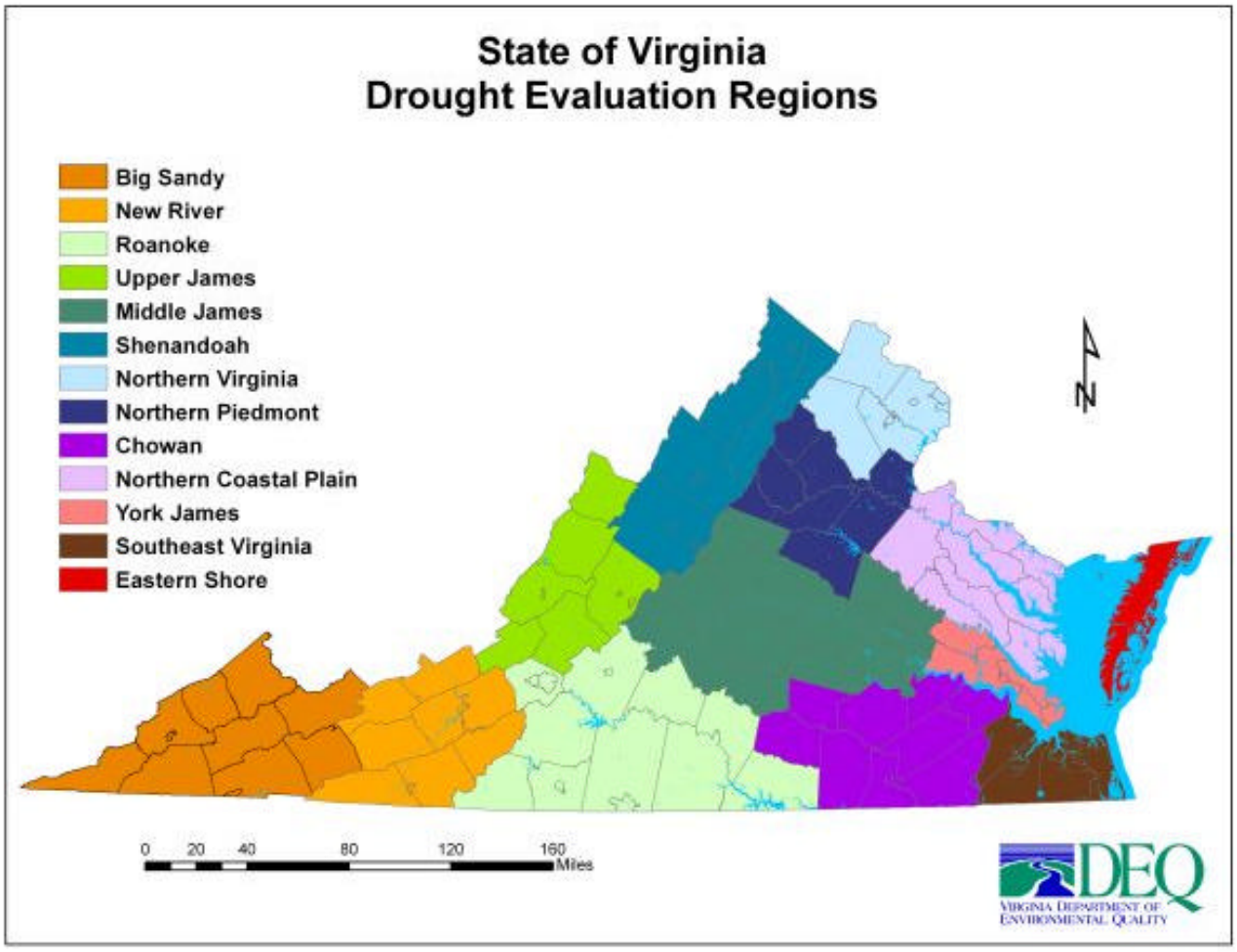
The Drought Monitoring Task Force is activated with the first occurrence of *moderate drought conditions* (D1) in the Commonwealth or the occurrence of smaller scale moisture deficits that may fall beneath the level of resolution of the U.S. Drought Monitor. The DMTF monitors the advance of drought conditions in the Commonwealth using "drought indicators" such as: precipitation deficits; streamflows; ground water levels; and reservoir storage as well as the Standardized Precipitation Index; Palmer Drought Severity Index; Crop Moisture Index, Keetch-Byrum Drought Index, and NOAA monthly and seasonal precipitation outlooks.

The Drought Monitoring Task Force continues to monitor precipitation deficits, stream flows, ground water levels, and reservoir levels across the Commonwealth in order to identify any significant hydrologic drought impacts.

IV.B.2. Drought Evaluation Regions

For the purpose of implementation of the "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 geomorphological features, and service areas of major water supplies. Regional boundaries were chosen to correspond with local governmental boundaries to simplify the implementation of the 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 displayed in **Figure 36** below.

Figure 36: Virginia's Drought Evaluation Regions



IV.B.3. 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. 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 are identified in the Virginia Drought Assessment and Response Plan and fall into the categories of "Drought Watch Responses" which 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; "Drought Warning Responses" which are generally responses that are required when the onset of a significant drought event is imminent; and "Drought Emergency Responses" which are generally response that are required during the height of a significant drought event.

IV.B.4. Drought Monitoring Web Site

DEQ maintains information about the current status of drought conditions and links to drought related web sites on the "drought monitoring" page of the Water Resources Management Website (http://www.deq.virginia.gov/waterresources/drought.php).

DEQ is currently updating the drought monitoring web site to provide more flexible, up to date information to the Virginia Drought Monitoring Task Force. The task force will be able to use this information to help them evaluate the drought indicators more quickly, and with a more complete insight into the current trends in the drought indicator metrics. The cornerstone functionality that will be added will be real-time screening of drought conditions, based on the criteria outlined in the "*Virginia Drought Assessment and Response Plan*". A preliminary analysis will be integrated into a single browse-able map that will indicate if a given hydrologic or political division falls under one of the three drought conditions. The user may select the time period for analysis (i.e., the last week, month, water year to date, etc.) in order to determine if a region is trending towards or away from a particular drought condition.

V. Water Resource Management Program - Status

V.A Water Supply Planning Regulations

Informed management of Virginia's water resources is crucial to the health and welfare of Virginia's citizens, environment and continued economic prosperity.

The Local and Regional Water Supply Planning regulation details information to be reported in a locality's water supply plan regarding existing water sources, existing water uses, and existing resource information. The regulation requires water supply plans to address conservation and drought response as part of the plan's water management actions. Contingency plans are required to be developed in accordance with the proposed regulation. Finally, all local and regional water supply plans are required to include a statement of need based on the adequacy of existing water sources to meet current and projected water demand over the planning horizon. In the event that existing sources are determined to be inadequate to meet demand over the planning period, water supply plans are required to include an analysis conducted in accordance with the requirements of this regulation that identifies alternative ways of meeting the shortfall in water supply.

The program is envisioned as a state and local partnership with the localities having the lead role in identifying their future demands and the state providing technical support and oversight.

Implementation of this program will result in a statewide understanding of local water needs and potential alternatives for at least 30 years into the future. It will also allow for improved preparation for future drought, earlier identification of resource and inter-jurisdictional conflicts, increased opportunities for public input and the potential to reduce conflicts in future permit processes.

V.A.1 Local and Regional Water Supply Planning Efforts

Pursuant to 9 VAC 25-780, all counties, cites and towns in the Commonwealth must develop local or regional water supply plans. The goal of this planning effort is to ensure that localities develop water supply plans that can adequately meet local needs; are based on the best available information; represent the least environmentally damaging, practicable alternative; and are supported by the public to the greatest extent possible.

V.A.1.a Water Supply Plan Submittal Dates

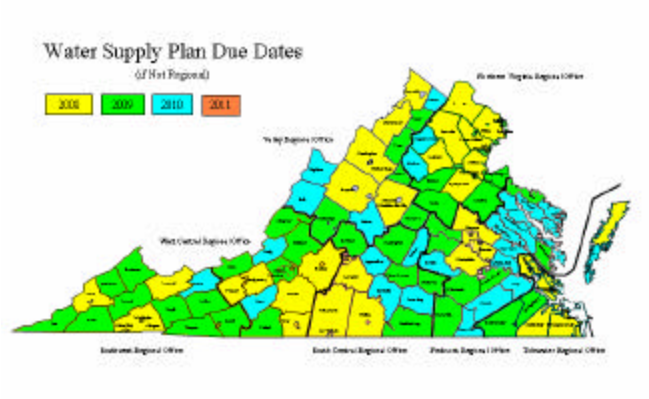
The regulation establishes a schedule for submittal of these water supply plans based on the latest U.S. Census data as indicated in **Table 3**.

