Vermont Surface Water Assessment and Listing Methodology

In accordance with

USEPA Guidance

Prepared by:

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Contents

Executive Summary

The Federal Water Pollution Control Act, also known as the Clean Water Act, requires States to develop and submit to the US Environmental Protection Agency two surface water quality-related documents. The documents, to be prepared every two years, arise out of two sections of the Act. Section 305(b) of the Act requires submittal of a report that describes the quality of the State's surface waters and contains an analysis of the extent to which its waters provide for the protection and propagation of a balanced population of fish, shellfish and wildlife. This analysis is also referred to as the extent to which Vermont's waters achieve the Act's fishable and swimmable goals. The biennial Vermont Water Quality Assessment Report is commonly known as the "305(b) Report."

The second document, developed in response to Section 303(d) of the Act, is a listing of surface waters that:

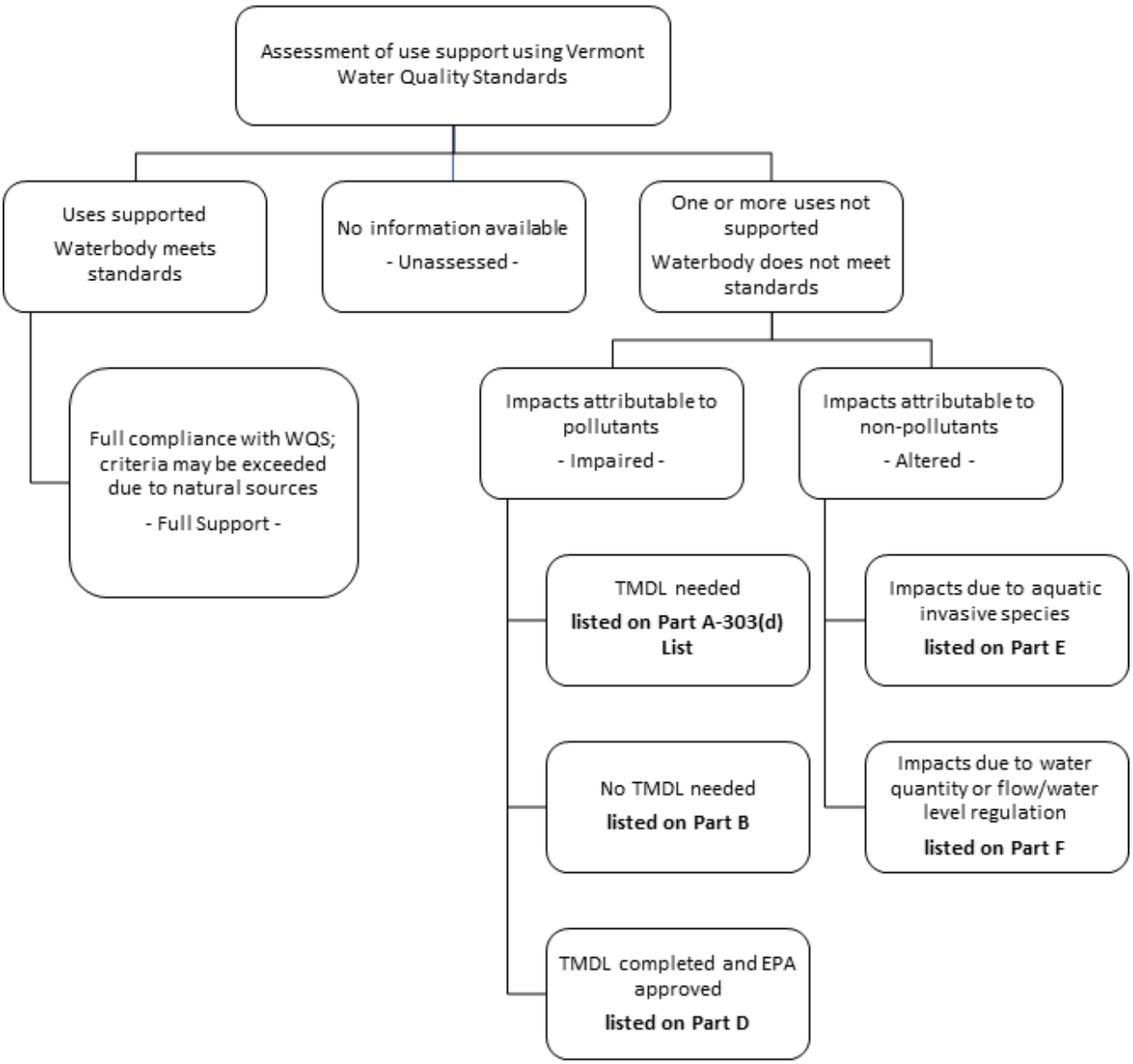
1. are impaired or threatened by one or more pollutants; and,
2. are not expected to meet Water Quality Standards within a reasonable time even after the application of best available technology standards for point sources of pollution or best management practices for nonpoint sources of pollution; and,
3. require development and implementation of a pollutant loading and reduction plan, called a Total Maximum Daily Load, which is designed to achieve Water Quality Standards.

The collection, analysis and evaluation of water quality monitoring data and other information represent the assessment of a water's condition. The assessment of a water is most accurate when judgements about the water's condition are made using chemical, physical, and/or biological data of known reliability collected through monitoring. While not as reliable as data collected though monitoring, an assessment of a water's condition can also consider professional opinion, direct observations, or other qualitative information.

The Vermont Water Quality Standards (VWQS) are promulgated by the Watershed Management Division for the Agency of Natural Resources, and are used in planning, management, and regulatory programs to protect Vermont's surface waters. The VWQS are used in determining the condition of surface waters including whether the water meets (attains) or does not meet (exceeds or violates) certain criteria. The assessment of a water's condition within the context of the VWQS requires consideration of the water's classification, a variety of designated or existing uses, and a series of criteria which can be numerical or narrative. The outcome of an assessment conducted by the Vermont Department of Environmental Conservation (VTDEC) is to categorize Vermont's surface waters as either "full support," "altered," "impaired", or "unassessed". Over time, the Department is gradually reducing the number of waters characterized as "unassessed."

This document describes the process used by the VTDEC when making water quality attainment decisions to fulfill 305(b) reporting and 303(d) listing requirements. The document contains an overview of the Water Quality Standards (Chapter 1); a description of water quality monitoring approaches that are utilized and their linkage to assessment efforts (Chapter 2); the four assessment categories and the factors and decision principles applied when evaluating data and other information to determine if a water meets the Standards (Chapter 3); and, the rationale when deciding where and how to list a particular water (Chapter 4). Figure 1 illustrates the major components of VTDEC's assessment and listing process.

Figure 1. Organization of Vermont's water quality assessment and listing categories



Chapter One. Introduction

The VTDEC is charged with implementing the Vermont Water Quality Standards (VTANR, 2022), which establish goals for the State's waterbodies and provide a regulatory basis for water quality management. The document defines designated uses for Vermont's surface waters (rivers, streams, lakes, and ponds) as well as water quality criteria to protect those uses. The classification of waters as Class A(1), Class B(1), Class A(2), or Class B(2) is also attributed management goals that dictate the appropriate criteria to support designated and existing uses.

To determine whether the State's waters meet the Vermont Water Quality Standards, the Department must characterize the quality of Vermont's surface waters and determine what factors or stressors may be bringing about observed changes. In Vermont and nationwide, significant emphasis is placed on how the condition of surface waters is determined and whether waters comply with the applicable water quality criteria. The methods used for making these determinations are important because whether the waters meet or do not meet the water quality standards informs and directs water quality management strategies for each waterbody and may lead to significant regulatory consequences. It is essential that determinations are accurate and defensible.

The following table serves to indicate applicable designated uses. Chapter Four of this Assessment Methodology describes VTDEC's approach towards assessing the level of support of these designated uses considering the criteria established in the Water Quality Standards.

Table 1. *Designated Uses for Water Classifications.*

Designated Uses	**Class A(1)**	**Class B(1)**	**Class A(2)**	**Class B(2)**
Aquatic Biota and Wildlife	✓	✓	✓	✓
Aquatic Habitat	✓	✓	✓	✓
Aesthetics	✓	✓	✓	✓
Recreation - Boating	✓	✓	✓	✓
Recreation - Fishing	✓	✓	✓	✓
Recreation – Swimming & Other Primary Contact Recreation	✓	✓	✓	✓
Public Water Supplies			✓	✓
Irrigation of Crops & Other Agricultural Uses				✓

Surface water assessment is part science and part careful observation of the causes of the measured conditions. Assessment begins with an examination of the water's chemical, physical and biological condition, and the causality of the conditions observed. Data is used to estimate the Water Quality Standards "attainment status" of waters. Selecting representative data with known and quantifiable precision is the first step in assessing standards attainment. If a waterbody is determined not to attain one

or more criteria of the Vermont Water Quality Standards, it is necessary to determine whether the impact to the surface water is of natural or anthropogenic origin. Identifying the cause of impairment will have considerable bearing on decisions about what approach to initiate to restore the waterbody. The Department also seeks to provide avenues for Vermont's community to contribute in a meaningful way to the protection and improvement of waters.

This document explains how VTDEC carries out surface water quality monitoring and assessment activities and how it makes decisions on a regular basis regarding a water's condition based on the Vermont Water Quality Standards. It also describes how VTDEC considers certain factors and how VTDEC makes decisions when interpreting data and observations obtained through monitoring efforts, whether monitoring information is generated by VTDEC or by others. This document does not describe VTDEC's broad array of monitoring programs, which can be found in Appendix A of the Water Quality Monitoring Program Strategy.

