

CHAPTER 4 SURFACE WATER QUALITY ASSESSMENT

Virginia's waters are well-known and beloved features of the state. The New River in the southwestern region of the state is considered, despite its name, to be the oldest river in North America. The famous folk song *Oh Shenandoah* refers to the Shenandoah River that runs through northwestern Virginia. The largest river in the state—the James—is considered “America’s Founding River”, carrying the early Jamestown settlers. Virginia Beach is a favorite destination during the summer. The Chesapeake Bay, the largest estuary in the United States, continues to delight visitors with its natural beauty, recreational opportunities, history, and seafood. Virginia’s surface waters are very important to the state’s welfare, economically as well as culturally, and for this reason it is crucial to characterize this resource with as much accuracy as possible.

The following chapter begins by describing how DEQ accomplishes this. Results of the 2012 assessment, broken down by region, are then provided and discussed. This chapter ends with the results of DEQ’s trend analyses, an overall “snapshot” of statewide water quality captured by DEQ’s freshwater probabilistic monitoring, and a summary of near-shore oceanic monitoring conducted during the summer 2010.

CHAPTER 4.1 ASSESSMENT METHODOLOGY

Revisions to the assessment guidance manual have improved assessment methodologies, quality, and consistency. Additionally, the assessment guidance manual provides the public an opportunity to review and comment on the assessment criteria and methodologies used by DEQ to determine designated use attainment. The 2012 draft manual was public-noticed in March 2011, and DEQ received public comments on the updated draft manual through April 2011. DEQ released the final 2012 Assessment Guidance Manual in June 2011.

“Ten Percent Rule”

State and federal law requires DEQ to produce a biennial report on the condition of its waters to Virginia’s citizens and the EPA. The waters are evaluated in terms of whether the appropriate designated uses are met. These primary uses are: 1) wildlife, 2) aquatic life, 3) fish consumption, 4) shellfish harvest, 5) recreation (primary and secondary contact recreation) and 6) public water supply use. There are additional sub-uses associated with the Chesapeake Bay. DEQ employs the “Percent Method” to assess conventional pollutant impacts in waters for two uses: aquatic life use and recreation use.

Previous national guidance recommended that states use an assessment method based on assumptions about the kind and frequency of data needed to support an assessment. The objective of assessment is to determine whether waters are fully supporting or impaired for the designated uses of an assessment unit (AU). A 10.5% exceedence threshold is used for determining full support or impairment for conventional parameters (i.e., dissolved oxygen, pH, and temperature). An exceedence rate that is greater than 10.5% with at least 2 exceedences is considered impaired. This percentage rule is governed by the fact that sampling is associated with unknown equipment and human error, as well as an acknowledgment that designated uses are not impacted by infrequent, short-term exceedences of water quality standards.

In recent years, DEQ has been encouraged to spread its monitoring efforts over more of the state’s waters. To achieve this goal with a fixed monitoring budget, the average collection frequency changed from monthly to bimonthly (every two months). This monitoring frequency has been applied to a rotating watershed scheme with approximately 1/3 of the watersheds being monitored bimonthly for a 2-year cycle with all watersheds being monitored within 6 years. The benefit from this change is that more streams and more stream miles can be assessed. The disadvantage is that the data collected from each station are fewer (12 samples/2 years). The data set has become wide geographically but more shallow in frequency. Additional monitoring program review and possible update stems from the need for additional monitoring data for Total Maximum Daily Load (TMDL) development.

Rubric Used to Assess Support of Designated Uses

Virginia bases its water quality assessment on the ability of the waters to support the associated designated uses. Designated use support is based on the waters meeting the criteria for each use as defined in the numeric and/or narrative water quality standards. The following is a general description of the criteria used to determine the quality of the waters relating to each of the designated uses. A summary is found in Table 4.1-1. Additional information related to the degree of use support can be found at the water quality standards website: <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityStandards.aspx>

1. Not Assessed

Waters with no data for any uses or a single sample (conventional/bacteria parameters only) (Category 3A).