Table 3: Plan Submittal Schedule

Category	Plan Due Date
Population In Excess of 35,000	November 2, 2008
Population In Excess of 15,000 But No More Than 35,000	November 2, 2009
Population Less Than or Equal to 15,000	November 2, 2010
Election to Participate in a Regional WS Plan	November 2, 2008
Regional WS Plan	November 2, 2011

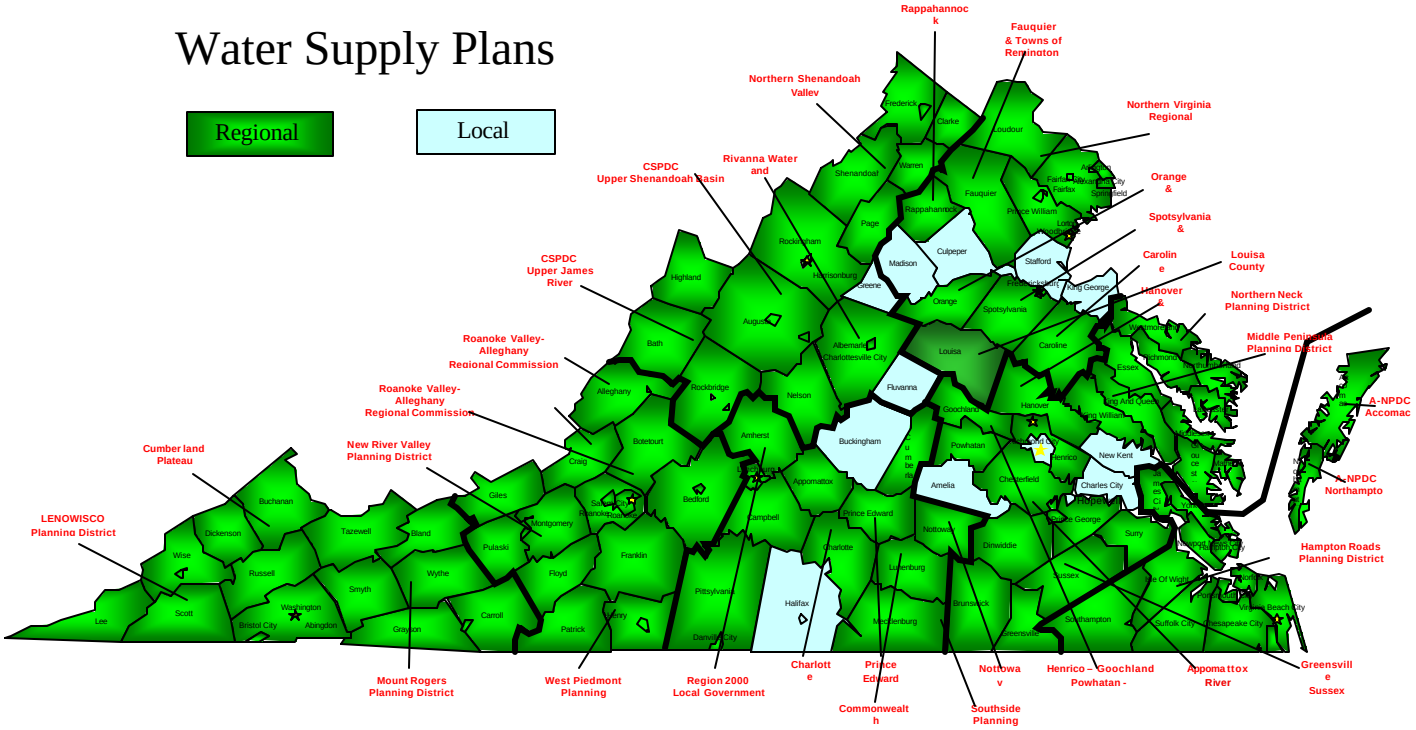
Figure 37 illustrates the distribution of these due dates across the localities in Virginia if no regional designations have been made.

Figure 37: Water Supply Plan Due Dates (If Not Regional)



Based on the current local activities related to the development of the required water supply plans it appears that the majority of Virginia's local governments will be pursuing a regional approach to their water supply planning efforts. **Figure 38** illustrates the current extent of the interest in participating in regional water supply planning efforts.

Figure 38: Water Supply Plan Due Dates (Recognizing Regional Efforts)



V.A.2 Water Supply Planning Grants

In order to assist with the cost of implementation of these regulations, the DEQ has established a competitive grant process for proposals from local governments for development of their local or regional plans. These grant funds are to be supplemented by local funds to address the regulation requirements.

V.A.2.a Funding Summary

Over the course of the past three years, a total of 59 local government authorities have submitted proposals for funding requests for a total of $2,545,067 through the Local and Regional Water Supply Planning Grants Program. The Local and Regional Water Supply Planning program has provided grants totaling $1,098,418 through this highly competitive bid process to partially fund efforts for development of water supply plans for a total of 37 local government authorities.

V.A.2.b Fiscal Year 2008 Grants

A total of 25 applications were received during the Local and Regional Water Supply Planning Grant Cycle for FY 2008. These applications contained requests for a total of $1,111,649. DEQ awarded a total of $300,000 to thirteen local government authorities (see **Table 4: FY 08 Grant Awards**). These thirteen programs represent thirteen "regional" water supply plans encompassing a total of 124 localities (17 Cities; 38 Counties; and 69 Towns).

Table 4: FY 08 Grant Awards

Local Government	Grant Award
Central Shenandoah Planning District Commission – Upper James River Basin	$20,000
Central Shenandoah Planning District Commission – Upper Shenandoah Basin	$35,000
Greensville County Water & Sewer Authority	$20,000
LENOWISCO Planning District Commission	$25,000
Lunenburg County	$20,000
Middle Peninsula Planning District Commission	$30,000
Mount Rogers Planning District Commission	$25,000
Prince Edward County	$30,000
Region 2000 Local Government Council	$30,000
Roanoke Valley-Alleghany Regional Commission – Alleghany Highlands	$10,000
Roanoke Valley-Alleghany Regional Commission – Greater Roanoke	$20,000
Southside Planning District Commission	$10,000
West Piedmont Planning District Commission	$25,000

V.A.2.c Fiscal Year 2007 Grants

DEQ awarded $500,000 in Fiscal Year 2007 to assist 14 local and regional government authorities (see **Table 5: FY 07 Grant Awards**) in the development of water supply plans.

Table 5: FY 07 Grant Awards

Local Government	Grant Award
Accomack-Northampton Planning District Commission	$30,000
Appomattox River Water Authority	$30,000
Central Shenandoah Planning District Commission	$50,000
Cumberland Plateau Planning District	$40,000
Greensville County Water and Sewer Authority	$35,000
LENOWISCO Planning District Commission	$40,000
Mount Rogers Planning District Commission	$40,000
New River Valley Planning District Commission	$40,000
Northern Neck Planning District Commission	$40,000
Nottoway County	$25,000
Rivanna Water and Sewer Authority	$20,000
Roanoke Valley-Alleghany Regional Commission	$30,000
Southside Planning District Commission	$40,000
West Piedmont Planning District Commission	$40,000

These 14 programs represent 14 "regional" water supply plans encompassing a total of 140 localities (15 Cities; 39 Counties; and 86 Towns).

V.A.3 Water Supply Plan Status

There are currently 34 known "regional" programs and 29 known local programs underway to develop water supply plans. As of this report DEQ has received one regional plan for review by the Technical Evaluation Committee (TEC).

The Water Supply Plan is a piece of a local or regional water supply program. The entire program undergoes formal review and approval by DEQ and the TEC. To date, DEQ has received and reviewed a number of draft partial/complete plans and a number of water supply planning element deliverables that have been funded through the

Local and Regional Water Supply Planning Grant program.

V.A.4 Water Supply Planning Technical Assistance Activities

In addition to monetary assistance, DEQ continues to provide water supply planning program technical assistance sessions to local government officials, state agency personnel, and trade/professional organization members through informational meetings, PowerPoint presentations, and workshops. The purpose of these educational activities is to describe the water supply planning process and criteria outlined in the regulation, the benefits of proactive, comprehensive planning, and try to find solutions to meet local needs and meet regulatory requirements.

V.A.4.a Data Management Workshop

The Water Supply Planning Staff conducted a Data Management Workshop on March 8, 2007 as part of the ongoing education activities for local government authorities that had received grant funding and who were actively involved in the data collection and management activities of the water supply planning effort. The objectives of this workshop were to: conduct a post-implementation discussion of how the program is working; allow for a free exchange of information on experiences gathering data to comply with the regulation among the individuals developing the plans; review any obstacles and limitations to acquiring the data; discuss any successful model approaches to obtaining and managing the data; solicit ideas on improvements that could be made; and allow for input on how the DEQ may manage this data over time as part of the State Water Resource Plan. Staff plans to hold this type of meeting and discussion periodically with program participants.

V.A.4.b Water Supply Planning Program Web Site

DEQ also maintains a water supply planning program webpage that is regularly updated to keep localities; regional government authorities; and stakeholders informed of program news, fact sheets, tools, and information resources to assist with the development of local and regional water supply plans. The Water Supply Planning Website can be accessed at: http://www.deq.state.va.us/watersupplyplanning/.

V.A.4.c Presentations

Since the initiation of the water supply planning efforts, the WSP Staff has participated in both formal presentations and informal informational sessions to more than 75 different audiences, ranging from local government representatives, boards of supervisors, planning district commissions, utility directors, conference attendees and interested citizens in support of the Water Supply Planning Program. Through these educational activities, DEQ is building partnerships and incorporating stakeholders early and continuously in Virginia's water supply planning process. This effort is necessary for tangible results, public support and program success. DEQ will continue to partner with local governments and other interested parties to assist local and regional water supply plan development.

V.B. Wellhead Protection Program Efforts

This section of the annual report provides an overview of the current Wellhead Protection Program Efforts.

