**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 statutory, regulatory and assessment needs. With the development and implementation of the [Water Quality Monitoring Strategy](https://www.deq.virginia.gov/home/showpublisheddocument/9481/637594584576270000), 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 Water Quality Monitoring Strategy was updated in 2004, 2007, 2013, and 2021 and has been formally approved by the United States Environmental Protection Agency (USEPA).

To achieve the objectives of the Water Quality Monitoring Strategy[[1]](#footnote-1) 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 Restoration Objectives:

(a) Surface Water Quality 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, and as resources allow, 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 / Restoration:

(7) Provide data to define the cause, severity and geographic extension of impaired waters.

(8) Provide adequate data for development of TMDLs, including model development and validation and establishing TMDL end-points, as well as non-TMDL approaches to address impaired waters.

(9) Provide adequate data, by means of follow-up monitoring, to evaluate the implementation of TMDLs and other best management practices, and the restoration of impaired waters.

(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.

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 Strategy, a monitoring network composed of multiple programs and special studies was identified and developed. A summary of the primary monitoring programs is included below. A more detailed description of each monitoring program is available in Chapter 3 of DEQ’s [Water Quality Monitoring Strategy](https://www.deq.virginia.gov/home/showpublisheddocument/9481/637594584576270000).

**WATERSHED (AW)** The ambient watershed (AW) network of stations represents the largest single section of the monitoring program. AW stations are those that are sampled within a major river basin every other month for two years and then rotated to a new set of stations in another basin the following two years, thus completing a statewide cycle in six years.

**Chesapeake Bay Non Tidal Program (BN)** The design of the Chesapeake Bay non tidalnetwork is based on recommendations from the U.S. EPA Chesapeake Bay Program Office and encompasses a multi-state water quality characterization effort. Load estimates at the Fall Line are important for characterizing headwater areas and tracking progress of best management practices toward nutrient and sediment reductions under the Chesapeake Bay cleanup program. Through the cooperative agreement, monthly data collected by USGS and DEQ as well as USGS storm event data are combined with the Bay wide non-tidal data for status and trends using a Weighted Regression on Time, Discharge, and Season (WRTDS) as developed by Hirsch et al. and Moyer et al.[[2]](#footnote-2)

**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 EPA’s collaborative National Coastal Condition Assessment Surveys on a rotating basis once every five years.

**CHESAPEAKE BAY TIDAL PROGRAM (CB)** The Chesapeake Bay (CB) tidal monitoring program is based on recommendations from the U.S. EPA Chesapeake Bay Program Office and encompasses a multi-state water quality characterization effort, covering the extensive tidal portions of Virginia’s Bay tributaries, mainstem, small creeks and embayments. In Virginia, the Bay Program monitoring effort is accomplished through monitoring by DEQ regional offices and via cooperative agreements with Old Dominion University and the Virginia Institute of Marine Science: <https://www.deq.virginia.gov/water/chesapeake-bay>

**CLINCH RIVER MONITORING (CL)** Threatened and endangered freshwater mussel populations were the focus of a 5 year intensive water quality study in order to better identify the inorganic, ionic, and trace elemental constituents present in the water column throughout the impacted zone, upstream and downstream reference reaches along the mainstem Clinch River. Field work for this study was completed in November 2019. During the study 401 discrete samples were collected from 40 stations for a total of more than 15,954 analytical values for 79 water quality variables. Final analytical report expected to be completed in 2022.

**CITIZEN MONITORING (CM)** Citizen monitoring are those stations identified through public participation as targeted for specific monitoring. Public notification for requests from citizens to DEQ to include water quality monitoring is usually a result of problems identified by the public. Notification occurs in the fourth quarter of the calendar year with sampling scheduled to begin in the next monitoring year, if the citizen nomination is accepted: <https://www.deq.virginia.gov/water/water-quality/monitoring/citizen-monitoring>.

**DAN RIVER (DR)** The Dan River long-term special study was initiated to monitor instream conditions following a 2014 coal ash spill in Eden, North Carolina. The program monitors a 32 mile stretch of the Dan River from where the river enters the state below the spill site to the headwaters of Kerr Reservoir. Scheduled monitoring included metals and field measures through 2017. Since 2017, a grant from the National Fish and Wildlife Federation has funded fish tissue collections at 15 sites in the Roanoke basin. This work will continue through 2022. The program is also providing information useful to water supply taste and odor issues at multiple intakes within the reach.

**FACILITY INSPECTION (FI)** Monitoring associated with DEQ facility inspections are not specifically identified in the water quality monitoring strategy, but are integral to evaluating discharges authorized by Virginia Pollutant Discharge Elimination System (VPDES) permits. Specific sample locations are identified on an as-needed basis and 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 use a statistical sampling design to characterize the overall water quality of the Commonwealth for free-flowing streams: <https://www.deq.virginia.gov/water/water-quality/monitoring/probabilistic-monitoring>.