2. Insufficient Information

Waters that have a single exceedence in a small dataset (2-9 samples for conventional/bacteria parameters) are considered insufficient data (Category 3B). Additionally, waters will be classified as insufficient (Category 3B) where professional judgment is not sufficient to determine if a designated use is met. Waters where the data are not QA/QC approved but the data review indicates potential degradation are categorized as insufficient but having observed effects (Category 3C). Waters where the data are not QA/QC approved but the assessment results indicate acceptable water quality will be considered insufficient data with no observed effects (Category 3D). Waters that were previously categorized as fully supporting a designated use (Category 2) will default to Category 3 after two assessment cycles of no new data.

3. Fully Supporting

The following is a description of the types of data and the acceptable criteria used to assess waters as fully supporting designated uses. These waters would be placed in Category 2A or 2C unless all designated uses are fully supporting, upon which the water would be placed in Category 1.

Conventional/Bacteria Parameters:

Waters that are fully supporting their designated uses can have up to 10.5% exceedences of water quality standards for the parameters fecal coliform, *E.coli* or enterococci bacteria (recreation use), and the conventional parameters dissolved oxygen, temperature, nutrients and pH (aquatic life use) without negatively affecting designated uses. Natural variables can cause exceedences of these criteria in the 0-10.5% range and still fully support both aquatic life and recreation designated uses. All data assessed as fully supporting must be QA/QC approved.

Water quality standards (9 VAC 25-260-50) criteria for DO, pH and Temperature do not apply at < 7Q10 flow. 7Q10 is the lowest flow averaged (arithmetic mean) over a period of seven consecutive days that can be statistically expected to occur once every 10 climatic years (a climatic year begins April 1 and ends March 31). Data for these parameters that are from flow conditions below 7Q10 will not be used in the Integrated Report.

Toxic Pollutants:

For toxic pollutant assessment in free-flowing streams, waters where there are one or more samples and no exceedences of aquatic life criteria within a running 3-year period, using grab samples or SPMD data, are considered fully supporting for aquatic life and wildlife use. For public water supply and human health-related criteria in other surface waters, one or more samples and no exceedences during the reporting period, using grab samples or SPMD data, are considered fully supporting for PWS and/or fish consumption use. Additional information on the details of using this approach can be found in Part VI, Section 6.5.3 of the 2012 Assessment Guidance Manual.

For toxic pollutant assessment in estuarine waters, where there are several types of toxic data available, a “weight of evidence” approach has been initiated. Additional information on the details of using this approach can be found in Part VI, Section 6.5.3 of the 2012 Assessment Guidance Manual.

Fish Tissue/Sediment Contamination

Waters with one or more samples, with no exceedences of the fish or fish tissue screening values found in Appendix E-1 or E-2 or sediment screening values (SVs) found in Appendix F of the 2012 Assessment Guidance Manual, are considered fully supporting.

Biological Evaluation:

For free-flowing stream biological community assessment, data for the overall assessment period are rated as not impaired where no biological assemblage (e.g. macro-invertebrates) has been modified beyond the natural range of reference conditions based on the newly adopted Virginia Stream Condition Index (VSCI) or the Coastal Plain Macroinvertebrate Index (CPMI) methodology.

A project to refine the estuarine biological assessment methodology has recently been completed and approved for use by EPA and DEQ. Additional information on this new methodology can be found in Section 6.4.2.3 of the 2012 Assessment Guidance Manual.

Fish Advisories:

Waters where the VDH has not issued any fish advisories or prohibitions.

Shellfish Advisories:

Those growing areas where no restriction or prohibition (condemnation) on shellfish harvesting is imposed as indicated by the Department of Shellfish Sanitation (DSS) summary dated January 2011.

Beach Closures/Advisories:

No VDH beach closures and/or geometric mean exceedences, based on QA/QC approved sampling data, during the assessment period.