V.B.1 The Wellhead Protection Program

EPA granted final approval to **Virginia's Wellhead Protection Program** on May 26, 2005. Protection of ground water based public water supplies will be achieved through ongoing regulatory and non

regulatory State programs and through voluntary participation by local governments with land use management authorities. DEQ serves as the lead agency for coordination of this voluntary protection program. The Virginia Department of Health is the Commonwealth's regulatory authority for public water supplies, including ongoing oversight of the Drinking Water State Revolving Fund Program.

V.B.2 Wellhead Protection Implementation Projects

In January 2006 three wellhead protection implementation projects, funded cooperatively through federal grants allocated to the Virginia Departments of Health and Environmental Quality, began on the Eastern Shore and in James City County. The funding source was a combination of Safe Drinking Water Act dollars and Clean Water Act dollars. The funds were offered through a competitive process. In the summer of 2006 another round of proposals were solicited; awards were made to the Town of Stanley, the James City County Service Authority, the Town of Lovettsville, and Wythe County. In each instance awards were made to municipalities to protect their ground water based public water supplies. Their proposals addressed some aspects of source water protection, including public education on potential contaminant sources; hosting household hazardous waste collection days; and well abandonment. Another round of proposals will be solicited in the summer of 2007.

V.C. Ground Water Withdrawal Permitting Program Status

This section of the annual report provides a discussion and overview of the current efforts being undertaken in the GWWPP Program.

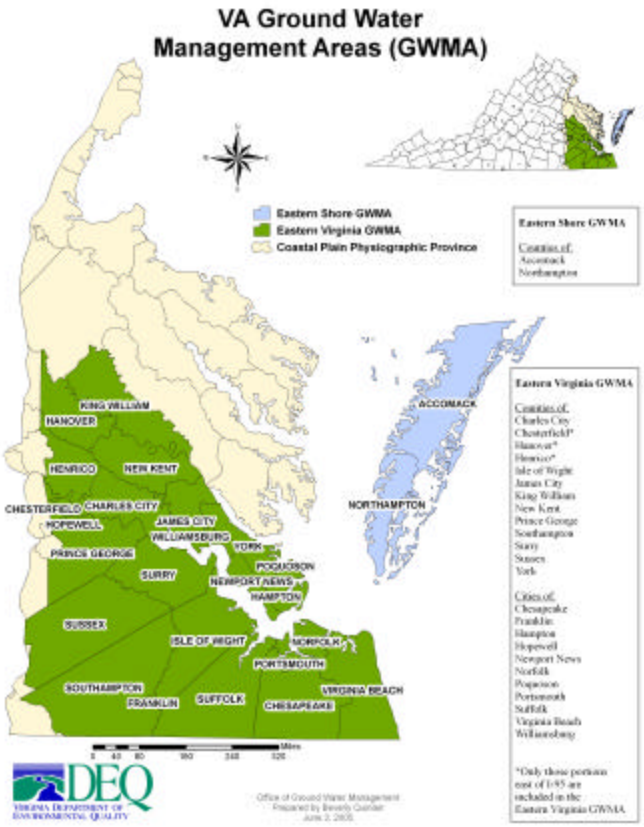
V.C.1. Ground Water Withdrawal Permitting Program Overview

The Virginia Ground Water Act of 1973 recognized the duty of the SWCB to manage ground water resources and declare management areas. Subsequently, two Ground Water Management Areas (GWMAs) were declared; the Eastern Virginia GWMA and the Eastern Shore GWMA (see **Figure 39**). In 1992, the statute was updated and currently the permitting program operates under regulations developed pursuant to The Ground Water Management Act of 1992. Ground Water Management Areas are initiated by SWCB motion or petition from any locality when 1.) ground water levels are declining, 2.) well interference is occurring, 3.) the resource may be overdrawn, or 4.) adverse changes to water quality are expected or have occurred. This program is partially funded by permit fees.

Ground Water Withdrawal Permits are required in the management areas for any withdrawal in excess of 300,000 gallons in any month. Permit applications for new withdrawals or for increases to existing withdrawals are evaluated for sustainability, considering the combined impacts from all existing lawful withdrawals. Applications for new or expanded withdrawals are recommended for denial in areas where the ground water resource is predicted or identified through monitoring to be below resource protection limits established by regulation.

The areal extent of the two existing GWMAs results in regional permitting programs in the Tidewater and Piedmont Regional Offices. There are 240 active permits and 100 active applications in process. Technical evaluations of impacts and resource sustainability are developed by specialized ground water modeling staff. The program achieved full staffing in mid-2007.

Figure 39: Ground Water Management Areas in Virginia



V.C.2. Ground Water Withdrawal Permitting Program Activity

GWWPP permitting and technical staff meet with all prospective permit applicants to discuss the permitting process and technical requirements prior to application submission. **Table 6** provides a summary of DEQ's Ground Water Permitting actions for 2006 and for the period of January 1 through June 30, 2007. GWWPP staff also provides technical support to applicants by reviewing and providing comments on all proposals for field data collection in support of permit development.

Table 6: Summary of DEQ Ground Water Withdrawal Permitting Actions

Action	2006	Jan 1 – June 30, 2007
Historic Permits Issued	17	2
Other Permits Issued	7	7
Permit Modifications	3	2
Administrative Continuances	1	0
Applications Received	26	22
Pre-Application Meetings	34	16
Aquifer Test Plans Reviewed	14	21

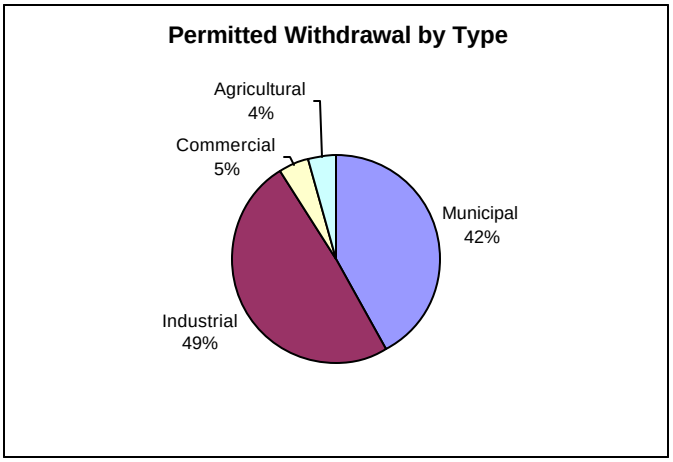
V.C.3. Ground Water Withdrawal Permitting Program – Evaluation of Withdrawals and Impacts

This section of the GWWPP section of the annual report examines and evaluates the withdrawals and impacts in the Coastal Plain of Virginia.

V.C.3.a. Coastal Plain Ground Water Demands

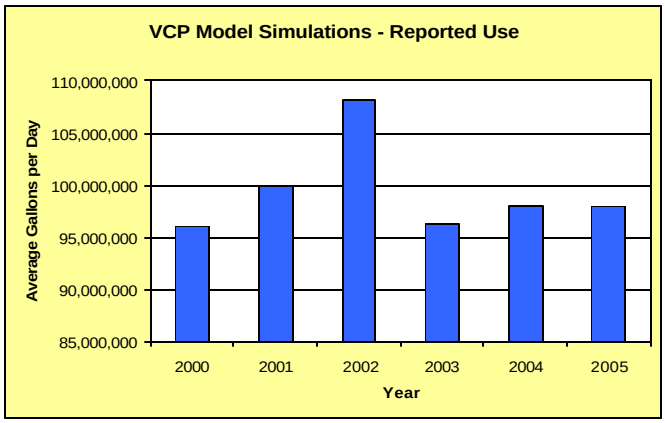
DEQ is required by the Ground Water Management Act of 1992 "to conserve, protect and beneficially utilize the ground water of this Commonwealth and to ensure the public welfare, safety and health (§ 62.1-254)". The confined aquifers of the Coastal Plain Aquifer System have historically yielded high rates of ground water satisfying much of the area's industrial, commercial, municipal, and agricultural demands (see **Figure 40**).

Figure 40: GWMA Withdrawal Demands



Large withdrawals from these sand aquifers produce overlapping cones of depression and some interference among wells has occurred. In addition, decades of water level observations in these aquifers indicate a declining trend in water levels: water levels are falling at a rate of about 2 feet per year in the Middle Potomac aquifer. The reported ground water use in Virginia's Coastal Plain has remained fairly constant in recent years with the exception of increased use during drought years (see **Figure 41**).

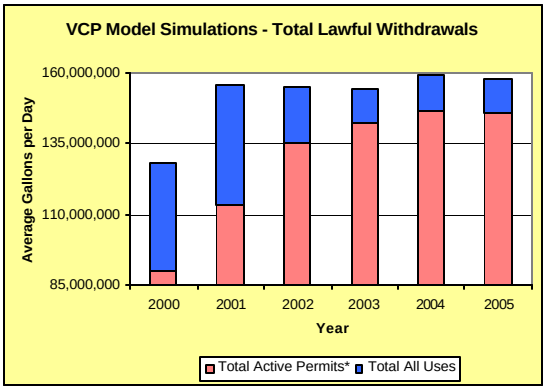
Figure 41: Ground Water Withdrawal – Reported Use



V.C.3.b. Coastal Plain Ground Water Permit Allocations

Since 2000, the total withdrawal amount allowed by all active permits has increased by more than 50% (see **Figure 42**). Much of this increase is the result of municipal requests for expanded withdrawals. As water purveyors try to maximize supply and consider drought risk, their requests for additional ground water allocation increases.

