

## CHAPTER 6 GROUND WATER PROTECTION PROGRAMS/ASSESSMENT

The 2005 USGS Water Use report (<http://pubs.usgs.gov/circ/1344/>) estimated that approximately 2.2 million Virginians depended on ground water for their domestic supply. Approximately 3 out of every 10 Virginians use ground water from public water supplies, private wells, or springs for their daily water supply. While Virginia's groundwater is generally of good quality, both the quality and quantity can vary across the five physiographic provinces found in the state. Reliance on groundwater is also highly variable across the state, depending on a variety of geographic, geologic, and socioeconomic factors.

General ground water quality information by physiographic province:

### Cumberland Plateau

Geology: Sedimentary rock yielding ground water of varying quality

Pollution Potential: Moderate

The Cumberland Plateau province, encompassing the Southwestern tip of Virginia, is underlain by sedimentary rocks, principally sandstone, shale, and coal. Ground water quality here varies with depth. The first 100 feet of rock below stream level is often of poor quality, tending to be sulfurous and iron-rich, and naturally saline waters occur at depths greater than 300 feet. Better quality water can be found at depths of 150 to 300 feet below stream level, however. In coal mining areas, some ground water has become acidic due to mine drainage and is usually unsuitable for most uses.

### Valley & Ridge

Geology: Sedimentary rocks including limestone, dolomite, and shale

Pollution Potential: High in limestone areas where ground water moves rapidly

Consolidated sedimentary rocks deposited beneath ancient seas underlie the Valley and Ridge Province to the west of the Blue Ridge. In the lowlands, such as the Shenandoah Valley, limestone and dolomite occur beneath the surface forming the most productive aquifers in Virginia's consolidated rock formations. In contrast, sandstone and shale are the rock types often present in the ridges and upland areas, which yield only enough water for rural and domestic supplies.

The connection between ground water and surface water plays a major role in ground water recharge in the Valley and Ridge. Recharge can also occur through surface run-off into limestone sinkholes, bypassing filtration through the soil. This can cause serious water quality problems since polluted surface water may be introduced directly into the ground water system. Ground water quality can also be adversely affected by private trash dumps located in sinkholes that receive surface run-off. In addition, carbonate formations contribute to the "hardness" of the ground water.

The karst limestone type of terrain in the valley poses difficult problems for wellhead protection area delineation since underground conduits may act much like surface rivers. Some studies have suggested that surface water drainage patterns may be the best way to delineate wellhead protection areas in such circumstances.

### Blue Ridge

Geology: Impervious rock. Well yields are low

Pollution Potential: High, because of rapid movement of water in fractures, joints, and bedding planes.

The Blue Ridge Province is a relatively narrow zone to the west of the Piedmont, from 4 to 25 miles wide, with mountains of some of the highest elevations in the state. Beneath a thin layer of soil and weathered rock lies the bedrock, a relatively impervious zone containing water primarily in joints, fractures, and faults. On the eastern flank of the Blue Ridge, igneous and metamorphic rocks are most common while sedimentary rocks are more common on the western flank. Steep terrain and thin soil covering result in rapid surface run-off and low ground water recharge.

There has been little residential or industrial development in the Blue Ridge itself, so ground water use has been mainly for domestic needs rather than for public wells. The lower slopes of the mountains are the most favorable areas for ground water accumulation. Springs are common and are often used for private water supplies.

#### Piedmont

Geology: Diverse geology with a wide range of ground water quality and availability

Pollution Potential: Low to moderate

The largest physiographic province in Virginia is the Piedmont, extending from the fall line on the east to the Blue Ridge Mountains in the center of the state. Hard, crystalline igneous and metamorphic formations dominate this region with some areas of sedimentary rocks and saprolite deposits overlying the bedrock. The size and number of fractures and faults in the bedrock which store and transmit ground water decrease with depth, so most significant water supplies are found within a few hundred feet of the surface. Fairly large yields of water can be obtained where fracture and fault systems are extensive such as the Western Piedmont along the base of the Blue Ridge Mountains.

The diversity of the subsurface geology of the Piedmont Province results in wide variations in ground water quality and well yields, with ground water use at many locations limited. A few areas, for example, have problems with high iron concentrations and acidity. Because of the range in ground water quality and quantity in this region, as well as the subsequent varying potential for contamination, well site evaluation and well monitoring is very important here. From a wellhead protection standpoint, assumptions about the porosity and permeability of the overlying saprolite may have to be made so that reasonable estimates of wellhead protection areas can be calculated.

#### Coastal Plain

Geology: Unconsolidated sand, clay, marl, and shell strata. Groundwater is abundant and use is high.

Pollution Potential: High, due to geology and population density

The Coastal Plain in Virginia extends inland from the coast about 110 miles to the fall line and passes roughly through Fairfax County, Fredericksburg, Richmond, Petersburg, and Emporia. The Eastern Shore is part of this region and the two counties there have been conducting studies for several years to develop a more detailed understanding of their ground water situation. The Coastal Plain region is the only one in Virginia that is composed mostly of unconsolidated deposits, primarily alternating layers of sand, gravel, shell rock, silt, and clay. More ground water is stored in these very permeable materials than in any other province in the state. The pollution potential in the uppermost unconfined aquifer is high because of the permeability coupled with the high population density and agricultural activities in the area.

