

## CHAPTER 3 SURFACE WATER MONITORING PROGRAMS

At the core of assessing the quality of the Commonwealth's waters are the data generated from the collection and analysis of ambient surface water samples. DEQ has a long history of water quality monitoring, beginning with the first sample collected in June 1941. Over the years, the focus of monitoring has been guided by various regulatory and assessment needs. With the development and implementation of the Water Quality Monitoring Strategy in 2000, the ambient monitoring program entered a new era of statewide multilayered network monitoring that is designed to produce representative data that supports the evaluation, restoration, and protection of the quality of the Commonwealth's waters for the purposes of fishing, swimming, boating, drinking, and the propagation and growth of a balanced, healthy community of indigenous aquatic organisms. The strategy was updated in 2004 and 2007 and has been formally approved by the United States Environmental Protection Agency (USEPA).<sup>1</sup>

To achieve this goal and satisfy scientific, legislative and aesthetic requirements related to the quality of the Commonwealth's aquatic resources, DEQ has established a series of specific objectives to identify and define the diverse functions of the Water Quality Monitoring Program:

### 1. Assessment and Remediation Objectives:

#### **(a) Status Quo Characterizations and Assessments:**

- (1) Provide accurate, representative data for water quality characterization and assessment of all surface waters within the state.
- (2) Establish consistent statewide siting, parameter selection and monitoring techniques, to ensure data reliability and the comparability of data.
- (3) Assure that the frequency of sampling and the total number of observations collected are sufficient to provide adequate data for scientific, statistically based and defensible assessment procedures.
- (4) Assure that, whenever possible, flow rates are determined simultaneously with the collection of water quality data.
- (5) Monitor, according to a plan and schedule, all substances discharged into state waters that are subject to water quality Standards or are otherwise necessary to determine water quality conditions.
- (6) Continually evaluate the overall success of the Commonwealth's water quality management efforts.

#### **(b) Impaired Waters / Remediation:**

- (7) Provide data to define the cause, severity and geographic extension of impaired waters:
- (8) Provide adequate data for TMDL model development and validation.
- (9) Provide adequate data, by means of follow-up monitoring, to evaluate the implementation of TMDL's and other best management practices.

#### **(c) Variability, Trend Assessments and Forecasts:**

- (10) Provide adequate data and analytical procedures for short, medium, and long-term statistical evaluation of water quality variation and trends within identifiable, geographically defined waterbodies.

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<sup>1</sup> Millennium 2000 Water Quality Monitoring Strategy, Virginia Department of Environmental Quality, October 2004.

## 2. Permit Objectives:

(11) Provide data for the calculation of permit limits for the issuance, re-issuance and/or modification of effluent discharge permits.

(12) When water quality problems are suspected, provide data to detect and document water quality impairments and/or to evaluate permit adequacy, whether permitted dischargers are in compliance with permit limits or not.

## 3. Efficiency Objectives:

(13) Improve the efficiency of the Monitoring Program by minimizing resource requirements and the duplication of efforts while maximizing the use of integrated data collected by state and federal agencies, public utilities, private enterprises and citizens groups for statewide water quality assessments.

(14) Increase the use of biological monitoring (e.g., benthic macroinvertebrates, fish, and/or aquatic vegetation assemblages), as well as fish tissue and sediment monitoring for specific assessments of water quality.

(15) Investigate, identify and characterize additional avenues of actual or potential water quality impairment, including ground water contribution and aerial deposition.

(16) Guarantee adequate Quality Assurance/Quality Control (QA/QC) procedures to provide precise, accurate and representative water quality data for all assessment purposes.

## 4. Research Objectives:

(17) Provide data to validate special stream designations and/or specific water quality criteria.

(18) Evaluate new methodologies for sampling, analyzing and assessing water quality.

(19) Provide data for other research objectives.

As a result of the implementation of the new strategy, a monitoring network of multiple programs and special studies was identified and developed to include the following programs:

**WATERSHED (AW)** DEQ's ambient watershed network of stations represents the largest single section of the monitoring program. Detailed information on the purpose and objectives of these stations and their selection can be found in Section III.B. of the Monitoring Strategy.

**ESTUARINE PROBABILISTIC MONITORING (C2)** The estuarine probabilistic monitoring program covers the tidal estuarine waters of the Chesapeake Bay, coastal Delmarva and the Back Bay / North Landing River drainages. It is designed to characterize the Commonwealth's estuarine waters. This program is also integrated into National Coastal Assessment Surveys on a rotating basis once every five years.

**CHESAPEAKE BAY (CB)** Chesapeake Bay Program identified in section III.E.1 of the strategy. The design of this program is through the Federal-Interstate Chesapeake Bay Program and encompasses a multi-state water quality characterization effort, <http://www.deq.virginia.gov/Programs/Water/ChesapeakeBay.aspx>.

**CITIZEN MONITORING (CM)** These stations are monitored due to specific requests from the public, usually as a result of local concerns. Notification occurs in the fourth quarter of the calendar year with sampling scheduled to begin in the next monitoring year, <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring.aspx/>.

**FACILITY INSPECTION (FI)** Facility inspections are not specifically identified in the water quality monitoring strategy but are integral to determining compliance with discharge limits. Specific sample

locations are not included in the monitoring plan but only estimated numbers of samples for the purpose of calculating annual budgets.

**FRESHWATER PROBABILISTIC (FP)** The freshwater probabilistic monitoring program covers the non-tidal free-flowing waters of the state. The program is designed to answer the question of what is the overall water quality of the Commonwealth for free-flowing streams: <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/ProbabilisticMonitoring.aspx>.

**FISH TISSUE (FT)** Fish tissue and sediment monitoring program<sup>2</sup> conducted by central office staff from the Office of Water Quality Standards, <http://www.deq.virginia.gov/fishtissue/>.

**MERCURY (HG)** Mercury Special Study Program paid for by the responsible parties.

**INCIDENT RESPONSE (IR)** Incident response samples are the same as PC but are non-petroleum in origin.

**POLLUTION COMPLAINTS (PC)** Pollution complaints are special samples collected generally as a result of a petroleum spill.

**REGIONAL BIOLOGICAL (RB)** Biological monitoring program which focuses on the analysis of the benthic macroinvertebrate community as a tool to detect water quality conditions. The methodology follows the USEPA Rapid Bioassessment Protocol II. For additional information visit the biological program website at <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/BiologicalMonitoring.aspx>.

**RESERVOIR MONITORING (RL)** Reservoir monitoring which is described in the Lake Monitoring Guidance<sup>3</sup> available at <http://www.deq.virginia.gov/Portals/0/DEQ/Water/Guidance/092005.pdf>.

**SPECIAL STUDIES (SS)** Special studies are identified by individual project plans and are generally specialized intensive targeted monitoring efforts designed to answer specific hypothesis related to water quality conditions.

**TMDL (TM)** TMDL monitoring stations are those stations associated with the development of a TMDL and subsequent implementation plan for segments listed on the 303(d) list, <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL.aspx>.

**TREND (TR)** Trend stations are those long term stations sited for permanent monitoring for the purpose of detecting water quality trends for a wide variety of environmentally important water quality parameters.

**OBSERVED EFFECTS (OE)** Those stations with insufficient data for assessing and usually are those stations with small data sets during an assessment cycle that indicate a potential problem. These stations are considered carryover stations and will be sampled until sufficient data is available to determine the water quality conditions.

### *Data Summary*

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<sup>2</sup> Virginia Department Of Environmental Quality, Water Quality Standards, Office Of Water Quality Programs 2001 Fish Tissue And Sediment Monitoring Plan, May 9<sup>th</sup>, 2001.

<sup>3</sup> Lake Monitoring Guidance, Virginia Department of Environmental Quality, December 1999. Revised in 2002

Between January 2005 and December 2010 DEQ staff collected multiple samples at 5,497 stations. From these stations, the number of independent observations for the common field measurements was 198,682 for temperature, 173,299 for pH, 181,710 for dissolved oxygen, 169,832 for specific conductivity, and 97,291 for salinity. These samples were analyzed for a variety of chemical constituents including nutrients, bacteria, metals, pesticides, herbicides and toxic organic compounds; 689 different parameters were sampled for a total of 905,339 data points.

The number of stations representing a particular type of stream segment, the types of samples collected, the parameters analyzed, and the sampling frequency all vary depending on site conditions and program emphasis. A detailed report of sample locations, matrices, parameters, and frequency is available in the Annual Monitoring Plans at <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring.aspx>.

Each basin summary, found in Chapter 4.3 of this report, lists the ambient water quality monitoring (AWQM) and biological (benthic) monitoring summary data within the basin. Summaries of the sampling data collected at each station during the reporting period are provided as an Appendix supplement to this report and can be found on the DEQ water webpage <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs.aspx>.

**Contact:** For further information on the Ambient Monitoring Program contact:

Roger E. Stewart  
629 East Main Street  
Richmond, Virginia 23219  
**(804) 698-4449**  
[roger.stewart@deq.virginia.gov](mailto:roger.stewart@deq.virginia.gov)

This chapter describes the water monitoring programs that provide data used in the 303(d)/305(b) assessment process.

## CHAPTER 3.1 FRESHWATER BIOLOGICAL MONITORING PROGRAM

Virginia's freshwater biological monitoring program began in the 1970s to fulfill requirements of the Federal 106 Grant agreement. DEQ uses benthic macroinvertebrate communities to assess the ecological health of wadeable freshwater streams and rivers. Benthic macroinvertebrates are animals without backbones that live in or on sediment or other substrates and can be seen by the unaided eye. Benthics include crustaceans, mollusks, and immature forms of aquatic insects such as caddisfly, stonefly or mayfly nymphs.

Biological monitoring, using benthic macroinvertebrates, is an invaluable tool for evaluating the temporally integrated, overall effects of the water and sediment quality in streams and rivers. Benthic macroinvertebrate communities integrate water quality and the effects of different pollution stressors through time, providing a holistic measure of their aggregate impact. Because of their sedentary nature, macroinvertebrates are good indicators of localized conditions. Most species have a complex life cycle of approximately one year or more, and thus integrate the effects of fluctuations in water quality over time which conventional water quality surveys may miss. In essence, benthic macroinvertebrates are considered to be virtual "living recorders" of water quality conditions over time. The structure and functioning of macroinvertebrate communities are extremely sensitive. These communities may exhibit responses to water quality pollutants for which specific criteria or standards have not been defined, chemical analyses are not normally performed, or tolerance is below chemical detection limits.

DEQ's biological monitoring program examines over 150 stations annually. Reasons for bioassessments can include targeted monitoring, probabilistic monitoring, tracking local pollution events, follow-up on waters of concern identified through volunteer citizen monitoring and TMDL monitoring. Data from the biological monitoring program are used for periodic review and assessment of state waters as required by Section 305(b) of the Clean Water Act. Biological monitoring is one tool used for assessing the aquatic life designated use of state waters established in 9 VAC 25-260-10 A. that states in part, "All state waters, including wetlands, are designated for the following uses: ...the propagation and growth of a balanced, indigenous population of aquatic life, including game fish, which might reasonably be expected to inhabit them..."

DEQ uses two bioassessment indices to assess the biotic integrity in non-tidal freshwater streams and rivers in Virginia. In the Coastal Plain, which is characterized by low gradient streams east of the fall line, the Coastal Plain Macroinvertebrate Index (CPMI) methodology is used. This multimetric index was developed in 1997 by the Mid-Atlantic Coastal Streams (MACS) workgroup. The CPMI is a multimetric bioassessment index which was calibrated for low gradient Coastal Plain streams which exhibit different benthic macroinvertebrate communities from non-coastal stream communities.