Figure 42: Ground Water Withdrawal Permits (GWMAs) and other lawful withdrawals



*Withdrawals by the City of Norfolk are simulated at the "average of their actual historical ground water usage" as prescribed by the GWMA of 1992, section 62.1-263, 1999 revision. For the 2005 report, Norfolk was simulated at 2.45 million-gallons per day but the permit allows 15.94 million-gallons per day.

V.C.4. Coastal Plain Ground Water Permits – Optimizing Permit Allocations Considering Resource Limits

Field data and predictive modeling indicate allocations for withdrawals from Virginia's coastal plain aquifers may be approaching the limits of sustainability in several areas.

DEQ has developed a Ground Water Withdrawal Action Plan to evaluate and address the difficult issues associated with ground water withdrawal in the Coastal Plain. As a result of this effort, new ideas are being implemented to ensure the maximum amount of ground water is protected for all beneficial uses.

The sections that follow look at different approaches for optimizing permit allocations while taking into consideration existing resource limitations.

V.C.4.a Permits with Under Used Allocations

The regulations provide authority for reopening and reducing permit allocations for facilities that do not use at least 60% of their permitted amount within the first five years of the permit. An initial review of existing permits identified some 20 facilities for which this option may be implemented. Additional supply may be realized if the allocated amounts are not needed. GWWPP staff expects to begin reviews of these permits in fall of this year.

V.C.4.b Development and Implementation of Program Specific Compliance and Enforcement

Historically, minimal staff resources have been utilized to provide compliance assistance or to pursue enforcement of ground water withdrawal permits. In 2006, the Division of Water Resources allocated one staff position to develop and establish a compliance and enforcement program. The position also is responsible for a broad list of responsibilities including inspections, compliance assistance, and enforcement.

The permit compliance program has been implemented, program-specific enforcement procedures have been developed and an inspection program has been initiated. In addition to identifying unreported withdrawals, the inspection program has provided educational information to the public about the importance of ground water management in the Commonwealth, thereby increasing the regulated community's compliance with statutes and regulations.

V.C.4.c Establish Student Cooperative Program

The GWWPP has encountered problems recruiting qualified applicants to fill modeling positions and applicants with hydrogeology experience. DEQ management has supported development of a Cooperative Graduate Engineering Program with Virginia universities to expose talented potential employees to DEQ's mission and programs, allow DEQ to complete specific research projects, and provide an opportunity to attract qualified applicants for DEQ employment.

V.C.4.d. VDACS EQIP adds Irrigation Water Conservation Initiative

GWWPP staff and Virginia Department of Agriculture and Consumer Services (VDACS) staff have cooperated to incorporate a water conservation initiative to Virginia's administration of federal Farm Bill funds. Agricultural users who develop irrigation management plans and reduce impacts to ground water may be eligible under the VDACS Environmental Quality Incentive Program (EQIP) for matching funds to implement their water conservation proposals. These monies became available in 2006 and are expected to be available for at least the next two years. GWWPP staff is partnering with VDACS and Natural Resources Conservation Service (NRCS) to streamline the application process and to offer local forums intended to provide technical assistance to permittees who wish to apply for this program.

V.C.4.e. Development of Drought Based Withdrawal Permit

Many of the ground water withdrawal permits have a strong drought-relief component. As an example, some permits authorize the withdrawal of ground water to supplement public water supplies when surface water sources are impacted by drought conditions. Previously, 10-year permits were issued with an annual limit developed from the "worst case scenario" even though it is unlikely that drought conditions would be experienced for all 10 years. This has the result of reserving a component of the resource as a daily demand that would, in fact, be transient in nature and rarely utilized. As a remedy to this problem, DEQ has developed a "lump sum" permit. These permits consider normal daily demand while providing for episodic drought relief by specifying a maximum withdrawal limit for the term of the permit in

addition to an annual limit. The full term limit, or "lump sum," would allow for 10 years of normal daily demand but the annual limit would specify a maximum withdrawal during drought conditions. This provides protection for normal demand in the total permitted simulations while allowing for unusual drought demands without limiting resources unnecessarily.

V.C.5. Total Permitted Impacts

The GWWPP uses ground water flow models developed by the USGS to simulate the combined effects of all lawful withdrawals in order to evaluate resource availability for new or expanded uses. Each year the simulated withdrawals are updated with new permit information to create a Total Permitted Simulation. The actual reported use is also simulated and compared to field measurements to evaluate model performance (see **Table 7**).

Table 7: Summary of Coastal Plain Ground Water Withdrawals by Aquifer

Aquifer	Total Use (MGD)
Columbia	0.43
Yorktown-Eastover	5.35
Chickahominy-Piney Point	4.22
Aquia	0.14
Virginia Beach	0.08
Upper Potomac	16.01
Middle Potomac	56.93
Lower Potomac	14.83
TOTAL	97.99

The Virginia Coastal Plain Model (VCP Model) covers the aquifer system east of I-95 and simulates nine confined aquifers and a water table aquifer. Steadily declining water levels over the period of record and loss of capacity for wells near the western edge of this area present the biggest challenges to sustainability.

The Eastern Shore Sharp Model (ESS Model) covers the Eastern Shore and simulates the freshwater portions of the confined aquifer system and the water table. Modeling and field data indicate salt water intrusion is the greatest challenge to sustaining the Shore's fresh ground water supply.

As demand increases, the impacts from new users can result in loss of capacity for existing users. Regional ground water flow models are used to simulate the potential changes to ground water levels that would result if all permittees were to exercise the limits of their permits. This evaluation is intended to protect the ability of existing lawful users to continue their withdrawals unencumbered.

Each year the GWWPP modeling staff updates the VCP Model for current actual withdrawals and issues a report of these simulations. The report, model, and GIS files are then made available on the DEQ website for download. The "Annual Use Simulation" is developed by simulating the actual withdrawals reported by permitted facilities (in GWMAs) and the withdrawals reported to the Virginia Water Use Data System for unregulated areas of Virginia's Coastal Plain. The resulting water levels are compared to available field measurements to evaluate model performance.

The "Total Permitted Simulation" is then developed from the Annual Use Simulation. The actual use reported by permitted facilities is replaced with the full withdrawal authorized by permit (see **Table 8**). The resulting water level predictions are used to evaluate all new and expanded use proposals.

Table 8: Total Permitted – Withdrawals Simulated

Maximum Permitted Amounts	145.99 MGD
Other Reported Withdrawals	12.18 MGD
Total Simulated Withdrawals	158.17 MGD

The Ground Water Withdrawal Regulations (9 VAC 25-610 et seq.) defines the limit of allowable drawdown for each confined aquifer such that 20% of the pre-development water levels/pressures is reserved. This limit, or "critical surface", is intended to protect the aquifers from dewatering and compaction. The most recent Total Permitted Simulation identifies four confined aquifers with areas where the water levels are predicted below

this threshold. This means any proposals that would result in additional impacts in those areas can not be permitted. Maps identifying these problem areas are included in **Appendix 3**. The full report is available for download at http://www.deq.virginia.gov/gwpermitting/forms.html (see "Simulations of Ground Water Use in the Virginia Coastal Plain").

V.D. Virginia Water Protection Permit Program – Surface Water Withdrawal Permitting Efforts

This section of the annual report provides a brief overview of the current water supply permitting efforts within the Virginia Water Protection Program within the DEQ.

V.D.1 Current Surface Water Withdrawal Permitting Activity

A permit is expected to be issued to Cumberland County to build a 15 billion gallon reservoir on Cobbs Creek that will be used to provide a reliable water supply to the counties of Cumberland, Powhatan, Henrico and Goochland for decades into the future. The site has a relatively small amount of wetland and stream impacts (32 acres of wetlands and 15 miles of small streams) and will supply approximately 47 million gallons per day of new safe yield to the region. In addition to its obvious water supply benefit the project will also benefit the environment by putting water back into the James River under low flow conditions. Water releases will travel about 45 miles down the James where they will be withdrawn and treated near Richmond. This project will benefit the citizens of central Virginia and the ecology of the James River for years to come.

Charlottesville and suburban Albemarle County were hard hit by the 2002 drought. Mandatory conservation measures were enacted as the drought depleted over half of the community's available water supply storage. That problem is well on its way to being resolved thanks to a permit expected to be issued by DEQ that will allow the Rivanna Water and Sewer Authority to quadruple its useable water supply at the existing Ragged Mountain Reservoir. The additional storage will also benefit the aquatic environment by allowing some of the existing tributaries that are currently used for water supply to return to more normal instream flow regimes.

The election of elevating existing dams to create more storage is becoming a trend, driven in part by mandates from the Department of Conservation and Recreation Division of Dam Safety that order localities to upgrade the spillway capacities of existing dams. Big Stone Gap and Amherst County Public Service Authority have taken this approach. Rivanna Water and Sewer Authority and the City of Bedford are planning to take this approach. In the case of Bedford, the City estimated that dam safety improvements will cost $5 million and the cost of adding storage at the same time will cost an additional $163,000.