A large portion of the state's ground water use occurs in the Coastal Plain, which has two separate ground water systems, one shallow and one deep. In many places, a shallow unconfined aquifer system lies above relatively impermeable clay beds and is the source of water for hundreds of domestic and other small capacity wells. The principal source of major ground water withdrawals is a deeper system of confined aquifers. The recharge area to these aquifers occurs miles away from where the formations outcrop but infiltration from the water table and shallower confined aquifer also recharge the deeper confined aquifers and could carry pollutants into these deeper reaches. The coastal plain presents a complex wellhead protection problem where the deep confined aquifers are concerned. The shallower aquifer, however, may have a more direct interaction with the surface and present a relatively straightforward challenge.

Except for areas where saltwater, iron, and hydrogen sulfide occur, the natural water quality in the Coastal Plain aquifers is good. In aquifers near a salt water interface, salt water may migrate west as aquifers are pumped. As a result, water from the deep aquifers on much of the lower York-James Peninsula and the Norfolk-Virginia Beach area generally contains high chloride concentrations, rendering the water too salty for domestic use without treatment.

The following paragraphs briefly describe ground water protection activities in the Commonwealth. Information provided in Tables 6-1, 6-2, 6-3, 6-4 and 6-5 is presented for the Commonwealth as a whole. Budgetary constraints within the Commonwealth prevent coordinated data collection activities designed to characterize ambient ground water quality and changes to that quality over time on a statistically valid statewide basis.

### *Ground Water Protection Steering Committee*

Ground water programs in Virginia strive to maintain existing high quality water through adopted statutes, regulations, and policies. Advancing ground water protection efforts is the goal of many state programs in numerous state agencies. In late 1986, an interagency committee was formed to stimulate, strengthen, and coordinate ground water protection activities in Virginia. The Ground Water Protection Steering Committee (GWPS) continues to meet with representation from the following agencies:

Department of Environmental Quality (DEQ)  
Department of Health (VDH)  
Department of Mines, Minerals, and Energy (DMME)  
Virginia Polytechnic and State University (VPI&SU)  
Department of Housing and Community Development (VDH&CD)  
Department of Agriculture and Consumer Services (VDACS)  
Department of Conservation and Recreation (DCR)  
Department of General Services, Division of Consolidated Laboratories (DCLS)  
US Geological Survey (USGS)

### *Ground Water Characterization Program (GWCP)*

During the 2005 session, the General Assembly passed legislation and provided funding to establish water supply and ground water characterization programs within DEQ in response to negative impacts experienced by many localities, businesses, and domestic well users during the drought of 2002.

The Commonwealth is divided into three regions to include the Coastal Plain, Piedmont-Blue Ridge, and Valley-Plateau. The organizational objective of the GWCP 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. GWCP staff will assure that necessary information is available to support resource management decisions, water supply planning activities, ground water availability, drought monitoring, and support the expansion or creation of ground water management areas.

Initial efforts will include 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 develop procedures to automate the acquisition of new data. Long range goals include expansion of the State Observation Network west of the fall line and publication of regional ground water resources reports.

### 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 date, the State Water Control Board ground water resource reports are the only readily available source of information pertaining to the occurrence, movement, and availability of ground water for a large number of the areas initially investigated. Although the majority of these historical reports are out of print, the reports are available electronically:

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<http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/GroundwaterCharacterization/ReportsPublications.aspx>

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

#### Statewide Well Construction Database

Since each ground water geologist is charged with characterizing the ground water framework of extremely large regions, initial efforts have concentrated on the construction of a state-wide water well construction and water quality database. Over the years, water well information has been collected by different state and federal agencies for a variety of purposes. Prior to the adoption of the Groundwater Act of 1973 (Chapter 3.4 of Title 62.1, Waters of the State, Ports and Harbors), collection and submission of water well reports was largely a voluntary effort. Agencies such as DMME – Division of Geology and Mineral Resources, USGS, VDH, and the SWCB had their own versions of water well reports and collected them for different purposes.

Water Well Completion Reports (WWCR), also known as GW-2 forms, was a requirement of the Groundwater Act of 1973, and they were required to be submitted to the SWCB. The SWCB collected and digitized approximately 22,000 wells and springs throughout the state from approximately 1968-1991. During this period, SWCB staff obtained well coordinates manually from 7.5' USGS topographic quadrangles. Well construction, location, and some water quality information was initially transferred onto paper punch cards and uploaded into EPA's STORET database. By the early 1980s, data was entered into STORET via remote computer terminals.