Public Water Supply Source Closures:

No VDH public water supply source closures based on sampling data during the assessment period.

4. Fully Supporting but Having an Observed Effect

The following is a description of the types of data and the acceptable criteria used to assess waters as fully supporting but having an observed effect for a designated use(s). It is the intent of the agency to focus additional monitoring resources on the waters that are identified as having an observed effect, based on initial monitoring data analysis. These waters would be placed in the federal Category 2 and the Virginia sub-category 2B.

Conventional Screening Parameters:

Free-flowing waters with 1 or more exceedences for sediment and/or toxicity test are considered fully supporting but having an observed effect for aquatic life use (Category 2B). This designation is deemed appropriate because the causative agent(s) of toxicity of an environmental sample is rarely known. A water with a single geometric mean exceedence for bacteria standards would be considered Category 2B for the recreation use.

Toxic Pollutants:

For toxic pollutant assessment in free-flowing streams, a single exceedence of aquatic life criteria within a 3-year period, using grab samples or SPMD data, is considered fully supporting but having an observed effect for aquatic life and wildlife. For public water supply use or human health criteria in other surface waters, a single exceedence is considered fully supporting but having an observed effect for PWS and fish consumption use.

For toxic pollutant assessment in estuarine waters, where there are several types of toxic data available, a “weight of evidence” approach has been initiated. If no additional toxic data is available, the water would be assessed the same as the free-flowing waters.

Fish Tissue/Sediment Contamination:

Waters with a single exceedence of a water quality standards-based tissue value or tissue screening value found in Appendix E-1 or E-2 from one or more fish tissue or SPMD samples, or an exceedence of a screening value for sediment found in Appendix F of the 2012 Assessment Guidance Manual, are fully supporting but having an observed effect for fish consumption and aquatic life, respectively.

Biological Evaluation:

VSCI or CPMI assessment scores below the impairment threshold but the biologist’s best professional judgment has determined a lack of confidence in the biological survey due to natural conditions is considered fully supporting with observed effects. If impairment was discovered from the last two samples, a documented justification for not assessing as impaired is expected. Another biological assessment should be scheduled to make a final aquatic life use determination for waters assessed as fully supporting but having an observed effect for aquatic life use.

The use of the previous EPA accepted estuarine (B-IBI) biological assessment methodology has been continued for 2012.

Fish Advisories:

A VDH fish consumption advisory, where a general advisory has been issued but fish consumption is not limited, are considered fully supporting but having an observed effect. This would include the kepone advisory for the tidal James River.

Shellfish Advisories:

Those growing areas, as indicated by the DSS summary dated January 2011, that have been classified as conditionally approved (seasonal condemnations) are considered fully supporting but having an observed effect.

Beach Closures/Advisories:

A single geometric mean exceedence and/or one short term (less than one week in duration) beach closure and/or two short term (less than one week in duration) swimming advisories due to bacteria contamination that, based on QA/QC approved data within the 6-year assessment cycle, have a low probability that the pollution will recur (based on best professional judgment) are considered fully supporting with observed effects. Best professional judgment decisions will be based on scientific data indicating the source of the pollution causing the closure/advisory is transient and there are no plans to implement pollution reduction measures or other controls, or documentation shows that mitigation has occurred and the two most recent years of water quality data, subsequent to the mitigation, show an improvement that fully supports the designated use.

Public Water Supply Source Closure:

One short term VDH public water supply source closure during the 6-year assessment cycle with a low probability that the pollution will recur is considered fully supporting but having an observed effect. The source of the pollution is generally transient and there are no VDH plans to implement pollution reduction measures or other controls.

Other Criteria for Waters having Observed Effects

Waters for which “evaluated” data, trend analysis for parameters with no water quality standards but with screening criteria, or other water quality indicators appear to indicate an apparent effect on designated use(s) or a potential for water quality problems are considered to have “observed effects”. Waters can be designated as having observed effects where there is a possible loss of a designated use documented by ancillary data such as fish kills with unknown causes and/or pollution potential documented by non-QA/QC approved non-agency studies or reports. These waters are considered insufficient data with

observed effects (Category 3C). For monitoring purposes, waters with observed effects should be considered in the next regional monitoring plan for additional or continued monitoring during the next reporting period as resources allow.