V.D.2 VWPP Regulations Amended

Improvements continue to be made in the area of water supply permitting. Recent amendments have been incorporated into the Virginia Water Protection Program Permit (VWPP) Regulation (9 VAC 25-210) regarding surface water permitting issues and concerns that compliment the comprehensive water supply planning process. These amendments are the result of several concurrent efforts and processes including: the Virginia Water Protection Permit Water Permitting (VWP) Technical Advisory Committee (TAC) that developed amendments through a seven month consensus based process; comments received during a public comment period on the proposed amendments; the Minor Surface Water Withdrawal (WP5) TAC that attempted to establish a General Permit for Minor Surface Water Withdrawals during a lengthy consensus based process; incorporation of key concepts and language from the WP5 TAC process into the VWPP regulation; modification of key concepts and language from the WP5 TAC process based on comments from the VWPP TAC and WP5 TAC before and during a

joint meeting of both TACs on October 26, 2006 and administrative changes made to the regulation.

The amendments: 1) clarify which water withdrawals are excluded from the permit requirement and under what conditions; 2) institute a new pre-application panel and public information meeting process for surface water projects; 3) create an Emergency Virginia Water Protection Permit for public water supplies during drought; 4) include new language regarding permit conditions for withdrawals in the Potomac River consistent with the Potomac Low Flow Allocation Agreement; 5) define what information will be considered in the evaluation of cumulative impacts to instream flow; 6) clarify what information is submitted by the applicant to demonstrate that an alternatives analysis has been conducted; 7) create a new variance provision to address temporary relaxation of permit conditions during drought; and 8) establish a new joint public notice process for surface water projects requiring both a VWPP permit and a Virginia Marine Resources permit.

Additional changes were made as a result of the incorporation of key concepts and language from the WP5 TAC process and the proposed General Permit for Minor Surface Water Withdrawals. These amendments: 1) establish a distinction between major (90 million gallons per month or greater) and minor (less than 90 million gallons per month) surface water withdrawals; 2) provide for regulatory exclusions for certain surface water withdrawals from VWPP requirements; 3) create a reporting requirement for some surface water withdrawals excluded from VWPP requirements; 4) create a streamlined application process for new or expanded minor surface water withdrawals; 5) establish applicable permit standards for new or expanded minor surface water withdrawals, and 6) clarify the requirements for evaluation of project alternatives for minor surface water withdrawals for public surface water supply withdrawal projects.

There are also a number of administrative amendments that will allow for a more efficient and understandable application, review and issuance process. In addition, staff has developed a streamlined application and issuance process for small withdrawals which will significantly reduce the cost and administrative burden of obtaining permits for minor water users. These amendments became effective on July 25, 2007.

V.D.3 Effective Water Resource Management

DEQ Division of Water Resource staff have participated in inter-state forums, conferences, and training programs. At each venue, DEQ's program is deemed exemplary in its implementation of the best available technology to evaluate proposed water withdrawals. DEQ is hopeful that its ground water characterization and surface water modeling efforts will mature quickly enough to more completely define the Commonwealth's rich water resources that support so much of Virginia's economy, environment and quality of life for her citizens. As the Program matures, the staff and management continue to refine and improve program implementation to insure the maximum amount of water resources is available to satisfy the Commonwealth's beneficial uses.

VI. Issues Facing the Water Resources Division Programs

Development and management of water resources of the Commonwealth requires the integration of a number of complex and interrelated program areas and concerns. This section addresses some of the individual program issues that are currently facing program staff and management.

VI.A. Water Supply Planning Program Issues

The Water Supply Planning staff continues to work with Virginia localities to assist in their development of local and regional water supply plans.

VI.A.1. Funding for WSP Competitive Grants Program

Over the course of the past three years, the Local and Regional Water Supply Planning Grants Program has provided grants totaling $1,098,418 to partially fund efforts for the development of water supply plans for a total of 37 local government authorities. During this same period the requests for funding totaled $2,545,067, leaving an unfunded request balance of $1,446,649. As the deadlines for plan submittal get closer the grant program becomes more competitive. The current priorities for grant evaluation are the promotion of regional approaches to water supply planning and the consideration of areas with the greatest fiscal need. Given the limited funding, many worthy opportunities to support local and regional planning are not funded with supporting grants from the program. This situation is of significant concern to local governments.

VI.A.2. WSP Plan Submittal Deadlines

Two important program milestones will occur next year (November 2, 2008). First, local governments will have to submit formal notice to DEQ regarding which type of program they will be submitting to comply with the regulations--individual or regional. Second, individual programs are due from localities with populations greater than 35,000. At this time, less than a dozen localities are working on individual local programs and it is unclear how many of the regional efforts will succeed. If these regional efforts are unsuccessful, it is expected that a significant number of local programs will be submitted next November.

VI.A.3. Development of a State Water Resources Plan that Assesses Competing Water Demands

The State Water Resources Plan is envisioned as a framework for presenting the information developed in local and regional water supply plans. In addition, it will identify the water resource management consequences of the combined statewide water demand and the local preferred sources to supply unmet water needs.

The State Plan will provide a statewide snapshot of what the water supply needs are, where they are met, and our best estimate of the resource's ability to meet additional needs. The State Plan will be used as a tool to manage water resources to ensure their continued availability, while also maximizing environmental and economic benefits.

An important result of this planning is that DEQ will be able to identify areas of the state where multiple users want the same source for their water needs. The State Plan will also allow DEQ to identify existing areas of the State where water availability may be insufficient now or in the future based on these locally identified needs. By identifying these conflicts in advance, users and DEQ can have the opportunity to try and find resolutions to these conflicts through regional solutions, alternative sources, or other options.

The State Plan will be the embodiment of a continuous and iterative planning process that evolves in response to changing conditions over time. The development of appropriate analytical techniques necessary to complete these analyses is a significant and complex undertaking that will

likely raise important policy issues among the competing interests that depend on our water resources.

VI.B. Establishing Instream Flows for Beneficial Uses

DEQ is charged with protecting instream flows and instream beneficial uses through water supply planning and through the issuance of Virginia Water Protection Permits. There is currently not an established set of instream flow targets for protecting instream beneficial uses that is unique to the uses that exist in each of the State's major watersheds. Each watershed has its own distinctive set of uses and competing interests. Defining these interests and assigning a requisite instream flow necessary to preserve its viability is essential to determining water availability. DEQ staff intends to initiate a peer review process to assemble the best available science regarding flows necessary to support these uses.

VI.C. Determining the Impact of Surface Water Withdrawals Excluded From VWP Permits

Approximately 90% of all existing surface water withdrawals in Virginia are excluded by statute from VWP permit requirements. A permit can only be required when the withdrawal is increased in such a manner as to require a 401 certification under the Clean Water Act. This exclusion has made any comprehensive management of the surface water resource very difficult. Current state reporting requirements require reporting of the total amount withdrawn during the calendar year, the maximum day withdrawal, and the month that the maximum day occurred. This does not provide the maximum amount each user can withdraw by law before it will need to obtain a permit. The amended VWP regulation requires that these excluded users provide DEQ with this information. It is likely that this information will demonstrate that significantly less water is available for new and expanded uses in certain watersheds than has been previously understood.

VI.D. Ground Water Characterization Program Issues

This section of the annual report examines the issues and concerns being dealt with under the GWCP.

VI.D.1. Comprehensive Statewide Database Needed

Multiple state and federal agencies have collected data on ground water, well location and construction. This information is in various states of development and databases have been designed for specific agency purposes. One of DEQ's goals is to merge the various sources of historical and new ground water information into one statewide database that can be used for regional analysis of ground water aquifer systems. The ongoing initiative to create well construction, geochemical and spring databases described in Section II.C. will require continued support over a number of years to reach this important goal. Readily available data is critical to the ability to describe and characterize ground water resources.

VI.D.2. Funding for State Observation Well Network Expansion

In order to extend the limited funds available to the State Observation Wells (SOWs) expansion project, OGWC has been working cooperatively with localities to identify and use existing wells that are no longer in use by the well-owner to serve as SOWs. This approach has had mixed results depending on the enthusiasm of the locality, the suitability of the abandoned well to serve as a monitoring well, and the location of available abandoned wells. Increased funding would allow for the installation of new wells in areas that are more suitable for long-term monitoring.

VI.D.3. Regional Issues and Initiatives

This section provides a brief overview of the identification of some current regional issues and the need for new initiatives by DEQ's GWCP.

VI.D.3.a. Coastal Plain

Virginia's Northern Neck region (Lancaster, Northumberland, Richmond and Westmoreland Counties) is experiencing development and population growth that has given rise to citizen and local government concerns over the future availability of ground water. DEQ staff has been in discussions with Northern Neck localities regarding the potential benefits of being designated a Ground Water Management Area. Additional state observation wells as described in Section II.2.6. will be necessary to better describe the hydrogeologic framework of this region to support adequate ground water withdrawal management.

Other ground water issues in the coastal plain that require additional investigation include developing a monitoring program to better define the cone of depression in the Piney Point aquifer in James City and New Kent Counties and the area in Southampton County where simulated water levels are dropping below the critical surface of the Potomac aquifer. Measured water levels are within tens of feet of the 80% critical surface at the Diascund Research Station located in western James City County. At this time, there are an insufficient number of observation wells in the Piney Point aquifer and the Potomac aquifer in these two areas to accurately monitor water levels.

VI.D.3.b. Piedmont/Blue Ridge

The drought of 2002 highlighted the susceptibility of the Piedmont and Blue Ridge areas to drought related water shortages as evidenced by the thousands of residential, agricultural, and municipal wells that failed to maintain water supply requirements. In order to provide a better understanding of the temporal and regional effects of drought in the Piedmont and Blue Ridge areas, the ongoing State Observation Well (SOW) expansion initiative should be continued and expanded.