With the adoption of VDH's Private Well Regulations [12 VAC 5-630-10 through 480] (effective September 1, 1989), responsibility for collection of WWCR was transferred from the SWCB to the local health departments. In the past few years, local health departments have begun to enter private well information into a database called VENIS and have acknowledged the importance of coordinates on well records. VDH is in the process of revising private well and septic regulations and hopes to include GPS locations as a requirement. Unfortunately, local health departments are not entering well construction information into VENIS and currently have no plans to do so in the near future. 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 are supportive of electronic submittal of WWCRs and are encouraging the distribution of this software to drillers and local governments.

Well completion reports for public supplies (>15 service connections or >25 individuals) have been collected by the VDH Office of Drinking Water since the mid 1960s. Location information and other data pertaining to the use of the public supplies for most have been entered into the EPA's State Safe Drinking Water Information System (SDWIS). It appears that use of this database will require additional searching at VDH to match the well completion report on record with the location information in SDWIS.

The USGS maintains a Groundwater Site Information (GWSI) database of wells used in various historical and ongoing studies. Well construction, geologic, and other information exists for 7,022 wells in the

Virginia portion of the database.

One of DEQ's goals is to merge the various sources of historical and new well information into one statewide database that can be used for regional analysis of ground water aquifer systems. Major challenges to this goal are the fact that each database has its own numbering or indexing system. Duplicate wells exist in the various databases. Duplicate wells may or may not reference the other numbering systems of the different databases. The various databases have varying degrees of location accuracy as some were obtained from topographic quads and others were obtained using global positioning systems. Efforts to sort, clean up, and merge this data were completed in 2010: <http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/GroundwaterCharacterization/WellDatabase.aspx>.

#### Statewide Legacy Geochemical Database

Upon completion of the Statewide Well Construction Database in FY09, the GWCP began compiling a master database of legacy ambient water quality data of waters from wells and springs throughout the Commonwealth. 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 ionic 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 ionic concentrations (above background levels) due to ground water contamination from anthropogenic sources, for predicting chemical and biological interactions due to the contamination of ground water, and for optimizing well placement to insure high quality drinking water for private residences and municipalities. The initial effort to compile water quality data into a single database is complete. Additional effort is required to identify duplicate wells and resolve locational inaccuracies.

#### Statewide Legacy Spring Database

The GWCP is in the process of creating a statewide spring database. <http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/GroundwaterCharacterization/SpringDatabase.aspx>.

To date, spring locations are largely unmapped in most parts of the region and limited information is fragmented among DEQ, DCR, USGS, and DMME – Division of Geology and Mineral Resources about the location, discharge, and basic water quality of such waters. A comprehensive database of this basic information is necessary for any attempt to understand regional water resources in such complex terrains as the carbonate aquifers of western Virginia. This geospatial database will also have value to other programs in DEQ such as Pollution Response and Petroleum Storage Tanks that deal with subsurface contaminant transport. Working agreements, standardized forms and definitions have been developed by GWCP that will be used by field personnel in sister agencies such as DCR, and DMMR in order to multiply the rate of compilation of new springs into a central database of spring locations, morphology, discharge, and basic geo-chemistry.

#### *State Observation Well (SOW) Program*

The DEQ collects data on ground water levels at 214 wells and the USGS collects data on ground water levels at 144 wells, with periodic water quality samples taken at 19 of those wells. One hundred sixteen of the wells in the DEQ/USGS observation well network have been converted to real time monitoring with levels measurements captured once every 15 minutes and uploaded to the internet using satellite technology. Data from the wells in the DEQ/USGS observation well network was published in a Final 2012

bound report entitled, *Water Resources Data, Virginia, Volume 2: Ground water and ground-water-quality records*, until 2006. Currently, DEQ/USGS water level and water quality data are available on a USGS interactive map browser at <http://wdr.water.usgs.gov/adrgmap/index.html>. The information provided by the research stations is important for monitoring drought conditions, determining when ground-water recharge actually occurs, and monitoring the effects of ground water withdrawal. Additionally, the ground water level data collected cooperatively by the DEQ and USGS contributes to a long-term Coastal Plain ground water modeling project.

The GWCP was recently allotted a limited amount of funds to be used in the expansion of Virginia's real-time state observation well network that is operated in cooperation with the USGS Virginia Water Science Center <http://waterdata.usgs.gov/va/nwis/current/?type=gw>. Twenty-nine new SOW were added between January 2005 and December 2010. If these stations were distributed evenly throughout Virginia, there would be a density of one (1) monitoring station for every 701 miles of the state. Most, however, are located in the coastal plain region of eastern Virginia (45 out of 61). Eight (8) real-time research stations are located in the Piedmont and eight (8) are currently located west of the Blue Ridge Mountains. Considerable effort is underway to establish a higher density of real-time monitoring wells west of Interstate 95.

In order to extend the limited funds available to the SOW expansion project, the GWCP has attempted to work cooperatively with localities to identify and use existing wells no longer in use by the well-owner. This approach has had mixed results depending on the enthusiasm of the locality and the suitability of the abandoned well. Increased funding would allow for the installation of new wells in areas that are more suitable for long-term monitoring.

### *Geochemical Sampling Program Development*

The GWCP is currently developing an ambient water quality monitoring program to obtain geochemical data from existing and recently acquired wells in the USGS/DEQ observation well network. State Observation Wells will be sampled for major ionic constituents and basic field parameters. These data will be incorporated into the DEQ geochemical database. It is anticipated that approximately 12 wells will be sampled annually. Sampling protocol and procedures are expected to be completed by early 2013. GWCP staff is currently procuring sampling equipment. Sample collection should begin in 2015. The number of wells that are selected will be based on program budget; each sample costs DEQ approximately \$2,500.

### *EPA/DEQ/USGS Cooperative Studies*

DEQ continues to cooperate with the USGS on a multi-year effort to update and revise the hydrogeologic framework and the ground water flow models utilized to better manage the ground water resources of the Virginia Coastal Plain. The newly revised models for the Virginia's mainland Coastal Plain and Virginia's Eastern Shore was delivered in 2008. Additionally, the cooperative effort between DEQ and the USGS to update the hydrogeologic framework has resulted in the publication of an award winning Professional Paper #1731, *The Virginia Coastal Plain Hydrogeologic Framework*, coauthored by E. Randolph McFarland (USGS) and T. Scott Bruce (DEQ). The paper was recently made available online at [http://pubs.usgs.gov/pp/2006/1731/pp1731\\_download.htm](http://pubs.usgs.gov/pp/2006/1731/pp1731_download.htm) and a limited number of copies were published in late 2007. This report presents the results of a multiyear study done in cooperation with the DEQ, the USGS and the Hampton Roads Planning District Commission with funding provided through EPA Clean Water Act grant funds. 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. The report also provides a timely revision and update of the hydrogeologic framework for the Virginia Coastal Plain that was developed during the USGS RASA program.

With advancement of a new regional understanding of the Virginia Coastal Plain aquifer system, effective management of the ground-water resource is further predicated on knowledge of its chemical quality. No comparable effort has been undertaken for over 18 years, during which a large amount of additional

ground-water quality data have been generated from diverse sources but nowhere collectively summarized. Additionally, in light of the newly revised hydrogeologic framework, the distributions of dissolved chemical constituents are only meaningfully determined within the context of the current understanding of the aquifer system. A USGS Professional Paper entitled, "Ground Water Quality Data and Regional Trends in the Virginia Coastal Plain, 1906-2007" was published in 2010.

### *Ground Water Management Act of 1992*

The 1992 session of the Virginia General Assembly adopted the Act and repealed the Ground Water Act of 1973. The Act establishes criteria for the creation of ground water management areas and requires entities that withdraw more than 300,000 gallons of ground water per month to obtain permits. The Act also requires previously exempted agricultural ground water withdrawals to obtain ground water withdrawal permits. The DEQ adopted regulations to implement the Act effective September 23, 1993 and amended January 1, 1999. This regulation includes specific requirements for agricultural ground water withdrawal permits and requires DEQ to perform technical evaluations of those proposed withdrawals.

### *Storage Tank Compliance Program*

The Registration Program tracks ownership and technical information for more than 16,000 owners of 79,500 Underground Storage Tanks (USTs) and Aboveground Storage Tanks (ASTs) at 28,000 facilities in the Commonwealth. Each year the program receives over 2,000 registrations that report new tanks, tank closures, and amendments to existing tank information, such as changes of ownership. DEQ and the public use the registration information to determine the identity of persons responsible for pollution prevention measures and cleanup of releases.

The AST Compliance Program regulates AST facilities of 25,000 gallons or greater that store oil. Nearly 1.4 billion gallons of oil are stored in the 3,600 active regulated AST facilities across the Commonwealth. Through facility inspections, the program seeks to ensure that Virginia's AST facilities have measures in place to prevent releases and to respond quickly and effectively if releases occur.

The UST Compliance Program regulates USTs larger than 110 gallons that contain regulated substances, which include most petroleum products. Over 169 million gallons of regulated substances are stored in the 18,000 active USTs across the Commonwealth. Through tank inspections, the program seeks to ensure that USTs in the Commonwealth have measures in place to prevent releases and to have immediate notice of actual releases.

On August 8, 2005, President Bush signed H.R. 6, the Domenici-Barton Energy Policy Act of 2005. In Title 15 of the Act are amendments to Subtitle I of the Solid Waste Disposal Act addressing the regulation of underground storage tanks (primarily petroleum). Based upon EPA guidelines, DEQ revised its regulations September 15, 2010 to incorporate UST secondary containment, delivery prohibition and operator training requirements.

Existing State Water Control Law (§62.1-44.34:9(2) & (8)) requires DEQ to carry out its powers and duties with regard to underground storage tanks in accordance with applicable federal laws and regulations.

### *Storage Tank Remediation Program*

The Remediation Program directs the investigation and cleanup of petroleum-contaminated sites managed by responsible parties. The DEQ ensures that appropriate emergency response, initial abatement measures, site investigation and site remediation are performed by the responsible party. The DEQ also authorizes activities eligible for reimbursement from the Virginia Petroleum Storage Tank Fund.

The DEQ will conduct investigation and cleanup of high-priority petroleum contaminated sites in instances where the responsible party is unknown or financially unable to undertake the required work. Through a Final 2012

number of contractors, the DEQ conducts emergency response, initial abatement measures, site investigation and site remediation.

The DEQ also provides immediate, interim, and permanent relief to individuals whose drinking water wells have been rendered unusable by petroleum contamination. Through a DEQ contractor, carbon filtration units (CFUs) are installed and maintained on contaminated wells until a permanent solution is implemented. Permanent solutions typically include extension of an existing public water supply or installation of a new well free from petroleum contamination.

More than 9,500 site cleanups were completed from January 2005 through December 2010. Average cleanup time and average cleanup costs per site are among the lowest in the nation.

### *Office of Solid Waste Activities*

The DEQ's Office of Solid Waste implements the requirements for ground water monitoring and corrective action as specified by Subtitle D of the Resource Conservation and Recovery Act (RCRA). Funding for the program comes from the Commonwealth's General Revenue augmented by permit fees. All ground water data are collected by the solid waste facilities and their consultants and reviewed by staff for adherence to regulatory requirements under 9 VSWMR 20-81-10 et seq.

Information provided in Table 6-4 Solid Waste Landfill Corrective Action category was derived for the sites in Virginia's Solid Waste Corrective Action universe, as reported through September, 2011. More than 100 sites have been identified as having the potential for impacts on human health and the environment by exceeding one or more of their groundwater protection standards. In cases where ground water monitoring detects exceedences above ground water protection standards (such as EPA's Maximum Contaminant Levels for drinking water), facilities are required to implement clean-up measures under a process called groundwater Corrective Action. As shown in Table 6-4, the number of sites which have implemented ground water Corrective Action across the Commonwealth is 59. To date, two landfill sites have met their ground water clean-up goals and have been allowed to terminate corrective action.

### *Office of Remediation Programs*

Included in Table 6-4 are ground water contamination statistics from the DEQ's Office of Remediation Programs (ORP). ORP consists of the Federal Facilities Restoration Program, Superfund Program, Voluntary Remediation Program, Site Assessment Program, and the Brownfields Program. The Federal Facilities Restoration Program includes 42 Army, Navy, Air Force, Defense Logistics Agency, and NASA installations and 12 Formerly Used Defense Sites. Currently 13 Federal Facilities are listed on the National Priority List (NPL). The mission is to clean up contaminated sites at military installations through a partnering team process. The Department of Defense, NASA, and the EPA support the program. The Superfund Program, funded with both Federal and State dollars, carries out activities required by law or legal agreements at 22 NPL sites. Four of these sites have now been cleaned up and delisted. The Voluntary Remediation Program (VRP) provides a mechanism for eligible participants to voluntarily clean up properties not mandated for remediation under existing environmental laws. This program serves as a mechanism for cleanup of brownfields sites. There are currently 388 VRP sites that are potential candidates for clean up, formally in the program, or have been cleaned up under the program. EPA funding supports the Voluntary Remediation Program. The Site Assessment Program (SAP), supported by EPA, is designed to assess potential CERCLA sites for inclusion on the NPL. The DEQ's Brownfields Program, also supported by EPA, provides incentives to owners and/or developers of potential brownfield sites to promote the redevelopment and reuse of these underutilized properties. The Brownfields program has assisted with the successful redevelopment of over 50 sites in Virginia in the last three years. None of these five programs currently collect ground water quality data; however, they do receive and review data collected by outside sources.

## *Hazardous Waste Ground Water Activities*

Throughout the reporting period from Jan 1, 2005 – Dec 31, 2010, the DEQ implemented the requirements for ground water monitoring and corrective action as specified by the Resource Conservation and Recovery Act (RCRA). Beginning in August 2009, the DEQ's Office of Remediation Programs assumed these responsibilities. Funding for the program activities comes from an EPA grant covering hazardous waste management activities such as permitting, closure and corrective action, as well as compliance and enforcement. The grant does not cover data collection, with the exception of quality control samples. All ground water data are collected by the hazardous waste facilities and their consultants, and are reviewed by DEQ staff for adherence to regulatory requirements.

Under RCRA, ground water quality is evaluated at both permitted and un-permitted facilities that have land-based units for the treatment, storage and disposal of hazardous waste. Permitted sites have to meet strict operational requirements to eliminate or minimize the risk of impacts on human health and the environment. Permits include contingency requirements mandating clean-up in case of a release of hazardous waste from a regulated unit or as identified during the site-wide RCRA Corrective Action process. Un-permitted sites are sites where operation has ceased and the facility is in the process of removing and/or decontaminating contaminated media (closure), sites where a permit is about to be issued, or sites where RCRA Corrective Action is being undertaken under an Order or agreement with EPA. The information in the RCRA Corrective Action category in Table 6-4 has been combined into one reporting metric including both permitted and un-permitted sites.

Information provided in the Table 6-4 RCRA Corrective Action category was derived for all the sites in Virginia's 2020 Corrective Action universe, as identified by EPA. These sites, currently numbering 120, have been previously identified as exhibiting or having the potential for impacts on human health and the environment. The Corrective Action universe has been expanding over the last several years from the initial high priority sites to include all sites in Virginia (high, medium and low priority). The number of future additions to the Corrective Action universe is expected to be small.

Most facilities have more than one waste management unit, and all units need to be evaluated for potential impacts and undergo remediation if necessary. All sites are currently in various stages of evaluation and, where applicable, site clean-up. To date, ground water impacts were identified at 60 sites. For an additional 44 sites, it was determined that groundwater has not been impacted. For the remaining 17 sites, additional investigation will be required.

At the 60 sites where ground water monitoring has detected exceedences above applicable ground water protection standards (such as EPA's Maximum Contaminant Levels for drinking water), facilities are required to implement clean-up measures. In recent years, EPA and the states have added more tools to the RCRA Corrective Action process to facilitate clean-up at a faster pace. These tools include the Facility Lead program, options for interim corrective measures, interim milestones such as environmental indicators for ground water and human health, and procedures to determine when the corrective action process is complete. These tools are seeing increasing use throughout Virginia.

As shown in Table 6-4, 50 of the 60 sites with confirmed ground water contamination have stabilized and/or have had the contaminant source removed. Corrective action plans for interim and/or final measures to remediate impacted ground water have been developed for 43 sites, seven more than were reported previously. Some type of active remediation is ongoing at 32 sites, three more than were reported previously. Four sites have met their ground water clean-up goals, and it should be noted that of all 120 sites, 31 additional sites overall have completed the Corrective Action process and have met the applicable soil and/or ground water clean-up targets.

More detailed information for each site as well as an interactive map of Virginia facilities in the RCRA Corrective Action program can be found on DEQ's web site at <http://www.deq.state.va.us/Programs/LandProtectionRevitalization/PermittingCompliance/RCRACorrectiveAction.aspx> or on EPA's Corrective Action page at <http://www.epa.gov/reg3wcmd/ca/va.htm>.

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## Source Water and Wellhead Protection Efforts

Building grassroots support for ground water and wellhead protection continue to be priorities of the GWPSC and its member agencies. VDH met their obligations for source water assessments as outlined in the 1996 Amendments to the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA). These assessments offer a reasonable starting point for protection activities. In the fall of 2004, DEQ completed a Wellhead Protection Plan for the Commonwealth and submitted it to EPA for approval. DEQ elected to move forward with the submittal of an EPA approved wellhead protection program with the expectation of leveraging funds from the SDWA to assist localities in implementation of local plans. The plan received EPA approval in May 2005. VDH and DEQ are cooperating on a program that offers competitive grants to local governments with ground water based public water supplies. The funding source is the Safe Drinking Water Act Drinking Water State Revolving Fund Set-Asides. Additional information can be found at <http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/GroundwaterProtectionSteeringCommittee/WellheadProtection.aspx> including information on funding opportunities.

**Table 6-1 Public Water Supply Systems and Population Served from Virginia's Source Water Assessment and Protection Reporting (as of Oct 14, 2011)**

Total Number of Public Water Supply (PWS) systems	2,776
Total Number of GW-Dependent PWS Systems	2,445
Total Number of Community Water Supply Systems	1,166
Total Number of GW-Dependent Community Water Supply Systems	852
Total Population Relying on Community Water Supply Systems	6,606,184
Total Population Relying on GW-Dependent Community Water Supply Systems	495,578
Total Number of GW-Dependent Non-Transient Non-Community PWS Systems	524
Total Number of GW-Dependent Transient Non-Community PWS Systems	1,069

## Pesticide Disposal Program

The Virginia Department of Agriculture and Consumer Services (VDACS) have conducted a highly popular and successful Pesticide Disposal Program since 1990. Since the Program's inception, more than 1.6 million pounds of unwanted pesticides have been collected from agricultural producers, licensed pesticide dealers and commercial pest control firms, homeowners and golf courses. There is no cost to participants.

To administer the Program, Virginia is subdivided into five regions. A pesticide disposal program is conducted annually in localities within one of the regions. Once all five regions have been served, the program starts another cycle. The Pesticide Disposal Program requires participants to transport their unwanted agricultural and commercial pesticides to a central collection site where the hazardous waste disposal contractor packages the pesticides for eventual disposal. If a participant cannot safely containerize the unwanted pesticides for transport, the disposal contractor will make such arrangements.

The pesticide disposal program has benefited from a high level of interagency cooperation among the VDACS, DEQ, DCR, DCLS, and Virginia Cooperative Extension. Initial funding to support this program

was pooled from Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Clean Water Act (Sections 319 Non Point Source and 106 Ground Water Protection) grants as well as the Office of Pesticide Services (OPS) program fees. Currently, the program is supported entirely by OPS program fees. Additional information may be found at <http://www.vdacs.virginia.gov/pesticides/disposal.shtml>.

*Plastic Pesticide Container Recycling Program*

The Virginia Department of Agriculture and Consumer Services (VDACS) and Virginia Cooperative Extension (VCE) conduct an annual plastic pesticide container recycling program. Since its inception, the program has collected and granulated a total of 1,040,725 plastic pesticide containers. This equates to over one million pounds of plastic collected for refabrication.

The Plastic Pesticide Container Recycling Program addresses a challenge for agricultural producers and custom applicators. Typically, pesticide applicators dispose of their empty, clean plastic pesticide containers by hauling them to the local sanitary landfill. Recycling is an environmentally responsible alternative for the disposal of properly rinsed plastic pesticide containers. Granulated chips are transported to recycling facilities and fabricated into items such as pallets, fence posts, field drain tiles and parking stops thus keeping them out of landfills and reducing the potential for contamination from improperly rinsed containers which have either been landfilled or disposed of improperly.

To participate in the Program, a locality must make application to VDACS and agree to collect, inspect and store the properly rinsed containers until granulation. VDACS provides up to \$1,875 per locality annually in reimbursement costs to participating localities to offset the cost of the program. This program is funded through OPS program fees. Additional information may be found at <http://www.vdacs.virginia.gov/pesticides/recycling.shtml>

*Ground Water Protection Program Conclusion*

Ground water programs in Virginia strive to maintain the existing high water quality. The Virginia Ground Water Protection Steering Committee (GWPSC), established in 1986, continues to meet as a vehicle for sharing information, for directing attention to important ground water issues, and for taking the lead on ground water protection initiatives requiring an inter-agency approach. This inter-agency advisory committee is designed to stimulate, strengthen, and coordinate ground water protection activities in the Commonwealth. Ground water protection activities in the Commonwealth are as varied as the funding sources that support them.

<http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/GroundwaterProtectionSteeringCommittee/WellheadProtection.aspx>

**Table 6- 2 Primary Sources of Ground Water Contamination**

Contaminant Source	Ten Highest-Priority Sources()	Factors Considered in Selecting a Contaminant Source	Contaminants
Agricultural Activities			
Agricultural chemical facilities			
Animal feedlots			
Drainage wells			
Fertilizer applications		(F) State GW Protection Strategy	(E)
Irrigation practices			
Pesticide applications		(F) State GW Protection Strategy	(A,B)

Storage and Treatment Activities			
Land application		(F) State GW Protection Strategy	(E)
Material stockpiles			
Storage tank (above ground)			
Storage tank (underground)		(F) State GW Protection Strategy	(D)
Surface impoundments		(F) State GW Protection Strategy	(E)
Waste piles			
<b>Disposal Activities</b>			
Landfills		(F) State GW Protection Strategy	(M) 40 CFR-App IX
Septic systems		(F) State GW Protection Strategy	(J)
Hazardous waste generators			
Hazardous waste sites			
Industrial facilities			
Material transfer operations			
Mining and mine drainage		(F) State GW Protection Strategy	(M) Acid Leachate
Pipeline and sewer lines			
Salt water intrusion		(F) State GW Protection Strategy	(G)
Urban runoff		(F) State GW Protection Strategy	(M) NPS pollutants such as fertilizers & heavy metals
Other sources (please specify)			

A-Inorganic Pesticides      H-Metals  
 B-Organic Pesticides        I-Radionuclides  
 C-Halogenated Solvents    J-Bacteria  
 D-Petroleum Compounds    K-Protozoa  
 E-Nitrite                        L-Viruses  
 F-Fluoride                      M-Other  
 G-Salinity/Brine

**Table 6-3 Summary of State Ground Water Protection Programs**

Programs or Activities	Check* (?)	Implementation Status	Responsible State Agency
Active SARA Title III Program	?	fully-estab.	DEQ
Ambient ground water monitoring system			
Aquifer vulnerability assessment	?		
Aquifer mapping			
Aquifer characterization		cont. efforts	DEQ
Comprehensive data management system			
EPA-endorsed Core Comprehensive State Ground Water Protection Program (CSGWPP)			
Ground water discharge permits (VPA)	?	fully-estab.	DEQ
Ground water Best Management Practices			
Ground water legislation (Quantity)	?	fully-estab.	DEQ
Ground water classification			
Ground water quality standards	?	fully-estab.	DEQ
Interagency coordination for ground water protection initiatives	?	fully-estab.	DEQ
Nonpoint source controls	?	cont. efforts	VDCR
Pesticide State Management Plan (Generic)	?	fully estab.	VDACS
Pollution Prevention Program			
Resource Conservation and Recovery Act (RCRA) Primacy	?	fully-estab.	DEQ
Source Water Assessment Program	?	fully-estab.	VDH
State Superfund			EPA primacy
State RCRA Program incorporating more stringent requirements than RCRA Primacy			
State septic system regulations	?	fully-estab.	VDH
Underground storage tank installation requirements	?	fully-estab.	DEQ
Underground Storage Tank Remediation Fund	?	fully-estab.	DEQ
Underground Storage Tank Permit Program	?	fully-estab.	DEQ
Underground injection Control Program			EPA primacy
Well abandonment regulations	?	fully-estab.	VDH
Well Installation regulations	?	fully estab.	VDH