5. Pollutant Caused Impaired or Threatened Waters Not Needing a TMDL

Impaired or threatened waters not needing a TMDL are listed in the federal Category 4. These are waters that are impaired but an EPA-approved TMDL has been developed and approved by EPA (Category 4A), waters where other pollutant control requirements are reasonably expected to result in attainment of designated use(s) (Category 4B) and waters that are naturally impaired (Category 4C).

6. Pollutant Caused Impaired or Threatened Waters Needing a TMDL

Those waters impaired or threatened by pollutant(s) and needing a TMDL are included in the 303(d) list. These waters are placed in the federal Category 5 (needing a TMDL) and the Virginia sub-categories of 5A, 5B, 5D and possibly 5C and 5E. The following is a description of the types of QA/QC-approved data and the acceptable criteria used to assess waters as impaired or threatened for the designated uses.

Conventional Parameters:

Waters with long-term or chronic pollutant-related problems based on the assessment of monitored data are considered impaired and needing a TMDL. For conventional parameters, at least two exceedences of water quality standards and exceedences >10.5% are considered impaired and needing a TMDL. Additionally, waters with two or more exceedences of a monthly geometric mean analysis are considered impaired. Geometric mean analysis is normally associated with the BEACH monitoring program conducted by VDH but also could be associated with a designed, multiple sample per month, bacteria special study.

Toxic Pollutants:

For toxic pollutant assessment in free-flowing streams, waters where there are two or more exceedences of the same acute aquatic life toxic criteria in a running 3-year period using grab samples or SPMD data are considered impaired for aquatic life use and wildlife use. For public water supply or human health criteria in other surface waters, two or more exceedences of the same criteria within the reporting period using grab samples or SPMD data are considered impaired and needing a TMDL for PWS or fish consumption use.

For toxic pollutant assessment in estuarine waters, where there are several types of toxic data available, a "weight of evidence" approach has been initiated.

Fish Tissue Contamination:

Waters exceeding the same toxic human health criteria-based tissue value (TV), listed in Appendix E-1 of the 2012 Assessment Guidance Manual, two or more times are impaired for fish consumption. For example, the following situations would qualify as impaired under these guidelines :1) two or more tissue samples from different fish species exceeding the same TV during one sampling event; or 2) two or more samples of the same or different species exceeding the same TV from different sampling events within the assessment period.

Biological Data:

For free-flowing waters where the biological community VSCI or CPMI survey data are confirmed to be moderately or severely impaired, are considered impaired and needing a TMDL. Based on professional judgment and/or other supplemental data, a second survey may be required to confirm moderate impairment and pollutant related causes. In this case, the initial assessment would be considered fully supporting but having an observed effect and follow-up monitoring scheduled.

Fish Advisories:

Virginia Department of Health (VDH) fish consumption prohibitions and/or advisories, where fish consumption is specifically limited, are considered evidence of non-attainment of the designated use and are therefore considered impaired and needing a TMDL.

Shellfish Advisories:

Those growing areas, as indicated by the DSS summary dated January 2011, that have been classified as prohibited or restricted (condemnations) based on bacteria data are considered impaired and needing a TMDL. Restricted areas that have been administratively condemned due solely to the presence of a VPDES permitted outfall or administrative closure where no data is available will not be assessed as the shellfish use has been administratively removed.

Beach Closures/Advisories:

Two or more geometric mean exceedences, one or more beach closures of one week or more duration, or two or more swimming advisories of one week or more duration due to bacteria contamination, and, based on QA/QC approved data within the assessment cycle, there is a medium to high probability that the closure/advisory will recur (based on best professional judgment) are considered evidence of impaired recreation use and a TMDL is needed.

Public Water Supply Source Closure:

One or more VDH public water supply source closures within the assessment cycle with a medium to high probability that the pollution will recur indicate non-attainment and a TMDL is needed. There are plans to implement pollution reduction measures or controls.

Chesapeake Bay Aquatic Life

See Chapter 4.4 of this report, or Section 6.4 of the 2012 Assessment Guidance Manual.

Table 4.1-1 Summary of the designated use assessment methodology

Designated Use	Parameter/Data Type	Fully Supporting	Observed Effects (either as supporting or with insufficient data)	Impaired
Aquatic Life Wildlife (toxics only)	Conventional ¹	<ul style="list-style-type: none"> • $n \geq 2$, exceedence rate $\leq 10.5\%$ for field parameters • Median lacustrine TP² below criterion • 90th percentile lacustrine chlorophyll a below criterion 	<ul style="list-style-type: none"> • Evaluated³ data with an exceedence rate $> 10.5\%$ • Single exceedence in small dataset ($n < 10$) 	<ul style="list-style-type: none"> • $n \geq 2$, exceedence rate $> 10.5\%$ for field parameters • Two exceedences in small dataset • Median lacustrine TP above criterion • 90th percentile lacustrine chlorophyll a above criterion
	Biological	Benthic index scores \geq impairment threshold	<ul style="list-style-type: none"> • Evaluated³ data suggest degraded community • Benthic index score conflicts with biologist's best professional judgment 	Benthic index score $<$ impairment threshold
	Toxics	$n \geq 1$, no exceedences	<ul style="list-style-type: none"> • Single water column grab or SPMD⁴ sample exceedence of acute aquatic life use criteria • Single water column grab or SPMD sample exceedence of chronic aquatic life use criteria in a 3-year period • Single sediment toxicity test or screening value 	Two or more grab or SPMD exceedences of the same acute aquatic life criteria in a 3-year period

Designated Use	Parameter/Data Type	Fully Supporting	Observed Effects (either as supporting or with insufficient data)	Impaired
			exceedence (aquatic life only)	
Recreation	Bacteria	<ul style="list-style-type: none"> No geometric mean exceedence $n \geq 2$, exceedence rate $\leq 10.5\%$ 	<ul style="list-style-type: none"> Single geometric mean exceedence Evaluated³ data with exceedence rate $> 10.5\%$ Single exceedence in small dataset ($n < 10$) 	<ul style="list-style-type: none"> Two or more geometric mean exceedences $n \geq 2$, exceedence rate $> 10.5\%$ Two exceedences in small dataset
	VDH notice	No swimming advisory	As single short-term (< 1 week) VDH closure/advisory with low probability of recurrence, based on bacteria data	One or more closure(s) and/or two or more advisories > 1 week duration with medium or high probability of recurrence, based on bacteria data
Shellfishing	VDH notice	Approved shellfish harvest waters	Area classified as "conditionally approved"	Areas classified as "restricted" or "prohibited"—excluding VPDES ⁵ outfalls and administrations closures where no data are available
Fish Consumption	Toxics	No exceedences of fish tissue criteria	<ul style="list-style-type: none"> Single exceedence of a human health criterion using grab sample or SPMD data Single exceedence of a tissue value or tissue screening value 	<ul style="list-style-type: none"> Two or more exceedences of a human health criterion using grab sample or SPMD data Two or more exceedences of a tissue value
	VDH notice	No advisories	A VDH advisory which does not limit consumption is in effect	A VDH advisory or restriction limiting or prohibiting consumption
Public Water Supply	Toxics	$n \geq 1$, no exceedences	A single exceedence of human health criteria using grab or SPMD data	Two or more exceedences of the same human health criteria using grab samples or SPMD data
	VDH notice	No closures	A single VDH closure with low probability of recurrence	One or more closure with medium or high probability of recurrence

¹ Refer to 2012 Assessment Guidance Manual for assessment methodology specific to continuous monitoring data. These methods also do not apply to Chesapeake Bay criteria.

² TP = total phosphorus concentration. Along with lacustrine chlorophyll a, only data from the most recent two years are aggregated.

³ Evaluated data are any Level II data submitted to DEQ. See Chapter 3.5 for more information.

⁴ SPMD = semi-permeable membrane device (an instrument that passively samples ambient toxics over some length of time)

⁵ VPDES = Virginia Pollution Discharge Elimination System

EPA ASSESSMENT CATEGORIES and VIRGINIA SUBCATEGORIES

FULLY SUPPORTING - Waters are supporting one or more designated uses

- EPA Category 1 - Attaining all associated designated uses and no designated use is threatened

Va Category 1A - waters are attaining all uses and a TMDL has been developed for one or more uses.

- EPA Category 2 – Available data and/or other information indicate that some, but not all of the designated uses are supported.

Va. Category 2A - waters are supporting all of the uses for which they are monitored.

Va. Category 2B - waters are of concern to the state but no water quality standard exists for a specific pollutant, or the water exceeds a state screening value or toxicity test.

Va. Category 2C - waters are now attaining the use(s) for which they were originally 303(d) listed and the TMDL is EPA approved but other applicable use(s) were not monitored and assessed.

INDETERMINATE - Waters needing additional information.

- **EPA Category 3** - Insufficient data and/or information to determine whether any designated uses are met.

Va. Category 3A - no data are available within the data window of the current assessment to determine if any designated use is attained and the water was not previously listed as impaired.

Va. Category 3B - some data exists but it is insufficient to determine support of any designated uses. Such waters will be prioritized for follow up monitoring.

Va. Category 3C - data collected by a citizen monitoring or other organization indicate water quality problems may exist but the methodology and/or data quality has not been approved for a determination of support of designated use(s). These waters are considered as having insufficient data with observed effects. Such waters will be prioritized by DEQ for follow up monitoring.

Va. Category 3D - data collected by a citizen monitoring or other organization indicate designated use(s) are being attained but the methodology and/or data quality has not been approved for such a determination.

IMPAIRED - Waters are impaired or threatened but a TMDL is not required.

- **EPA Category 4A** - water is impaired or threatened for one or more designated uses but does not require a TMDL because the TMDL for specific pollutant(s) is complete and US EPA approved.
- **EPA Category 4B** - water is impaired or threatened for one or more designated uses but does not require the development of a TMDL because other pollution control requirements (such as VPDES limits under a compliance schedule) are reasonably expected to result in attainment of the water quality standard by the next reporting period or permit cycle.
- **EPA Category 4C** - water is impaired or threatened for one or more designated uses but does not require a TMDL because the impairment is not caused by a pollutant and/or is determined to be caused by natural conditions.

IMPAIRED - Waters are impaired or threatened and require a TMDL.

- **EPA Category 5** - Waters are impaired or threatened and a TMDL is needed.

Va. Category 5A - a water quality standard is not attained. The water is impaired or threatened for one or more designated uses by a pollutant(s) and requires a TMDL (303d list).

Va. Category 5B - the water quality standard for shellfish use is not attained. One or more pollutants causing impairment require TMDL development.

Va. Category 5C - the water quality standard is not attained due to “suspected” natural conditions. The water is impaired for one or more designated uses by a pollutant(s) and may require a TMDL (303d list). Water quality standards for these waters may be re-evaluated due to the presence of natural conditions.

Va. Category 5D - a water quality standard is not attained where TMDLs for a pollutant(s) have been developed, but one or more pollutants are still causing impairment requiring additional TMDL development.

Va. Category 5E - effluent-limited waters receiving discharges from facilities not expected to meet compliance schedules by next permit cycle or reporting period.

Va. Category 5F - the water quality standard is attained for a pollutant(s) with a TMDL and 303(d) delisting approved, but the water remains impaired for additional pollutant(s) requiring TMDL development.

- **EPA Category 5M** – waters impaired due to atmospheric mercury.