A more in-depth investigation of the relationship between topography, lithology, geologic structure, and the occurrence and movement of ground water in the Piedmont and Blue Ridge areas is necessary to insure the presence of dependable production wells. The potential presence of a deeper ground water system than normally utilized could be an invaluable resource for industrial and municipal ground water supply in the Piedmont and Blue Ridge areas. An effort to define the existence and extent of a deep ground water circulation pattern in the fractured rock terrain should be investigated.

An initiative to investigate the geologic settings of existing high-yielding wells in the Piedmont and Blue Ridge areas is ongoing. OGWC staff members are coordinating with well owners and municipalities to obtain historical pump test data and run geophysical logs on high yielding wells in an effort to inventory and catalog the geologic factors that contribute to high well yields in fractured rock. It is anticipated that a subset of these wells will provide additional information regarding the existence of deeper ground water flow systems discussed above.

An increasing number of counties in the Piedmont and Blue Ridge areas have implemented ground water ordinances requiring detailed geologic and hydrogeologic investigation and testing to insure the adequacy of the newly drilled wells, and to minimize impacts of new ground water uses on existing wells. Investigations required by these ordinances have, and will continue to generate valuable geophysical and aquifer test data. OGWC staff will continue to provide guidance on developing such ordinances and when applicable, assist with the creation and planning of site-specific tests for the purpose of water resource management and scientific investigation.

VI.D.3.c. Valley and Ridge/Appalachian Plateau

Counties in the northern portion of the Shenandoah Valley have experienced water supply issues related to population growth and economic expansion. The Frederick County Service Authority (FCSA) signed an agreement with a quarry operator to use the quarry as a ground water extraction/storage facility following cessation of quarrying activities. FCSA already uses two other abandoned quarries for ground water extraction in other parts of the county. Rockingham County is seeking to expand its water extraction capabilities in response to increased growth in the eastern part of the county. Augusta County is looking for additional water supplies in the western portion of the county to supply its growing population.

Clarke and Frederick Counties have contracted with the USGS to conduct comprehensive ground water studies of their counties. OGWC has provided assistance to USGS scientists in data collection, and has been involved with several new geophysical studies that are designed to be able to better characterize ground water flow in limestone terrain. OGWC also assisted USGS staff conducting age-dating of water in the Warm Springs Valley of Bath County.

Throughout the region, data on ground water resources is being sought by county officials and their consultants for water supply planning purposes. OGWC has provided what ground water data is available to several counties, consultants, and planning district commissions. These needs for data and expanded utilization of ground water resources highlight the need to expand ground water investigations in the region.

VI.E. Ground Water Permitting Program Issues

This section of the annual report takes a close look at the issues facing the Ground Water Permitting Program.

VI.E.1. Impact of Current Development Proposals on Declining Water Levels in the Fall Zone

The term "fall zone" is used to describe the western edge of Virginia's Coastal Plain where the productive, high-capacity aquifers gradually thin to a feather-edge of sediments at the base of the Piedmont area. As use of the productive aquifers increases, this area experiences the largest relative decline in capacity. This effect occurs because the aquifers are thinner to the west and nearer to land surface resulting in relatively lower available pressures and capacity before any withdrawals occurred. For example, the pre-development water levels in the Middle Potomac aquifer in Hanover County would have been a couple hundred feet above the top of the aquifer while in Suffolk the same aquifer would have had water levels approaching a thousand feet above the top of the aquifer.

Currently there are 11 proposals to initiate new withdrawals or expand existing withdrawals in the near fall zone area of King William and New Kent counties. These new or expanded uses propose 6,000,000 gallons per day of withdrawals in areas currently shown to be at or beyond the limits of the resource to sustain existing demands. DEQ staff is working with these applicants and the Counties that will ultimately own and operate any permitted systems to 1) identify long-term water conservation measures that may be incorporated at the planning stages to reduce demand and 2) minimize the impacts to the potable aquifer system from residential irrigation demands or other 'luxury' uses.

VI.E.2. Expiring Historic Permits

Applications are expected for 21 permits expiring in 2007 and for 17 permits expiring in 2008. Most of these expiring permits were issued based on historic use and did not include a technical evaluation of impacts. It is likely that most of these applicants will be required to perform significant on site data collection to support the application

process. It is also likely that, for some subset of these applicants, the technical evaluation performed by DEQ staff may demonstrate the unavailability of sufficient ground water resources.

VI.E.3. Revision of Regulation

The Ground Water Withdrawal Action Plan identified changes to the current regulations that should be considered. A technical advisory committee will be convened and a significant amount of staff resources will be required to adequately investigate potential revisions to the regulation. Staff will attempt to develop a consensus based regulatory revision to the greatest extent possible.

VI.E.4. Application of New Models

DEQ has partnered with the USGS over the past five years to develop new regional ground water flow models. The new models maximize current computing capabilities and explicitly consider all aquifers and confining units. Other refinements in these regional models allow much smaller impacts to be evaluated using these regional tools. Transitioning these new models to the applied environment will require changes to existing procedures, significant increases in computing capabilities, and may have regulatory implications.

VII. Appendices

Appendix 1: Virginia's Water Resources Data

State Population (2006 Estimate) - 7,642,884

State Surface Area – 42,769 square miles

Major River Basins (with Current Estimates of Flow):

Potomac/Shenandoah (5,808 square miles) – 1,842 MGD
Rappahannock (2,891 square miles) – 1,131 MGD
York (2,701 square miles) – 1,099 MGD
James (10,253 square miles) – 5,558 MGD
Chesapeake Bay/Small Coastal (1,712 square miles) – 97 MGD
Chowan River/Albemarle Sound (4,122 square miles) – 1,777 MGD
Roanoke (6,378 square miles) – 2,277 MGD
New (4,703 square miles) - 3,296 MGD
Tennessee/Big Sandy (4,202 square miles) – 2,618 MGD

Perennial River Miles (freshwater) - 50,537 miles

Publicly Owned Lakes and Reservoirs

Larger than 5,000 acres	5	109,838 acres
Smaller than 5,000 acres	243	52,392 acres
Total	248	162,230 acres

Freshwater Wetlands - 808,000 acres

Tidal and Coastal Wetlands - 236,900 acres

Estuary - 2,557 Square Miles

Atlantic Ocean Coastline - 120 Miles

Statewide Average Annual Rainfall - 42.8 inches

Average Freshwater Discharge of All Rivers - Approximately 25 billion gallons per day

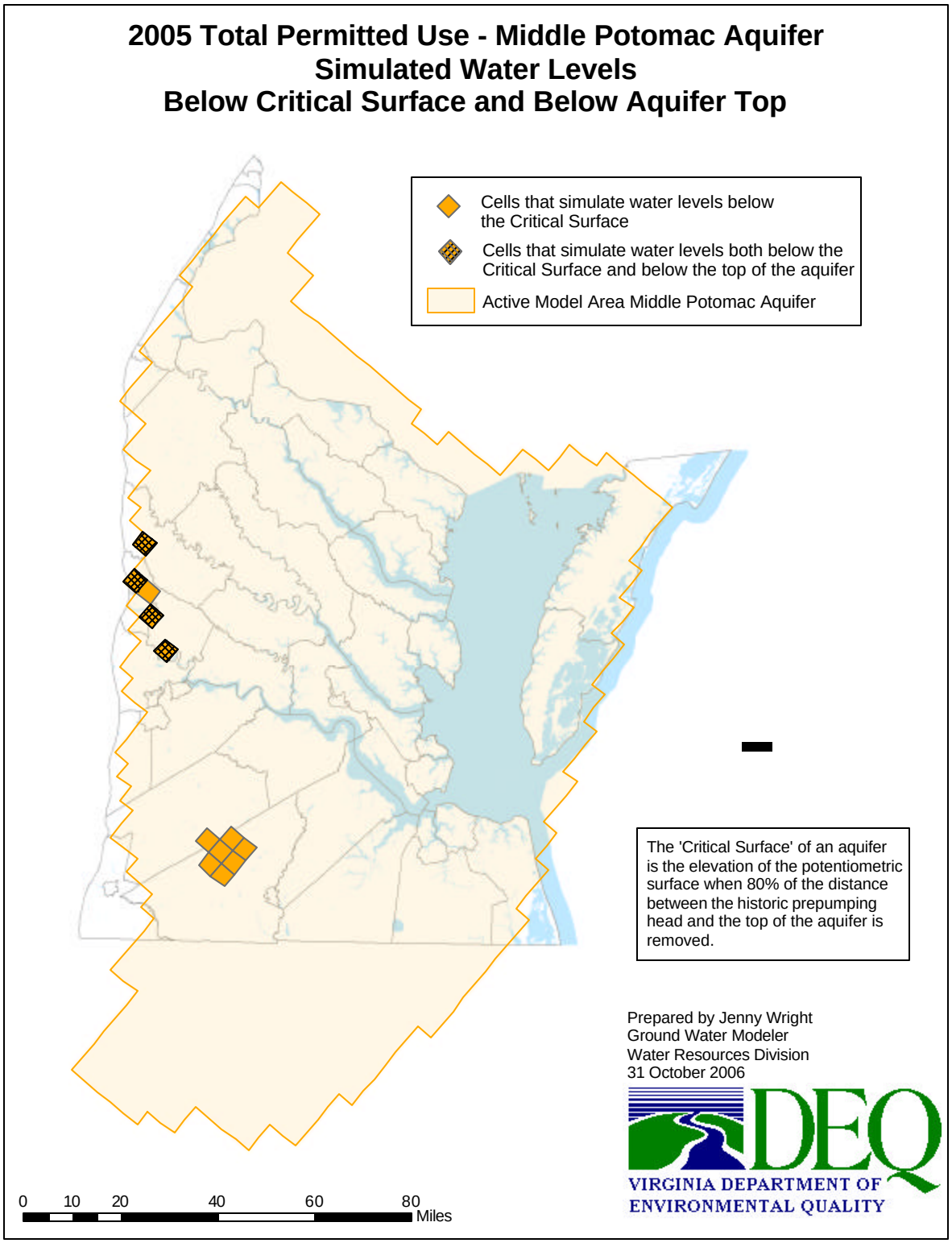
Average Freshwater Discharge into the Chesapeake Bay – Approximately 9,727 million gallons per day