**Table 6-4 Ground Water Contamination Summary**

Aquifer Description Commonwealth of Virginia

Data Reporting Period January 1, 2005 - December 31, 2010

Source Type	Present in reporting area	Number of sites in area	Number of sites that are listed and/or have confirmed releases	Number with confirmed groundwater contamination	Contaminants	Number of site investigations (optional)	Number of sites that have been stabilized or have had the source removed (optional)	Number of sites with corrective action plans (optional)	Number of Sites with active remediation (optional)	Number of sites with cleanup completed (optional)
NPL		22	22	16	(A) append 9	22	17	20	20	4
CERCLIS (non-NPL)		200+	< 150	< 80	PAHs, VOCs SVOCs, metals					
Voluntary Remediation		388	300+	300+	(A) & (B)	257				188
Federal Facilities Restoration(NPL)		13	13	13	(A), (B), others	13	13	13		
Federal Facilities Restoration (nonNPL)		29	18	18	(A), (B), others	18	18	18		
Leaking UST & AST as of DEC 2010		30,799	30,799		petroleum hydrocarbons				1,021	29,421
RCRA Corrective Action	PERMITTED (includes state and federal permits) and UNPERMITTED (closing, permit to be issued, or remediating under alternate mechanism)	120	120	60	(A), (B), others	60 <sup>(1)</sup> 120 <sup>(2)</sup>	50 <sup>(1)</sup>	43 <sup>(1)</sup>	32 <sup>(1)</sup>	4 <sup>(1)</sup> 35 <sup>(2)</sup>
Solid Waste Landfills	Permitted and unpermitted (monitoring under enforcement action)	243 (total) 238 permitted 5 unpermitted	Not Applicable	108	VOCs, SOCs, metals	47	Not Applicable	59	55	2
State Sites										
Nonpoint Sources										
Other (specify)										

**Source Type Abbreviations**

NPL - National Priority List (DEQ staff: K.Greene)  
 CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, & Liability Information System (DEQ staff:D.Harris)  
 Voluntary Remediation (DEQ staff: K.Greene)  
 Federal Facilities (DEQ staff: K.Sismour)  
 UST & AST- Underground Storage Tanks & Above ground Storage Tanks (DEQ staff: B.Lamp)  
 RCRA - Resource Conservation & Recovery Act (DEQ staff: J.Schneider)  
 Solid Waste Landfills (DEQ staff: J.Schneider)

**Notes**

<sup>(1)</sup>Information for sites with confirmed ground water contamination only  
<sup>(2)</sup>Information for all sites

**Contaminant Type**

(A) listed and characteristic hazardous waste  
 (B) metals, halogenated organics, POL,PCB, Pesticides

**Table 6-5 Aquifer Monitoring Data**

Hydrogeologic Setting <sup>(1)</sup> Commonwealth of Virginia

Spatial Description (optional) <sup>(2)</sup> \_NA\_

Map Available (optional) <sup>(3)</sup> \_NA\_

Data Reporting Period <sup>(4)</sup> January 1, 2005 through December 31, 2010

Monitoring Data Type	Total No. of Wells Used in the Assessment <sup>(5)</sup>	Parameter Groups	Number of Wells									
			No detection of parameters above MDLs or background levels		Nitrate concentrations range from background levels to less than or equal to 5 mg/l  No detection of parameters other than nitrate above MDLs or background levels and/or located in areas that are sensitive or vulnerable		Nitrate ranges from greater than 5 to less than or equal to 10 mg/l  Other parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs <sup>(10)</sup>	Parameters are detected at concentrations exceeding the MCLs <sup>(11)</sup>	Number of wells removed from service <sup>(12)</sup>	Number of wells requiring special treatment <sup>(13)</sup>	Background parameters exceed MCLs <sup>(14)</sup>	
			ND <sup>(6)</sup>	Number of wells in sensitive or vulnerable areas (optional) <sup>(7)</sup>	Nitrate =5mg/l VOC, SOC, and other parameters not detected <sup>(8)</sup>	Number of wells in sensitive or vulnerable areas (optional) <sup>(9)</sup>						
Finished Water Quality Data from Public Water Supply Wells	3,597	VOC	8,285									
		SOC <sup>(1b)</sup>	6,072									
		NO <sub>3</sub>	9,024		792							
		Other <sup>(1b)</sup>										

These numbers are provided by the Virginia Department of Health, Office of Drinking Water (J.Vivas). Data is given for wells associated with mixed systems (surface and ground water) and ground water based systems. SOC data is limited due to waiver programs and no detections in systems that were monitored. VOC and SOC data may be incomplete due to optional data entry requirements in VDH field offices. MCL exceedence information required additional work that VDH staff limitations prevented. Software modernization efforts underway at EPA may make providing this information in future reports an easier task. Ambient data, Untreated Water Quality data from PWS, and unregulated well data is not collected or not available.

Column 5: Total number of wells (3,597) is a subset of sample results for VOC, SOC, and NO. There may be multiple sample results for a single well.  
 Column 6: No detections for NO<sub>3</sub> analysis (9,024) is a combined total of sample results for contaminants 1038 and 1040.