Throughout the Assessment and Listing Methodology document, the terms "waters" and "water resources," are used generically and mean lakes and ponds, perennial streams and rivers, and wetlands. The Department does not conduct or carry out any systematic monitoring on many other types of waterbodies including vernal pools, lakes and ponds less than five acres, or ephemeral or intermittent streams. This Assessment and Listing Methodology document is evolving and reflects the ever-improving methods available for water quality monitoring and interpretation. Vermont's residents, federal and academic collaborators, and others are encouraged to view the Assessment and Listing Methodology with an eye towards where and how they can improve or add to the quality of data and other information used to understand, protect, and improve Vermont's water resources.

Chapter Two. Surface Waters Assessment Methodology

Overview and Data Sources

The assessment process involves identifying, compiling, and evaluating all existing and readily available water quality data and information as well as evident point and nonpoint source pollution impacts on designated and existing uses specific to the basins and waters being assessed in any given year. The data is maintained in EPA's ATTAINS or in databases specifically designed to allow the population of the ADB. Vermont relies on the following sources of reliable data and information when assessing use support:

1. VTDEC Watershed Management Division (monitoring data)
2. VTDEC Water Investment Division (stakeholder and community information)
3. VTDEC Wastewater Management Program (National Point Source Discharge Elimination System permit compliance, residuals management)
4. Drinking Water and Ground Water Protection Division (indirect discharge permit compliance)
5. VTDEC Waste Management and Prevention Division (residuals management, solid and hazardous waste sites monitoring data)
6. VTDEC Laboratory Services at the Vermont Agricultural and Environmental Laboratory (VAEL) (quality assurance, analytical services, pollutant data)
7. Vermont Agency of Natural Resources Enforcement Division (violations of water quality standards)
8. Vermont Department of Fish & Wildlife (data on game fish and temperature, habitat studies)
9. Vermont Department of Health (beach closure information, fish consumption risk assessments)
10. Vermont Department of Forests, Parks, and Recreation (bacteriological testing, beach closure information)
11. Vermont Agency of Agriculture, Food, and Markets (agricultural water quality violations, maintaining Noxious Weeds list)
12. US Department of Agriculture, Natural Resource Conservation Service (agricultural nonpoint sources, locations of pollution abatement projects)
13. Community and community associations (community monitoring data, location of sources, complaints)
14. US Geological Survey Water Resources Division (monitoring and research)
15. US Forest Service (fish habitat and water quality data and information)
16. US Environmental Protection Agency (monitoring and research)
17. US Army Corps of Engineers (environmental assessments of project waters)
18. University of Vermont, Vermont State Colleges System, and other colleges (monitoring and research)

The VTDEC Biomonitoring and Aquatic Studies Section and Rivers Program provide much of the data used in the assessment of monitored river miles. The VTDEC Lakes and Ponds Program provides much of the data used in the assessment of monitored lake acres. The other sources noted above provide fewer and less widespread, but nevertheless important, data.

Monitoring to Collect Assessment Data

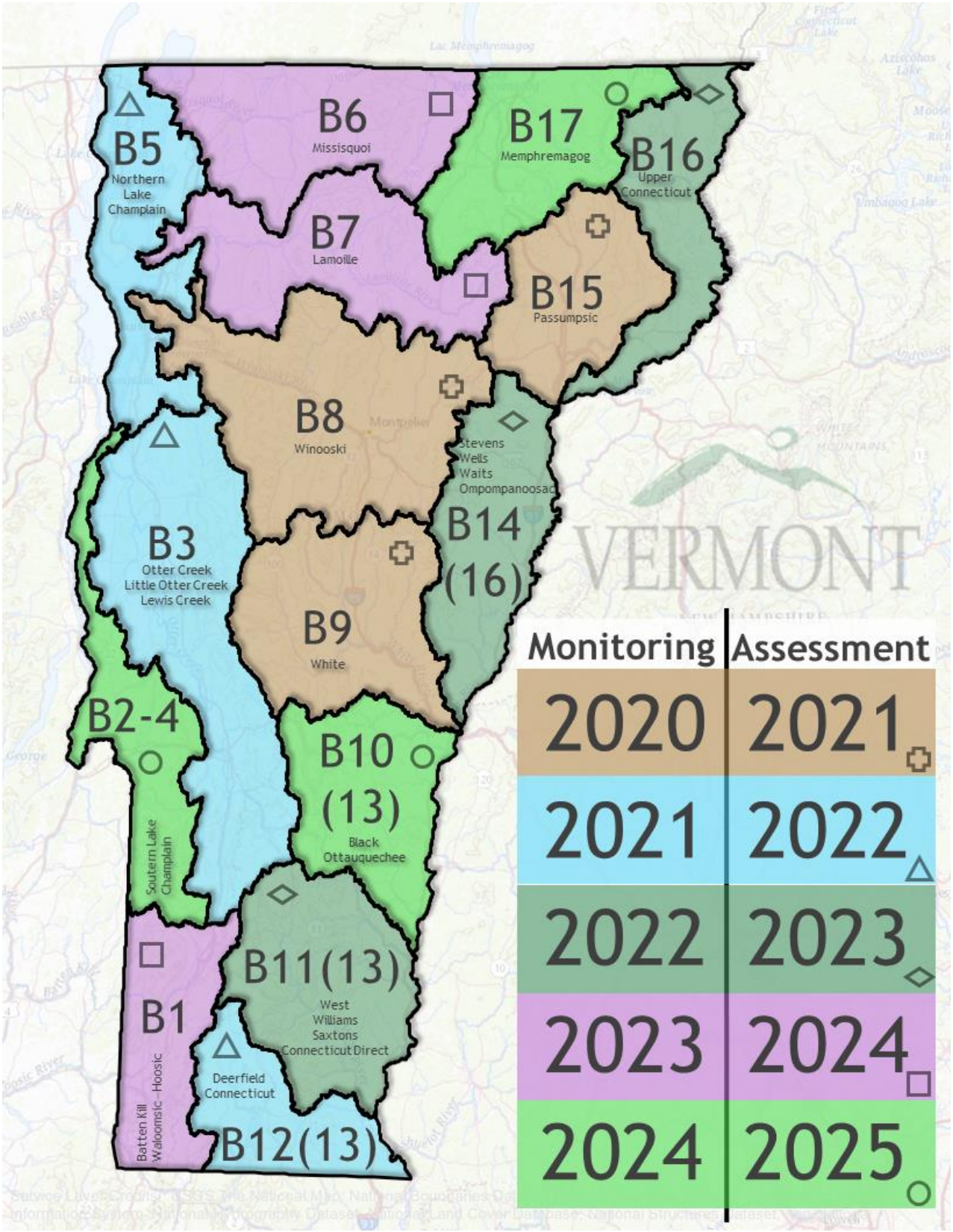
A full description of the Department's monitoring work is provided in the VTDEC Water Quality Monitoring Strategy 2011 - 2020, May 2015. The document contains goals, objectives, and recommendations as well as complete descriptions of the various monitoring and assessment programs in the VTDEC Watershed Management Division. The primary monitoring designs utilized include targeted, probability-based, and

special or TMDL related studies. These monitoring designs are conducted across all waterbody types including lakes, rivers and wetlands assessing the chemical, biological, and physical conditions.

Rotational Watershed Assessment Approach

For the purposes of water quality management planning and implementation, which includes assessing and reporting water quality information, Vermont has been divided into fifteen planning basins. Each major basin has from four to twenty-two watersheds, subwatersheds and river mainstem segments. These sub-watersheds and mainstem river segments and the various lakes and ponds are known as “waterbodies.” There are a total of 208 river and stream waterbodies (37 as mainstem segments) and 574 lake and pond waterbodies designated throughout Vermont. The fifteen major river basins are in one of four large regional drainages: Lake Champlain, Connecticut River, Lake Memphremagog, or Hudson River. The fifteen basins are presented in Figure 2.

Figure 2. Rotational assessment schedule among Vermont's 15 planning basins



To more thoroughly assess the State's surface waters and to take advantage of all existing and readily available sources of water quality information, the VTDEC Watershed Management Division (WSMD) applies a five-year rotational watershed assessment process. By focusing evaluations on selected basins each year, more systematic, intensive, and integrated efforts can be made to collect and evaluate information related to the sources and causes of pollution. The scheduled assessment year for each basin is shown in Figure 2 above.

Under the rotational monitoring and assessment process, VTDEC staff compile and evaluate all water quality and biological data and information, determine impacts to designated and existing uses, and document very high quality waters for particular uses. Once the data and other information for each waterbody in a particular basin is assessed, a Basin Assessment Report (BAR) is prepared. Each BAR presents the latest conditions across waterbody types, any detectable trends, and targeted opportunities for future monitoring.

The information contained in each BAR is also an early and vital piece of the tactical basin planning process conducted by the Watershed Planning Program within the Water Investment Division of VTDEC. One or more assessment reports have been prepared for all the basins and can be viewed on the Assessment and Listing page of the Watershed Management Division's webpage. The basin assessment process has evolved over time, so some of these earlier versions may have slightly differing content than more recent versions.

Biological Monitoring and Assessments

Assessment of biological integrity is conducted in the state's rivers and streams for the purpose of establishment of baseline biological condition, trend detection, classification, evaluation of permitted activities, and site-specific impact evaluation. Macroinvertebrate and/or fish populations of rivers and streams considered to be "wadeable" are assessed by comparing a series of biological metrics measuring community structure and function to numeric indices that represent the biological expectation for the stream type being evaluated. These numeric indices are used to directly interpret the narrative criteria for biota found in the Vermont Water Quality Standards.

The Department implements biocriteria only when appropriate reference conditions have been described. The Department recognizes differences between biological expectations for different types of waterbodies including lakes, ponds, wetlands, streams, and rivers. Management decisions are made accordingly.

VTDEC uses monitoring of fish and macroinvertebrate communities for direct assessment of aquatic biota use attainment in wadeable streams and rivers. To date, biocriteria have not been developed for Vermont's non-wadeable, ephemeral or intermittent streams, or for wetlands or lakes, though indices for lakes are being evaluated utilizing aquatic macrophytes and lake bottom macroinvertebrates. A Vermont led regional lake biomonitoring workgroup continues to pursue the development of biocriteria for lakes.

The methods to determine individual site assessments are outlined in the "Application of Biocriteria for Fish and Macroinvertebrate communities in Vermont Wadeable Streams and Rivers" (VTANR, WQS. 2022, Appendix G). Using the biocriteria procedures, the integrity of the aquatic biota is attributed a rank of "Excellent" to "Poor". Rankings are indicative of aquatic biota use support status for each water quality classification and water management type.

Sampled streams include macroinvertebrate and fish community surveys where possible. Failure of either community to meet criteria indicates that the site/reach does not comply with applicable aquatic biota standards. While information from both assemblages is desirable, an overall biological assessment

declaring support or non-support of aquatic biota uses can be made based on just one community alone. A determination of support or nonsupport is made only when data has been determined to be fully representative of the stream reach under consideration. Approximately 130 river sites are assessed each year in the late summer-early fall (September to October 15) on a five-year rotational watershed basis.

The biological potential for various sites has been established through statewide reference site monitoring. Information from long-term monitoring of reference sites also serves to refine existing biocriteria and detect trends in baseline biological integrity. The long-term goal of reference site monitoring is to gather information on a set of known reference sites every year or every other year. There are twelve of these long-term biological stream reference sites. Sites are stratified across stream ecotypes differing in drainage area size, elevation, and alkalinity, and include each of the stream types identified for biological criteria in the standards. Human activity in reference site drainages is minimal relative to other streams in the ecoregion, and most reference sites have significant portions of land with state and federal protection from future development.

Macroinvertebrate and/or fish populations may be sampled to assess a stream's site-specific condition. Where point-source impact assessments are conducted (including an evaluation of the appropriate chemical and physical data), potential pollution sources are spatially bracketed (i.e., above and below) with sample sites to determine effects on the aquatic biota attributable to the pollution source.

Chemical Condition

Chemical water quality monitoring occurs across the state in rivers and streams in a variety of ways: targeted, probability-based, and special studies. Examples of targeted monitoring include the LaRosa Partnership Program (LPP) and water quality samples collected by the Ambient Biomonitoring Network (ABN). LPP monitoring stations are normally sampled eight to ten times during the spring and summer season, and may be monitored from one to several years, depending on the monitoring purpose. LPP data can provide enough information to make assessment determinations (i.e., impaired, or full support). Chemical monitoring associated with the ABN is used to help interpret the biological data, which is relied upon more heavily for assessment purposes.

Results from probabilistic surveys are used to determine statewide water quality conditions regarding use attainment and can provide statistically sound estimates on a statewide or basin-wide basis. Probability-based monitoring involves the systematic monitoring of randomly selected waterbodies.

Special chemical studies are usually only conducted in response to compelling data and information obtained from fixed-station and probability-based projects. The number and nature of special studies is commonly dictated by the nature of issues that need further monitoring or that arise as interest or funding permits. These types of studies include detailed sampling to assess use support or standards violations, stressor identification, diagnostic-feasibility studies, effectiveness evaluations of pollution control measures, and watershed-based surveys and evaluations. These evaluations are usually resource intensive and are reserved for issues of particular interest. Additionally, data from these investigations are usually organized and presented in a summary report format and would not be used separately for assessments.

Lakes Monitoring and Assessments

Lakes and ponds in Vermont are monitored and assessed through a multitude of programs, too numerous to summarize here. Monitoring is conducted to identify current conditions and assess long-term water

quality, habitat, climate, and other ecological trends. A full description of VTDEC lakes monitoring programs is provided on the Lakes Program website.

As with numerous monitoring programs, lake assessment is conducted for a variety of parameters through numerous assessment programs and methodologies. Through these multiple assessment processes, determinations of compliance with the standards are documented. A full description of VTDEC lakes assessment programs is provided on the Lakes Program website.

Stream Geomorphic/Physical Habitat Assessment

Data collected during stream geomorphic assessments according to recognized procedures provide a better understanding of the physical processes and features shaping a watershed; help identify high quality habitat or habitat and aquatic communities that have been compromised; and contribute to understanding the effects of watershed land use activities on stream condition.

The Vermont Stream Geomorphic Assessment Protocols provide a method for assigning a geomorphic and physical habitat condition to stream reaches. The term "departure from reference" is used synonymously with stream geomorphic condition throughout the protocols. The degree of departure is captured by the following three terms:

A stream reach in *reference and good* condition:

- Is in dynamic equilibrium which involves minor to moderate localized change to its shape or location while maintaining the fluvial processes and functions of its watershed over time and within the range of natural variability; and
- Provides very high to high quality aquatic and riparian habitat with persistent bed features and channel forms that experience periodic disturbance because of erosion, deposition, and woody debris.
- Aquatic communities are likely assessed as "Excellent" to "Very Good" when sampled in a subset of the geomorphically assessed reach (absent other limiting factors on biological communities)

A stream reach in *fair* condition:

- Has experienced major changes in channel form and fluvial processes outside the expected range of natural variability; may be poised for additional adjustment with future flooding or changes in watershed inputs that would change the stream type; and
- Provides aquatic and riparian habitat that may lack certain bed features and channel forms due to increases or decreases in the rate of erosion and deposition-related processes.
- Aquatic communities are expected to be assessed in the "Good" to "Fair" range depending on whether the sample site reflects the erosional or depositional changes underway.

A stream reach in *poor* condition:

- Is experiencing severe adjustment outside the expected range of natural variability; is exhibiting a new stream type; is expected to continue to adjust, either evolving back to the historic reference stream type or to a new stream type consistent with watershed inputs; and
- Provides aquatic and riparian habitat that lacks certain bed features and channel forms due to substantial increases or decreases in the rate of erosion and deposition-related processes. Habitat features may be frequently disturbed beyond the range of many species' adaptability.

- Aquatic communities are likely “Fair-Poor” or “Poor”. Aquatic biota sampling sites from previous years may not exist in the same location due to the stream type departure.

Phase 1 of the VTDEC protocols is the remote sensing phase and involves the collection of data from topographic maps and aerial photographs, from existing studies, and from very limited field studies. Geomorphic reaches and provisional reference stream types are established based on valley landforms and their geology. Predictions of channel condition (departure from reference), adjustment process, and reach sensitivity are based on evaluations of watershed and river corridor land use, and channel and floodplain modifications.

Phase 2 of the protocols is known as the rapid field assessment phase and involves the collection of field data from measurements and observations at the reach or sub-reach (segment) scale. Existing stream types are established based on channel and floodplain cross-section and stream substrate measurements. Stream geomorphic condition, physical habitat condition, adjustment processes, reach sensitivity, and stage of channel evolution are based on a qualitative field evaluation of erosion and depositional processes, changes in channel and floodplain geometry, and riparian land use/land cover. At least Phase 1 and Phase 2 stream geomorphic data will be used in determining altered waters due to physical problems.

Aquatic Invasive Nuisance Species Monitoring and Assessment

VTDEC monitors and assesses aquatic plant and animal threats and their nuisance level, whether a native or non-native aquatic species. Aquatic nuisance species can have significant impacts on the designated uses of surface waters biological, aesthetics, recreational, and as public resource. VTDEC assesses aquatic species to establish a reference of their growth, abundance of cover, evaluation of permitted activities, and site-specific impact evaluation and impacts of the non-target species present.

Aquatic Invasive (Non-Native) Species

In statute, aquatic (non-native) invasive plants or “Noxious Weeds” (listed by the Vermont Agency of Agriculture, Food and Markets) outcompete and displace plants in natural ecosystems and managed lands and have significant environmental, agricultural, and economic impacts. If a non-native species will likely cause social and/or ecological problems, control of the species may be recommended before it reaches nuisance densities. The Department understands the potential of invasive species to proliferate, spread rapidly, outcompete native species, and dominate an aquatic habitat.

Aquatic Nuisance Species

In statute, “aquatic nuisance” is defined as:

> *“Undesirable or excessive substances or populations that interfere with the recreational potential or aquatic habitat of a body of water. Aquatic nuisances include rooted aquatic plant, animal, and algal populations.”*

Assessing Aquatic Invasive Nuisance impacts to Surface Waters involves many considerations, including:

- Complaints from members of the public about the extent of proliferation of nuisance species.
- Uses (swimming, fishing, boating, and aesthetics) may be affected, either positively or negatively by aquatic organisms. The effect of these aquatic organisms on different uses needs to be considered and balanced.

- The presence of certain aquatic plant species can be used as indicators of nutrient enrichment, e.g., certain species may be present in small numbers in many waters, but when growing in abundance, they may indicate an elevated nutrient level. These include *Elodea canadensis*, *Ceratophyllum demersum,* and *Zosterella dubia*.
- Nutrient enrichment. Generally, as nutrients increase due to eutrophication, nuisance aquatic plant or algae growth also increases. If a water is known to have elevated nutrient levels, it's possible the aquatic growth will be elevated above natural levels as well. An increase of nutrients might also occur when aquatic plant beds are reduced naturally or through management activities.
- Ecological stability. In some cases, a significant reduction of aquatic plant growth can stimulate excessive algae growth, simply trading one problem for another. Likewise, a significant reduction in the population of an animal species may alter food web dynamics. The risk of these occurrences or other sudden shifts in species composition needs to be considered.
- Expected natural growth of a waterbody. Generally, the smaller and shallower a waterbody, the more aquatic plant and algae growth is likely. It is difficult to cause a waterbody to support an amount of growth less than its natural state. A variety of waterbody types and associated growth is a positive attribute for both the ecological and recreational landscape.

Data Solicitation and Quality

In conjunction with each biennial assessment and reporting cycle, VTDEC solicits data to further enhance the quantity and spatial coverage of water quality data and other information that is used in assessing surface waters. The solicitation for water quality data is distributed to various watershed groups and is posted on the WSMD website. The solicitation seeks data and information to be submitted by mid-November in odd-numbered years to be considered for the even-year reporting cycle. Data and other information submitted after that date will be considered for the next reporting cycle.

Data used must be of known quality and be representative of the water's condition. All data generated by VTDEC in conjunction with WSMD monitoring programs are subject to quality assurance planning using USEPA quality assurance guidance. Moreover, all data generated in part or whole using funding from USEPA must be subject to a USEPA-approved quality assurance project plan (QAPP). All data generated in conjunction with any active and/or approved QAPP are considered readily available and reliable data (subject to data limitations identified in the quality assurance/quality control validation and verification process for each project) and are considered in determining use support. Data can be rejected from consideration if it does not meet data quality objectives established by individual QAPPs. VTDEC's Quality Management Plan and Water Quality Monitoring Strategy provide listings of project specific QAPPs. Guidance and assistance regarding quality assurance is also provided by the Vermont Agriculture and Environmental Laboratory.

For data provided by organizations other than VTDEC and WSMD such as consultants, colleges, universities, and community-based activities, data quality must be assured prior to considering it as the sole basis for use support. The number of samples, the length of the sampling period, the antecedent weather conditions, degree of compliance or violation, and other factors are all considered when evaluating data from other organizations. Where data of unknown or unquantifiable quality are at odds with companion data of quantified quality, the higher quality data will be accorded higher weight in determining use support. Where data of unknown or suspect quality are the only information available, the waterbody is scheduled for additional monitoring prior to determining use support.

Vermont Surface Water Assessment Categories

Vermont's rivers, streams, lakes, and ponds have been categorized into "waterbodies" which serve as the cataloging units for the overall statewide assessment. Waterbodies are typically entire lakes, subwatersheds of river drainages, or segments of major rivers. Using data that is quality assured along with other contextual information that is reliable, the Watershed Management Division determines whether each waterbody meets or does not meet Vermont Water Quality Standards, and then places waters into one of four assessment categories, considering the waterbody classification and water management type. The three categories used in Vermont's surface water assessment are **full support, altered,** and **impaired**. Waters that support designated and existing uses and meet Water Quality Standards are placed into the full support category. Waters that do not support uses and do not meet standards are placed into the altered or impaired category. Waters can also be put into an **unassessed** category. These assessment categories are described below.

Full Support Waters

This assessment category includes waters of high quality that meet all use support standards for the water's classification.

In Vermont, there are many waters, such as intermittent streams, that are a lower priority for sampling given resource constraints, lack of public access or interest, and competing needs within VTDEC's water quality monitoring program. VTDEC therefore makes preliminary assessments, where practical, by considering five factors that address the likelihood that significant stressors exist within the subject watershed. Waters that meet all these factors are then considered to support their uses. The factors VTDEC uses to develop preliminary, screening-level assessments for these waters are:

- no discharges or contaminated sites in proximity to the waterbody;
- low probability of habitat degradation as evaluated by "Phase One" geomorphic assessments or other remote sensing evaluations;
- nearby sites have biological assessment findings compliant with Vermont Water Quality Standards for similar class;
- no problems are uncovered during outreach efforts associated with the rotational assessment process and basin planning; and
- no known water level manipulations.

Altered Waters

These are waters where a lack of flow, water level or flow fluctuations, modified hydrology, physical channel alterations, documented channel degradation, or stream type change is occurring and arises from some human activity, OR where the occurrence of aquatic invasive species has had negative impacts on designated uses. These aquatic communities are altered from the expected ecological state.

This assessment category includes those waters where there is documentation of water quality standards violations for flow and aquatic habitat, but EPA does not consider the problem(s) caused by a pollutant.

Impaired Waters

These are surface waters where there are chemical, physical, and/or biological data collected from quality assured and reliable monitoring efforts that reveal 1) an ongoing violation of one or more of the criteria in the Water Quality Standards and 2) a pollutant of human origin is the most probable cause of the violation.

Unassessed Waters

Waters for which VTDEC has limited monitoring data and available information to make an assessment decision.

Chapter Three. Assessment Use Support Determinations

The chapter provides specific criteria, principles for making decisions, and other information that VTDEC applies when assessing water quality conditions and determining whether individual designated uses are fully supported, altered, impaired, or unassessed. Information below is presented by each of the seven designated uses to show how relevant, representative, and reliable water quality monitoring data and other information relates directly to the degree of use support for assessment reporting purposes. If not otherwise specified, the decision-making criteria apply to both streams and lakes.

Consistent with Section 29A-301 of the Vermont Water Quality Standards, waters in which one or more applicable water quality criteria are not met due to natural influences are not considered to be in noncompliance with respect to such criteria. In such waters, activities may be specifically authorized by a permit, provided that those activities do not further reduce the quality of the receiving waters and would comply with all other applicable criteria.

Aquatic Biota and Wildlife Use

In assessing Aquatic Biota and Wildlife Use, the VTDEC Watershed Management Division uses a direct measure of biological communities, primarily macroinvertebrates and fish, to determine use support. Specific decision-making criteria are as follows:

Aquatic Biota and Wildlife Assessment using Biological Monitoring

Streams

Full Support: Biological assessments for fish and/or macroinvertebrate communities demonstrate compliance with appropriate threshold criteria as described in DEC biocriteria implementation methodologies. In the absence of biological data or applicable biocriteria, all available information and data are used to make scientifically defensible weight-of-evidence findings that designated aquatic biota uses are fully supported. In most cases, biological condition ratings of *Excellent, Very Good,* and *Good* will indicate full support status for Class A(1), Classes B(1) and A(2), and B(2) respectively.

Altered: Biological assessments for fish and/or macroinvertebrate communities demonstrate non-compliance with appropriate threshold criteria as described in DEC biocriteria implementation methodologies and the cause is not a pollutant (e.g., flow regulation or aquatic invasive species). In the absence of biological data or applicable biocriteria, all available information and data are used to make scientifically defensible weight-of-evidence findings that designated aquatic biota uses are not fully supported. In most cases, biological condition ratings of *Very Good* or lower*, Good* or lower*,* and *Fair* or lower will indicate altered status for Class A(1), Class B(1), and Class A(2)/B(2) respectively. Generally, biological data indicating non-attainment from the previous two or more successive samples are necessary to determine this condition.

Impaired: Biological assessments for fish and/or macroinvertebrate communities demonstrate non-compliance with appropriate threshold criteria as described in DEC biocriteria implementation methodologies if the cause is due to a pollutant of human origin. In the absence of biological data or applicable biocriteria, all available information and data are used to make scientifically defensible weight-of-evidence findings that designated aquatic biota uses are not fully supported. In most cases, biological condition ratings of *Very Good* or lower*, Good* or lower*,* and *Fair* or lower will indicate impaired status for Class A(1), Class B(1), and Classes A(2) and B(2) respectively. Generally, biological data indicating non-attainment from the previous two or more successive samples are necessary to determine this condition.

For wadeable streams for which the combined nutrient criteria in 29A-306 apply, representative monitoring shows that phosphorus concentrations and at least one nutrient response condition exceed the criteria contained in Table 2.

Aquatic Habitat Assessment

In assessing Aquatic Habitat Uses, the VTDEC Watershed Management Division uses several types of water quality and water quantity data and information to determine use support. The specific data types are habitat assessment, conventional pollutants, toxicants, and invasive aquatic species. For lakes, additional assessment guidelines are used to assess directly or indirectly uses when considering conventional pollutants, nutrients, and information regarding water-level impacts. Specific decision-making criteria are as follows:

Full Support: Depending on the water's classification (A(1), B(1), A(2), B(2)), very high or high quality habitat with up to a moderate change from natural or reference condition exists "consistent with the full support of all aquatic biota and wildlife uses."

Altered: Changes to the habitat show a moderate change from reference depending on the water's classification. There is an undue adverse effect on the physical nature of the substrate. Aquatic habitat surveys show significant deviation from the reference condition due to human-caused changes and/or Reach Habitat Assessment indicated "fair" to "poor" conditions. All life cycle functions, including over-wintering and reproductive requirements, are not adequately maintained, and protected due to the physical habitat changes.

Impaired: A pollutant of human origin is shown to cause more than the allowable change to aquatic habitat as defined by Vermont Water Quality Standards.

Conventional Pollutants (temperature, pH, D.O., turbidity, phosphorus, nitrate-nitrogen.)

Streams and Lakes

Full Support: Waters that are not impaired due to conventional pollutants, assessed using the Vermont Water Quality Standards.

Altered: This assessment category is not used in this context.

Impaired: Temperature: Due to human activities, water temperatures are too high or too low to fully support aquatic biota, wildlife, and aquatic habitat uses according to the Vermont Water Quality Standards Section 29A-302(1).

Acidity: Reliable, representative monitoring indicates that pH values repeatedly fall below 6.5 standard units or exceed 8.5 standard units across a range of weather conditions, and values are not due to natural sources.

Dissolved oxygen: Reliable, representative monitoring indicates D.O. values (concentration or percent saturation) repeatedly fall below the standard for the water's classification except as noted below.

Turbidity: Reliable, representative monitoring shows that the mean turbidity values are above the standard for a water's classification as measured at or below dry weather base-flow conditions and values are not due to natural sources.

Nitrates: Reliable, representative monitoring shows that nitrate-nitrogen repeatedly and/or consistently exceeds the standard for the water's classification and elevation as noted in the Vermont Water Quality Standards Section 29A-302(3).

Phosphorus: Reliable, representative monitoring shows that phosphorus concentrations repeatedly and/or consistently exceed the criteria contained in the Vermont Water Quality Standards Section 29A-302(2).

Lakes Only – Alkalinity and Dissolved Oxygen

Full Support: Waters that are not impaired.

Altered: This assessment category is not used in this context.

Impaired: Reliable monitoring data indicates that alkalinity routinely drops below 2.5 mg/l (as acid neutralizing capacity) during the spring runoff period. Reliable monitoring data indicates that a lake's hypolimnetic dissolved oxygen concentration falls to (or near) 0 mg/l or 0% saturation for a period of greater than 50% of the summer stratification period. However, if in the best professional judgement of DEC scientists, the dissolved oxygen deficit is due to natural causes (e.g., morphometry and meromixis), aquatic biota uses will be considered instead as fully supported.

All Toxics

Streams and Lakes

Full Support: Waters that are not impaired due to toxicants, as described below.

Altered: Toxicants are considered pollutants, therefore, the category "altered" is not applicable.

Impaired: In most cases, the following exposure presumptions are applicable to compliance determinations: for any one pollutant, an acute aquatic biota criterion is exceeded more than once within a 3-year period, for longer than one hour, above ten-year, seven-day flow minimum (7Q10) flows; or a chronic aquatic biota criterion is exceeded for more than four consecutive days in a three-year period, above 7Q10 flows.

(DEC recognizes that the literal interpretation of the exposure scenario cited would be difficult to replicate in a field situation. The language cited reflects the exposure conditions used to develop the numerical criterion that is the water quality standard. It is likely that available monitoring data would be collected under a variety of temporal and spatial formats. In evaluating data, DEC uses the exposure assumptions of the criterion development as guidelines in the interpretation of data and uses empirical and judgmental means to assess whether there is reasonable potential for those exposure assumptions to be violated. Given the variable nature of available information, evaluations will vary on a case-by-case basis. DEC takes into consideration guidance provided by EPA when evaluating toxicants in surface waters (see "Technical Support Document for Water Quality-based Toxics Control." EPA/505/2-90-001).

Chloride

Continuous Monitoring Using Conductivity: Where continuous monitoring datasets indicate an average chloride concentration exceeding 230 mg/L for more than one 96-hour period in a three-year period, the waterbody will be assessed in non-support (See Appendix A).

Aquatic Invasive Nuisance Species

Full Support: Aquatic Biota and Wildlife and Aquatic Habitat Uses are not altered by aquatic invasive species.

Altered: Moderate to heavy infestation of aquatic invasive species with substantial impact to native communities (for aquatic macrophytes, locally abundant growth in >50% of littoral zone to dense growth in >75% of littoral zone).

Fluctuated Reservoirs and Lakes

Reservoirs present special cases with regards to assessment of Aquatic Biota and Wildlife and Aquatic Habitat Uses. In the absence of direct biological measurements beyond routine aquatic plant survey data, assessment can be made using the following decision-making 'tree.' To use this decision tree, several pieces of information regarding the reservoir are useful. These include bathymetry, maximum and mean waterbody depth, the limnological shoreline development index, and the magnitude and timing of the drawdown. These data can be used collectively to estimate the proportion of the littoral zone likely to be affected by a drawdown regimen. Where available, biological data (in particular the presence and distribution of aquatic macrophytes within the littoral zone) are also useful.

1) Can the level of the waterbody be regulated by an artificial structure (e.g., dam, sluice, weir)?
   Answer is NO: no alteration due to water level fluctuation. ***Full Support.***

   Answer is YES: go to 2.

2) Is the artificial structure regulated (e.g., Section 401 Water Quality Certification, 10 V.S.A Chapter 43 Dam Order, Water Resources Board rules; Public Service Board Certificate of Public Good or 30 V.S.A Section 401,)?
   Answer is NO: an alteration could potentially exist but must be verified by direct assessment before the waterbody can be correctly assessed; go to 4.

   Answer is YES: go to 3.

3) Do the conditions of the regulation subject the waterbody to periodic water level fluctuations that are attributable to operations?

   Answer is NO: ***Full Support - no alteration due to water level fluctuation if operated in accordance with the regulatory conditions.***

   Answer is YES: Go to 4***.***

4) Is the waterbody in fact subject to periodic fluctuations that are attributable to operation or manipulation of the outflow structure?
   Answer is NO: ***Full support at time of assessment.*** There is potential for stress due to the ability of the outflow operators to fluctuate water levels if owner deems necessary, which can negatively impact littoral zone communities.

   Answer is YES: Go to 5.

5) Does there exist a sufficient area of littoral habitat below the drawdown zone to enable establishment of a viable and stable aquatic community, with all expected functional groups, while accommodating the drawdown regimen, **or** does available biological data suggest that such a community exists within the drawdown zone?

Answer is NO: ***altered.*** These alterations create more than a moderate change to aquatic habitat. Littoral zone impacts of this magnitude will have cascading impacts throughout the trophic web, resulting in more than a moderate change in aquatic biota from the reference expectation. Aquatic macroinvertebrate and fish assemblages exhibit more than moderate changes in the relative proportions of tolerant, intolerant, taxonomic, and functional components. Accordingly, the entire acreage is assessed as altered.

Answer is YES: ***full support.*** These stresses cause no more than a moderate change to aquatic habitat. Littoral zone impacts of this magnitude could have cascading effects within the trophic web of the waterbody, but these are presumed to create no more than a moderate change to aquatic biota from the reference expectation based on the relative proportions of tolerant, intolerant, taxonomic, and functional groups. Aquatic Habitat Use

Swimming/Contact Recreation Use

For assessment of Swimming/Contact Recreation Use, the DEC Watershed Management Division uses one or more types of data to determine whether this use is supported. The specific data types are bacterial monitoring, cyanobacteria reports, presence and density of aquatic nuisance species, and on rare occasions, the presence of chemical contaminants. Decision-making criteria are as follows:

Indicator Bacteria

To assess waters for support of swimming and contact recreation using *E. coli* monitoring data, a minimum number of data points are necessary, and supporting contextual data such as antecedent weather and flow conditions must be considered. DEC considers at least five (5) reliable and quality assured sample results over a swimming season and gathered across a range of weather/flow conditions to be the minimum practical number of samples necessary to document representative conditions and to assess attainment of contact recreational uses. In a practical sense, weekly or more frequent *E. coli* data across the swimming season is most useful to determine impairment and observe weather-related patterns in bacterial concentrations. If there are questions regarding the representativeness of the data, the water is identified as needing monitoring and is recommended for follow-up *E. coli* sampling in the next season.

In keeping with the epidemiological studies that are the basis of the USEPA's E. coli indicator bacteria standard (USEPA 2012), there should be sufficient evidence that the contamination is from a human source. If contamination sources are unclear, further source investigation may be necessary before an assessment can be made.

Vermont's standards for bacteria are based on EPA's 2012 Recreational Water Quality Criteria. In Class A waters, *E. coli* are not to exceed the geometric mean of 126 organisms/100 ml obtained over a representative period of 60 days and no more than 10% of samples may be above the statistical threshold value of 235 organisms/100ml, with none attributable to the discharge of wastes. The same criterion applies to Class B waters, except for the preclusion of treated waste, and with criteria in a shorter averaging period for waters receiving CSOs.

The following guidelines are applied during the assessment process:

Full Support: Waters are suitable for swimming with generally low *E. coli* values.

Altered: *E. coli* indicator bacteria are considered a pollutant. This assessment category is not applicable.

Impaired: For class B waters, the geometric mean of 126 *E. coli* /100 ml is exceeded in a given segment or area **and/or** more than 10% of the samples are above 235 organisms/100 ml. The contamination must be attributable to sources other than natural sources. DEC accepts a weight-of-evidence approach to confirm that *E. coli* values are or are not of natural origin. The WQS state that samples should be obtained "over a representative period of 60 days" and "in water receiving combined sewer overflows, the representative period shall be 30 days". However, at least five samples collected regularly over the representative period is recommended, and flow and antecedent precipitation are important in this determination.

For Class A(1) and A(2) waters, the geometric mean of 126 *E. coli* /100ml is exceeded over a representative period of 60 days **and/or** more than 10% of the samples are above 235 organisms/100ml. No elevated *E. coli* can be "attributable to the discharge of wastes".

Generally, data from at least two swimming seasons are needed to assess waters as impaired for swimming.

Alternatively, waters with CSOs present that discharge on a relatively frequent basis are considered impaired for swimming without the direct water *E. coli* sampling numbers (per the sampling parameters described above).

Aquatic Invasive Nuisance Species

Full Support: Swimming/Contact Recreation Use is not altered by aquatic invasive species.

Altered: Moderate to heavy infestation of aquatic invasive species with substantial impact to swimming (for aquatic macrophytes, this would be locally abundant growth in >50% of littoral zone to dense growth in >75% of littoral zone).

Impaired: Aquatic invasive species are not considered a pollutant; therefore, this assessment category does not apply.

Chemical Contamination

Water quality criteria do not address incidental/accidental ingestion of water or dermal exposure to recreational users where there is chemical contamination present. Chemical contamination can enter surface waters or be deposited on beaches from both natural and anthropogenic sources. These may be point sources, such as municipal and industrial outfalls, or nonpoint sources such as runoff from land or leaching from old hazardous waste sites. In most cases there will be significant dilution or attenuation of contaminants.

Drinking water guidelines can provide a starting point for deriving values that could be used to make a screening level risk assessment. It has been suggested (WHO Guidelines for Safe Recreational Waters 2009) that water quality standards for chemicals in recreational waters should assume that recreational water makes only a minor contribution to intake.

It is assumed that contribution of swimming is equivalent of 10% of drinking-water consumption. Based on drinking water consumption value of 2.4 liters a day, this would result in an intake of 200ml per day from recreational contact with water. A simple screening approach therefore would be that a substance occurring in recreational water at a concentration of ten times the drinking water guidelines (VDOH Drinking Water Guidance) would need further assessment.

Organic contaminants can be present in surface waters from industrial and agricultural activity. EPA studies have shown that dermal contact and inhalation can contribute as much as water ingestion. Many of these are associated with sediments and particulate matter. Consideration should be given to the possibility of sediment being disturbed and ingested by infants and young children. EPA Regional Screening Levels (RSL) for Residential Soil can be used to screen sediment chemistry data from a site. If the screening value is exceeded, it suggests the need for specific evaluation of the contaminant taking local circumstances into consideration.

Full Support: No chemical contamination present in sediments or surface waters at level of concern.

Altered: This category is not used under these situations.

Impaired: A water is part of a Superfund site or other hazardous waste site where special health and safety training and precautions are required to access the site or the public is restricted access from all activities including swimming, fishing, and trespassing for health and safety reasons by an entity such as the Vermont Department of Health.

Fishing - Recreational Uses

For assessment of Fishing Use, the DEC Watershed Management Division uses information regarding water quantity, water quality, and other information regarding the game fishery and records of public feedback and complaints to determine levels of support.

General Conditions

Full Support: Water quantity and quality sufficient for fishing according to class.

Altered: Fishing is limited due to insufficient or diminished water, plant growth, or channel alterations.

Impaired: Fishing is limited due to water quality or aquatic habitat impairment(s) caused by pollutants from human sources. Reliable, representative monitoring shows that temperature repeatedly and/or consistently exceeds the standard for the water's classification and fish habitat designation as noted in the Vermont Water Quality Standards Section 29A-302(1) and the Protection of Human Health criteria in Appendix C.

Aquatic Invasive Nuisance Species

Full Support: Fishing Recreational Uses are not altered by aquatic invasive species.

Altered: Moderate to heavy infestation of aquatic invasive nuisance species with substantial impact to fishing (for aquatic macrophytes, this would be locally abundant growth in >50% of littoral zone to dense growth in >75% of littoral zone).

Fish Consumption Advisories

Vermont interprets the U.S. EPA guidance on fish consumption use attainment to indicate that no waters fully support fish consumption. This is due to well-documented contamination of varying levels of lakes by mercury in waters, sediments, and aquatic biota arising from atmospheric deposition. In the tissues of fish inhabiting Lake Champlain (and elsewhere), other contaminants including polychlorinated biphenyls, polyaromated hydrocarbons, and "DDT" derivatives, have been identified.

DEC does not, however, subscribe to the notion that fish tissue consumption is impaired on a statewide basis. This is because the Vermont Department of Health has determined that most fish species can be

consumed from most Vermont waters, albeit at a reduced rate. Fish consumption use is considered impaired only if the fish species subject to the consumption advisory is documented to exist in the waterbody and contaminant data exist for that species from the waterbody. This approach is consistent with current EPA guidance.

Full Support: No fish non-consumption advisory in effect.

Altered: Tissue contaminants are derived from the deposition or release of pollutants into the aquatic environment. Accordingly, this assessment category is not relevant.

Impaired: Fish consumption use is considered impaired only if the fish species subject to the consumption advisory is documented to exist in the waterbody and contaminant data exist for the species from the waterbody. For a given fish species present in a waterbody, a 'no-consumption' advisory is in place for a designated sub-population (e.g., children or women of childbearing age) or for the general population.

Boating - Recreational Use

For assessment of Boating Use, the DEC Watershed Management Division uses information regarding water quantity and water quality.

General Conditions

Full Support: Water quantity and quality sufficient for boating according to class.

Altered: Boating is limited due to insufficient or diminished water, plant growth, or channel alterations. Boating is not feasible to the degree deemed achievable for the water's class.

Impaired: Boating is limited due to water quality or aquatic habitat impairment(s) caused by pollutants from human sources.

Aquatic Invasive Nuisance Species

Full Support: Boating Recreational Uses are not altered by aquatic invasive species.

Altered: Moderate to heavy infestation of aquatic invasive nuisance species with substantial impact to boating (for aquatic macrophytes, this would be locally abundant growth in >50% of littoral zone to dense growth in >75% of littoral zone).

Public Water Source Use

Public water source use is assessed using data on toxicants and bacteria; information on water treatment plant operation and operating costs; and data describing cyanobacterial (blue-green algae) toxin concentrations.

Full Support: Water quality suitable as a source of public water with disinfection and filtration.

Altered: A well-established *Dreissenid* mussel infestation or frequent cyanobacteria blooms have increased cost or effort to produce water that is suitable for drinking.

Impaired*:* Criteria established by the Federal Safe Drinking Water Act can be met only by employing treatment practices that operationally or financially supersede customary practices that include filtration

and disinfection. Criteria exceeded in the Humna Health section of the Water Quality Standards, Appendix C, Consumption of Water and Organisms.

Aesthetics Use

For assessment of Aesthetic Use, the DEC Watershed Management Division uses water quality and water quantity information from field surveys for rivers and streams and public feedback and complaints as well as field surveys for lakes and ponds to determine levels of support.

General Conditions

Full Support: Water character, flows, water level, riparian, and channel characteristics exhibit good to excellent aesthetic value consistent with the waters classification. Water clarity and substrate condition is good. No floating solids, oil, grease, scum. Limited or no record of public concern.

Altered: Aesthetic quality is poor due to a diminished amount of water to no water in the channel or lake resulting from human activities. Streambanks are severely slumping, stream is braided, channel is highly straightened and rip-rapped, and channel bed material is severely jumbled and unsorted.

Impaired: Aesthetic quality of water is poor. Water is frequently and unnaturally turbid. Substrate is unnaturally silt-covered, mucky, or otherwise changed to adversely affect the aesthetics in an undue manner. The presence of solid waste, floating solids, scum, oil, or grease occurs frequently and persistently. Rocks are unnaturally and extensively colored by metal contamination.

Aquatic Invasive Nuisance Species

Full Support: Aesthetics Use is not altered by aquatic invasive species.

Altered: Moderate to heavy infestation of visible aquatic invasive species with substantial impact to aesthetics (for aquatic macrophytes, this corresponds to locally abundant growth in >50% of littoral zone to dense growth in >75% of littoral zone).

Combined Nutrient Criteria for Lakes, Ponds, and Reservoirs

Full Support: All available sampling data from within the last 10 years (with a minimum of five years of data over that period) show with 95% confidence based on a one tailed T-test that the mean of the total phosphorus annual means or all nutrient response annual means do not exceed the criteria contained in Table 3 of Section 29A-306 of the Vermont Water Quality Standards; or, for full support at the B(2) classification level only, sampling data from a minimum of two visits show expected total phosphorus concentrations (e.g. TP < 18 µg/l) or nutrient response conditions (e.g. chlorophyll-a < 7.0 µg/l, Secchi disk depth > 2.6 m) for the lake's characteristics based on best professional judgement and documentation of little or no impact from post-industrial land use changes and/or human disturbances (e.g. Vermont Lake Score Card Shoreland Score is "Good Condition" and Watershed Score is "Minimally Disturbed").

Impaired: All available sampling data from within the last 10 years (with a minimum of five years of data over that period) show with 95% confidence based on a one tailed T-test that the mean of the total phosphorus annual means ***or*** all nutrient response annual means exceed the criteria contained in Table 3 of Section 29A-306 of the Vermont Water Quality Standards; or sampling data from a minimum of two visits show extremely high total phosphorus concentrations (e.g. TP > 100 µg/l) [a] or extreme nutrient response conditions (e.g. chlorophyll-a > 25 µg/l, Secchi disk depth < 1.0 m) [c] exceeding expected values for the lake's

characteristics based on best professional judgement and documentation of post-industrial land use changes and/or human disturbances (e.g. Vermont Lake Score Card Shoreland Score is “Poor Condition” and Watershed Score is “Highly Disturbed”).

[a] Based-on Nurnberg 1996 characterization of hyper-eutrophic conditions in the summer epilimnetic zone

Agricultural Water Supply Use

There are no EPA definitions for agricultural water supply nor any state definitions and criteria. Consequently, this use is unassessed, and the three assessment categories are not used.

Chapter Four. Listing and De-Listing Methodology

For the purposes of identifying and tracking important water quality problems where the Vermont Water Quality Standards are not met, VTDEC has developed the Vermont Priority Waters List. This list is composed of several parts, each identifying a group of waters with unique water quality concerns. Development of each part is guided by various regulations and/or management considerations including federal Clean Water Act (CWA) requirements, EPA guidance, or Vermont-specific management objectives. This list is produced biannually on even numbered years. Table 2 outlines the composition of the Priority Waters List while specific details of each list's composition are given below.

Table 2. Summary of Vermont Priority Waters List

List Section	Assessment status	Description
Part A (303(d) List)	Impaired	Also known as the CWA §303(d) Impaired Waters List. This federally mandated list identifies impaired waters scheduled for TMDL development
Part B	Impaired	Waters assessed as impaired for which TMDLs are not required
Part D	Impaired	Impaired waters that have completed and EPA approved TMDLs
Part E	Altered	Waters not in compliance with VTWQS due to the presence of invasive aquatic species
Part F	Altered	Waters not in compliance with VTWQS due to flow regulation

Impaired Waters

All waters determined to be impaired are placed on Part A (303(d) List), Part B, or Part D.

Part A - 303(d) List

Part A of the Priority Waters List identifies impaired surface waters that are scheduled for total maximum daily load (TMDL) development. Part A of the List is prepared in accordance with current EPA guidance and federal regulations 40CFR 130.7 ("Total maximum daily loads (TMDL) and individual water quality-based effluent limitations"). A TMDL is required for these waters to establish the maximum amount of a pollutant that may be introduced into the water after the application of required pollution controls and to ensure the VTWQS are attained and maintained.

In addition to identifying the waterbody, Part A identifies the pollutant(s) causing the impairment, the priority ranking for TMDL development, which water use(s) are impaired, and a brief description of the specific water quality problem if known.

Identification of Pollutant

The federal regulation governing 303(d) List development, 40CFR §130.7(b)(4), requires states to include the "pollutants causing or expected to cause violations of the applicable water quality standards". This

pollutant then becomes the basis for TMDL loading allocations or for the control measures necessary to bring about compliance.

Where there is monitoring data that identifies a violation of numeric criteria, identification of the pollutant is evident. For example, long-term monitoring data may identify a segment of Lake Champlain as exceeding the numeric criterion for total phosphorus. Other numeric criteria are less indicative of the specific pollutant as in the instance of a dissolved oxygen criteria. The numeric criterion in this instance can be measured (low dissolved oxygen) but the pollutant causing that condition is not directly identified. Where there is monitoring data that identifies a violation of a narrative standard, the identification of the causal pollutant becomes more complex. An example is where biomonitoring data indicates a violation of the biocriteria for aquatic biota use support.

In the instance of a biocriteria violation, VTDEC attempts to be as accurate as possible in identifying the causal pollutant. Where appropriate, VTDEC subscribes to EPA's Stressor Identification Methodology (USEPA, 2000b) or similar process. These assess site specific stressors and indicators such as biological and habitat indicators, land use information, proximity of known pollutant sources, or other relevant information to identify by inference the most probable causal pollutants or stressors. This process can provide a defensible list of pollutant stressors or suite of stressors of common origin as in the case of runoff from impervious surfaces (i.e., stormwater).

At times, however, it may be necessary to identify a water as impaired without providing a specific causal pollutant. In these instances, the pollutant is identified as "undefined".

TMDL Scheduling

Priority ranking for TMDL development is done with consideration of many factors. These include but are not limited to: (1) health issues, (2) the nature, extent, and severity of the pollutant(s), (3) the use or uses that are impaired, (4) the availability of resources and methods to develop a TMDL, (5) the degree of public interest, and (6) the utility of TMDL development to the elimination of the impairment.

Public Comment Opportunity, Submittal to EPA, and EPA Approval

Upon compilation of the draft Part A-303(d) List, it is made available to the public for review and comment. Notification of availability is at a level sufficient to allow broad coverage of the general public and may include notices in newspapers, websites, and direct notification through email or mailing lists. In addition to notification, public meetings may be conducted to further the public's understanding. Following receipt of public comments, a response summary is developed that describes how the comments were addressed. Appropriate changes are made to the list and a final version of the Part A-303(d) List is then sent to the New England regional office of EPA for review and approval.

De-listing

During development of new Part A-303(d) Lists, there may arise the need to propose de-listing water(s) identified on previous lists. Waters proposed for de-listing are identified during the Part A-303(d) List comment period and the rationale and justification for such proposals is presented. The waterbody-specific rationale is intended to provide "good cause" for de-listing and may be based on the following determinations:

- Assessment and interpretation of more recent or more accurate data demonstrate that the applicable WQS(s) is being met.

The absence of impairment can be substantiated by data of a comparable quantity and quality as the data that was required to assess the water as impaired (for example, 2 years of biological or chemical data needed to establish impairment generally means 2 years of data needed to establish attainment).

- Flaws in the original analysis of data and information led to the segment being incorrectly listed.
- Documentation that a water included on a previous Part A-303(d) List was not required to be listed by EPA regulations, e.g., segments where there is no pollutant associated with the non-compliance.
- A determination pursuant to 40 CFR 130.7(b)(1)(iii) that there are other pollution control requirements required by state, local, or federal authority that will result in attainment of WQS(s) for a specific pollutant(s) within a reasonable time.

  To de-list these impaired waters from Part A, VTDEC must be convinced that other pollution control requirements, such as best management practices, will result in the attainment of Vermont Water Quality Standards. Specifically, DEC needs to show that (1) there are legal requirements in place (e.g., regulations, permits implementing regulations) that apply to the source(s) causing the water quality impairment and (2) that such legally required pollution control practices are specifically applicable to the impairment in question **and** are sufficient to cause the water to meet water quality standards within a reasonable time. These waters are then listed on Part B of the Vermont Priority Waters List.

- Approval or establishment by EPA of a TMDL since the last Part A-303(d) List.
  These waters are then listed in Part D of the Vermont Priority Waters List if they remain impaired.
- Other relevant information that supports the decision not to include the segment on the Part A-303(d) List.

Part B List

All waters listed in Part B are assessed as impaired and do not require development of a TMDL as described in 40 CFR 130.7. Impaired waters that do not need a TMDL are those where other pollution control requirements (such as best management practices) required by local, state, or federal authority are expected to address all water-pollutant combinations and the Water Quality Standards are expected to be attained in a reasonable period. DEC will provide information to show that (1) there are legal requirements in place (e.g., regulations or permits implementing regulations) that apply to the source(s) causing the water quality impairment and (2) that such legally required pollution control practices are specifically applicable to the impairment in question **and** are sufficient to cause the water to meet water quality standards within a reasonable time. Additional discussion of the Part B requirements is given in the EPA Integrated Report guidance document (USEPA 2005).

Part D List

All waters identified on Part D are assessed as impaired and have completed and approved TMDLs. If future assessments show the impairment has been eliminated, the waters will be removed from the Part D List. A comprehensive list of completed TMDLs is maintained on the Watershed Management Division's website.

Altered Waters

All waters determined to be altered are placed on one of two lists that track altered waters. These lists include Part E List (water altered by invasive non-native species), and Part F (waters altered by flow regulation). The listing methodology for each list is given below.

Part E List

Waters appearing in Part E are assessed as "altered." They represent situations to be given priority for management where aquatic habitat and/or other designated uses have been altered to the extent that one or more designated uses are not supported due to the presence of aquatic invasive species.

Waters will be removed from the Part E List when the population of the aquatic invasive species declines or is eliminated, and the water is assessed as in "full support" of the designated uses.

Part F List

Waters appearing in this part of the Vermont Priority Waters List are assessed as "altered." They represent priority management situations where aquatic habitat and/or other designated uses have been altered by flow regulation to the extent that one or more designated uses are not supported. Alterations arise from flow fluctuation, obstructions, or other manipulations of water levels that originate from hydroelectric facilities, dam operations, or water withdrawals for industrial or municipal water supply or snowmaking purposes.

Waters will be removed from the Part F List as corrective actions are implemented.

Full Support Waters

Waters that fully support designated uses are not tracked on the Vermont Priority Waters List.

Stressed Waters

In previous iterations of this Assessment and Listing Methodology, an assessment category of "stressed waters" was included and waters listed as such. This category attempted to identify waters for which, 1) stressors were not at sufficient level to cause impairment but could be problematic, 2) more monitoring was needed to make a complete assessment decision, and 3) watershed features were observed that could be problematic for water quality in the future. The Stressed Waters List was eliminated as an assessment category in 2021 in a transition relying on purely data driven assessment decisions.

Comparison to EPA's Listing Categories

In 2005, the USEPA issued guidance (USEPA 2005) to provide states a recommended reporting format and suggested content to develop a single document that integrates the reporting requirements of Clean Water Act section 303(d) and 305(b). Known as the "Integrated Report", it is EPA's strategy to report on water quality standards attainment of assessed waters, document availability of data and information for each segment, identify trends in water quality conditions and provide information to managers for priority setting. This comprehensive report is broken down into five parts into which all water segments within a state can be categorized. These categories are described in Table 1.

Table 3. USEPA Integrated Report listing categories

Category 1	All designated uses are supported, no use is threatened

Category 2	Available data and /or information indicate that some but not all the designated uses are supported	
Category 3	Insufficient available data and/or information to make a use support determination	
Category 4	Available data and/or information indicate that at least one designated use is not being supported or is threatened, but a TMDL is not needed. This category is further divided into subcategories a-c;	
	4a	Segments with completed TMDLs
	4b	Segments for which control measures other than a TMDL are expected to bring about WQS compliance
	4c	Segments demonstrating failure to meet WQS but not by a pollutant
Category 5	Available data and/or information indicate that at least one designated use is not being supported and a TMDL is needed – 303(d) List	

As guidance, Vermont is not required to follow the USEPA suggested listing format as outlined in the guidance document and has instead opted to present the state's Priority Waters List as described above. It should be noted however that VTDEC does submit Vermont's water quality status to EPA electronically which is compatible with the five-category format. Table 4 compares the parts of the Priority Waters List to EPA's five categories.

Table 4. EPA Categories compared to Vermont's Priority Waters Lists

EPA Category	Vermont listing component	Notes
Category 1	NA	Waters in full support are not tracked on the Priority Waters List[1]
Category 2	NA	Waters where some but not all the uses are supported are not tracked on the Priority Waters List
Category 3	NA	Unassessed waters are not tracked on the Priority Waters List[2]
Category 4a	Part D	The waters in Part D are assessed as impaired. Waters coming back into compliance after a TMDL is complete will be removed from Part D.
Category 4b	Part B	Requirements other than a TMDL are expected to bring an impaired water into compliance.
Category 4c	Parts E & F	A pollutant is not the cause of impairment, no TMDL required
Category 5	Part A	EPA approved 303(d) list as well as proposed delistings

1 Waterbodies or river miles in full support can be identified from Vermont's database through queries

2 Waterbodies or river miles that are not assessed can be identified from Vermont's database through queries

Chapter Five. References

USEPA. 2012. 2012 Recreational Water Quality Criteria. EPA-820-F-12-058. Washington, D.C.

USEPA. 2005. Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act

USEPA. 2000b. Stressor Identification Guidance Manual. EPA-822-B-00-025. Washington, D.C.

VTANR, WQS. 2022. Vermont Water Quality Standards Environmental Protection Rule Chapter 29A (effective November 15, 2022). Montpelier, Vermont.

Appendix A: Using Conductivity as a Surrogate for Chloride

Continuous Conductivity Datasets

Chloride is a unique parameter when it comes to measuring it in the aquatic environment. Not only can you measure it directly in the laboratory from grab samples, but specific conductivity has been shown to be a reliable surrogate for measuring it in the field. By using modern water quality probes and dataloggers, continuous estimates of chloride can be obtained for weeks or months at a time. Simple regression equations relate specific conductivity measurements to chloride concentrations and recent studies in the Chittenden County region of Vermont have successfully employed these techniques. The continuous datasets make it easier to make assessments relating the three aspects of the WQS: magnitude, duration, and frequency, and are particularly useful in assessing the 4-day duration aspects of the chronic criterion.

Where adequate continuous conductivity datasets exist, they will be assessed based on the duration of exposure and the frequency of exceedance criteria as described below:

Acute Criterion Dataset

A continuous dataset applicable for the acute criterion means specific conductivity samples taken at least every 15 minutes for a duration that equals or exceeds the duration of the acute criteria (i.e. 1 hour). The arithmetic average chloride concentrations estimated from specific conductivity measurements, taken over the 1 hour, shall be compared to the acute criterion to determine compliance or noncompliance.

Chronic Criteria Dataset

A continuous dataset applicable for the chronic criterion means specific conductivity samples taken at least every hour for a duration that equals or exceeds the duration of the chronic criteria (i.e., 96 hours). The arithmetic, moving average of chloride concentrations, estimated from specific conductivity measurements, taken over the 96-hour period shall be compared to the chronic criterion to determine compliance or noncompliance.

For a continuous dataset to be considered complete and comparable to the criteria, samples must have been collected over a time period that encompass the exposure period that the criteria is based on (i.e., 1 hour for acute and 96 hours for chronic criteria).

Rolling averages are calculated for all possible blocks of 1 hour (acute criteria) or 96 hours (chronic criteria). The time blocks overlap. For example, the 1 hour average value is calculated when four specific conductivity measurements were made within any given hour at 15 minute increments and the 96 hour average value is calculated if 384 specific conductivity measurements are made over any given four day period.

For comparison of continuous datasets to the frequency component of the standard, the average of either the acute or chronic exceedances shall not exceed the frequency of exceedance (i.e. an average of no more than 1 exceedance every 3 years).

Specific Conductivity as a Chloride Surrogate

Specific conductivity can be used as a surrogate for chloride samples. When specific conductivity is used as a surrogate for chloride, it is necessary to collect at least 2 chloride samples within each time period that the specific conductivity to chloride relationship is to be used. These samples will be used to confirm that the site fits the statewide specific conductivity to chloride relationship. If confirmation samples do not adequately fit the statewide relationship, a site-specific relationship can be developed (see discussion below).

Conductivity/Chloride Relationship

An ordinary least squared regression was fit to all chloride-specific conductivity data pairs collected in Vermont from 2003 to 2010, and again in 2013. A minimum chloride threshold of 30 mg/L was applied to these data. Chloride concentration observations below 30 mg/L are numerous, far below water quality criteria, and tend to bias the results of regression analyses; removing low chloride concentrations improves regression fit and model diagnostics. A total of 441 observations were used in the model.

The final regression equation has an adjusted r-squared value of 0.94 (Eqn. 1):

$$\boldsymbol{Chloride}\ (\boldsymbol{mg/L}) = -\mathbf{69.72} + \mathbf{0.292} * \boldsymbol{Specific\ Conductivty}\ (\mu\boldsymbol{S}) \qquad \text{Eqn. 1}$$

This r-squared value indicates that specific conductivity explains about 94% of the observed variation in chloride concentration.

The Division anticipates that this regression equation will be sufficient in most cases to accurately estimate chloride concentrations when site specific regressions are not available. However, where site specific data is sufficient, a site-specific regression may be preferred.

Criteria for Using the State-Wide Chloride Regression

Study Areas without a Site-Specific Chloride Regression

If the organization/researcher has not developed a site-specific chloride regression that is equal to or better than the WSMD state-wide chloride regression, the organization/researcher should use the WSMD state-wide chloride regression. The organization/researcher should follow the steps listed below to verify that the state-wide regression is acceptable for their study site.

1. The organization/researcher will collect at least 2 data pairs of chloride concentration and specific conductivity on water samples collected from the study area. If possible, the data pairs should be collected during different flow conditions and seasons.

2. If the data pairs consistently fall outside the 95th percentile prediction interval for the WSMD state-wide regression, then the organization/researcher should question whether the WSMD state-wide regression is appropriate for their study site. A figure depicting the WSMD state-wide regression line with 95% prediction intervals is provided below for reference.

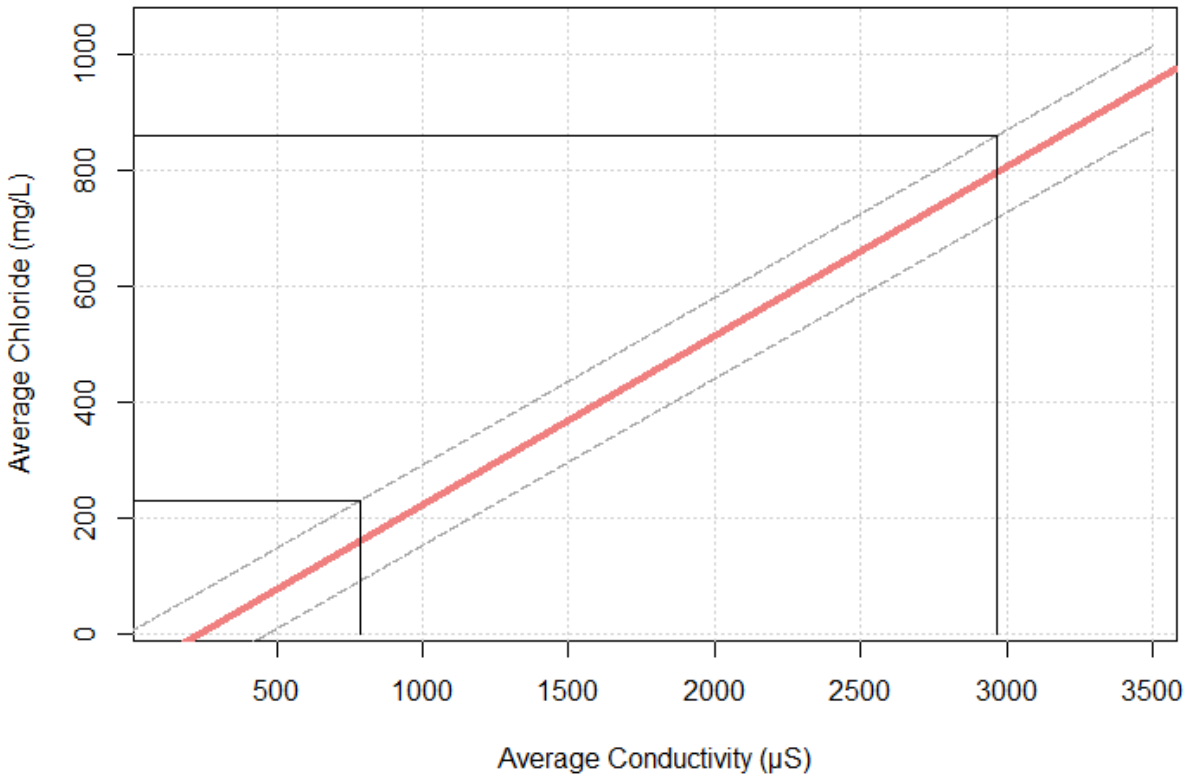


Figure A1. WSMD state-wide chloride-specific conductivity regression line with 95% confidence intervals. The points at which the 95% prediction interval exceeds the chronic (230 mg/L) and acute (860 mg/L) chloride concentrations are shown.

3. Because confidence and prediction intervals vary across the range of observed values, no single equation for these intervals can be provided. However, using the WSMD state-wide regression, the conductivity values associated with a 95% prediction interval above the relevant chloride criteria can be calculated; these values show the threshold at which an observed conductivity concentration is no longer 95% sure to be below the chloride criteria, based on the fitted model (see Table A1).

Table A1. Specific conductivity values whose 95% prediction interval exceed the chronic and acute chloride criteria, respectively. For instance, we cannot be 95% confident that a conductivity value of 784 (µS) is below the chronic standard.

Chloride (mg/L) Standard	Conductivity (µS)
Chronic, 230	784
Acute, 860	2966

Study areas with Site-Specific Chloride Regressions

If the organization/researcher has developed a site-specific chloride regression that is equal to or better than the WSMD state-wide chloride regression, the organization/researcher should use the site-specific

regression. The following guidance should be used to determine if the site-specific regression is superior to the state-wide regression.

1. The chloride-specific conductivity data pairs should be representative of the study area in terms of seasons and flow conditions. In particular, the data pairs should have the following characteristics:

- If the organization/researcher collects specific conductivity data during the winter season (Nov-Mar), the data pairs should be collected during the winter season. If the organization collects specific conductivity data during the summer season (Jun-Sept), the data pairs should be collected during the summer season. If the organization collects specific conductivity data in both seasons, the data pairs should be collected from each season.

- Some of the data pairs should be collected during low flow conditions and some from high flow conditions in each season.

- Some of the data pairs should be for water samples with "high" conductivity readings relative to the maximum specific conductivity measured in the study area. The maximum conductivity in a calibration data pair should not be less than 75% of the maximum conductivity measured in the study area.

2. The site-specific regression should have a reasonable r-squared that will be evaluated by the WSMD on a case-by-case basis. As currently formulated, the state regression has an adjusted r-squared value of 0.94.

3. The site-specific regression should meet the four principal assumptions of linear and generalized linear regressions:

- The relationship between chloride and specific conductivity should be linear and additive.
- Model errors should be normally distributed.
- Model errors should exhibit statistical independence; for instance, error values should not be correlated by date, time, month, season, etc.
- Model errors should demonstrate constant variance (*homoscedasticity*) with regards to sample time and date, predicted chloride values, and specific conductivity values.