Appendix 2: TOP 50 WATER WITHDRAWERS DURING 2006

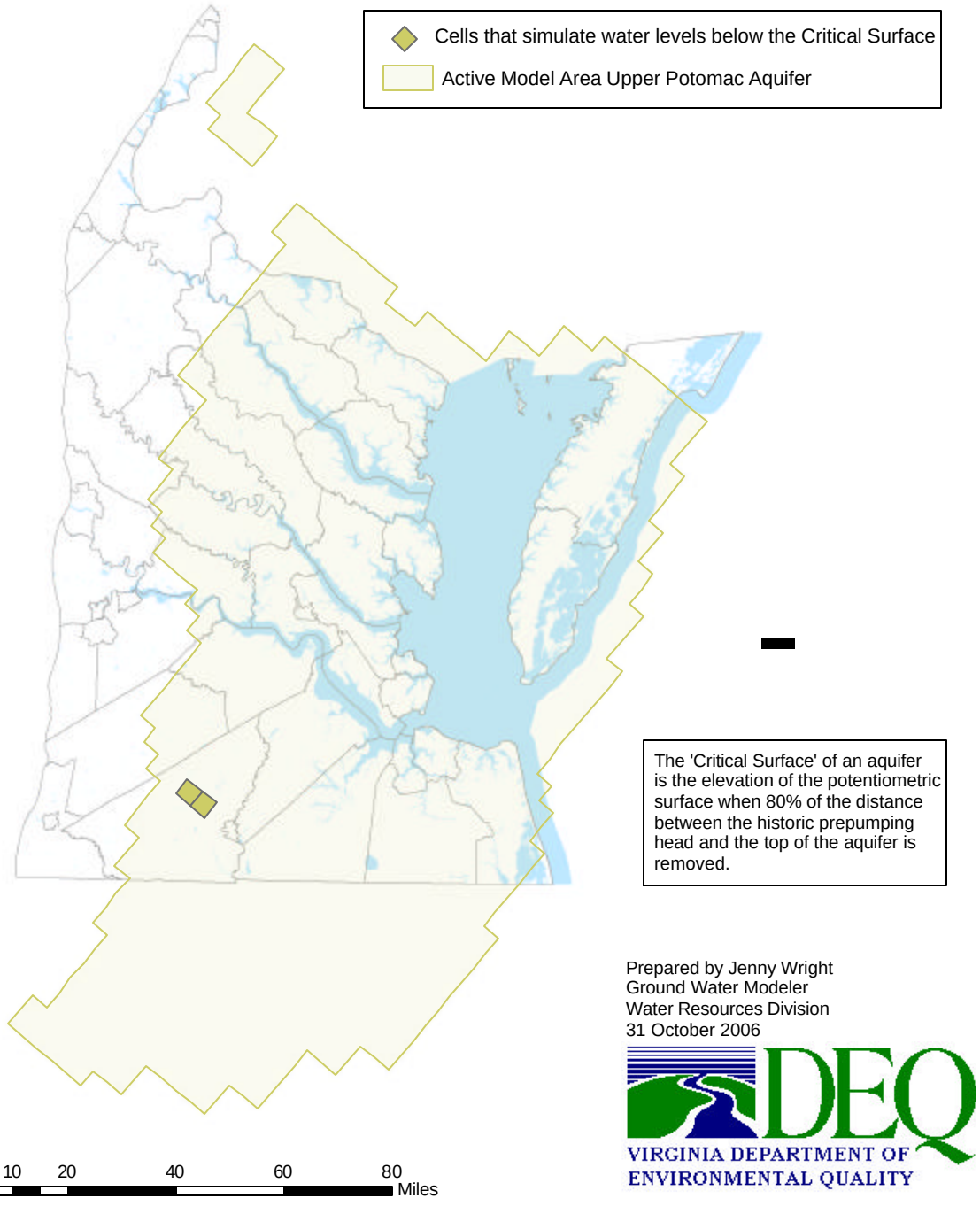
OWNER NAME	SYSTEM	TOTAL (MGD)	CATEGORY*
DOMINION GENERATION	NORTH ANNA NUCLEAR POWER	2153.55	PN
DOMINION GENERATION	SURRY NUCLEAR POWER PLANT	1924.69	PN
DOMINION GENERATION	CHESTERFIELD POWER STATION	887.24	PF
DOMINION GENERATION	YORKTOWN FOSSIL POWER PLANT	670.88	PF
DOMINION GENERATION	CHESAPEAKE ENERGY CENTER	571.61	PF
AMERICAN ELECTRIC POWER CO	GLEN LYN POWER PLANT – GILES	256.25	PF
MIRANT POTOMAC RIVER LLC	POTOMAC RIVER GENERATION - ALEXANDRIA	231.72	PF
DOMINION GENERATION	POSSUM POINT POWER PLANT – PRINCE WILLIAM	200.00	PF
DOMINION GENERATION	BREMO BLUFF POWER PLANT – FLUVANNA	133.95	PF
HONEYWELL INTERNATIONAL INC	HOPEWELL PLANT	120.48	MAN
FAIRFAX COUNTY WATER	POTOMAC RIVER – FAIRFAX	85.74	PWS
FAIRFAX COUNTY WATER	OCCOQUAN – PRINCE WILLIAM	71.01	PWS
RICHMOND, CITY OF	RICHMOND, CITY	70.87	PWS
NORFOLK, CITY OF	NORFOLK– SUFFOLK	62.63	PWS
CINERGY SOLUTIONS OF NARROWS	CELCO PLANT – GILES	60.30	MAN
GIANT YORKTOWN INC	YORKTOWN REFINERY – YORK	59.95	MAN
MEADWESTVACO CORPORATION	COVINGTON PLANT – ALLEGHANY	39.36	MAN
INTERNATIONAL PAPER CORP	FRANKLIN PLANT – ISLE OF WIGHT	35.75	MAN
APPOMATTOX RIVER WATER AUTH.	LAKE CHESDIN – CHESTERFIELD	30.61	PWS
DUPONT E I DE NEMOURS & CO	SPRUANCE PLANT – CHESTERFIELD	28.82	MAN
NEWPORT NEWS, CITY OF	NEWPORT NEWS	27.61	PWS
HENRICO COUNTY	HENRICO COUNTY WTP	25.98	PWS
NEWPORT NEWS, CITY OF	NEWPORT NEWS – NEW KENT	25.02	PWS
VIRGINIA BEACH, CITY OF	VIRGINIA BEACH	23.67	PWS
NEWPORT NEWS, CITY OF	NEWPORT NEWS – YORK	21.77	PWS
VIRGINIA AMERICAN WATER	HOPEWELL DISTRICT	20.36	PWS
HONEYWELL NYLON LLC	CHESTERFIELD PLANT	19.37	MAN
PORTSMOUTH, CITY OF	PORTSMOUTH - SUFFOLK	18.29	PWS
ST LAURENT PAPER PRODUCTS	WEST POINT PLANT	17.81	MAN
WESTERN VA WATER AUTHORITY	ROANOKE, CITY OF	16.53	PWS
UNITED STATES GOVERNMENT	RADFORD AMMUNITIONS PLANT - MONTGOMERY	15.53	MAN
SMURFIT-STONE CONTAINER	HOPEWELL PLANT – PRINCE GEORGE	12.92	MAN
NORFOLK, CITY OF	NORFOLK - SUFFOLK	12.33	
VIRGINIA, COMMONWEALTH OF	COURSEY SPRING FISH STATION - BATH	11.92	AGR
WESTERN VA WATER AUTHORITY	SPRING HOLLOW RESERVOIR - ROANOKE	11.91	PWS
DOMINION/OLD DOMINION ELECTRIC	CLOVER POWER STATION - HALIFAX	11.37	PF
MANASSAS, CITY OF	MANASSAS – PRINCE WILLIAM	11.00	PWS
LYNCHBURG, CITY OF	LYNCHBURG - AMHERST	10.86	PWS
FAIRFAX, CITY OF	FAIRFAX, CITY OF - LOUDOUN	10.74	PWS
AMERICAN ELECTRIC POWER CO	CLINCH RIVER POWER PLANT - RUSSELL	10.71	PF
GEORGIA-PACIFIC	BIG ISLAND PLANT - BEDFORD	9.15	MAN
MERCK & CO	ELKTON PLANT - ROCKINGHAM	8.90	MAN
WINCHESTER, CITY OF	WINCHESTER - WARREN	8.33	PWS
CHESTERFIELD COUNTY	CHESTERFIELD COUNTY	8.20	PWS
RIVANNA WATER & SEWER AUTH	ALCSA & CHARLOTTESVILLE	7.53	PWS
CHESAPEAKE, CITY OF	CHESAPEAKE	7.40	PWS
SPOTSYLVANIA COUNTY	MOTTS RUN WTP - SPOTSYLVANIA	7.02	PWS
BLACKSBURG-C'BURG-VPI WTR	BLACKSBURG-CHRISTIANSBURG-VPI-MONTGOMERY	6.92	PWS
CHEMICAL LIME COM OF VIRGINIA	KIMBALLTON PLANT 1 - GILES	6.90	MAN
STAFFORD COUNTY	STAFFORD COUNTY	6.74	PWS
TOTAL		8,108.20	