For non-coastal streams, assessment of the benthic macroinvertebrate community is based on the Virginia Stream Condition Index (VSCI). The VSCI was developed for Virginia freshwater non-coastal streams by USEPA's contractor Tetra Tech, Inc. Using historical data collected in Virginia at reference and stressed streams from 1994-1998, Tetra Tech compared the historical data against additional data collected from 1999-2002. The VSCI is based upon recent advances in bioassessment methods contained in "*Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers, Second Edition*" (Barbour et al. 1999). The VSCI, a multimetric calculation of benthic integrity converted into a single numerical score, resulted in a single reference condition for the entire non-coastal portion of the Commonwealth against which all future benthic samples will be compared. The development of this index is considered a significant step in the advancement of the biomonitoring program to address a wide range of monitoring and assessment needs. Based on recommendations from public comment and the Academic Advisory Committee, the VSCI was validated using a spatially diverse (ecoregionally and stream size) data set free of pseudoreplication. These probabilistic data sets have allowed DEQ to narrow data gaps and test the VSCI against many classification variables and confirm with certainty, the VSCI is a good assessment tool for Virginia streams.

**Contact:** For further information on the Freshwater Benthic Macroinvertebrate Monitoring Program contact:

Richard Browder  
629 East Main Street  
Richmond, Virginia 23219  
**(804) 698-4134**  
[richard.browder@deq.virginia.gov](mailto:richard.browder@deq.virginia.gov)

## CHAPTER 3.2 ESTUARINE/COASTAL PROBABILISTIC MONITORING PROGRAM

Virginia's estuarine probabilistic monitoring module was initiated in the summer of 2000 with a five-year grant (CR-828544-01 – period 2000-2004) from EPA's "National Coastal Assessment (NCA) Program", formerly known as the "Coastal 2000 Initiative". This original, five-year effort was defined under the terms of a proposal titled "Monitoring the US Atlantic Coast: Assessing Virginia's Estuaries and Tidal Tributaries to the Chesapeake Bay and the Atlantic Ocean", submitted to the US-EPA in the spring of 2000. Specific field methodologies and Quality Assurance requirements of the Coastal 2000 / National Coastal Assessment Program are described in the EPA documents "[National Coastal Assessment Field Operations Manual](#)" (EPA 620/R-01/003) and "[National Coastal Assessment Quality Assurance Project Plan 2001-2004](#)" (EPA/620/R-01/002).

### *Purpose*

The original goals of the National Coastal Assessment (Coastal 2000) Program were to:

- Assess the ecological condition of estuarine resources,
- Determine reference conditions for ecological responses/stressors, and
- Build infrastructure in EPA Regions and participating states.

Additional, more specific federal objectives were to:

- Assess the health or condition of the estuarine waters of the United States and track changes in that condition through time,
- Assess the health or condition of the estuarine waters of the various coastal states and track changes in that condition through time,
- Utilize the approach to identify reference conditions for estuarine waters in the United States, and
- Utilize existing state monitoring programs as appropriate

The geographic extent of the Estuarine/Coastal ProbMon Program is restricted to the eastern-most regions of the state. It is coordinated through the DEQ Central Office in Richmond and is carried out primarily by the Piedmont (PRO - Glen Allen) and Tidewater (TRO - Virginia Beach) Regional Offices. A few of the estuarine probabilistic sites (usually 1 or 2 sites annually) fall within the geographic jurisdiction of the Northern Regional Office (NRO) in Woodbridge.

At the state level, DEQ defined its agency goals and objectives relative to its comprehensive statewide Water Quality Monitoring (WQM) Program. Each participating DEQ region needs to complete its assigned probabilistic stations in order for DEQ to reach defensible conclusions about overall estuarine water quality from a statewide perspective.

### *Monitoring Design*

The sampling strata for tidal tributaries have been geographically defined, by estuary size and drainage location, and a set of 50 randomly selected sampling sites are selected each year. In the past these were provided annually by the EPA/ORD Gulf Ecology Division (GED) Laboratory in Gulf Breeze, Florida (2000-2004), or the Atlantic Ecology Division (AED) Laboratory in Narragansett, Rhode Island (2005-2007) upon request. Since 2007 DEQ has performed its own site selection for the state sampling design using software provided by EPA/ORD/AED.

The two principal sampling strata in the state design consist of (1) small tidal tributaries to the Chesapeake Bay and its major tributaries and (2) tidal tributaries and embayments of the Atlantic coast and Back Bay/North Landing River (which discharge into Pamlico/Albemarle Sounds, North Carolina). The major tidal tributaries to the Chesapeake Bay (the Potomac, Rappahannock, York and James Rivers), as well as the

Bay mainstem, are effectively characterized by the probabilistic monitoring of Virginia's Chesapeake Bay Program. Periodically (2000, 2005-06, and 2010), these larger waters were also included in the national survey sampling design for the purpose of integration into the standardized National Coastal Assessment (NCA) Program.

In the first year of sampling, 35 sites were selected in Virginia's portion of the Chesapeake Bay mainstem and the tidal portions of its major tributaries (Rappahannock River, York River, James River, & Elizabeth River - the tidal portions of the Potomac River mainstem are entirely in the state of Maryland). To better characterize smaller estuarine subdivisions, DEQ has in subsequent years (2001-2004) emphasized, and will continue to emphasize, minor tidal tributaries to the Chesapeake Bay, the Atlantic Ocean, and to Pamlico/Albemarle Sound by sampling at 50 sites annually. Virginia's participation in the interstate Chesapeake Bay Program already provides adequate probabilistic monitoring for the characterizations of the Chesapeake Bay mainstem and its major tidal tributaries (e.g., lower Potomac, James, York, and Rappahannock Rivers). The "weighting" of the current sampling design guarantees that each year approximately 70% of the sites (~35 stations) are selected in the Chesapeake Bay drainage and approximately 30% (~15 sites) are selected in coastal drainages. This assures that approximately 90 sites will be available to characterize the coastal estuary resource class by the end of each six-year period.

### *Core and Supplemental Water Quality Indicators*

From 2001 through 2006, with the resources provided by EPA NCA/Coastal 2000 Grants, estuarine probabilistic stations were sampled for the complete suite of parameters described in the National Coastal Assessment QAPP cited above, as well as additional parameters utilized by the Chesapeake Bay Program. The total suite of water column parameters includes profiles of temperature, pH, DO, salinity and Photosynthetically Active Radiation (PAR), as well as samples for chlorophyll, nutrients and suspended solids measurements at near-surface, mid-depth and near-bottom. In addition, homogenized sediment samples are collected for local (DCLS) analyses of particle size and total organic carbon (TOC), as well as for metals and organic contaminant analyses and toxicity testing at EPA-contracted laboratories. A separate, 0.04 m<sup>2</sup> sediment sample is collected and sieved in the field for later identification of macroinvertebrate benthic infauna species to complete the "Sediment Quality Triad" (SQT) for "weight-of-evidence" ecological evaluations and assessments. In the past, EPA Grant funds also provided for the contracting of the Fisheries Science Laboratory at the Virginia Institute of Marine Science (VIMS) for fish trawls. These trawls were used to collect fish community-structure data, epibenthic organisms, incidental fish for pathological examinations, and targeted fish species for the analyses of metals and organic contaminants in whole fish tissues. Due to resource limitations, fish sampling is only included when additional funds are available for national surveys. Beginning in the summer of 2003, DEQ started supplementing the NCA core indicators with additional sampling for bacteria (fecal coliform, *E. coli*, and enterococci) and when resources permitted for dissolved and total trace metals.

Sample handling and shipping varies with the type of sample and its final destination for analysis. All samples are collected from boats anchored at the monitoring sites and are appropriately labeled and stored on wet ice at 4° C during transport to the responsible DEQ Regional Office. Samples to be analyzed at the Virginia State laboratory (DCLS) are maintained on ice and shipped daily to Richmond by overnight courier service. Such samples are received and processed within 24 hours of collection. Analyses are completed within the holding time specified in the pertinent QAPPs and EPA analytical method descriptions, after which the resultant data is entered into the DCLS LIMS system. Analytical results are subsequently transmitted to and permanently stored in the DEQ CEDS 2000 database on a daily basis. Turnaround time from sample arrival at DCLS to receipt of analytical data varies from 48 hours to 21 days, depending upon sample type.

Sediment samples that are analyzed chemically and toxicologically by other contracted laboratories are held under refrigeration at DEQ Regional Offices and are shipped to Richmond by courier on a weekly basis. Sediment toxicity samples are united and shipped weekly via overnight air to the contracted laboratory. Sediment chemistry samples are frozen and accumulated prior to shipping to the contracted laboratory.

Typically, the sediment chemistry samples are delivered in two batches, one at the midpoint and one at the end of the sampling season. Benthic infauna samples are preserved in (10%) buffered formalin as soon as they are collected and are maintained at DEQ Regional Offices until the end of the field season (late September). They are then united at the DEQ Central Office and shipped to the Benthic Ecology Laboratory at Old Dominion University (ODU). Sediment chemistry and toxicity results are generally received by the end of the calendar year. The separation, identification and enumeration of benthic taxa require more time, and results from benthic analyses performed at ODU are normally available the following spring.

When included in the program, data related to fish community structure, epibenthic invertebrates, and habitat collected by VIMS trawl sampling are immediately entered into their onboard SAS database during the process of collection. Target fish species selected for chemical tissue analyses are individually labeled and wrapped and maintained on ice during transport to the laboratory. Once there, they are frozen and maintained until the end of the field season (October). They are shipped overnight, on dry ice, to EPA/GED for storage and later transshipment. Fish pathology specimens are maintained in Dietrich's solution until the end of the field season and are subsequently shipped to EPA/GED. Fish community, epibenthic macroinvertebrate and habitat data are united into a final report which VIMS sends to DEQ soon after the end of the field season in October or early November. Turnaround time for fish tissue chemical data and fish pathology data from EPA-contracted laboratories is currently at least two years.

### *Frequency/Duration*

As is typical of probabilistic survey programs, monitoring sites are sampled only once and new sites are randomly selected each year. Under the conditions defined by the NCA QAPP, sampling occurs during the summer months from 1 July through 30 September. This period also coincides with the sampling "window" defined for the use of the Chesapeake Bay Program's ["Benthic Index of Biological Integrity"](#) (B-IBI), which is utilized to evaluate the ecological health of the benthic community.

DEQ's Estuarine Probabilistic Monitoring Program was proposed and developed as a major component of the agency's Ambient Water Quality Monitoring Program and is fully implemented at this time. The resources formerly provided by the initial EPA Coastal 2000 Grant facilitated the implementation of the program in 2000 and terminated at the end of September 2004. A transitional National Coastal Assessment Grant provided funding at a reduced level during the 2005-2006 interim. Beginning in 2007, DEQ has continued the Estuarine ProbMon Program with a slightly reduced suite of parameters using supplemental probabilistic monitoring funds from federal §106 grants, complimented by Chesapeake Bay and general fund resources.

### *Quality Assurance Measures*

DEQ's field and laboratory activities adhere to QA/QC protocols specified in the [National Coastal Assessment Field Operations Manual](#) (EPA 620/R-01/003) and the [National Coastal Assessment Quality Assurance Project Plan 2001-2004](#) (EPA/620/R-01/002), except where specific variations have been authorized by the Regional NCA QA Officer. Authorized departures include the use of submerged pumps and hoses for the collection of subsurface water samples and vacuum field-filtration of nutrient and chlorophyll samples. Both of these procedures are specifically described in the corresponding sections of the contemporary QAPP and SOPs for Virginia's Chesapeake Bay Monitoring Program.

DEQ requires that a minimum of 10% QA samples (field duplicates, field blanks, etc.) be collected at estuarine ProbMon field sites for all locally analyzed parameters. At present, one or two QA sites from among the 50 sites sampled are randomly selected annually for each of the three DEQ Regional Offices.

### *Data Management*

Both samples and the resultant data collected within the Estuarine Probabilistic Monitoring Program follow diverse pathways. Standard procedures for the preservation, transportation and delivery of samples to

the Virginia Division of Consolidated Laboratory Services (DCLS) and of sample shipment to other contracted laboratories were described above.

The data flow and data management for water and sediment samples analyzed by DCLS follow pathways and turnaround times as described for the WQM Program in general. Analytical results are quality assured by DCLS and stored in their LIMS database. Results that are complete and certified there are subsequently shipped electronically to the DEQ FTP site for upload into the CEDS 2000 database on a daily basis.

Currently, all data from locally (DCLS) analyzed samples reside in DEQ's CEDS database. The turnaround time from receipt of samples at the laboratory until data arrives in the database varies from 48 hours to 21 days depending upon sample type. All analytical results receive a QA review at DCLS, prior to shipment to the DEQ database, and another QA review by programmed algorithms (data range screenings, etc.) within the CEDS database. Data that are 'flagged' by the automated screening procedures undergo an additional evaluation by DEQ's QA Officer. Whatever questions arise concerning the location, date and time of samples arriving at DCLS, or about the accuracy of DCLS data transmitted to the CEDS database are resolved immediately via e-mail and voice communication between laboratory personnel and monitoring personnel at the DEQ Central or appropriate Regional Office.

### *Looking to the Future*

The National Coastal Assessment Program (Coastal 2000 Initiative) was instituted by EPA's Office of Research and Development (ORD) as an experimental program in 2000. The original five-year program was so successful and so well accepted by the participating coastal states that it was transferred to EPA's Office of Water (OW) as a permanent component of its national water quality monitoring strategy. An interim two-year grant supported the program (at a reduced level) during the 2005-2006 transition. Since then, the program has received partial support via the normal § 106 federal grant process.

Beginning in the summer of 2005, portions of the national design were coordinated with and integrated into the Chesapeake Bay Program's (CBP) probabilistic benthic monitoring program. Probabilistically-collected sediment-related parameters (sediment chemistry, sediment toxicity and benthic community structure – the 'Sediment Quality Triad' or SQT) from the minor tidal tributaries will supplement CBP efforts in the major tidal tributaries and mainstem of Chesapeake Bay. Use of the SQT facilitates the characterization and aquatic life use assessment of these minor tidal tributaries, where sample sizes are generally insufficient to apply the formal statistical assessment method utilized for the Benthic Index of Biological Integrity (B-IBI) in larger Chesapeake Bay assessment units (segments).

EPA carries out national probabilistic surveys on various aquatic resource classes on a five-year rotational basis. The last National Coastal Survey was performed in 2010. The most up-to-date NCA data can be found here: <http://www.epa.gov/emap/nca/html/data/index.html>.

**Contact:** For further information on the Estuarine Probabilistic Monitoring Program contact:

Donald H. Smith, Ph.D.  
Virginia Department of Environmental Quality  
629 East Main Street  
Richmond, Virginia 23219  
**(804) 698-4429**  
[donald.smith@deq.virginia.gov](mailto:donald.smith@deq.virginia.gov)

## CHAPTER 3.3 ESTUARINE BENTHIC MACROINVERTEBRATE MONITORING PROGRAM

Benthic organisms are important secondary producers, providing key linkages between primary producers (phytoplankton) and higher trophic levels (crabs, bottom feeding fish and water birds). Benthic invertebrates are among the most important components of estuarine ecosystems and may represent the largest standing stock of organic carbon in the Chesapeake Bay. Some benthic organisms, such as hard clams and soft-shell clams, are economically important. Others, such as polychaete worms and shrimp-like crustaceans, contribute significantly to the diets of economically important blue crabs and bottom-feeding juvenile and adult fish such as spot, croaker, striped bass, and white perch.

The objectives of the Chesapeake Bay Estuarine Benthic Macroinvertebrate Monitoring Program are:

1. To characterize the health of regional areas of the lower Chesapeake Bay as indicated by the structure of the benthic community.
2. To conduct trend analyses on long-term data, at fixed-point stations, to relate temporal trends in the benthic communities to changes in water and/or sediment quality. The trend analyses will be updated annually as new data are available.
3. To warn of environmental degradation by producing an historical data base that will allow annual evaluations of biotic impacts by comparing trends in status within probability-based strata and trends at fixed-point stations to changes in water and/or sediment quality.

21 fixed-point stations are sampled one time per year (September) and there is one probabilistic summer sampling per year.

**Contact:** For further information on the Estuarine Benthic Macroinvertebrate Monitoring Program contact:

Cindy Johnson  
629 East Main Street  
Richmond, Virginia 23219  
**(804) 698-4385**  
[cindy.johnson@deg.virginia.gov](mailto:cindy.johnson@deg.virginia.gov)

## CHAPTER 3.4 BEACH MONITORING PROGRAM - VIRGINIA DEPARTMENT OF HEALTH

### *Introduction*

The “Beaches Environmental Assessment and Coastal Health (BEACH) Act” of 2000 amended Section 303 of the Federal Water Pollution Control Act (33 U.S.C. 1313) by specifying monitoring and reporting requirements for pathogens and pathogen indicators in coastal recreational waters for the purpose of protecting public health and welfare. An additional requirement of this Act was the publication of a list of “discrete coastal recreation waters adjacent to beaches or similar points of access that are used by the public.” The resultant “[National List of Beaches](http://www.epa.gov/ost/beaches/list/list-of-beaches.pdf)” [http://www.epa.gov/ost/beaches/list/list-of-beaches.pdf] was first published by the U.S. EPA in March of 2004. A current list of the beaches monitored in Virginia is available and cited below. The requirements of the BEACH Act apply only to states and tribes that have coastal recreational waters, defined by the Clean Water Act (Section 303(c) as the “...Great Lakes and marine and estuarine coastal waters that are designated by a state or tribe for use for swimming, bathing, surfing, or similar water contact activities...”

Within the Commonwealth of Virginia, the Division of Environmental Epidemiology (DEE) of the Virginia Department of Health (VDH) initiated the Beach Monitoring Program for Virginia in 2002. In addition to the immediate reporting requirements and public notices relative to swimming advisories, results obtained by the VDH are communicated to DEQ for inclusion in the agency’s biennial 305(b)/303(d) Water Quality Assessment Reports. The specific 305(b) assessment methodologies for using (1) swimming advisories and/or (2) the enterococci concentration data from the BEACH Monitoring Program were discussed by VDH and DEQ. The final decision on appropriate methodologies is incorporated into the 2008 Assessment Guidance Manual for the Integrated 305(b)/303(d) Report.

The BEACH Monitoring Program for Virginia is designed to provide seasonal monitoring coverage of coastal and Chesapeake Bay beaches within the Commonwealth. A public bathing beach is defined by the Code of Virginia (1980, c.428, section 10-217, 10.1-705) as “a sandy beach located on a tidal shoreline suitable for bathing in a county, city or town and open to indefinite public use.” Based on these characteristics, forty-seven public beaches were identified prior to December of 2003, by which time their locations were communicated to EPA for the National List of Beaches. As of July 2004, a total of 47 Virginia beaches were being monitored by the BEACH Program [VDH Beach Monitoring](#). Currently, 46 beaches in Virginia are being monitored by the BEACH Program. Sampling at three beaches was discontinued due to limited public access at those beaches; the BEACH Act applies to public beaches only. The rationale for identifying and enumerating individual beaches is discussed below, in the section on ‘siting.’ The localities participating in this program include the cities of Virginia Beach, Norfolk, Hampton, Newport News, and Yorktown, as well as King George County, Gloucester County and Northampton and Accomack Counties on the eastern shore of Virginia.

### *Purpose*

Monitoring of beaches is conducted to protect human health. Weekly monitoring is conducted to determine if levels of indicator bacteria (enterococci) meet the criteria of the State Water Quality Standards.

### *Monitoring Design and Station Siting*

The number of sampling stations at a beach is based on EPA guidance available in PDF format from the following webpage: <http://www.epa.gov/waterscience/beaches/grants/guidance/index.html>. The rationale for siting and enumerating individual beaches is based on beach size and whether (1) it is small and is treated as a single entity for swimming advisories, or (2) if it is more extensive and individual sections may be closed independently. In summary, the current list of responsible health districts and

beaches includes:

Rappahannock Health District (Fairview Beach) - 1 beach  
Peninsula Health District (Newport News, Yorktown) - 5 beaches  
Hampton City Department of Health - 3 beaches  
Norfolk Department of Public Health - 10 beaches  
Virginia Beach (24 miles long) - 22 beaches  
Three Rivers Health District (Gloucester Point) - 2 beaches  
Eastern Shore Health District - 3 beaches

Total = 46 beaches

Samples are taken in the middle of a typical bathing area. If the beach is short, samples are taken at a point corresponding to each lifeguard chair or one sample for every 500 meters of beach. (Sample results from several sites in the same beach unit may be united into a single arithmetic average for comparison with the Water Quality Standard and evaluation for swimming advisories - see below.) If the beach is long (more than 5 miles) samples are spread out along the entire beach (e.g., Virginia Beach, which is 24 miles long, has 22 sampling stations spaced at least one mile apart). Locations of sites are identified by coordinates of latitude and longitude and remain uniform from year to year in order to maintain a permanent, long-term database on beach water quality.

The most updated information relative to the BEACH Monitoring Program, including maps of many of the specific sampling sites, the most recent bacterial count results, and a list of swimming advisories, may be found at [VDH Beach Monitoring](#).

### *Frequency*

Beaches are sampled for indicator bacteria on a weekly basis from mid-May through September. When the Water Quality Standard at a specific beach is exceeded, or when the results of bacterial analysis are inconclusive, follow-up sampling is repeated as soon as possible.

### *Sampling*

As per EPA guidance, samples are collected in water knee deep (approximately 0.5 meters), and 0.3 meters below the surface. The VDH Beach Monitoring Protocol provides general guidelines for sampling procedures (as well as orientation on data averaging and the interpretation of results and on issuing and lifting swimming advisories). Samples are maintained refrigerated on 'wet' ice and are delivered to the laboratory for processing within six hours of collection.

Samples are collected on the regular monitoring day, rain or shine, unless conditions are dangerous to sampling staff. (If a decision is made not to sample because a violation of the standard is expected [e.g., heavy storm drain overflow], the beach is posted with a swimming advisory.) Samples are collected and transported in the same way at all sites. The sites are approached on foot and sampled from the beach. All the samples are grab samples, using sterile bottles that are supplied by the laboratory doing the bacterial analysis.

Whenever the water quality standard is violated at a site, Dr. Charles Hagedorn of the Department of Crop and Soil Sciences at Virginia Polytechnic Institute and State University is sent supplemental samples for bacterial source tracking. Fluorometric studies are also performed on these supplemental samples to determine contamination by human versus animal fecal matter. In addition, Dr. Hagedorn's enterococci results, using both the Membrane Filtration (MF) and Enterolert (MPN – Most Probable Number) methodologies, are subsequently compared to results from the local laboratories using the same method.

Final 2012

### *Duration*

Beach monitoring sites are considered permanent, fixed sites of the VDH Beach Monitoring Program. Sampling will continue as long as funding is available. As mentioned above, the sampling is conducted from mid-May through the September swimming season.

### *Core and Supplemental Water Quality Indicators*

The indicator organism used for estuarine and marine beaches is enterococci. Laboratory analysis of enterococci levels in beach water samples is conducted using EPA approved methods. Beach monitoring stations are specifically sampled for enterococci. Additional measurements of air and water temperature, dissolved oxygen, pH and salinity are taken at each of the beach sites during each visit.

### *Quality Assurance*

A Quality Assurance Project Plan was approved by EPA Region 3. As mentioned above, the Virginia Department of Health provides uniform guidance for sampling procedures, as well as orientation on data averaging and the interpretation of results and on issuing and lifting swimming advisories. The general SOP used for field sampling is Standard Methods, 9060, Samples Collection, 20th Edition (pp. 9-19 through 9-21). More specific SOPs for laboratory analyses of bacterial (enterococci) samples are produced by the individual laboratories performing the service (e.g., the Newport News Waterworks SOP for the Enterolert methodology). As previously mentioned, an additional effort to maintain QA/QC consists of collecting grab samples from each site with bottles supplied by the same laboratory doing the subsequent bacterial analysis.

There is an annual Quality Assurance/Quality Control training program, conducted by the Beach Monitoring Coordinator, for all field personnel and their supervisors. Training is given in operating and calibrating equipment, the proper way to collect samples, and how to fill out lab forms for clarity, consistency and completeness. Additional training is provided on how to troubleshoot and correct equipment malfunctions and how to report results. In-the-field training is also given at the same time.

### *Data Management*

The VDH Division of Environmental Epidemiology (DEE) received weekly data reports by e-mail from each local health department on the same day they received the results from their respective laboratories until 2007. DEE personnel aggregated the data on an Excel spreadsheet as soon as they were received and posted beach monitoring and swimming advisory data on the VDH Beach Monitoring webpage. Beach monitoring data and swimming advisory data were then stored in an Access database. Since 2007, beach sampling personnel in local health departments enter sampling results into a secure online database (the Beach Monitoring and Notification Database) through VDH's intranet system. The Beach Monitoring and Notification Database is maintained by DEE. Should sampling results indicate an exceedence of the water quality standard for enterococcus group bacteria and a swimming advisory is issued by the local health department, then swimming advisory duration information is also entered into the online database by the local health department. Timely data submission is emphasized so that the VDH Beach Webpage can be updated as soon as data are available. This is especially true when swimming advisories have been issued. Currently, DEE personnel query the online database for the most recent sampling and swimming advisory results reported by the local health districts and export the results in .html format for immediate posting to the VDH beach monitoring web page <http://www.vdh.virginia.gov/Epidemiology/dee/beachmonitoring/>.

Until 2007, data were periodically sent to EPA, via CDX for STORET, in an XML schema specified in the data user's guide (Beach Monitoring Data User Guide, EPA-823-R-03-004, May, 2003). Since 2007,

EPA has indicated that they wish to receive data submissions to STORET in a new XML schema and through a new exchange program, WQX. Beach monitoring data are submitted to EPA, via WQX for STORET in an XML schema specified by EPA and described in the data user's guide (Water Quality Exchange (WQX) XML Training Manual, August 2010). Beach swimming advisory data is submitted to EPA via CDX for PRAWN in an XML schema specified by EPA and described in the data user's guide (PRAWN Beach Notification Data User Guide v. 2.2.1 July 2010). EPA has indicated that they wish to receive the data on a yearly basis, by January 31. Initially, VDH sent 2003 bacteria monitoring data to EPA at the same time that they provided general program information on beach locations, beach extents, state and local beach monitoring contacts, beach advisory authorities, monitoring data fields, and swimming advisory fields, in December of 2003. This information was submitted to meet the original grant requirements. BEACH monitoring and swimming advisory data is currently maintained in VDH's Beach Monitoring and Notification Database and EPA's STORET and PRAWN databases.

### *Data Analysis/Assessment*

*Swimming Advisories:* The VDH compares measured bacterial concentrations with Virginia's water quality standard for enterococci. The results from several simultaneously collected samples at the same beach unit may be united into a single arithmetic average for comparison with the standard, and for subsequent evaluation for issuing swimming advisories. The single sample, Instantaneous Standard concentration for enterococci is 104 colony forming units (cfu)/100ml. Samples above this level are in violation of the Virginia Water Quality Standards. A single violation of the instantaneous standard is sufficient to issue a swimming advisory for the beach in question.

If there is a violation of the Standard, the local health department contacts the locality in which the beach is located to inform them of the advisory and the beach is posted with a swimming advisory sign. A press release is issued to notify the public and a follow-up water sample is taken and delivered to the lab as soon as possible. Specific procedures for this process are documented in the VDH Beach Monitoring Protocol.

*305(b)/303(d) Assessment and Reporting:* The specific 305(b) assessment methodologies for using (1) swimming advisories and/or (2) the enterococci concentration data from the BEACH Monitoring Program was discussed by VDH and DEQ. As previously stated, the final decision on appropriate methodologies is incorporated into the DEQ Assessment Guidance Manual for the 2012 Integrated 305(b)/303(d) Report.

### *Reporting*

If bacteria levels exceed the water quality standards, the beach is posted with a swimming advisory sign and the public is notified through press releases to local newspapers and posting of results on the VDH web page <http://www.vdh.virginia.gov/Epidemiology/dee/beachmonitoring/>.

The results of swimming advisories and all bacterial data collected by the BEACH Monitoring Program are communicated to DEQ for use in the agency's biennial Integrated 305(b)/303(d) Report.

### *Programmatic Evaluation*

The BEACH Monitoring Program for Virginia participates in monthly conference calls with EPA Region III during the swimming season, i.e., May through September, which revert to bi-monthly conference calls during the off-season. The Beach Monitoring Program is grant funded, and reviews of the yearly proposals, progress reports, and database submissions are mechanisms for programmatic evaluation by EPA. Within VDH, there are monthly Beach Monitoring conference calls between the Division of Environmental Epidemiology and the participating health districts, and weekly reviews of data from each participating health district by the Division's Statistical Analyst and Database Manager and the Beach Monitoring Coordinator for Virginia.

### *General Support and Infrastructure Planning*

The BEACH Monitoring Program is a federally funded program. Yearly budgets are prepared well in advance to meet proposal submission deadlines established by EPA. VDH has received an annual grant to conduct the Beach Monitoring Program for Virginia since December 2002. Future changes in methodologies will depend upon EPA recommendations, and expansion of the current program may occur in response to the opening of new public beaches or their identification by local health districts.

**Contact:** For further information on the BEACH Monitoring Program contact:

Dan Dietrich  
Division of Environmental Epidemiology  
Office of Epidemiology  
Virginia Department of Health  
Madison Bldg., Suite 418C East  
109 Governor Street  
Richmond, Virginia 23219  
**(804) 864-8141**  
[daniel.dietrich@vdh.virginia.gov](mailto:daniel.dietrich@vdh.virginia.gov)

## CHAPTER 3.5 CITIZEN AND NON-AGENCY WATER QUALITY MONITORING PROGRAM

Citizen water quality monitoring has been a stewardship activity in Virginia for many years. As both the volume and quality of water monitoring data collected by entities other than the Virginia Department of Environmental Quality (DEQ) has increased, so has the desire by many of these 'non-agency' organizations for DEQ to use submitted data for more than background information in Virginia's water quality assessments. Since 1999, the agency has encouraged citizen water quality monitoring by providing technical and, whenever possible, financial support. In addition to support for citizen monitoring, the agency has been actively attempting to expand our partnerships with an increasing number of other water quality monitoring programs that operate independently of DEQ.

Starting with the 2004 water quality assessment report, DEQ began using chemical monitoring data collected by citizen groups and other non-agency sources providing such data met DEQ Quality Assurance and Quality Control (QA/QC) protocols for determination of attainment of Water Quality Standards. This QA/QC process confirms whether citizen organizations and other non-agency data sources are using the same or similar sampling and testing methods that DEQ uses, ensuring that comparable data are used in any applications that include data from these sources.

In August 2004 DEQ created the Water Quality Data Liaison staff position. The purpose of the position is to provide guidance and technical support to citizen monitoring organizations, facilitate communication among citizen and non-agency water monitoring organizations, promote establishing new monitoring groups, and increase the amount and improve the quality of data shared with DEQ.

### *Citizen Monitoring*

Citizens of the Commonwealth monitor streams, lakes, and estuaries for a variety of parameters depending upon the goals of their own programs. Common ambient measures include many of the following physical and chemical parameters: water temperature, pH, dissolved oxygen, nutrients (various forms of nitrogen and phosphorus), or suspended solids in the water column. Biological parameters measured by citizen monitors often include benthic macroinvertebrates, *E. coli* bacteria, or chlorophyll *a*. Many of these parameters are routinely monitored by DEQ.

The Virginia Save Our Streams Program of the Virginia Division of the Izaak Walton League of America (VA SOS) took the lead in working with DEQ and the Department of Conservation and Recreation (DCR) to develop a statewide citizen monitoring program. This started with three separate letters of agreement signed by each agency in 1998 and was furthered by a three-way agreement signed in 1999. The latest version of the agreement, signed in October 2006, includes the Alliance for the Chesapeake Bay, Virginia Citizens for Water Quality and the Virginia Water Monitoring Council in addition to the original signatories from 1999.

Citizen monitoring efforts in Virginia received an additional boost in 1999 when the Virginia General Assembly approved a budget amendment to create the Citizen Water Quality Monitoring Grant Program in order to provide general funds, when available, for citizen monitoring activities. Since 1999, the Citizen Monitoring Grant Program has provided funding to over 100 different organizations. The financial support provided by the Commonwealth via this grant program has led to an increase in the quality and quantity of citizen-collected data submitted to DEQ and has proved an effective way for DEQ to encourage citizen volunteer groups to generate DEQ-approved water quality data. The grant requires recipients to submit Quality Assurance Project Plans (QAPP) and to follow DEQ approved procedures. In return, the grant recipient receives a grant award to help cover many of the costs associated with their monitoring

programs.

In 2002, the Virginia General Assembly passed legislation that established the Virginia Citizen Water Quality Monitoring Program in the Code of Virginia ([§62.1-44.19:11](#)). This legislation was later amended in 2007 under House Bill 1859 to establish a goal for DEQ to encourage citizen volunteers to monitor 3,000 stream miles by 2010. This goal was met during the 2010 305(b)/303(d) Integrated Report where 3,499.45 stream and river miles were monitored by citizen groups.

### *Quality Assurance*

Currently, DEQ has contacts with approximately 180 citizen monitoring organizations. Of these, 110 groups submitted water quality data for review and consideration for use by DEQ in this assessment. However, while not all citizen monitoring data submitted could be used in this assessment report, all citizen-generated data is important to DEQ and helps to characterize the quality of Virginia's waters.

Data used in this report were collected under documented protocols, standard operating procedures, and QA/QC methods as approved by DEQ for water quality assessment. Data where the exact sampling location could not be confirmed by DEQ were not used in this assessment. Data collected by citizen volunteers not used directly for this assessment report will still be used by DEQ, and other agencies, to help prioritize future monitoring and restoration work. Additional information associated with assessing citizen monitoring data is available in the 2012 Water Quality Assessment Guidance Manual found on the DEQ website: <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments.aspx>.

In order to assist citizen monitoring organizations with developing their monitoring programs, the *2003 Virginia Citizen Water Quality Monitoring Methods Manual* was revised in October 2007. The manual provides additional guidance on acceptable QA/QC procedures and protocols. A copy of this manual is available on the DEQ website: <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring.aspx>.

As outlined in the *Virginia Citizen Water Quality Monitoring Methods Manual*, DEQ has three levels to determine the quality of citizen and other non-agency water monitoring data. These levels increase in rank from Level I to Level III based on increasing levels of DEQ approved QA/QC protocols. Definitions of each level and how groups can achieve each of them are outlined below.

**Level I - Not approved by DEQ for assessment:** There is no Quality Assurance Project Plan (QAPP) or Standard Operational Procedures (SOP) on file. Monitoring and/or laboratory analysis does not follow DEQ sampling methods or quality assurance protocols or monitor for parameters that do not have a Virginia Water Quality Standard.

- Data used by DEQ to identify sites that may require DEQ to perform follow-up monitoring.
- Data used for educational or outreach purposes.
- Data can notify DEQ of significant pollution events for rapid agency response.

**Level II - Partially approved by DEQ:** May be using a monitoring method similar to DEQ protocols but not fully approved by DEQ due to difference in sampling or testing methodology. The monitoring group may have a DEQ approved QAPP and/or SOP on file.

- All uses as stated in Level I
- Used for 305(b) assessment to identify possible waters with observed effects or waters that appear to be healthy but will need DEQ monitoring data to confirm status (Category 3C or 3D).

**Level III - Approved by DEQ:** Group follows DEQ testing protocols and quality assurance. Field sampling and laboratory testing protocols are approved by DEQ or DEQ approved accrediting authority. Group possesses a DEQ approved QAPP and SOP with no deviation from DEQ-approved standardized methods (EPA methods, Standard Methods, etc). Finally, the group must provide calibration and quality control associated information to DEQ when submitting data. This information must meet the specific criteria stated in the QAPP.

- All uses as stated in Level II
- DEQ views this level of data as if DEQ had collected and analyzed the sample. Data that meets Level III criteria will be used in the 305(b) water quality assessment and for 303(d) listing/delisting of impaired waters.

As of December 2010, DEQ had awarded Level III status to 27 of the 110 citizen monitoring organizations who have submitted water quality data to the agency. The desire of many groups to have DEQ use their data, the continued efforts by DEQ to help citizen groups to match DEQ protocols, and the Citizen Monitoring Grant Program, have helped to increase the number of Level III data submissions.

For the 2012 assessment report, DEQ received citizen monitoring data from 1,786 sites. Twelve of these sites met Level I requirements, 974 sites met Level II, and 800 sites met Level III for at least one water quality parameter. Of these 1,774 Level II and III stations, 87 sites had either missing sample site coordinates or were located near non representative locations such as at permitted wastewater outfalls. This is the largest amount of citizen monitoring data ever received to date by DEQ. The following citizen monitoring organizations submitted water quality data to DEQ:

<b>Alliance for the Chesapeake Bay</b>	<b>George Mason High School</b>	<b>Poquoson Citizens for the Environment</b>
<b>Ashburn Village Monitors</b>	<b>Goose Creek Association</b>	<b>Potomac Appalachian Trail Club</b>
<b>Audubon Naturalist Society</b>	<b>Headwaters Soil and Water Conservation District</b>	<b>Prince William Soil and Water Conservation District</b>
<b>Blackwater/Nottoway Riverkeeper</b>	<b>Historic Green Springs, Inc.</b>	<b>Randolph Macon College</b>
<b>Bull Run Mountains Conservancy</b>	<b>Hoffler Creek Wildlife Foundation</b>	<b>RappFLOW</b>
<b>Chesapeake Bay Governors School</b>	<b>Isle of Wight Ruritan Club</b>	<b>Riverine Chapter of the Virginia Master Naturalists</b>
<b>Clean Virginia Waterways/ Longwood University</b>	<b>John Marshall SWCD</b>	<b>Rockfish Valley Foundation</b>
<b>Cowpasture River Preservation Association</b>	<b>Lake Anna Civic Association</b>	<b>Save Little Pimmit Run</b>
<b>Cubitt Creek Monitors</b>	<b>Leesville Lake Association</b>	<b>Southside Soil and Water Conservation District</b>
<b>Dividing Creek Association</b>	<b>Lord Fairfax Soil and Water Conservation District</b>	<b>StreamWatch</b>
<b>Ferrum College/ Smith Mountain Lake Association</b>	<b>Loudoun Wildlife Conservancy</b>	<b>Thomas Jefferson Soil and Water Conservation District</b>
<b>Friends of Blacks Run Greenway</b>	<b>Mattaponi and Pamunkey Rivers Association</b>	<b>Timberlake Homeowners Association</b>
<b>Friends of Chesterfield's Riverfronts</b>	<b>McClure River Restoration Project</b>	<b>Upper Tennessee River Roundtable</b>

<b>Friends of Norfolk Environment</b>	<b>National Committee for the New River</b>	<b>Virginia Karst Monitors</b>
<b>Friends of the North Fork Shenandoah River</b>	<b>Nelson County Master Gardeners</b>	<b>Virginia Save Our Streams</b>
<b>Friends of the Shenandoah River</b>	<b>Opequon Watershed Inc.</b>	
<b>Friends of Russell Fork</b>	<b>Phi Theta Kappa- Blue Ridge Community College</b>	

The Alliance for the Chesapeake Bay submitted ambient (chemical and physical) data collected by the following affiliate organizations:

<b>Elizabeth River Project</b>	<b>George Washington's Birthplace National Monument</b>	<b>Tidewater SWCD</b>
<b>Friends of the Rappahannock Chemical Monitoring Program</b>	<b>Isle of Wight Water Watchers</b>	<b>Tidewater Resource Conservation and Development Council</b>
<b>Friends of Stafford Creeks</b>	<b>Leesylvania State Park</b>	

The Friends of the Shenandoah River submitted ambient (chemical and physical) data collected by the following affiliate organizations:

<b>Augusta River Monitors</b>	<b>Friends of the North Fork Shenandoah River</b>	<b>Opequon Watershed Inc.</b>
<b>Friends of Page Valley</b>	<b>Friends of the Shenandoah River</b>	<b>Warren County Water Monitoring Group</b>

The VA SOS program is the largest citizen and benthic macroinvertebrate monitoring program in Virginia. The VA SOS Modified Rocky Bottom Method protocol determines the benthic community health in higher gradient streams with riffles typical to those found in the western part of Virginia. DEQ and VA SOS consider the data submitted to be Level II because it provides general information on the overall health of a benthic community.

In response to requests from citizens located in the eastern part of Virginia, VA SOS also developed a protocol for low gradient, freshwater, non-tidal streams. At the time of this report, DEQ has not approved the low gradient freshwater streams for QA Level II or III.

The Virginia Save Our Streams Program of the Virginia Division of the Izaak Walton League of America submitted benthic macroinvertebrate data collected by the following affiliate organizations:

<b>Albemarle County</b>	<b>Friends of the Rockfish Watershed</b>	<b>Patrick County SWCD</b>
<b>Amelia County Landfill</b>	<b>Goose Creek Association</b>	<b>Pedlar River Institute</b>
<b>Bluestone Watershed Committee</b>	<b>Grundy High School</b>	<b>Pound River Watershed Coalition</b>
<b>Buchanan Citizens Action Group</b>	<b>Roanoke Valley Governor's School</b>	<b>Radford University Green Team</b>
<b>Buckingham Citizen Action League</b>	<b>Headwaters Association</b>	<b>RappFLOW</b>
<b>Clinch Coalition</b>	<b>Holston River Water Quality Monitors</b>	<b>Reston Association</b>
<b>Clinch Valley SWCD</b>	<b>Hungry Mother State Park</b>	<b>Rivanna Conservation Society</b>
<b>Cowpasture River Preservation Association</b>	<b>Independence High School</b>	<b>Riverine Chapter of the Virginia Master Naturalists</b>
<b>Culpeper SWCD</b>	<b>John Marshall SWCD</b>	<b>Roanoke Valley Monitors</b>
<b>Dan River Basin Association</b>	<b>Kittrell Stream Team</b>	<b>Smith Mountain Lake Association</b>

<b>Douthat State Park</b>	<b>Lake Anna Civic Association</b>	<b>StreamWatch</b>
<b>Elliott Creek Watershed Protection Council</b>	<b>Lord Botetourt High School</b>	<b>Upper James River Roundtable</b>
<b>Emory and Henry College</b>	<b>Loudoun Wildlife Conservancy</b>	<b>Upper Rappahannock Watershed Stream Monitoring Program</b>
<b>Environmental Education Center</b>	<b>Maury River Middle School</b>	<b>Upper Tennessee Roundtable</b>
<b>Environmentally Concerned Citizens Organization</b>	<b>Maury River Monitors</b>	<b>Virginia Run Home Owners Assoc.</b>
<b>Franklin County Master Naturalists</b>	<b>Mountain Stream Stewards</b>	<b>Virginia's Explore Park</b>
<b>Friends of Page Valley</b>	<b>Middle River Monitors</b>	<b>Virginia Tech</b>
<b>Friends of the North Fork of the Shenandoah River</b>	<b>New River SWCD</b>	<b>Walker Creek Watershed Group</b>
<b>Friends of the North River</b>	<b>North Cross School</b>	<b>Warren County Chapter of the Izaak Walton League</b>
<b>Friends of the Rappahannock River</b>	<b>Northern Virginia SWCD</b>	<b>Washington and Lee University</b>
<b>Friends of the Pedlar River</b>	<b>Patrick County Monitors</b>	

Below is an alphabetical summary of the water quality data contributions by citizen monitoring organizations that DEQ included in this report. Additional information is available in a table at the end of this summary and in Appendix D.

The Alliance for the Chesapeake Bay (ACB) coordinates with affiliate organizations in eastern Virginia. ACB volunteers monitor a conventional suite of ambient parameters including dissolved oxygen, temperature, pH, salinity, and water clarity. Trained volunteers monitored at 76 stations and collected 3,227 samples during the six-year data window used for this report. Most dissolved oxygen and temperature data met DEQ criteria to assess water quality conditions. Other data not meeting the criteria were used to determine if follow-up monitoring is needed.

The Audubon Naturalist Society (ANS) monitors benthic macroinvertebrates in the Potomac River sub-basin using the ANS protocol. Trained ANS volunteers monitored eight stations and participated in 43 sampling events during the data window for this report. DEQ included submitted data in the assessment to determine if follow-up monitoring is needed.

The Blackwater/Nottoway Riverkeeper Program (BNRP) is an organization that helps educate and promote environmental stewardship in the Blackwater and Nottoway Rivers. As part of this education and stewardship effort, the BNRP conducts routine monitoring for temperature, pH, dissolved oxygen, nutrients, and *E. coli* at 14 stations in several counties in southeastern Virginia. DEQ has received 171 sampling events for the 2012 305(b)/303(d) Integrated Report. DEQ will use this data in the assessment to determine if follow-up monitoring is needed.

Bull Run Mountains Conservancy (BRMC) is a non-profit organization that strives to protect the Bull Run Mountains through education, research, and stewardship. As part of this effort, BRMC has provided temperature, dissolved oxygen, and pH data from six stations consisting of 15 observations. This data will help determine the need for DEQ follow up monitoring stations.

The Chesapeake Bay Governors School, in association with the Tidewater Resource Conservation and Development, monitored for dissolved oxygen, pH, temperature, and turbidity on 16 occasions at four stations from December 2003 to November 2006. Upon review of calibration logs, quality assurance project plan, and other documents, DEQ will assess dissolved oxygen, pH, and temperature data collected by this organization.

Clean Virginia Waterways, in partnership with Longwood University, collected 639 *E. coli* samples from 23 stations along the Appomattox River as part of the Appomattox River Water Quality Monitoring Program. Two stations, composed of 18 samples, were not included in the assessment due to missing latitude and longitude information. Upon review of sampling and laboratory procedures, DEQ will assess the *E. coli* data collected after November 2004.

The Cowpasture River Preservation Association collects *E. coli* samples using the Coliscan Easygel method. DEQ received data from 15 stations comprising of 320 samples from January 2007 to December 2009. Data will be used to determine additional monitoring locations by DEQ and help with TMDL implementation efforts.

The Cubitt Creek Monitors collected 70 samples for temperature and *E. coli* at 10 stations in Cubitt Creek. Submitted data will be used to determine the need for additional monitoring by DEQ.

The Dividing Creek Association (DCA) has been an active monitoring and stewardship organization located on Dividing Creek near Kilmarnock, Virginia. Since 2008, DCA has begun an enhanced monitoring program and submitted data from 48 stations consisting of 627 sample events. By following DEQ recognized protocols, DEQ will utilize temperature, dissolved oxygen, and pH data for assessing the health of Dividing Creek. *E. coli* bacteria and water clarity data will be considered to justify the need for establishing follow up monitoring stations by DEQ.

The Friends of Blacks Run Greenway, in partnership with James Madison University and several local high schools, conducted an intensive *E. coli* monitoring program in Blacks Run using Coliscan test kits. This project was supported through DEQ in an effort to determine potential areas for restoration efforts as part of the Blacks Run TMDL IP. Volunteers collected 152 samples at 15 stations and DEQ will use this data to determine if follow-up monitoring is needed.

The Friends of Chesterfield's Riverfront (FOCR) monitors at 32 stations in Chesterfield County. For this assessment report, FOCR submitted data from eight stations covering 1,062 sampling events. Parameters include temperature, dissolved oxygen, pH, and *E. coli*. DEQ will use the data to make follow-up monitoring determinations.

Friends of Norfolk Environment collected Enterococcus samples at 11 stations comprising of 132 sample events during 2010. Old Dominion University performed the analysis and the data will be used by DEQ to assess recreation related water quality standards at the monitoring locations.

Friends of the North Fork of the Shenandoah River (FNSR) are an affiliated group with the Friends of Shenandoah River. Along with the routine monitoring done under the larger Friends of Shenandoah River and Virginia Save Our Streams programs, FNSR collected 107 nutrient, *E. coli* and field parameter samples at 8 stations. Of the submitted data, 2 sample sites composed of 16 sample events were not included in this assessment report due to being located within VPDES permitted mixing zones.

The Friends of the Shenandoah River (FOSR) monitors ambient water quality for dissolved oxygen, pH, temperature, ammonia, nitrate, and orthophosphate in the Shenandoah River Subbasin. From 2005 to 2010, FOSR collected 11,408 samples from 256 stations. Of the submitted data, 36 sample sites composed of 501 sample events were not included in this assessment report due to missing site coordinates or located within VPDES permitted mixing zones. DEQ is assessing FOSR data for ammonia, dissolved oxygen, pH, temperature, and the parameter nitrate in areas designated for drinking water in this report.

Friends of Russell Fork monitored 19 stations and collected 317 *E. coli* and temperature readings. The data will help DEQ determine the need for additional monitoring in the areas sampled by this group.

Students from George Mason High School are collecting *E. coli* samples using the Coliscan Easygel

method at four stations. From the start of the monitoring in February 2009 to December 2010, the students collected 56 samples. The data will help DEQ in identifying areas for future agency sampling.

The Goose Creek Association (GCA) collected 667 water chemistry, *E. coli*, and benthic macroinvertebrate samples at 23 stations over the course of this reporting period. GCA volunteers collected benthic macroinvertebrate data using Virginia Save Our Streams protocols and submitted to DEQ via Virginia Save Our Streams. DEQ will use the dissolved oxygen, pH and *E. coli* data to determine if follow-up monitoring is needed. Temperature data will be assessed to indicate if the sampling stations are showing water quality attainment or impairment.

The Headwaters Soil and Water Conservation District (HSWCD) conducted an intensive *E. coli* monitoring program in Christians Creek using Coliscan test kits. This project was supported through DEQ in an effort to determine potential sources and areas for restoration efforts as part of the Christians Creek TMDL IP. HSWCD volunteers sampled at 14 stations collecting 65 samples from January 2006 through July 2006. Two stations comprising of four sample events was not included due to providing insufficient latitude and longitude coordinates to identify the sample location. DEQ included submitted data in this report to determine if follow-up monitoring is needed.

The Historic Green Springs, Inc. conducted monitoring in the York River Basin for temperature, pH, nutrients, and total suspended solids. Trained volunteers monitored seven stations and conducted 165 sampling events in this basin during the data window for this assessment. Temperature, dissolved oxygen, nutrient data meeting QA/QC requirements were used to assess water quality. Total suspended solids, and pH data was used to determine if follow-up monitoring is needed.

Hoffler Creek Wildlife Foundation collected 23 dissolved oxygen, pH, and temperature samples at one site during 2009. Data is being used to determine the need for future follow up sampling by DEQ.

The Isle of Wight Ruritan Club has been conducting water quality sampling at three stations. From September 2006 to July 2008, volunteers monitored on 60 occasions for temperature, dissolved oxygen, pH, along with conductivity and hardness testing. DEQ will use the temperature, dissolved oxygen, and pH data to identify if any of the monitored waterbodies need follow-up monitoring.

The John Marshal Soil and Water Conservation District (JMSWCD) has collected 1,131 samples at 33 sites in Fauquier County. JMSWCD collected samples to test for *E. coli* using Coliscan and sampled for temperature, dissolved oxygen, pH, and nutrients. The purpose of monitoring was to track TMDL implementation efforts and identify sites that would benefit from BMP installation. DEQ included the submitted data included the Coliscan results for Category 3C and 3D to determine if follow-up monitoring is needed.

The Lake Anna Civic Association collected samples on Lake Anna and its tributaries using a conventional suite of ambient parameters including dissolved oxygen, temperature, pH, *E. coli*, total phosphorus, and water clarity. Trained volunteers monitored 43 stations and conducted 776 sampling events in this basin during the data window for this report. Of the submitted data, 11 stations comprising of 168 sample events were not assessed as they are located in VPDES permitted mixing zones. DEQ is assessing the remaining data for dissolved oxygen, pH, temperature, total phosphorous, and *E. coli* for this report.

The Leesville Lake Association (LLA) include a group of volunteers committed to monitor and promote the environmental needs of Leesville Lake located just downstream of Smith Mountain Lake. By using a loaned DEQ multiprobe, LLA volunteers have monitored 12 stations covering 368 sample events. Though this monitoring, DEQ will assess data for temperature, dissolved oxygen, and pH. In addition, DEQ will use provided *E. coli* data via the Coliscan Easygel method to determine if follow-up monitoring is necessary.

The Lord Fairfax Soil and Water Conservation District (LFSWCD) monitored for *E. coli* bacteria levels

along Holman's Creek in Shenandoah County. LFSWCD staff used the Coliscan test kits to determine general trends in *E. coli* levels at 12 sites comprising of 233 sample events. The purpose of this monitoring was to track TMDL implementation efforts and identify sites that would benefit from BMP installation. DEQ will use the results to determine if follow-up monitoring is needed.

The Loudoun Wildlife Conservancy (LWC) monitors benthic macroinvertebrates in Loudoun County and is started to adopt the modified rocky bottom method used by Virginia Save Our Streams. Trained LWC volunteers monitored 33 stations during 936 sampling events for benthic macroinvertebrates and *E. coli* bacteria using the Coliscan method. DEQ will use the benthic data to determine if follow-up monitoring is needed.

The Mattaponi and Pamunkey Rivers Association (MPRA) has used Coliscan test kits to monitor sections of the Mattaponi and Pamunkey Rivers. MPRA volunteers collected 90 *E. coli* samples from 13 sites to assist DEQ with targeting areas for TMDL implementation efforts. Based on the training and technical assistance provided by DEQ, the agency is using the data in this report to determine if follow-up monitoring is needed.

The McClure River Restoration Project (MRRP) is conducting an intensive *E. coli* monitoring program in the McClure River watershed. DEQ has received data from 38 stations composed of 391 sample events from September 2006 through December 2008. Based on reviewing sampling and laboratory protocols, DEQ will use the data to assess water quality.

The National Committee for the New River (NCNR) began monitoring at 34 locations in the New River watershed in May of 2008. From May to December 2008, NCNR volunteers conducted 326 sample events testing for temperature, dissolved oxygen, pH, *E. coli*, and water clarity. DEQ will use the temperature, dissolved oxygen, and pH data to assess water quality at these locations. The *E. coli* data will be used to determine if follow-up monitoring is necessary due to the use of Coliscan Easygel by the volunteers.

The Nelson County Master Gardeners has picked up monitoring on four sites that were monitored by Rockfish Valley Foundation in 2007. Since June 2008, the group has monitored at 23 locations on 86 occasions using the Coliscan Easygel method to monitor for *E. coli* bacteria. Of the submitted data 10 stations comprised of 16 sample events were collected from unknown sample locations. DEQ will use the provided Coliscan data to determine if follow-up sampling is needed by the agency.

The Opequon Watershed Inc., an affiliate with the Friends of Shenandoah River, has used Coliscan test kits to monitor in the Opequon Watershed near Winchester, Virginia. Volunteer monitors collected 208 *E. coli* samples at 25 sites from April 2006 through September 2007. Monitoring was done to help track TMDL implementation efforts and identify sites that would benefit from BMP installation. DEQ is using the results to determine if follow-up monitoring is needed. Please note that the Friends of Shenandoah River monitored the same sites for other parameters.

The Phi Theta Kappa chapter of the Blue Ridge Community College collected pH, *E. coli*, and temperature data from two stations in 2010. Results from the 24 sample events will be used to determine the need for additional agency sampling for future monitoring.

Poquoson Citizens for the Environment (PCE) has been conducting temperature, pH, and *E. coli* sampling at 32 stations from January 2008 to December 2010. This sampling program collected 305 observations and submitted them to DEQ for inclusion in this assessment report. Based on the protocols used by PCE, DEQ will evaluate the data to determine if follow-up monitoring is necessary under the Category 3C/3D portion of this assessment report.

The Potomac Appalachian Trail Club collected benthic macroinvertebrate, water temperature, and pH

data at seven locations from March 2007 to October 2008. Volunteers collected 27 samples at these locations during this sampling period. DEQ will use the macroinvertebrate, temperature, and pH data to determine if follow-up monitoring is necessary.

The Prince William Soil and Water Conservation District collected 35 *E. coli* samples at 12 locations using the Coliscan Easygel method. The data is being used by DEQ to determine if follow-up monitoring is necessary under the Category 3C/3D portion of the assessment report.

Randolph Macon College located in Ashland, Virginia, has used Coliscan test kits to monitor nearby Mechumps Run. From September 2005 to October 2006, students collected 108 *E. coli* samples at 12 sites in an effort to assist DEQ in finding areas of high *E. coli* concentrations and to track TMDL implementation efforts. Based on training and technical assistance provided by DEQ, the agency is using the data to determine if follow-up monitoring is needed.

The Rappahannock Friends and Lovers of Our Watershed (RappFLOW) performed 89 sample events at 20 stations for dissolved oxygen, pH, temperature, and *E. coli* bacteria from April to June 2009. Upon review of calibration logs and other quality assurance materials, DEQ used the data in this assessment to determine if follow-up monitoring is needed.

The Riverine Chapter of the Virginia Master Naturalists began monitoring in March 2009. Volunteers collected 29 samples for dissolved oxygen, *E. coli*, pH, and temperature at six stations. Submitted data will be used by DEQ to determine the need for future agency sampling.

The Rockfish Valley Foundation collected 48 *E. coli* samples using the Coliscan Easygel method at six locations during 2007. The results will be used by DEQ to determine if additional follow-up monitoring is needed on the South Fork Rockfish River located in Nelson County.

Save Little Pimmit Run is a small neighborhood organization committed to preserving the health of Little Pimmit Run in Arlington and Fairfax Counties. From February to July 2008, volunteers collected 22 *E. coli* samples at five sample sites using the Coliscan Easygel method. Based on the data, DEQ will evaluate the *E. coli* results to determine if additional follow-up sampling is needed.

The Smith Mountain Lake Association (SMLA) and Ferrum College have partnered for many years to monitor water quality in and around Smith Mountain Lake. Since 2007, SMLA has enhanced their monitoring program to generate Level III data for temperature, dissolved oxygen, pH, and *E. coli* bacteria and well as provide Level II data for phosphorous and chlorophyll a. From May 2007 to September 2009, SMLA performed 2,443 sample events at 141 stations. DEQ will use the temperature, dissolved oxygen, pH, and *E. coli* data to assess water quality. Nutrient and chlorophyll a data will be used to determine if DEQ should perform follow-up monitoring at selected sites.

Southside Soil and Water Conservation District located in Charlotte and Lunenburg Counties collected 412 *E. coli* samples at 20 locations using the Coliscan Easygel method. Data provided to DEQ was used to determine if follow-up monitoring is necessary under the Category 3C/3D portion of the assessment report.

StreamWatch, an affiliated member of Virginia Save Our Streams (VA SOS), submitted benthic macroinvertebrate data collected during 820 sample events at 118 stations located around the Rivanna Subbasin. Of these 4 stations comprised of 24 samples were not included due to being sampled from unknown locations. Based on a validation study performed between StreamWatch enhanced benthic monitoring program and DEQ benthic metrics, it was determined that StreamWatch data is of equal quality to DEQ results. DEQ will use the submitted StreamWatch benthic data to assess water quality.

The Thomas Jefferson Soil and Water Conservation District collected 161 *E. coli* samples at 11 sites using the Coliscan Easygel method. Data provided to DEQ was used to determine if follow up monitoring

is necessary under the Category 3C/3D portion of the assessment report.

The Timberlake Homeowners Association monitors a privately owned lake just outside of Lynchburg. During this assessment period, volunteers collected dissolved oxygen, pH, temperature, nutrients, and *E. coli* data at 11 stations covering 114 sample events. Upon review of protocols and methods used by the volunteers, DEQ will assess water quality using this data.

The Upper Tennessee River Roundtable (UTRR), collected *E. coli* samples using Coliscan at several creeks located around Wise, Virginia. This project was supported through DEQ in an effort to determine potential sources and areas for restoration efforts as part of the Three Creeks TMDL IP. Volunteers collected 126 samples at nine stations from February 2006 to August 2007. Based on the training and technical assistance provided by DEQ, the agency is incorporating the data into this report to determine if follow-up monitoring is needed.

Virginia Karst Monitors are a group of caving enthusiasts who collected water quality samples near springs to determine the water quality condition of groundwater as it transitions to surface water. Volunteers collected dissolved oxygen, *E. coli*, pH, and temperature data on 44 occasions at 11 locations and submitted the data to DEQ. While the majority of the submitted data was located in areas not representative of surface water systems, some data did meet the classification of surface water and was used to determine the need for future agency sampling.

The Virginia Save Our Streams Program of the Virginia Division of the Izaak Walton League of America (VA SOS) coordinates with a number of affiliate organizations across Virginia. Trained VA SOS volunteers collecting benthic macroinvertebrate samples using the VA SOS Modified Rocky Bottom Method and submitted data from 488 stations composed of 2,135 sample events. Due to insufficient or missing site coordinates, 20 sampling stations covering 23 sampling events were not included. DEQ will use SOS data to determine if follow-up monitoring is needed.

**Table 3.5-1 Citizen Monitoring Data Submitted: Level II and III**

Citizen Monitoring Organizations	Potomac/ Shenandoah		James		Rappahannock		Roanoke		Chowan		Tennessee		Chesapeake Bay		York		New		Big Sandy		Unknown/ VPDES Locations		Total		
	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	
Alliance for the Chesapeake Bay	17	540	19	847	22	1,226							15	567	3	47							76	3,227	
Audubon Naturalist Society	8	43																					8	43	
Blackwater/Nottoway Riverkeeper									14	171													14	171	
Bull Run Mountains Conservancy	6	15																					6	15	
Chesapeake Bay Governors School					4	16																	4	16	
Clean Virginia Waterways			23	639																			23	639	
Cowpasture River Preservation Association			15	320																			15	320	
Cubitt Creek Monitors	10	70																					10	70	
Dividing Creek Association													48	627									48	627	
Friends of Blacks Run	15	152																					15	152	
Friends of Chesterfield's Riverfront			32	1,062																			32	1,062	
Friends of Norfolk Environment			11	132																			11	132	
Friends of Russell Fork																			19	317			19	317	
Friends of the North Fork of the Shenandoah River	6	91																			2	16	8	107	
Friends of the Shenandoah River	220	10,907																				36	501	256	11,408
George Mason High School	4	56																					4	56	
Goose Creek Association	23	667																					23	667	
Headwaters SWCD	12	61																			2	4	14	65	
Historic Green Springs Inc.															7	165							7	165	
Hoffler Creek Wildlife Foundation			1	23																			1	23	

**Citizen Monitoring Data Submitted: Level II and III Continued**

Citizen Monitoring Organizations	Potomac/ Shenandoah		James		Rappahannock		Roanoke		Chowan		Tennessee		Chesapeake Bay		York		New		Big Sandy		Unknown/ VPDES Locations		Total	
	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events
Isle of Wight Ruritan Club			3	60																			3	60
John Marshall SWCD					33	1,131																	33	1,131
Lake Anna Civic Association															32	608					11	168	43	776
Leesville Lake Association							12	368															12	368
Lord Fairfax SWCD	12	233																					12	233
Loudoun Wildlife Conservancy	33	936																					33	936
Mattaponi and Pamunkey Rivers Association															13	90							13	90
McClure River Restoration Project																	3	12	35	379			38	391
National Committee for the New River																	34	326					34	326
Nelson County Master Gardner's			13	70																	10	16	23	86
Opequon Watershed Inc.	25	208																					25	208
Phi Theta Kappa- Blueridge Community College	2	24																					2	24
Poquoson Citizens for the Environment														32	305								32	305
Potomac Appalachian Trail Club	7	27																					7	27
Prince William SWCD	12	35																					12	35
Randolph Macon College																12	108						12	108
RappFLOW					20	89																	20	89
Riverine Chapter Virginia Master Naturalists			6	29																			6	29
Rockfish Valley Foundation			6	48																			6	48
Save Little Pimmit Run	5	22																					5	22

**Citizen Monitoring Data Submitted: Level II and III Continued**

Citizen Monitoring Organizations	Potomac/ Shenandoah		James		Rappahannock		Roanoke		Chowan		Tennessee		Chesapeake Bay		York		New		Big Sandy		Unknown/ VPDES Locations		Total	
	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events
Smith Mountain Lake Association							141	2,443															141	2,443
Southside SWCD							20	412															20	412
StreamWatch			114	796																	4	24	118	820
Thomas Jefferson SWCD			11	161																			11	161
Timberlake Homeowners Association							11	114															11	114
Virginia Karst Monitors											3	15					6	24			2	5	11	44
Virginia Save Our Streams	166	936	125	483	32	190	91	390			40	80			1	1	8	27	5	5	20	23	488	2,135
<b>Total number of stations/samples</b>	<b>583</b>	<b>15,023</b>	<b>379</b>	<b>4,670</b>	<b>111</b>	<b>2,652</b>	<b>275</b>	<b>3,727</b>	<b>14</b>	<b>171</b>	<b>52</b>	<b>221</b>	<b>95</b>	<b>1,499</b>	<b>68</b>	<b>1,019</b>	<b>51</b>	<b>389</b>	<b>59</b>	<b>701</b>	<b>87</b>	<b>757</b>	<b>1,774</b>	<b>30,829</b>
<b>Overlap stations*</b>	<b>52</b>		<b>55</b>		<b>5</b>																			
<b>Net Unique Stations</b>	<b>531</b>		<b>324</b>		<b>106</b>		<b>275</b>		<b>14</b>		<b>52</b>		<b>95</b>		<b>68</b>		<b>51</b>		<b>59</b>		<b>87</b>		<b>1,662</b>	

\* Overlap stations refer to stations monitored by two or more monitoring organizations. Often this is due to sampling for different parameters.

### *Other Non-Agency Water Quality Monitoring*

By broadening the scope of our data solicitation beyond citizen monitoring, DEQ receives water quality data from an expanding pool of government, private industry, and other non-citizen monitoring organizations. The guidelines for accepting these datasets are the same as with citizen monitoring data. Each organization must show documented sample collection and testing protocols and pass routine inspections and laboratory audits by the agency. Depending on the degree of compliance with the vetting of the sampling methods and test procedures, the data can either be used directly for assessment or provide locations to establish future DEQ sampling sites.

Prior to the 2004 assessment report, DEQ received water quality monitoring data from the United States Geological Survey (USGS). The data collected by the USGS follows strict adherence to EPA sampling methods and analytical procedures that are fully approved by DEQ. In addition, the United States Forest Service (USFS) routinely submits benthic macroinvertebrate data. The benthic data collected by the USFS follow standard benthic macroinvertebrate monitoring protocols that are similar to DEQ benthic monitoring methods.

Since the 2004 report, additional agencies have begun submitting water quality data for assessment. Most of the data submitted for the 2012 assessment report comes from various federal, state, and local government agencies and select academic institutions.

For the 2012 assessment report, DEQ received data from 19 non-agency groups, which monitored at 512 sample sites. Six sites met Level I requirements, 79 met Level II and 427, up from 280 in the 2010 Report, met Level III for at least one water quality parameter. Of these 506 Level II and III stations, 8 sites had either missing sample site coordinates or were located near non representative locations such as at permitted wastewater outfalls. The following private and government organizations submitted water quality data to DEQ:

<b>Abingdon Sewage Treatment Plant</b>	<b>James City County Stormwater Division</b>	<b>Tennessee Valley Authority</b>
<b>Arlington County Department of Environmental Services</b>	<b>National Park service- Assateague Island National Seashore</b>	<b>United States Environmental Protection Agency</b>
<b>Appalachian Electric Power</b>	<b>National Park Service- Mid Atlantic Monitoring Network</b>	<b>United States Forest Service</b>
<b>Chesterfield County Department of Environmental Engineering</b>	<b>National Park Service- Richmond Area National Parks</b>	<b>United States Geological Survey</b>
<b>City of Newport News Raw Water Monitoring Program</b>	<b>Occoquan Watershed Monitoring Laboratory</b>	<b>VDH Beach Monitoring Program</b>
<b>Cumberland Resources Corporation</b>	<b>Page County Department of Environmental Services</b>	
<b>Edge Valley Preservation LLC</b>	<b>Reston Association</b>	

Below is an alphabetical summary of the water quality data from non-agency organizations that DEQ included in this report. Additional information is available in a table at the end of this summary and in Appendix D.

The Abingdon Sewage Treatment Plant submitted water quality data collected upstream of their facility to DEQ. From January 2005 through December 2010, the staff collected 59 samples from one sample site located upstream of their facility. Submitted data included stream flow, temperature, dissolved oxygen, pH, biochemical oxygen demand, nutrients, and *E. coli* bacteria. Upon reviewing sampling procedures and testing protocols, DEQ will assess water quality for temperature, pH, nutrients, and *E. coli*.

The Arlington County Department of Environmental Services coordinates a monitoring program to collect *E. coli* samples using the Coliscan Easygel method. Since starting in 2005, 213 samples from 13 locations along Four Mile Run in Arlington County were collected to identify areas showing high levels of *E. coli* bacteria. The results were submitted to DEQ to help with Total Maximum Daily Load (TMDL) Implementation Plan (IP) efforts by identifying locations that could benefit from the installation of Best Management Practices (BMP). DEQ included submitted data in this report to determine if follow-up monitoring is needed.

Appalachian Electric Power monitored ten stations in the Smith Mountain Lake as part of a study on levels of dissolved copper present in the water column resulting from algae control measures. AEP staff collected 100 samples from June 2005 to September 2009. DEQ will use this data to determine if copper levels are within acceptable aquatic life use criteria.

Chesterfield County Department of Environmental Engineering submitted water quality data for 28 stations comprising of 320 samples from January 2005 through December 2006 and consisted of temperature, dissolved oxygen, pH, nutrients, and similar parameters. Upon review of calibration logs and procedures, dissolved oxygen, pH, and temperature data did meet DEQ requirements for inclusion in this report. However, Chesterfield County has requested the agency not use their results for 303(d) listing or delisting but the agency is using the submitted data to identify follow-up monitoring locations.

The City of Newport News provided data collected along the Chickahominy River as part of a routine program to test source water used for drinking water. The program collected 373 samples at six stations from January 2005 through December 2006 that included sampling for dissolved oxygen, pH, temperature, and conductivity. After reviewing the sampling procedures and calibration logs, DEQ will assess water quality for dissolved oxygen, pH, and temperature.

The Cumberland Resources Corporation collected 73 water samples along seven sites located near their mining operations in Wise County from August through October 2010. The samples analyzed for pH, chloride, conductivity, total suspended solids, and osmotic pressure. Two of the sample sites comprised of two samples was collected at the permitted discharge points of two mines and were not assessed. Upon review of the testing protocols and sampling procedure, DEQ will include chloride and pH results in this assessment report. Conductivity, total suspended solids, and osmotic pressure were not included because Virginia has not adopted water quality standards for these parameters.

The Edge Valley Preservation LLC is a real estate developer committed to preserving the rural nature of Bundoran Farm located near Charlottesville, Virginia. To help ensure the area is preserved, the organization monitored on 48 occasions at eight locations for temperature, dissolved oxygen, pH, nutrients, and *E. coli* bacteria.

The James City County Stormwater Division collected *E. coli* samples using the Coliscan Easygel method. From April 2009 to March 2010, county staff collected 140 samples at 12 locations to identify areas of high *E. coli* populations. The results were submitted to DEQ to help with TMDL IP underway in the area to identify locations that could benefit from the installation of BMP's. DEQ included submitted data in this report to determine if follow-up monitoring is necessary.

The National Park Service Assateague Island National Seashore participates in a multistate monitoring program in waters surrounding Assateague island on Virginia's Eastern Shore. Park staff collected 306 samples at six sites located in Virginia to test for nutrient levels, algae concentration, and field parameters. DEQ will use the nutrient and field parameter data to assess water quality conditions.

The National Park Service Mid-Atlantic Monitoring Network established a unified monitoring program at the various National Parks located in Virginia and other mid-Atlantic states. Data from National Parks located in Virginia provided data to DEQ from 43 locations composed of 351 sample events for dissolved oxygen, pH, and temperature. DEQ will use the data to assess water quality conditions at these

locations.

The National Park Service Richmond Area National Battlefield Parks submitted additional benthic macroinvertebrate data collected on 24 occasions at eight sites. Upon review of the data, DEQ is using the results to determine if follow-up monitoring is needed.

The Occoquan Watershed Monitoring Laboratory monitors field parameters and total phosphorous at 15 sites along the Occoquan Reservoir. Trained field and laboratory staff conducted 1,747 sample events during the six year assessment window. Based on review of field and laboratory protocols, DEQ will include the results to assess water quality at the reservoir.

Page County Department of Environmental Services conducted an intensive *E. coli* monitoring program in the Hawksbill Run watershed using Coliscan Easygel. This project was supported through DEQ to determine potential bacteria sources and areas to establish restoration projects as part of the Hawksbill Run TMDL IP. Page County staff sampled at 26 stations in Hawksbill Run collecting 739 samples from September 2005 through February 2010. DEQ included submitted data in this report to determine if follow-up monitoring is needed.

The Tennessee Valley Authority has conducted reservoir monitoring along the South Fork of the Holston River. The monitoring consisted of collecting 91 *E. coli* and field parameter samples at three sites. Sampling and analysis followed standard methods and DEQ will use the data to assess water quality.

The United States Environmental Protection Agency (US EPA) submitted water chemistry and benthic macroinvertebrate data collected at four sites along Accotink Creek in Fairfax County from November 2005 through December 2006. Benthic macroinvertebrate samples followed EPA protocols and results were equated to Virginia Stream Condition Index (VSCI) and are acceptable for DEQ to include in this report. Water chemistry data provided to DEQ did not contain associated quality assurance information and was not included in this report.

The United States Forest Service (USFS) conducts an intensive benthic macroinvertebrate study in and around the national forests in Virginia. The USFS monitored at 157 stations and collected 278 benthic macroinvertebrate samples from April 2003 to July 2006. However, due to insufficient or missing site coordinates, 6 stations with data from 9 sampling events were not included in this report. Upon review of sampling protocols, DEQ will use the benthic macroinvertebrate data for assessing water quality.

The United States Geological Survey (USGS) submitted water quality data for 100 stations located in the eastern and central portions of Virginia. USGS staff collected and submitted data from 3,685 sample events from January 2005 to December 2010. The stations monitored many ambient water quality parameters from dissolved oxygen and pH to dissolved metals. In addition, USGS conducted continuous monitoring of dissolved oxygen, pH, and temperature at 10 stations collected 1,106,666 samples during the six year window. The USGS follows standard protocols for sampling and analysis of results. USGS monitoring data identified as having a Virginia Water Quality Standard were used by DEQ to assess water quality.

The Virginia Department of Health (VDH) collects *E. coli* and fecal Enterococcus bacteria samples from public beaches located in the eastern half of Virginia from May to October each year. For this assessment report, VDH staff collected 5,104 bacteria samples from 50 public beaches and submitted the results to DEQ. Due to VDH using the same sampling methods and laboratory procedures used by DEQ, VDH results were used by DEQ to assess water quality.

**Table 3.5-2 Non-Agency Data Submitted: Level II and Level III**

Other Non-Agency Groups	Potomac/ Shenandoah		James		Rappahannock		Roanoke		Chowan		Tennessee		Chesapeake Bay		York		New		Atlantic Ocean		Unknown/ VPDES Locations		Total	
	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events
Abingdon Sewage Treatment Plant											1	59											1	59
Appalachian Electric Power							10	100															10	100
Arlington County Volunteer Monitors	13	213																					13	213
Chesterfield County Office of Water Protection			28	320																			28	320
City of Newport News			6	373																			6	373
Cumberland Resource Corporation											5	71								2	2		7	73
Edge Valley Perseveration LLC			8	48																			8	48
James City County			12	140																			12	140
National Park Service (NPS)- Assateague Island																		6	306				6	306
NPS- Mid Atlantic Monitoring Network			20	121			5	83	1	8					17	139							43	351
NPS- Richmond National Battlefield Parks			8	24																			8	24
Occoquan Watershed Monitoring Laboratory	15	1,747																					15	1,747
Page County Department of Environmental Service	26	739																					26	739
Tennessee Valley Authority											3	91											3	91
US EPA	4	15																					4	15
United States Forest Service	25	61	93	164							10	10					23	34			6	9	157	278
United States Geological Survey	36	89,764	23	297,721	5	71	23	667,854	5	63	3	52,912	1	15	5	67	8	99					109	1,108,566
Virginia Department of Health- Beach Monitoring Program	1	125	8	775					9	944			29	2,996	2	213			1	51			50	5,104
<b>Total number of stations/samples</b>	<b>120</b>	<b>92,664</b>	<b>206</b>	<b>299,686</b>	<b>5</b>	<b>71</b>	<b>38</b>	<b>668,037</b>	<b>15</b>	<b>1,015</b>	<b>22</b>	<b>53,143</b>	<b>30</b>	<b>3,011</b>	<b>24</b>	<b>419</b>	<b>31</b>	<b>133</b>	<b>7</b>	<b>357</b>	<b>8</b>	<b>11</b>	<b>506</b>	<b>1,118,547</b>

## *Current Efforts to Support Citizen and Non-Agency Surface Water Quality Monitoring*

DEQ is committed to expanding the use of non-agency surface water quality monitoring data in future assessment reports. This is primarily due to an increasing need for additional water quality data and the growth in the sophistication in water quality monitoring by sources outside of DEQ. During the past couple of years, DEQ has been working on several projects to increase the amount and quality of non-agency data available.

For nearly six years, DEQ has provided equipment to citizen groups to monitor for *E. coli* bacteria using the Coliscan Easygel method. Candidate groups are selected based on their willingness to monitor in bacteria impaired waterbodies which currently have a TMDL Implementation Plan in place or soon will be. When funding is available, DEQ typically equips ten or more groups to perform monthly monitoring at ten or more locations in the TMDL waterway. The volunteer groups share the results with DEQ, and other interested parties such as local governments, to help identify areas of high fecal bacteria loading such as due to broken sewer lines. This information is helping to refine implementation activities to be more efficient. In addition, the volunteers often share their findings with their neighbors, which have helped improve participation in non point source best management practices.

In the fall of 2006, DEQ developed Guidance Memo No. 06-2010 to outline how citizen and other monitoring groups can quality their benthic macroinvertebrate monitoring data as Level III. This guidance was in response to the request of several citizen organizations that monitor for benthic macroinvertebrates to have their data used more by DEQ. With this guidance, DEQ continues to work with multiple citizen and non-agency monitoring organizations to enhance their benthic monitoring program resulting in generating Level III benthic data for assessment use. A copy of this guidance is available [online](http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring.aspx) at <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring.aspx>.

In 2007, DEQ unveiled a new online database application for citizen monitoring and other non-agency groups to submit water quality data. This application provides a centralized location to submit, store, and retrieve non-DEQ water quality data. In addition, the application allows the public to view most of the water quality data that are submitted to the agency.

In 2005, DEQ, in partnership with the Virginia Water Monitoring Council (VWMC), helped to develop a web-enabled application for the public to find contact information on water quality monitoring organizations across Virginia. This was enhanced further in 2009 by using a new web interface. With the development of the non-agency database, the VWMC application was upgraded and now allows users to see a map of sample locations found in the database application and provides an alternative way for the public to access citizen and non-agency water quality data at those sites. The VWMC application is accessible by going to their website <http://www.vwrrc.vt.edu/vwmc>.

Through these new and continuing efforts, DEQ is able to utilize data that was previously unavailable or unknown to the agency. DEQ values the contributions of non-agency monitoring staff and citizen volunteers and will continue to support their monitoring efforts however possible. With assistance from these organizations, DEQ is increasing monitoring coverage in Virginia.

Additional information is available on the DEQ citizen monitoring webpage: <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring.aspx>.

James Beckley  
Quality Assurance Coordinator  
629 East Main Street  
Richmond, Virginia 23219  
**(804) 698-4025**  
[james.beckley@deq.virginia.gov](mailto:james.beckley@deq.virginia.gov)

Stuart Torbeck  
Water Quality Data Liaison  
629 East Main Street  
Richmond, Virginia 23219  
**(804) 698-4461**  
[stuart.torbeck@deq.virginia.gov](mailto:stuart.torbeck@deq.virginia.gov)