**FISH TISSUE (FT)** The fish tissue program provides information to better understand pollutant levels in edible fish tissue with regard to evaluating fish consumption designated use, provides information needed for development of PCB and mercury TMDLs, and provides information to monitor restoration progress once an Implementation Plan is in place. Fish tissue and sediment monitoring isconducted by central office staff: <https://www.deq.virginia.gov/water/water-quality/monitoring/fish-tissue-monitoring>.

**GROUNDWATER (GW)** The Ambient Groundwater Characterization Program collects data on chloride concentrations in the Virginia Coastal Plain aquifers. This data is collected at trend stations (repeated wells) and spot samples to better define chloride concentrations throughout the coastal plain, as well as to assess temporal changes (increases in salinity) as a result of increasing groundwater withdrawals. The ambient program also collects dissolved methane samples from different coastal plain aquifers above the Taylorsville Basin. The buried Mesozoic basin is known to contain natural gas reserves. The ambient program is forming baseline data on water quality over the basin prior to any commercial recovery or enhanced recovery of the natural gas.

**HIGH FREQUENCY BACTERIA MONITORING (HF):** The HF network complements the agency’s routine monthly or bimonthly bacteria monitoring[[3]](#footnote-3) by allowing DEQ to collect data to conduct water quality assessments for the recreation designated use at approximately 100 sites total, with approximately 50 sites expected to be sampled each year. DEQ’s bacteria monitoring plan does not provide a real-time indication of swimming conditions for the public.

**MERCURY (HG)** The mercury special study program is a result of a settlement between the Commonwealth and the responsible parties contributing to mercury contamination associated with the Waynesboro DuPont Plant. The settlement set forth a 100 year study to determine the fate, transport and effects of mercury contamination in the Shenandoah River, the South Fork of the Shenandoah River, the South River, the North River, and associated tributaries.

**IMPLEMENTATION MONITORING (IM)** Post-TMDL implementation monitoring (IM) to track the progress of TMDL efforts following installation of best management practices and other controls on pollution sources.

**INCIDENT RESPONSE (IR)** Incident response (IR) samples may be collected as a result of a pollution complaint, and may be collected when a pollution event involves pollutants **other** **than petroleum** or petroleum products.

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

**POTOMAC EMBAYMENT (PE)** The Potomac Embayment special study was conducted in 2017 and 2019 only, and was targeted at the shallow waters of Pohick Creek (Pohick Bay & Gunston Cove) tidal embayments, Occoquan River (Belmont Bay), Dogue Creek, Neabsco Creek, Chopawamsic Creek, Quantico Creek, Aquia Creek, and Potomac Creek using continuous monitoring.

**QUALITY CONTROL (QA)** The quality assurance program is a component of each of the individual programs and varies in the number and types of quality control samples produced. Generally between two and ten percent of the samples collected in the field have associated quality control samples. These include field replicate samples, field blanks and standard reference material.

**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: <https://www.deq.virginia.gov/water/water-quality/monitoring/biological-monitoring>.

**RESERVOIR MONITORING (RL)** The reservoir monitoring program targets Virginia’s largest lakes and others by prioritizing the significance based on several criteria. Generally the largest lakes are sampled every year, and the others are sampled based on a rotating schedule.

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

**TMDL (TM)** Total maximum daily load monitoring stations are associated with the development of a TMDL or other non-TMDL approach, and/or a TMDL implementation plan for segments listed on the 303(d) list of impaired waters (not meeting water quality standards for designated uses), which indicate the segments that need a cleanup plan.

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

**ALGAE** **(AL)** Filamentous algae monitoring methods were developed and tested in 2016 and 2017. Monthly monitoring of filamentous algae (from May through October) continues in segments of the Shenandoah River basin.

**Data Summary**

Between January 2015 and December 2020 DEQ staff collected multiple samples at 3,420 water quality monitoring stations. From these stations, the number of independent observations for the common field measurements was 105,310 for temperature, 88,392 for pH, 89,425 for specific conductance, and 105,003 for dissolved oxygen. These samples were analyzed for a variety of physical and chemical constituents including nutrients (Nitrogen and Phosphorus N=80,688), bacteria (E.Coli and Enterococci N=52,626), metals (N=16,103), chlorophyll (N=9,458), solids (N=22,287), where N equals the number of total reported analytes.

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 Plan](https://www.deq.virginia.gov/water/water-quality/monitoring/water-quality-monitoring-plan).

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.

**Contact:** For further information visit the [Water Quality Monitoring Program](https://www.deq.virginia.gov/water/water-quality/monitoring) webpage.

# CHAPTER 3.1. CHESAPEAKE BAY MONITORING PROGRAMS IN VIRGINIA

The Virginia Chesapeake Bay Program is an ongoing water quality-monitoring program initially implemented by the Commonwealth of Virginia and its contractors in the summer of 1988 as one component of the overall Federal-Interstate Chesapeake Bay Monitoring Program (CBMP) operating Bay-wide. In Virginia, monitoring is conducted by the Virginia Department of Environmental Quality (DEQ), Old Dominion University (ODU), the U.S. Geological Survey (USGS) and the Virginia Institute of Marine Science (VIMS). In addition to monitoring for water quality, the CBMP includes long-term monitoring phytoplankton communities, benthic communities, and submerged aquatic vegetation as well as occasional special monitoring for such things as pathogens, sediment toxics or sediment nutrient fluxes. This comprehensive and coordinated monitoring of basic environmental aspects of the Bay provides extensive information for understanding important ecological inter-relationships. This understanding provides a sound scientific basis for support and development of environmental management actions within the Chesapeake Bay Watershed.

Data collected by DEQ, ODU, VIMS and USGS under the 117(e) Chesapeake Bay Monitoring Grant are regularly submitted to the Bay Program via the Data Upload and Evaluation Tool (DUET), a program designed to ensure the quality assurance and completeness goals of the Bay Program are met. Data are available to the public via the Chesapeake Bay Program’s website: <https://www.chesapeakebay.net/what/data>.

The Objectives of the CBMP are to:

1) Classify current physicochemical and living resource conditions in the Bay and Tributaries based on defined geographical areas categorized by salinity within the Bay (i.e. Polyhaline, Mesohaline, Tidal Fresh segments). Segments are also characterized in relation to water quality criteria developed by the CBMP such as submerged aquatic vegetation habitat goals and living resources habitat dissolved oxygen goals.

2) Assess ambient water quality conditions against pre-defined State water quality standards and criteria for parameters such as dissolved oxygen, pH, temperature, and ammonia.

3) Characterize long-term temporal and spatial trends. Long-term temporal trends are examined in order to assess the overall success of Bay restoration actions as specified in Watershed Implementation Plan goals (WIPs), and characterizations of spatial patterns are used as a factor to prioritize watersheds which may need more extensive restoration efforts than others.

**Chesapeake Bay Mainstem Water Quality Monitoring Program**

The design of the long-term Chesapeake Bay Mainstem Water Quality Monitoring Program is described in Appendix E of "Chesapeake Bay: A framework for action" (Chesapeake Bay Program (CBP). 1983b. Chesapeake Bay: A framework for action. Main document and Appendices. US Environmental Protection Agency (EPA), Philadelphia, PA). The Virginia Mainstem Monitoring Program is currently conducted by ODU and consists of 27 sites located from the mouth of the Chesapeake Bay to the Eastern Shore’s Pocomoke Sound. Sampling occurs monthly throughout the year except in June and August when sampling occurs twice monthly. Whenever possible, sampling is coordinated with the Maryland mainstem monitoring schedule to provide a synoptic picture of the Bay.

**Chesapeake Bay Living Resources Monitoring Program**

The Mainstem Monitoring also contains a living resource component that monitors phytoplankton and benthic organisms. Currently, Virginia only assesses the benthic component of the living resource 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. In Virginia, 21 fixed‑point stations are sampled for benthos one time per year (September) and 100 probabilistic sites are sampled once per year over the course of the summer.

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.

All data collected by ODU for DEQ’s Chesapeake Bay Program are available through the Chesapeake Bay Program Database: https://www.chesapeakebay.net/what/data

**Shallow Water Monitoring Program**

The near shore monitoring component was initiated as a cooperative agreement with the Virginia Institute of Marine Science (VIMS) in 2003 and consists of the deployment of continuous monitoring devices and data flow cruises that track throughout a select tributary or Bay segment in the polyhaline, oligohaline and mesohaline portions of Virginia’s Chesapeake Bay tributaries or segments of the mainstem from April through September of each year. The program was designed to rotate through Virginia’s major tributaries and Bay mainstem segments on a three year basis. The York and James systems were sampled 2006 - 2008, the Rappahannock and Potomac systems 2007 - 2009, the upper mainstem segments 2010-2015, the polyhaline segments of the Eastern Shore and tributaries 2016-2018, and the Lynnhaven River, Thalia Creek and the lower Chesapeake Bay polyhaline segment CB8PH were sampled in 2019- 2021.

All data collected for the Virginia Shallow water monitoring program may be found on the VIMS Virginia Estuarine and Coastal Observing (VECOS) website: <http://vecos.vims.edu/>.

Some aspects of continuous monitoring and dataflow are conducted through other non-CBP efforts (e.g. by Hampton Roads Sanitation District (HRSD), and National Estuarine Research Reserve (NERRS)) not described here. The data generated by these efforts is also available on the VECOS website and used by DEQ for assessment when available.

**Non-tidal Network**

The River Input Monitoring Program (RIM) was initiated in Virginia on July 1, 1988, to characterize the status and trends of nutrients and sediment loads to the Bay from the non-tidal watersheds of the major Bay tributaries. The program initially consisted of routine, monthly monitoring and storm events at one site at each of the Fall Lines of the James, Rappahannock, Appomattox, Mattaponi and Pamunkey Rivers. Since that time the non-tidal monitoring program has been expanded to include sites beyond just the fall-line stations in the North and South Forks of the Shenandoah River, the North Anna River, the Chickahominy River, the Rapidan River, the Smith River, and Rivanna River. In 2012, USGS began targeted storm sampling at sites already monitored routinely on the Appomattox, Rappahannock and Mattaponi Rivers and implemented a new site for routine and storm sampling on Polecat Creek for a total of 36 sites in Virginia.

Site selection for the non-tidal network are based on: 1) location to the outlet of rivers draining the Tributary Strategy Basin; 2) locations delivering the largest amounts of nutrients and sediment to the Chesapeake Bay or its tributaries; and, 3) importance to watershed modeling efforts for closing areas of large data gaps such as in the area of the Coastal Plain. USGS utilize these data to run status and trends through a Weighted Regression on Time, Discharge, and Season (WRTDS) as developed by Hirsch et al. and Moyer et al.2

USGS results for the WRTDS modeling are available on their Chesapeake Bay Webpage:<https://cbrim.er.usgs.gov/>.

# CHAPTER 3.2. 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. One 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](https://www.epa.gov/beach-tech/national-list-beaches)” was originally published by the U.S. EPA in 2004, and most recently updated in 2012. 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…”.

[Virginia’s BEACH Monitoring Program](https://www.vdh.virginia.gov/waterborne-hazards-control/beach-monitoring/) was initiated in 2002 by the Waterborne Hazards Control Programs of the Virginia Department of Health (VDH). In addition to the immediate reporting and public notification requirements relative to swimming advisories, results obtained by the VDH are communicated to DEQ for inclusion in the agency’s biennial IR. 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 2022 Assessment Guidance Manual for the IR.

The BEACH Monitoring Program in Virginia is designed to provide seasonal monitoring of coastal and Chesapeake Bay beaches within the Commonwealth. A public bathing beach is defined by the Public Beach Conservation and Development Act (Code of Virginia, Title 10.1, §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, 47 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, these beaches were being monitored by the BEACH Program [VDH Beach Monitoring](https://www.vdh.virginia.gov/waterborne-hazards-control/beach-monitoring/). Currently, 45 beach sites in Virginia are monitored by the BEACH Program. 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, and Newport News, as well as the counties of Mathews, York, King George, Gloucester, Northampton, and Accomack.

## Purpose

The purpose of the program is to monitor for indicators of fecal contamination of coastal beaches in an effort to reduce the risk of swimmers contracting disease or infection.

## Monitoring Design and Station Siting

The number of sampling stations at a beach is based on EPA guidance available at the following website: [EPA guidance for establishing number of BEACH sampling stations](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 placed under advisory independently. In summary, the current list of responsible health districts and beaches includes:

Rappahannock Health District (King George County, Fairview Beach) - 1 beach

Peninsula Health District (Newport News, York County/Yorktown) - 5 beaches

Hampton City Department of Health - 3 beaches

Norfolk Department of Public Health - 10 beaches

Virginia Beach - 22 beaches

Three Rivers Health District (Gloucester, Mathews) - 2 beaches

Eastern Shore Health District (Accomack, Northampton) - 5 beaches

Total = 48 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 at the same beach may be united into a single arithmetic average for comparison with the Beach Action Value 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 sampling sites, historical results, and swimming advisories, may be found on the [VDH BEACH Monitoring website](https://www.vdh.virginia.gov/waterborne-hazards-control/beach-monitoring/). Beach monitoring and notification results are exported from the Beach Monitoring and Notification (BMAN) database weekly during the season and posted to the website [Monitoring And Advisory Data By Year](https://www.vdh.virginia.gov/waterborne-hazards-control/statistics/). Data for prior years may also be reviewed on this page.

## Frequency

Beaches are sampled for fecal 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 0.3 meters below the surface in knee-deep water. VDH’s 2021 Quality Assurance Project Plan provides general guidelines for sampling procedures. Samples are placed on 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 due to weather conditions (e.g., heavy storm drain overflow), the beach is placed under a beach warning and electronic notifications are issued to indicate sampling and results will not be available to the public for that particular week. Samples are collected and transported in the same way at all sites. All samples are grab samples, using sterile bottles that are supplied by the laboratory performing analysis.

## Duration

Beach monitoring sites are considered permanent, fixed sites of the VDH BEACH Monitoring and Notification 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 fecal indicator organism used for estuarine and marine beaches are bacteria of the genus Enterococcus. Laboratory analysis of enterococci in beach water samples is conducted using EPA approved methods. Additional measurements of air and water temperature, turbidity, dissolved oxygen, pH and salinity are also taken at beach sites during each visit.

## Quality Assurance

VDH’s Quality Assurance Project Plan was updated and approved by EPA in May 2017. Sampling methods are based on sections 9060 and 9060B of Standard Methods for the Examination of Water and Wastewater (APHA 2012). Standard procedures for laboratory analyses of water samples for enterococci are produced by the laboratories performing the service and are also included in the Quality Assurance Project Plan. A draft version of this plan was provided to EPA in 2021 with the final update pending for 2022.

Annual training is provided for all field personnel and their supervisors. Training consists of sample collection and handling, data management, results interpretation, operation and calibration of equipment, and current program issues, updates, and quality assurance objectives.

## Data Management

VDH receives weekly results from laboratories by email, fax, and/or conventional mail. Timely data submission is emphasized so that the VDH BEACH Monitoring website can be updated as soon as results are available. Timely data submission is mostly critical when exceedances of the Water Quality Standard occur and swimming advisories need to be issued. Upon receipt of results, VDH local health district staff enters laboratory results into a VDH database. When results are entered, swimming advisories are posted on VDH’s Beach Advisory Map and Twitter @VDHBeach for public notification.

Data are annually sent to EPA, via CDX for STORET, in an XML schema utilizing formats specified in [EPA’s Beach Monitoring Data User Guide](https://www.epa.gov/beach-tech/submitting-beach-data-epa).

## Data Analysis/Assessment

## *Swimming advisories*

During the 2022 assessment period, VDH compared beach water sample results with the Beach Action Value (BAV) for enterococci. The results from several simultaneously collected samples at the same beach may be united into a single arithmetic average for comparison with the BAV, and for subsequent evaluation for issuing swimming advisories. The BAV for enterococci is 104 most probable number (MPN)/100ml. Sample results equal to or greater than 104 are placed under a swimming advisory. One sample exceedance of the BAV is sufficient to issue a swimming advisory. Additional information regarding the VDH BAV is available at <https://law.lis.virginia.gov/admincode/title12/agency5/chapter135/>.

If there is an exceedance of the BAV, the beach is posted with a swimming advisory sign and procedures for contacting the locality where the beach is located are followed. A press release is issued locally to notify the public, and a follow-up water sample is collected and delivered to the lab as soon as possible. Procedures for this process are documented in the VDH’s Quality Assurance Project Plan.

***305(b)/303(d) Assessment and Reporting***

As previously stated, 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 2022 Assessment Guidance Manual for the Integrated 305(b)/303(d) Report.

## Reporting

If sample results exceed the BAV, the beach is posted with a swimming advisory sign, the public is notified through press releases to local newspapers, and an advisory is posted on the VDH [Beach Advisory Map](http://www.vdh.virginia.gov/environmental-epidemiology/beach-monitoring/swimming-advisories-and-monitored-beaches-map/) and on the @VDHBeach Twitter page.

Sample results and public notification data are submitted to EPA annually as required. Data collected by the BEACH Monitoring Program are available to DEQ for use in the agency’s biennial Integrated 305(b)/303(d) Report via STORET (EPA database).

## Programmatic Evaluation

VDH participates in monthly conference calls and annual meetings with EPA to review the BEACH Monitoring Program in Virginia. The 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 is routine communication between the Division of Shellfish Safety and Waterborne Hazards and the participating health districts, and weekly reviews of data from each participating health district are performed by VDH’s BEACH Coordinator and support staff.

## General Support and Infrastructure Planning

The BEACH Monitoring Program is a federally funded program. Yearly budgets are prepared in advance to meet proposal submission deadlines established by EPA. 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 and Notification Program visit: <https://www.vdh.virginia.gov/waterborne-hazards-control/>

# CHAPTER 3.3. Citizen and OUTSIDE-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.

DEQ currently has contacts with over 200 citizen and other monitoring organizations. During this 2022 assessment cycle (data from 2015-2020), DEQ received data from 80 citizen monitoring groups, representing 1,655 monitoring locations. The agency also received data from 18 local, state and federal government organizations external to DEQ (referred to hereafter as outside agencies). Data submitted by outside agencies represented an additional 491 sites. The 2146 monitoring sites sampled by citizen and outside-agency groups were distributed across the entire state (Figure 3.3-1).

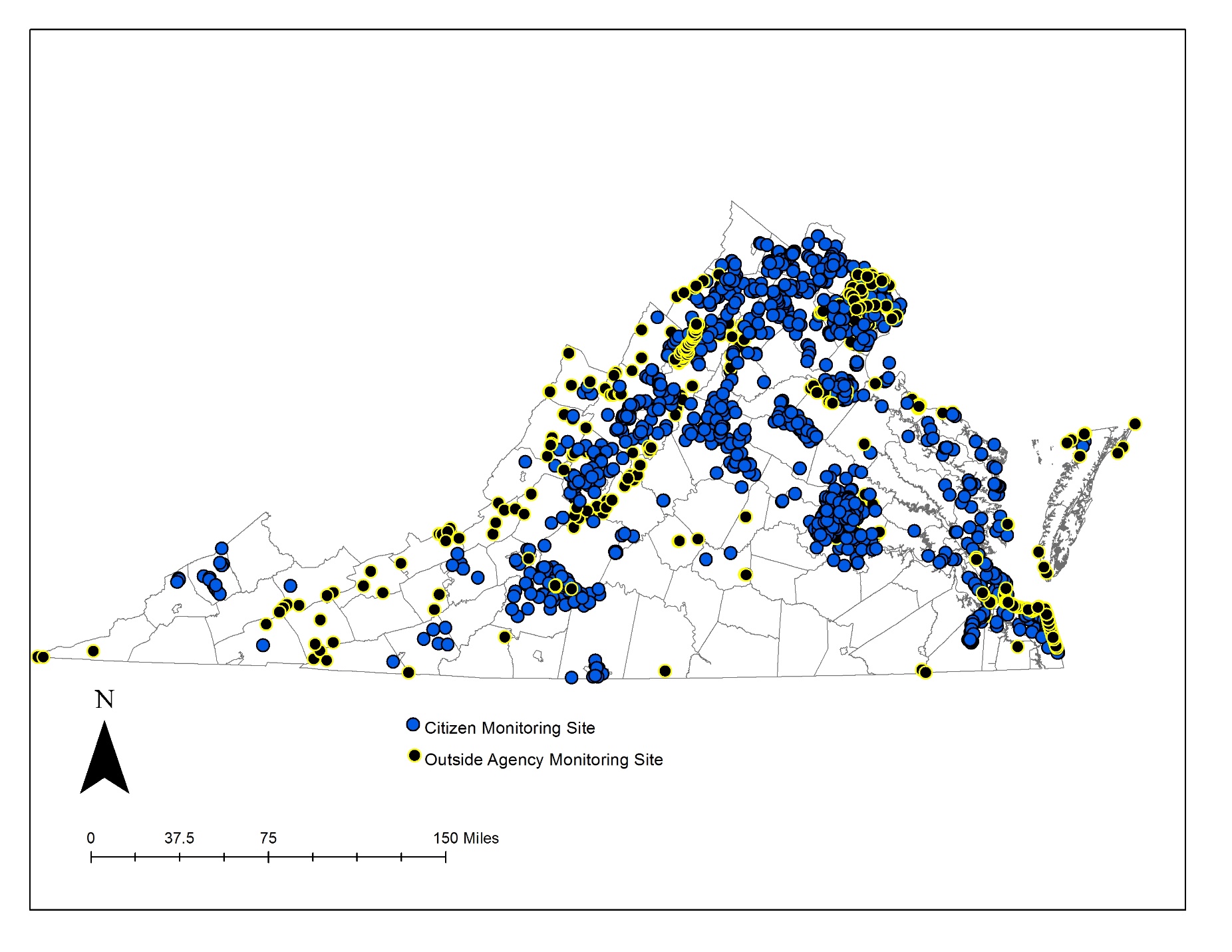


Figure 3.3-1: Citizen and outside-agency monitoring sites represented by data submitted for the 2022 Integrated Report.

**Quality Assurance and data submission requirements**

The majority of data submitted in this assessment cycle were collected under documented protocols, standard operating procedures, and using methods as approved or recognized by DEQ for water quality assessment. Such datasets met Level II or Level III QA/QC criteria, as described below and in Table 1. Data collected using unconfirmed protocols (Level I data) or where sampling occurred on waters not publically accessible, such as on private lakes are not used by DEQ for assessment, however they may be useful to the agency to help prioritize future monitoring and restoration work. Additional information on how submitted data was assessed is available in the 2022 Water Quality Assessment Guidance Manual: <https://www.deq.virginia.gov/water/water-quality/assessments/wqa-guidance-manual>.

In order to assist citizen water quality monitoring groups with developing their monitoring programs, the agency developed the Virginia Citizen Water Quality Monitoring Methods Manual. The manual provides guidance on acceptable QA/QC procedures and protocols. In addition to adhering to the procedures described in the manual and in this section, a data use authorization form must be submitted at the same time, or before data are submitted to DEQ, and data format requirements must be followed. The Virginia Citizen Water Quality Monitoring Methods Manual, as well as further information on QAQC procedures and data submission requirements are available at the citizen monitoring page of the DEQ website: <https://www.deq.virginia.gov/water/water-quality/monitoring/citizen-monitoring>.

In Virginia, the Department of Environmental Quality (DEQ) has developed three levels of data quality for citizen and other non-DEQ water quality monitoring data based upon both the level of data quality and the authorized uses of the data provided to the agency. In addition to agency needs, collected data may also be used to educate the community, to assist local governments in land use planning, to supplement data for university and professional studies, and to assist local soil and water conservation districts in prioritizing watershed work for best management practices. Data levels assigned by DEQ may be used by others to evaluate whether a given dataset is appropriate to meet project objectives. The 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** | **Appropriate Data Uses** | **QA/QC Protocols** |
| III | * List or delist waters on the 303(d) Impaired waters list * Assess waters for 305(b) Report * Use with DEQ data for TMDL development * All uses listed in Levels I and II | * DEQ-approved Quality Assurance Project Plan (QAPP) and field or lab Standard Operating Procedures (SOP). * Field and/or laboratory audit required. * Group provides calibration and quality control associated information to DEQ when submitting data. This information must meet the specific criteria stated in the QAPP. |
| II | * Identify waters for DEQ follow up monitoring * Track performance of TMDL implementation * All uses listed in Level I | * DEQ-approved Quality Assurance Project Plan and approved field or lab SOPs. * Field and lab audits quality control information may not be required. * At this level, there may be deviation from an approved method if it can be demonstrated that the method collects data of similar quality to an approved method. |
| I | * Education * Baseline Conditions * Notification of Possible Pollution Events * Local Land Use Decisions * Special Studies | * No Quality Assurance Project Plan (QAPP) or SOP required by DEQ. * Uniform methodology recommended. * QAPP, SOPs and/or lab methods do not meet DEQ quality assurance/quality control requirements or, * There is no Virginia Water Quality Standard for the parameter\*. |

Table 3.3-1: Quality assurance and quality control criteria for citizen and outside-agency data.

**\*** Virginia does not have water quality standards for several commonly monitored parameters (e.g. nutrients in freshwater streams, specific conductance and others). Data on parameters for which there is no standard may be used as Level II if used for Agency business that does not require a standard (e.g. tracking the progress of water quality cleanup efforts). Information about Virginia Water Quality Standards is available at: <https://www.deq.virginia.gov/water/water-quality/water-quality-standards>.

**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 November 2015, 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 110 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](https://law.lis.virginia.gov/vacode/title62.1/chapter3.1/section62.1-44.19:11/)). 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 when 3,499.45 stream miles were monitored.

For the 2022 assessment report cycle (data from 2015-2020), DEQ received citizen monitoring data from 1,655 monitoring sites and 26,460 sampling events (i.e. separate site visits for monitoring). Data from these sampling events were used to assess 3,174 miles of non-tidal freshwater streams, 64 square miles of tidal estuaries, and 33,347 acres of lakes (Table 3.3-2). Data were submitted from 80 citizen monitoring groups across the Commonwealth for the current assessment cycle (Table 3.3-3).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Group Type | Integrated Report Year | Monitoring Years | Stations Submitted | Sampling Events | Stream Miles | Estuary Square Miles | Lake Acres |
| Citizen Organizations | 2020 | 2013-2018 | 1,619 | 30,426 | 3,174 | 39 | 21,889 |
| Outside Agencies | 2020 | 2013-2018 | 1,048 | 14,587 | 1,663 | 338 | 10,357 |
|  |  |  |  |  |  |  |  |
| Citizen Organizations | 2022 | 2015-2020 | 1,655 | 26,460 | 3,887 | 64 | 33,347 |
| Outside Agencies | 2022 | 2015-2020 | 1,113 | 11,688 | 1,049 | 193 | 4,925 |

Table 3.3-2: Summary of data submissions by citizen organizations and outside agencies. Note: results for outside agencies differ from those in previous reports because this report includes Virginia Department of Health Shellfish Safety Data, which were excluded in past summaries (although these data were used in previous assessments).

| Citizen Monitoring Groups | | |
| --- | --- | --- |
| Alliance for the Chesapeake Bay | Green Aquia | Northern Virginia Trout Unlimited |
| Back Bay Restoration Foundation | Hampton Clean City Commission | Northern Virginia Community College |
| Beagle Ridge Master Naturalists | Hanover Caroline SWCD | Ocean Lakes Monitors |
| Caledon State Park | Henrico Area Water Quality Samplers | Peninsula Chapter Virginia Master Naturalists |
| Cedar Creek area monitors | Hickory Creek Team | Piedmont Environmental Council |
| Chesapeake Bay Foundation | Historic Rivers Master Naturalists | Pocahontas State Park |
| Chesapeake Bay Governor's School | James City County | Poquoson Citizens for the Environment |
| Chesapeake Beach Civic League | James River Association | Potomac Riverkeeper |
| Chesterfield Public Schools | James River Master Naturalists | Prince William Soil and Water Conservation District |
| Chesterfield WaterTrends | John Marshall SWCD | Randolph Macon College |
| Chincoteague Field Station | Jumping Run Team | Rappahannock Chapter IWLA |
| Christiansburg/Montgomery Chapter IWLA | Lake Anna Civic Association | Reedy Creek Coalition |
| City of Suffolk | Leesville Lake Association | Reston Association |
| Clean Valley Council | Lewis Ginter Botanical Gardens | Rivanna Conservation Alliance |
| Cowpasture River Preservation Association | Loudoun Wildlife Conservancy | Riverine Master Naturalists |
| Culpeper SWCD | Lynnhaven River Now | Rockbridge Water Monitors |

|  |  |  |
| --- | --- | --- |
|  | Citizen Monitoring Groups |  |
| Dan River Basin Association | Maury River Monitors | Shenandoah University |
| Ferrum College Stream Team | Maymont Foundation | Smith Mountain Lake Association |
| Franklin County High School | McClure River Restoration Project | Southeast CARE Coalition |
| Fredericksburg Area Monitoring for the Environment | Mentoring Young Scientists | SurfRider Foundation |
| Friends of Accotink | Middle Peninsula Master Naturalists | Timberlake Homeowners Association |
| Friends of Middle River | Nansemond River Preservation Alliance | Trantwood Lake Corporation |
| Friends of the Rappahannock | Natural Bridge Monitors | Virginia Aquarium and Marine Science Center |
| Friends of the Shenandoah River | New River Conservancy | Virginia Save Our Streams |
| G2 Associates | New River Valley Master Naturalists |  |
| George Mason High School | Northern Neck Master Naturalists |  |
| Goose Creek Association | Northern Neck SWCD |  |
| Great Neck Lake Association | Northern Virginia SWCD |  |

Table 3.3-3: List of 80 groups that submitted data for the 2022 report cycle (data from 2015-2020).

SWCD: Soil and Water Conservation District, IWLA: Isaac Walton League of America.

**Outside Agency Monitoring**

By broadening the scope of our data solicitation beyond citizen monitoring, DEQ is receiving water quality data from an expanding pool of government, private industry, and other non-citizen, professional organizations (referred to here as outside agencies)). 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 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 2022 assessment report comes from various federal, state, and local government agencies and select academic institutions.

For the 2022 assessment report (data from years 2015-2020), DEQ received data representing 491 monitoring sites and 11,066 sampling events collected by outside agencies. Data from these sampling events were used to assess 1,049 miles of non-tidal freshwater streams, 193 square miles of tidal estuaries, and 4,925 acres of lakes (Table 3.3-2). A total of 19 outside agencies submitted data for the 2022 report (Table 3.3-4).

|  |  |
| --- | --- |
| Outside Agencies | |
| Virginia Dept. of Conservation and Recreation Beach Program | Maryland Dept. of the Environment Shellfish Data |
| North Carolina Dept. of Environmental Quality | National Park Service -George Washington National Birthplace Monument |
| NPS Booker T. Washington National Monument Water Quality | NPS Appomattox Court House National Historical Park Water Quality |
| United States Geological Survey | NPS Richmond National Battlefield Park water quality |
| University of Virginia Trout Sensitivity Study | Tennessee Dept. of Environment and Conservation Division of Water Resources |
| National Park Service Water Resources Division | City of Suffolk |
| NPS Fredericksburg & Spotsylvania National Military Park | Maryland Department of the Environment Beaches Data |
| Occoquan Watershed Monitoring Laboratory | The Conservation Fund Freshwater Institute |
| Virginia Dept. of Health Beach Program  Virginia Dept. of Health Division of Shellfish Safety | United States Forestry Service |

Table 3.3-4: Outside agency organizations that submitted data for the 2022 report cycle (data from 2015-2020). NPS: National Parks Service.

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

DEQ is continuously working to provide opportunities for community involvement in water monitoring and in the water quality assessment process. For information on conducting water monitoring, submitting data to the agency, receiving agency funding for monitoring or recommending waters for monitoring by DEQ, please visit our citizen monitoring webpage: <https://www.deq.virginia.gov/water/water-quality/monitoring/citizen-monitoring>.

Through ongoing efforts, DEQ is able to utilize data that were previously unavailable or unknown to the agency. DEQ values the contributions of outside agency monitoring staff and citizen volunteers and will continue to support their monitoring efforts however possible. With assistance from these organizations, DEQ continues to increase the monitoring coverage in Virginia.

1. DEQ’s Water Quality Monitoring Strategy. Chapter 1 of the WQM Strategy includes more information on the objectives referenced in the text. Water monitoring is conducted and prioritized based on available resources. [↑](#footnote-ref-1)
2. Hirsh, R.M., Moyer, D.L., and Archfield, S.A., 2010, Weighted regression on time, discharge, and season (WRTDS); and, Moyer, D.L. Hirsh, R.M. and Hyer, K.E. 2012, Comparison of two regression-based approaches for determining nutrient and sediment fluxes and trends in the Chesapeake Bay watershed: U.S. Geological Survey Scientific Investigations Report 2012-5233, 118p. [↑](#footnote-ref-2)
3. Bacteria data is collected on a monthly or bimonthly basis at more than 800 monitoring stations per year as part of DEQ’s Ambient (AW), Trend (TR), TMDL (TM), Implementation (IM), and Chesapeake Bay (CB, BN) monitoring networks. Monthly or bimonthly data supports watershed modeling efforts, allows staff to calculate long-term trends, and is useful for tracking water quality improvements following implementation efforts. [↑](#footnote-ref-3)