*PF = FOSSIL POWER, PN = NUCLEAR POWER, PWS = PUBLIC WATER SUPPLY, MAN = MANUFACTURING, MIN = MINING, AGR = AGRICULTURE

Appendix 3: Ground Water Withdrawal Problem Areas



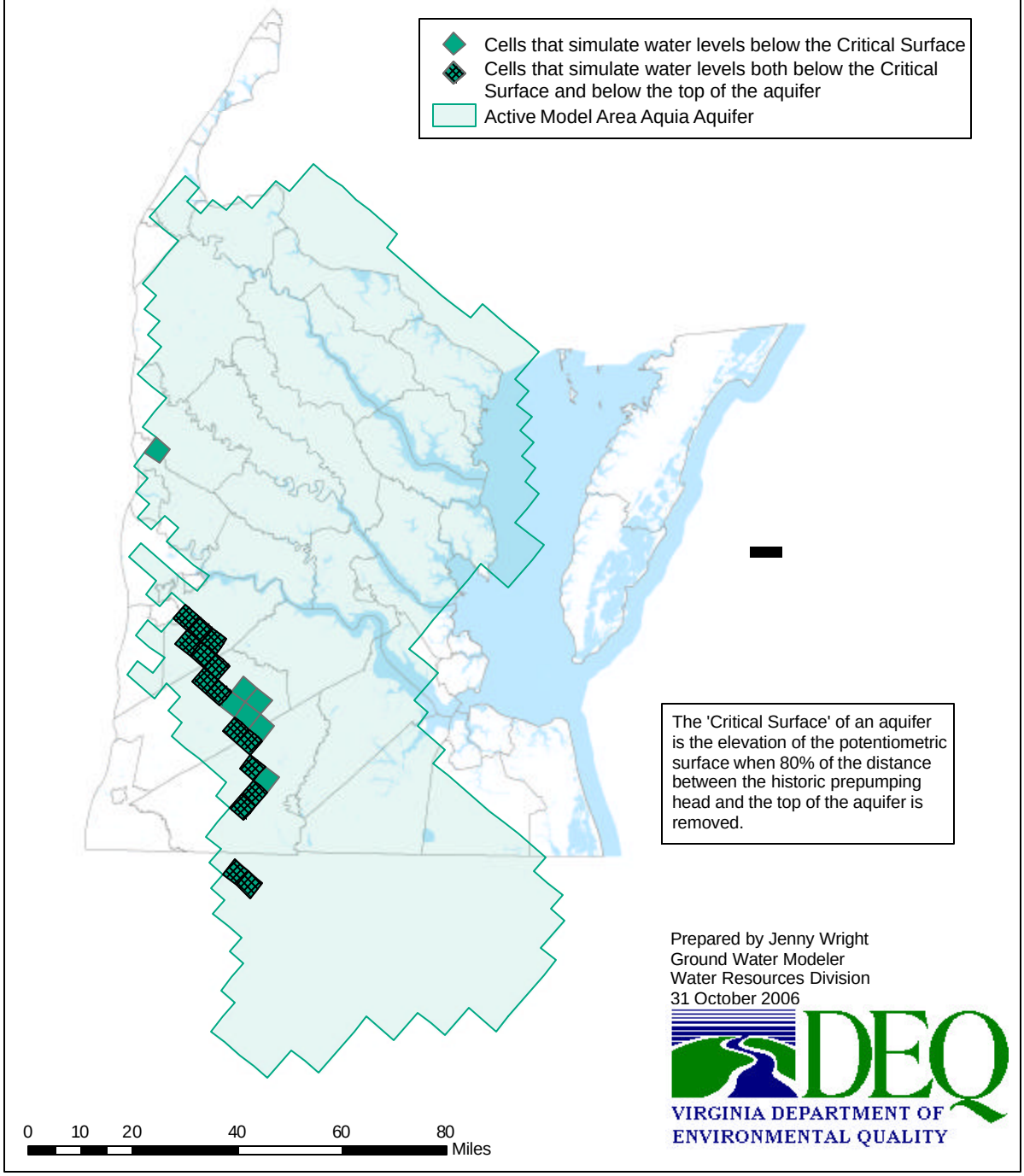
2005 Total Permitted Use - Upper Potomac Aquifer
Simulated Water Levels
Below Critical Surface and Below Aquifer Top



Prepared by Jenny Wright
Ground Water Modeler
Water Resources Division
31 October 2006

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

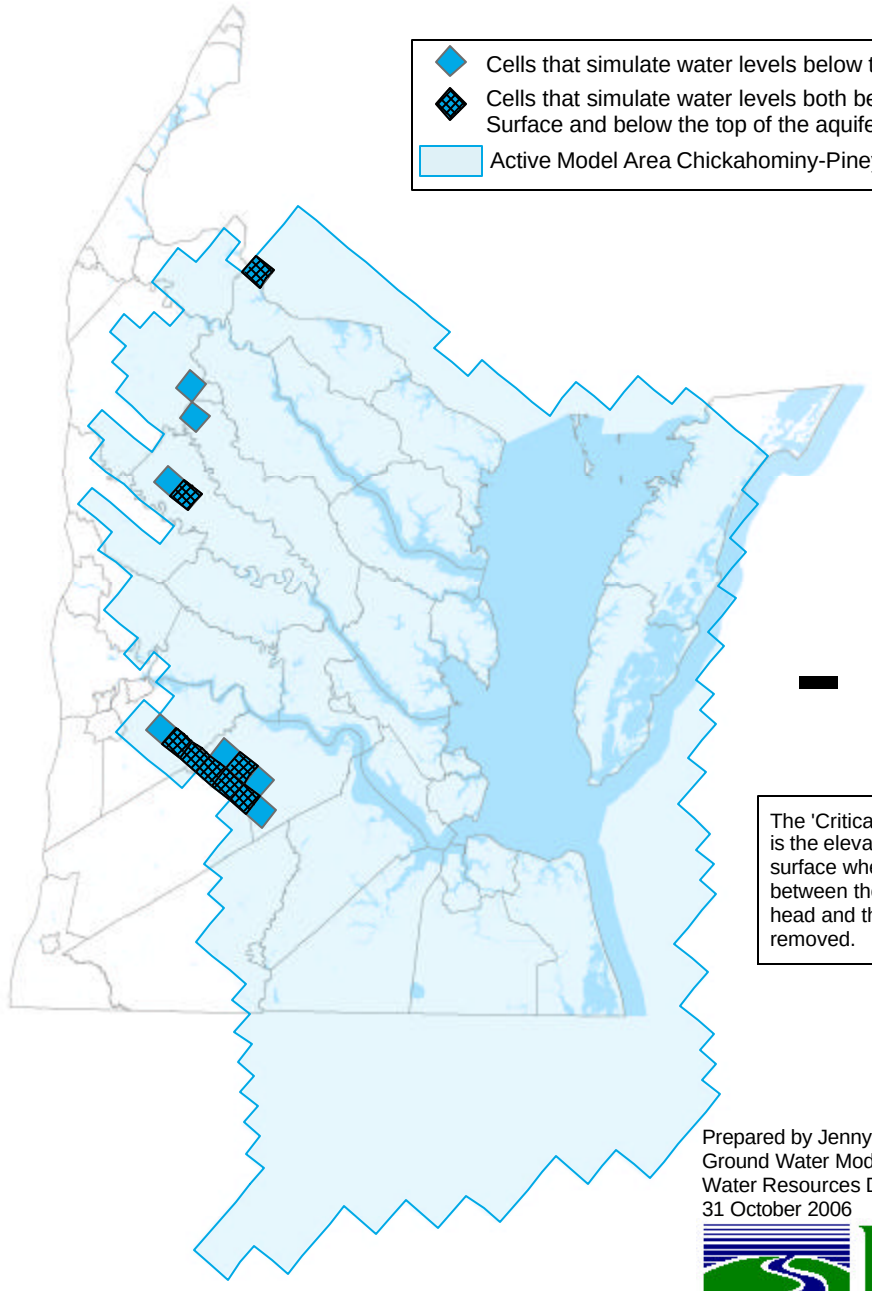
2005 Total Permitted Use - Aquia Aquifer
Simulated Water Levels
Below Critical Surface and Below Aquifer Top



Prepared by Jenny Wright
Ground Water Modeler
Water Resources Division
31 October 2006

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

2005 Total Permitted Use - Chickahominy-Piney Point Aquifer
Simulated Water Levels
Below Critical Surface and Below Aquifer Top



The 'Critical Surface' of an aquifer is the elevation of the potentiometric surface when 80% of the distance between the historic prepumping head and the top of the aquifer is removed.

0 10 20 40 60 80 Miles

Prepared by Jenny Wright
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Water Resources Division
31 October 2006

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY